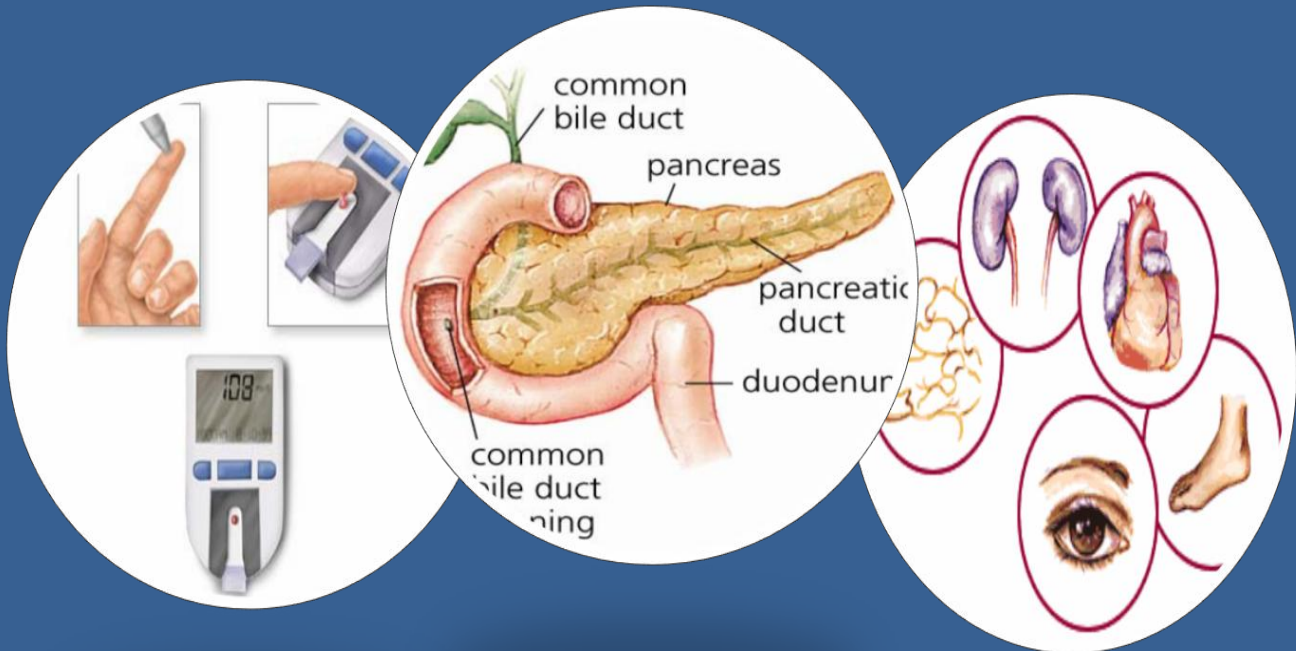


**Clinical Practice Guidelines and
Standards of Care of
Diabetes Mellitus in Sudan
2011**



Federal Ministry of Health *Non-Communicable Diseases* *Directorate* In collaboration with World Health Organization



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PREFACE

There is a need to provide simple and practical ways to assess persons with diabetes and make the right diagnosis and provide the best treatment and care.

Clinical Practice Guidelines assist health care providers to identify locally appropriate and sustainable ways of improving diabetes management. The development of this guidelines was carried out by a task force of Sudanese diabetes and public health experts under the auspices of the division of Non-communicable Diseases (NCD), Federal Ministry of Health (FMOH) sponsored by World Health Organization. The document have been drawn and adapted from the guidelines developed year 2001. The standard of care is based on up-to-date scientific knowledge and clinical practice taking into consideration the regional situation and resources.

As Sudan is a large country with variety multiple ethnic groups, appropriate levels of diabetes care should be defined according to the situation analysis and the resources available in each region of the country. Activities to improve diabetes care are to be coordinated within the National Diabetes Program. Modification and adaptation to the local needs and circumstances of these guidelines must be specified and accepted by both the professionals using them and the people with diabetes.

In order to scale up and standardize the management of diabetes the implementation of this guideline remains very critical. This calls for wide dissemination of the guideline and its acceptance and introduction into

All health facilities in this country whether public, private for no-profit or private for profit. Its application will provide all the relevant information that will guide future revisions of the guidelines to suit the national needs for diabetes management.

The dedication and support extended by Dr. Zeinab Swar Eldahab, Head of the Division of NCD and the staff of the division, particularly Dr. Neima Wagee Allah, Dr. Zeinab Amara, Dr. Safa Mokhtar, Dr. Manal Abdulla is gratefully acknowledged

*Professor Mohamed Ali Eltom
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ABBREVIATION

IR	Insulin Regular
2hPPG	Two Hour Post Prandial Glucose
BMI	Body Mass Index
BP	Blood Pressure
DKA	Diabetic Keto Acidosis
ECG	Electrocardiography
FBG	Fasting Blood Glucose
HbA1c	Glycosylated Hemoglobin A
HDL	High Density Lipoprotein
LDL	Low Density Lipoprotein
NPH	Neutral Protamine Hagedorn
CVD	Cardiovascular Disease
OGTT	Oral Glucose Tolerance Test
OHA	Oral Hypoglycemic Agent
PCOs	Polycystic Ovarian
VLDL	Very Low Density Lipid
WHO	World Health Organization

1

BASIC PRINCIPLES

1.1 Basic principles

- Diabetes mellitus prevention needs the effort of Health decision makers and health care professionals, to avail resources and educate the community.
- Changing lifestyle could be a big step towards diabetes prevention. And it is never too late to start.
- Making few simple changes in life-style, help to avoid the health complications of diabetes as nerve, kidney and heart damage.
- Emphasis should be placed on using appropriate diagnostic criteria.
- Treatment should consider correction of any associated cardiovascular risk factors such as smoking, hyperlipidemias, and obesity as well as monitoring of blood pressure and treatment of hypertension.
- Diabetes management requires teamwork. The doctor should work closely with other health providers and persons with diabetes.
- Self-care is essential strategy as well as education of the person with diabetes and his /her family is the cornerstone of management.
- The health care system should ensure that people with diabetes have access to the basic requirements essential to practice self – care.
- Record keeping is critically needed and should be considered as basic requirement for the management and follow up of all cases.
- Objectives and priorities of treatment must be tailored to individual needs; therapy targets should be determined for each individual.

1.2 Objectives:

Goals of these guidelines are to prevent occurrence of diabetes and to enable a life of normal length and fulfillment for people with diabetes.

Specific objectives;

- To prevent development of diabetes in high risk group.
- Relieving symptoms
- Correcting associated health problems and reducing morbidity, mortality and economic costs of diabetes.
- Preventing as much as possible acute and long-term complications: to monitor the development of such complications and to provide timely intervention.
- Improving the quality of life and productivity of the individual with diabetes.

1.3 Definition

Diabetes Mellitus a metabolic disorder of multiple etiology, characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs (1)

1.4 Predisposing Factors

1. Advancing age.
2. Family history
3. Excessive body weight
4. Excessive alcohol consumption
5. Physical inactivity.
6. Stress.
7. Unhealthy diet.
8. Gestational Diabetes Mellitus
9. Chronic use of steroids

1.5 Common symptoms of diabetes include

Individuals can experience different warning signs, and sometimes there may be no obvious warning, but some of the signs of diabetes are commonly experienced:

1. Frequent urination
2. Excessive thirst
3. Increased hunger
4. Weight loss
5. Tiredness
6. Lack of interest and concentration
7. Vomiting and stomach pain (often mistaken as the flu)
8. A tingling sensation or numbness in the hands or feet
9. Blurred vision
10. Frequent infections
11. Slow-healing wounds

The onset of type 1 diabetes is usually sudden and dramatic while the symptoms can often be mild or absent in people with type 2 diabetes, making this type of diabetes gradual in onset and hard to detect.(2)

1.6 Diagnosis

The diagnosis of diabetes in a symptomatic individual should never be made on the basis of a single abnormal value

Three ways to diagnose diabetes are possible, and each must be confirmed, on a subsequent day, by any one of the three methods given as follows:

1. Blood glucose concentration > 200 -mg/ dl (11.1 mmol/l). Casual is defined as any time of day without regard to time since last meal.

Or

1. FBG > 126 / dl (7.0 mmol/l). (Fasting is defined as no caloric intake for at least 8hs).

Or

2-hs BG > 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test (OGTT). The test should be performed as described by WHO (r1), using a glucose load containing the equivalent of 75 gm anhydrous glucose dissolved in water. This measure is not recommended for routine clinical use. (1)

1.7 Classification

1.7.1 Main types of diabetes

Type 1 diabetes (β -cell destruction, usually leading to absolute insulin deficiency) immune-mediated diabetes.

- ✓ This form of diabetes, previously encompassed by the terms insulin-dependent diabetes, type 1 diabetes, or juvenile-onset diabetes
- ✓ Results from a cellular-mediated autoimmune destruction of the β -cells of the pancreas.
- ✓ Autoimmune destruction of β -cells has multiple genetic predispositions and is also related to environmental factors that are still poorly defined.
- ✓ Although patients are rarely obese when they present with this type of diabetes, the presence of obesity is not incompatible with the diagnosis.
- ✓ These patients are also prone to other autoimmune disorders such as Graves' disease, Hashimoto's thyroiditis, Addison's disease, vitiligo, and pernicious anemia. (3)

Type 2 diabetes (ranging from predominantly insulin resistance with relative insulin deficiency to predominantly an insulin secretory defect with insulin resistance)

- ✓ This form of diabetes, previously referred to as non-insulin-dependent diabetes, type 2 diabetes, or adult-onset diabetes, is a term used for individuals who have insulin resistance and usually have relative (rather than absolute) insulin deficiency.
- ✓ At least initially, and often throughout their lifetime, these individuals do not need insulin treatment to survive.
- ✓ Most patients with this form of diabetes are obese, and obesity itself causes some degree of insulin resistance.
- ✓ Patients who are not obese by traditional weight criteria may have an increased percentage of body fat distributed predominantly in the abdominal region.
- ✓ Ketoacidosis seldom occurs spontaneously in this type of diabetes; when seen, it usually arises in association with the stress of another illness such as infection. (3)

Gestational diabetes mellitus (GDM)

- ✓ GDM is defined as any degree of glucose intolerance with onset or first recognition during pregnancy. The definition applies regardless of whether insulin or only diet modification is used for treatment or whether the condition persists after pregnancy.
- ✓ It does not exclude the possibility that unrecognized glucose intolerance may have antedated or begun concomitantly with the pregnancy.
- ✓ Six weeks or more after pregnancy ends, the woman should be reclassified, as described below (see diagnostic criteria for diabetes mellitus), into one of the following categories:

1) Diabetes

2) IFG

3) IGT

4) Normoglycemia.

- ✓ In the majority of cases of GDM, glucose regulation will return to normal after delivery. (4)

1.7.2 Other types of diabetes (1, 3, 5)

Genetic defects of the β -cell	They are inherited in an autosomal dominant pattern. Several forms of diabetes are associated with monogenetic defects in β -cell function. These forms of diabetes are frequently characterized by onset of hyperglycemia at an early age (generally before age 25 years). They are referred to as maturity-onset diabetes of the young (MODY) and are characterized by impaired insulin secretion with minimal or no defects in insulin action.
Diseases of the exocrine pancreas	Any process that diffusely injures the pancreas can cause diabetes. Acquired processes include pancreatitis, trauma, infection, pancreatectomy, and pancreatic carcinoma. With the exception of cancer, damage to the pancreas must be extensive for diabetes to occur.
Endocrinopathies	Several hormones (e.g., growth hormone, cortisol, glucagons, and epinephrine) antagonize insulin action. Excess amounts of these hormones (e.g., acromegaly, Cushing's syndrome, glucagonoma, pheochromocytoma) can cause diabetes. This generally occurs in individuals with preexisting defects in insulin secretion, and hyperglycemia typically resolves when the hormone excess is removed
Drug- or chemical-induced diabetes	Such as steroids and thiazides: Many drugs can impair insulin secretion. These drugs may not cause diabetes by themselves, but they may precipitate diabetes in individuals with insulin resistance. Certain toxins such as Vacor (a rat poison) and intravenous pentamidine can permanently destroy pancreatic β -cells such drug reactions fortunately are rare
Infections	Certain viruses have been associated with β -cell destruction e.g. congenital rubella coxsackievirus B, cytomegalovirus, adenovirus, and mumps

2 HEALTH DELIVERY

2.1 Quality of diabetes care

- Appropriate levels of diabetes care for different regions of Sudan should be defined according to the situation analysis and the resources available. From these two elements targets should be derived and prioritized.
- Activities to improve diabetes care should be coordinated within the National Diabetes Program. One key activity will be to advocate the development of regional programs to establish effective teams, units and centers.
- A team consists of, at least, a general practitioner and a professional educator, Nutritionists and nurse is the basic configuration for diabetes care at primary level.
- Units at hospitals and specialized centers should have greater resources and provide secondary and tertiary services. The diabetes center offers state of the art specialist facilities. Units have an intermediary role. Ideally, there should be at least one diabetes center supporting the diabetes program.
- A consensus should be reached to determine standards of care at each level of the health care system. These and the resources available will determine the level to which existing and /or newly established teams; units or centers are able to provide services at a minimum, desirable or optimal level.

2.2 Framework

Ensure provision of the following:

- **A diabetes team (professionals) with up – to date skills (6)**
 - Doctors
 - Educators (diabetes nurse specialists)
 - Nutritionists (dieticians)
 - Social worker
 - Podiatrists (foot care provider)
 - Psychologist (if needed)
 - Statistician
- **Structure**
 - Easy access for people with diabetes
 - Protocols for diabetes care
 - Facilities for education
 - Information for people with diabetes
 - Structured records
 - Recall system for annual review eye surveillance and others at high risk (Hyperlipidemia, microalbuminuria ,at-risk feet)
 - Database software for quality monitoring and development
 - Continuing education for professional staff
- **Process**
 - Service for regular review
 - Service for annual review
 - Education service
 - Foot care service
 - Emergency advice line

- Joint obstetric medical pregnancy and pre pregnancy service
- Children and Adolescents service
- Access to related professionals (heart, renal, eye, vascular specialists)
- Feedback from people with diabetes on service performance
- Regular review of service performance

2.3 Medical consultation

2.3.1 Infrastructure

Make available for consultations the following:

- Necessary members of the diabetes team
- Adequate time and adequate space
- Records and information for the individual with diabetes
- Means of communication to other health professionals involved in the individuals care

2.3.2 Aim

To facilitate timely and appropriate intensification of lifestyle and/or pharmaceutical therapy of patients who have not achieved beneficial levels of blood pressure, lipid, or glucose control.

2.3.3 Process

Include the following in any diabetes consultation

- **Welcome**
 - Friendly greeting of the individual and early establishment of rapport
- **Problem review**
 - Understanding of any recent events disturbing the person life style
 - Enquiry after general well being and identification of new difficulties
 - Review of self monitored result, and discussion of their meaning
 - Review of dietary behaviors and physical activity
 - Review of diabetes educations, skills, and foot care
 - Review of insulin therapy and experience of hypoglycemia
 - Review of other medical conditions and therapy affecting diabetes
 - Management of vascular risk factors identified at annual review
 - Management of complications and other problems identified at annual review
- **Analysis and planning**
 - Summary of an agreement on main points covered in consultation
 - Agreement on targets for future months
 - Agreement on, and explanation of, changes in therapy
 - Agreement on interval to next consultation
- **Recording**
 - Completion of a structured records

3

CLINICAL ASSESSMENT**3.1 Initial assessment**

- A complete medical evaluation should be performed to classify the diabetes, detect the presence of diabetes complications, review previous treatment and glycemic control in patients with established diabetes, assist in formulating a management plan, and provide a basis for continuing care.
- Laboratory tests appropriate to the valuation of each patient's medical condition should be performed.
- A focus on the components of comprehensive care (below) will assist the health care team to ensure optimal management of the patient with diabetes.

3.2 The components of comprehensive care:**3.2.1 Medical history**

- Age and characteristics of onset of diabetes (e.g., DKA, asymptomatic laboratory finding)
- Eating patterns, physical activity habits, nutritional status, and weight history; growth and development in children and adolescents
- Diabetes education history
- Review of previous treatment regimens and response to therapy (A1C records)
- Current treatment of diabetes, including medications, meal plan, physical activity patterns, and results of glucose monitoring and patient's use of data
- DKA frequency, severity, and cause
- Hypoglycemic episodes
- Hypoglycemia awareness
- Any severe hypoglycemia: frequency and cause
- History of diabetes-related complications
- Microvascular: retinopathy, nephropathy, neuropathy (sensory, including history of foot lesions; autonomic, including sexual dysfunction and gastroparesis)
- Macrovascular: CHD, cerebrovascular disease, PAD
- Other: psychosocial problems, dental disease (7)

3.2.2 A complete physical examination

It is a part of the minimum requirements. Certain aspects of the physical examination should receive special attention. These including:

- Height, weight, BMI
- Blood pressure determination, including orthostatic measurements when indicated
- Fundoscopic examination
- Thyroid palpation
- Skin examination (for Acanthosis nigricans and insulin injection sites)
- Comprehensive foot examination:
 - Inspection
 - Palpation of dorsalis pedis and posterior tibial pulses
 - Presence/absence of patellar and Achilles reflexes
 - Determination of proprioception, vibration, and monofilament sensation (7)

3.2.3 Laboratory assessment

- Fasting and/or 2-hour postprandial glucose
- HbA1c
- Chemistry panel, fasting lipid profile, urinalysis (including microscopy and urine microalbumin screening); mainly for type 2 DM
- ECG in adults at baseline
- Thyroid stimulating hormone for type 1 and for type 2, as indicated
- Investigation for long-term complications is not indicated at the initial stage for diabetic children

NB: Proper clinical assessment should be followed by formulating a management plan and refer for complication assessment. (7, 8)

3.4 Treatment plan:

3.4.1 Drugs and non-drugs

Formulated after discussion with the multidisciplinary diabetes team and the patient, including measures to:

- Control blood glucose
- Control and treat diabetic complications
- Address and treat associated risk factors such as obesity, physical inactivity, smoking, hypertension, and dyslipidaemia. (8)

Referral, if feasible, to:

- Diabetes educator, to evaluate patient's ability to perform self-monitoring of blood glucose and his/her ability to interpret the data
- Dietician
- Foot-care specialist
- Ophthalmologist for annual retinal screening, or more often as indicated
- Nephrologists, neurologist, and cardiologist, if needed. (8)

3.4.2 Follow-up and monitoring

3.4.2.1 Follow-up visits:

Emphasis should be placed on the importance of regular follow-up. During follow-up visits, education should be reinforced, growth monitored, blood glucose monitoring results reviewed. The frequency of the follow-up visits depends on the interval

3.4.2.2 Glycaemic control monitoring (7,9)

The level of glycaemic control should always be monitored; the absence of symptoms alone should not be taken as an indicator of good control.

- Self- monitoring should be encouraged.
- Methods and frequency of monitoring depend on the type of treatment, the local facilities available, and therapy targets set.
- Methods include:
 - fasting and 2-hour postprandial glucose each follow-up visit if feasible
 - quarterly HbA1c

- yearly chemistry panel, fasting lipid profile, urinalysis (including microscopy and urine microalbumin screening)
- ECG in adults at baseline, and then as clinically indicated.

People with diabetes should

- Be taught self-monitoring techniques
- Have their skills checked periodically and reinforced. The precision of blood glucose measurement should be verified at least every six months
- Keep a record of self-monitoring result
- Be assisted in acquiring knowledge and developing skills that enable them to modify treatment according to the results of self-monitoring (7,9)

3.4.2.2 Annual Review (7)

Include additionally, at annual review, surveillance of the following:

- Symptoms of ischemic heart disease, peripheral vascular disease, neuropathy, impotence
- Feet including footwear, deformity or poor skin condition, ischaemia, ulceration, absent pulses, sensory impairment
- Visual acuity
- Retinopathy by ophthalmoscope or retinal photography if available
- Kidney damage by albumin excretion and serum creatinine
- Hypertension
- Dyslipidaemia
- Injection sites

3.4.2.2 A schedule for clinical monitoring during the follow-up visits and annual review (7)

Review topics	Initial review/ Referral	Regular	Annual review
Long – term and/ or recent diabetes history	✓	✓	
Social history/ lifestyle review	✓	✓	
Diabetes understanding/ self – management	✓	✓	✓
Self-monitoring skills / results	✓	✓	✓
Complications history and / or symptoms	✓		✓
Smoking	✓	If problem	✓
Other medical history / systems review	✓		✓
Family history diabetes / arterial disease	✓		✓
Drug history / current drugs	✓	✓	✓
Weight / body mass index	✓	✓	✓
General examination	✓		
Foot examination / injection sites	✓	If problem	✓
Eye vision examination	✓	If problem	✓
Blood pressure	✓	If problem	✓
Glycated haemoglobin	✓	✓	✓
Lipid profile	✓	If problem	✓
Urine protein	✓	✓	✓
Urine albumin excretion	✓	If problem	✓
Serum creatinine	✓	If problem	✓

4 MANAGEMENT

4.1 Targets of management

Targets of management should be determined and fully discussed with the person with diabetes at the initial phase of management. The management targets include targets for glycaemic control and metabolic and non-metabolic target. Such targets are useful as:

- An integral part of diabetes care, do not manage diabetes on symptoms alone
- To indicate need for further intervention
- As the basis for short term and longer term individualized targets
- To decrease the risk of CVD; since most of the patients (with type two) are already having hyperlipidemia at the time of the diagnosis
- As an educational tool to help the person with diabetes

4.2 The target of glycaemic control

Option one: goal (7)

- Pre-prandial capillary plasma glucose 90–130 mg/dl (5.0–7.2 mmol/l)
- Peak postprandial capillary plasma glucose <180 mg/dl (<10.0 mmol/l)
- A1C <7.0%

Option two (1,11-13)

Glycaemic control indicator	Normal	Target	Action needed
Plasma values			
Pre meal glucose mg/dL	<110	90–130	<90 or >150
mmol/L	<6.1	5.0–7.2	<5.0 or >8.3
Bedtime glucose mg/dL	<120	110–150	<110 or >180
mmol/L	<6.7	6.1–8.3	<6.1 or >10.0
Whole blood values			
Pre-meal glucose mg/dL	mg/dL <100	80-120	<80 or >140
mmol/L	<5.5	4.4–6.7	<4.4 or >7.8
Bedtime glucose, mg/dL	<110	100–140	<100 or >160
mmol/L	<6.1	5.5–7.8	<5.5 or >8.9

The goals for glycaemic control should be individualized based on (7)

- Duration of diabetes
- Age/life expectancy
- Co- morbid conditions
- Known CVD or advanced micro vascular complications
- Hypoglycemia unawareness

- Individual patient considerations
- More or less stringent glycemic goals may be appropriate for individual patients.
- Postprandial glucose may be targeted if A1C goals are not met despite reaching preprandial glucose goals.

Higher blood glucose targets should be selected for patients

- Who are very young (aged below 7 years) or very old;
- With decreased life expectancy because of terminal illness (i.e. cancer);
- With hypoglycemia unawareness;
- With advanced retinopathy before control by photocoagulation;
- With unstable angina pectoris or transient cerebral ischaemic attacks;
- With history of generalized seizures;
- Who do not spontaneously recover from hypoglycemia (counter-regulatory unresponsiveness).

Recommendations for metabolic and non-metabolic targets (1,11,13)

Test	Good	Borderline	Poor
Total cholesterol, mg/dL (mmol/L)	<200 (5.2)	200–250 (5.2–6.5)	>250 (6.5)
Fasting triglycerides, mg/dL (mmol/L)	<150 (1.7)	150–200 (1.7–2.2)	>200 (2.2)
HDL-cholesterol, mg/dL (mmol/L)			
Male	>45 (1.15)	35–45 (0.9–1.15)	<35 (0.9)
female	>55 (1.40)	45–55 (1.15–1.40)	<45 (1.15)
LDL cholesterol mg/dL (mmol/L)	<100 (2.56)	100–130 (2.56–3.33)	>130 (3.33)
Total cholesterol/HDL ratio			
male	<6.4	-	-
female	<5.6	-	-
Body mass index (kg/m ²)			
male	<25.0	25.0–27.0	>27.0
female	<24.	0 24.0–26.0	>26.0
Blood pressure (mmHg)	<130/80	-	-

Use assessment levels to set targets:

Failure to attempt to reach agreed targets is inadequate care, unless this would lead to deterioration in quality of life

Be concerned about targets and **ask** yourself at consultations: Is it possible for the individual to approach each target more closely, without a counter balancing deterioration in quality of life

4.3 Management classified into:

1. **Non Pharmacological Life style modification**
2. **Pharmacological**

4.3.1 Non Pharmacological Life style modification

4.3 .1.1 LIFE-STYLE MODIFICATION

- Life –style modifications are the corner-stone for primary prevention of diabetes.
- Among individuals at high risk for developing type 2 diabetes, structured programs that emphasize lifestyle changes that include
 1. Moderate weight loss (5–10% of body weight)
 2. Regular physical activity (150 min/week=30 minutes/days 5 times a week)
 3. Dietary strategies including reduced calories, reduced intake of dietary fat (7%), high dietary fibers and whole grains can reduce the risk for developing diabetes and are therefore recommended
- Also life-style modification may prevent or delay type 2 DM in those with impaired glucose tolerance (IGT) or impaired fasting glucose (IFG) –pre diabetics. Monitoring for development of diabetes should be performed regularly (7)

4.3.1.2 Education (14)

- Education of the person with diabetes is an essential component of management in every case. To ensure appropriate management, the patient should acquire the basic knowledge and skills and his family and the health care team should work closely with the patient to achieve this objective and promote self –care.
- The person with diabetes should also be involved in setting therapeutic targets for weight, blood pressure and blood sugar control.

Provision of education

1. **Integrate** into regular clinical care by providing your own curriculum and programme
2. **Ensure** your diabetes team has adequately trained personnel
3. **Assess** special needs of each individual
4. **Be aware** of needs of special groups (young people, pregnant women, and the elderl

Basic educational requirements

- The person with diabetes should acquire adequate knowledge and skills in the following:
 - Definition of the disease, causes, signs & symptoms and manifestation.
 - Individual therapy targets.
 - Individual nutritional requirements and meal planning.
 - Type and extent of exercise and physical activity.
 - Interaction of food intake and physical activity with oral hypoglycemic drugs/ insulin.
 - Improvements in lifestyle, for example harmful effects of smoking, obesity and alcohol intake.
 - Self-monitoring and significance of results and actions to be taken
 - How to cope with emergencies (illness, hypoglycemia).
 - How to avoid complications and detect them at an early stage, e.g. how to take care of the feet.

Patient Education

A. Assessment of patient education

- Review of diabetes skills (self- monitoring, injections, hypoglycemia management, food identification)
- Biomedical measures (changes in body weight, glycated haemoglobin)
- Evidence of appropriate behaviors (footwear, use of injection sites and membership of diabetes association's)
- Assessment of life- style, emotional adjustment, and perception of barriers to life- style activities and self- care
- Perceptions of desired short- term goals (glucose control, weight), and long – term vulnerability (to prevent, delay the organ damage) (4)

The patient is support to perform this:

- As part of routine care visits, by direct enquiry.
- As part of annual review, or first contact, more formally.

1- At and shortly after diagnosis:

- The minimum skills to obtain control over the new situation.
- Supportive information on the nature and outcomes of diabetes.
- Basic information on self injection, self monitoring, hypoglycemia, dietary planning with special emphasis on carbohydrate accounting.

2- Follow up visit as soon as possible not more than one month from the diagnosis:

- Comprehensive coverage of topics covered previously, plus
- Coping with illness.
- Targets of insulin therapy.
- Healthy eating.
- Complications of diabetes.
- Associated risk factors (hypoglycemia, obesity, smoking, and hypertension).
- Foot care.

Special situations:

- Employment.
- Schooling.
- Driving.
- Travel
- Pregnancy, genetic counseling and contraception

3- In the long term:

- Reinforcement periodically after annual evaluation

Include family members and closed contact and significant others as appropriate.

Use group education to uncover problem and provide solutions and behavioral change through peer example

4.3.1.3 Exercise (7)

- Physical activity promotes weight reduction and improves insulin sensitivity, thus lowering blood glucose levels.
- Together with dietary treatment, a programme of regular physical activity and exercise should be considered for each person. Such a programme must be tailored to the individual's health status and fitness.

- **People should, however, be educated about the potential risk of hypoglycemia and how to avoid it.**
 - People with diabetes should be advised to perform at least 30 min/day for 5 days of moderate-intensity aerobic physical activity (walking) (50–70% of maximum heart rate).
 - In the absence of contraindications, people with type 2 diabetes should be encouraged to perform resistance training three times per week.

Manage physical exercise using:

- Formal recording of levels of physical activity
- Identification of new exercise opportunities and encouragement to develop these chances.

Appropriate self- monitoring, additional carbohydrate, and dose adjustment of glucose lowering therapy for those using insulin or insulin secretagogues

Warning:

- **About delayed hypoglycemia, especially with more prolonged, severe, or unusual exercise for those using insulin therapy.**

- **About risks of foot damage from exercise.**

- **Need to consider ischemic heart disease in those beginning new exercise programmes**

4.3.1.4 Dietary treatment

Diet is a basic part of management in every case. Treatment cannot be effective unless adequate attention is given to ensure appropriate nutrition. Nutritional management is an integral part of initial and continuing education programmes. Individualize intake to match needs, preferences and culture.

Aims:

- Ensure weight control
- Provide nutritional requirements
- Allow good glycaemic control with blood glucose levels as close to normal as possible
- Correct any associated blood lipid abnormalities
- Ensure consistency and compatibility with other forms of treatment if used, for example oral agents or insulin.

Process

Make review and recommendations of eating:

- At diagnosis
- On adjustment or change of treatment lines.
- When professional advisor is changed.
- Review on request.
- Review dietary management regularly:
- Is healthy eating a normal part of life – style?
- Does calorie distribution reflect the patient lifestyle and desires, as well as insulin regimen and local circumstances?

- Is calorie intake appropriate to desired body weight?
- Are regular meals and snacks taken at appropriate times?
- Is money being spent unnecessarily on special diabetes food products?

Recommend

- Carbohydrates should provide 45 - 65% of total daily calories. The type and amount of carbohydrate are both important. Best choices are vegetables, fruits, beans, and whole grains. These foods are also high in fiber
- Fats should provide 25 - 35% of daily calories. Monounsaturated (such as nuts and olive) and omega-3 polyunsaturated (such as fish) fats are the best types. Limit saturated fat (red meat, butter) to less than 7% of daily calories. Choose nonfat or low-fat dairy instead of whole milk products.
- Protein should provide 12 - 20% of daily calories, Patients with kidney disease should limit protein intake to less than 10% of calories. Fish and chicken are better protein choices than red meat.
- Lose weight if body mass index (BMI) is 25 - 29 (overweight) or higher (obese).
- Alcohol is harmful in general and particularly to diabetics.
- Routine vitamin and mineral supplementation is generally not needed in people with a well balanced diet, except special conditions like pregnancy and in lactation. There is at present, no definite evidence to confirm that such treatment has any benefits. (7)

4.3.1.5 Monitoring

Tests for Glucose Levels

- Both low blood sugar (hypoglycemia) and high blood sugar (hyperglycemia) are of concern for patients who take insulin.
- It is important, therefore, to monitor blood glucose levels carefully.
- Patients should aim for the following measurements:
 1. Pre-meal glucose levels of 90 - 130 mg/dL
 2. Bedtime levels of 110 - 150 mg/dL (7)

Glycosylated Hemoglobin Test.

- Hemoglobin A1C (also called HbA1c, HA1c, or A1C) is measured periodically every 2 - 3 months, or at least twice a year, to determine the average blood-sugar level over the lifespan of the red blood cell.
- While finger prick self-testing provides information on blood glucose for that day, the HbA1c test shows how well blood sugar has been controlled over the period of several months.
- For most people with well-controlled diabetes, HbA1c levels should be at or below 7%. (7)

Other Tests

- Other tests are needed periodically to determine potential complications of diabetes, such as high blood pressure, unhealthy cholesterol levels, and kidney problems.
- Such tests may also indicate whether current diet plans are helping the patient and whether changes should be made.
- Annual urine tests for microalbuminuria and creatinine proteins can indicate a future risk for serious kidney disease.

4.3.1.5 Other Factors Influencing Diet Maintenance

Weighing and Measuring.

- Weighing and measuring food is extremely important to get the correct number of daily calories.
- Along with measuring cups and spoons, choose a food scale that measures grams. (A gram is very small, about 1/28th of an ounce.)
- Food should be weighed and measured after cooking.
- After measuring all foods for a week or so, most people can make fairly accurate estimate by eye or by holding food without having to measure everything every time they eat.

Timing

- Patients with diabetes should not skip meals, particularly if they are taking insulin.
- Skipping meals can upset the balance between food intake and insulin and also can lead to low blood sugar and even weight gain if the patient eats extra food to offset hunger and low blood sugar levels.
- The timing of meals is particularly important for people taking insulin:
 1. Patients should coordinate insulin administration with calorie intake. In general, they should eat three meals each day at regular intervals. Snacks are often necessary.
 2. Some doctors recommend a fast acting insulin (insulin lispro) before each meal and a longer (basal) insulin at night.

4.3.1.6 Special Considerations for People with Kidney Failure

- Diabetes can lead to kidney disease and failure. People with early-stage kidney failure need to follow a special diet that slows the build-up of wastes in the bloodstream.
- The diet restricts protein, potassium, phosphorus, and salt intake. Fat and carbohydrate intake may need to be increased to help maintain weight and muscle tissue.
- People who have late-stage kidney disease usually need dialysis. Once patients are on dialysis, they need more protein in their diet. Patients must still be very careful about restricting salt, potassium, phosphorus, and fluids. Patients on peritoneal dialysis may have fewer restrictions on salt, potassium, and phosphorus than those on hemodialysis.

4.3.2 Pharmacological therapy

4.3.2.1 Role of Pharmacist in providing pharmaceutical care for diabetic patients :

- In diabetes mellitus the availability of medicines and their rational use are of paramount importance and critical for a successful therapeutic outcome.
- Failure to reach that can be the main reason for patient non-compliance or partial compliance towards the prescriber's instructions (WHO 2003); the patient has to be motivated sufficiently to use the prescribed treatment
- Patient Counseling by Pharmacists on medication information orally or in written form to the patient or co-patient is widely practiced now. It is a one-to-one interaction between the pharmacist and a patient or co-patient (a care giver).

4.3.2.2 Patient counseling should be on (15)

- Proper directions of medication use
- Advice on side effects
- How to store medications
- Diet and life style modifications
- Drug counseling points in diabetes

Drug category	Pharmacist's role
Sulfonylureas	Explain the methods to prevent, detect and manage hypoglycemia. Monitor for symptoms of jaundice. Discuss the administration time in relation to food and need for alcohol abstinence. Ask for history of sulfur sensitivity
Insulin	Explain the methods to prevent, detect and manage hypoglycemia. Educate the patient regarding newer insulin administration techniques, proper storage conditions for insulin. Ask the patient to carry sweets during travel and ask them not to miss their meals.
Metformin	Advise the patient to take Metformin with/after food. Monitor for muscle pain, unusual sleepiness, nausea, stomach pain, weight loss.
Acarbose	Encourage patients to take it with first bite of food. Monitor for abdominal pain and cramps. Advise the patient not to take sucrose (sugar) during hypoglycemic attack as it may not be absorbed when acarbose is taken.

4.3.2.1 Impact of patient counseling by pharmacists in Diabetes (15)

- More compliant in keeping clinic appointments, had fewer medication errors, fewer changes in therapeutic regimens and a lower incidence of hospital admissions, better glycemic control and improved quality of life than the control groups.
- Improvement in glycosylated hemoglobin and fasting blood glucose after four months.

4.3.2.2 Type 1 diabetes

- The first choice treatment pattern is the basal-bolus insulin therapy
- Keep close control of blood glucose to reduce the risk of chronic complications.
- The prescription of self-management algorithms for insulin therapy can facilitate the achievement of glycemic goals
- When HbA1c/ values are higher than the goal, appropriate treatment variations should be speedily implemented to rapidly reach and maintain good glycemic control in time taking into account the patient's possible poor adherence to the prescribed therapy
- Treatment with insulin pumps is an option to patients, whose educational evaluation and basal-bolus insulin therapy pattern (with rapid and slow acting analogues) have failed to achieve good metabolic control and, if there are frequent and /or asymptomatic hypoglycemic episodes. (16)

Plasma blood glucose (mg/dl) and A1C goals for type 1 diabetes by age group:

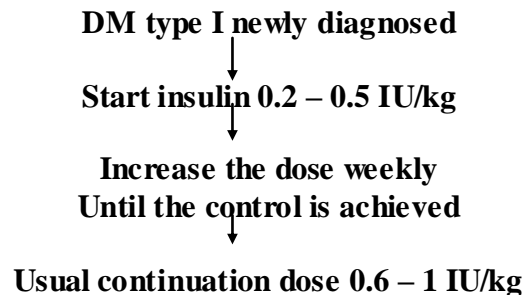
- Toddlers and preschoolers (0-6 years) before meals (100-180), Bedtime /overnight (110-200), A1C < 8.5% (but > 7.5%).
- **Rational:** high risk and vulnerability to hypoglycemia.

- School age (6-12 years) before meals (90 -180), bedtime /overnight (100-180), A1C < 8%.
- **Rational:** risk of hypoglycemia and relatively low risk of complications prior to puberty.
- Adolescents and young adults (13-19 years) before meals (90-130), bedtime /overnight (90-150), A1C < 8%
- **Rational:** Risk of severe hypoglycemia, developmental and psychological issues, a lower goal (< 7.0 %) is reasonable if it can be achieved without excessive hypoglycemia.

Suggest approach for insulin therapy for type 1 DM

Initiation of insulin therapy:

- Insulin should be started at time of diagnosis.
- If the patients presented with ketoacidosis the treatment should be initiated as described in section DKA section
- If the patient presented with hyperglycemia without ketonemia, the treatment can be initiated as following:



- Type 1 DM who present with hyperglycemia without the presence of ketonemia they can start the treatment as outpatient
- During honeymoon period insulin requirement dose as a small as 0.1 IU/kg can be sufficient

Suggest programs to administer insulin:

- 1- **Conventional insulin therapy program:** 2-3 daily injection of fixed dose of insulin: dose adjusted only for significant variation in food consumption or activity.
- 2- **Intensified conventional therapy program:** 2-3 daily injection, adjustment scale for rapid acting insulin doses given before breakfast & supper.
- 3- **Physiologic insulin replacement therapy program:** rapid acting insulin before each meal + basal insulin.

Conventional insulin therapy program

Specific regimens used in this program are as following:

- 1- Mixed insulin before breakfast & before supper: e.g. regular or rapid acting insulin & NPH at breakfast, regular or rapid acting insulin & NPH at supper.
 - a. 2/3 of required dose at morning, 1/3 at night.
 - b. 1/3 as start or rapid acting insulin, 2/3 intermediate.
 - c. Side effects: midnight hypoglycemia

- 2- Single morning intermediate insulin: e.g. NPH at breakfast. Insulin coverage for supper and early evening and overnight. Potential for hypoglycemia at peak time, 3 hours after dose. Can be improved either by adding start or rapid acting insulin at breakfast or giving intermediate insulin before breakfast and supper.
- 3- Morning mixed insulin + bedtime intermediate insulin, SIE bedtime hyperglycemia
- 4- Morning mixed insulin + supertime short of rapid acting + bedtime intermediate insulin.
- 5- Peak less basal insulin e.g. insulin glargine or detemir at bedtime. Not used for type 1 DM because it doesn't cover postprandial hyperglycemia.

4.3.2.3 Type 2 Diabetes:

- The first choice drug is metformin
- When HbA1c concentrations are higher than the Glycemic goal, appropriate treatment variations must be speedily implemented to rapidly reach and maintain good blood glucose control in time.
- The advance in the number of blood glucose-lowering medications has led to some confusion for both practitioners and patients regarding the most appropriate way to treat diabetes. The choice of specific
- Antihyperglycemic agents should be based primarily on their A1C lowering capacity, demonstrated safety and efficacy in long-term studies, tolerability and expense. Specific effects of individual therapies on cardiovascular disease risk factors, such as hypertension or dyslipidemia, are also considered important.
- It is essential to combine two or more oral hypoglycemic drugs in patients who lack good control with monotherapy.
- It is essential to start either basal or multi-injection insulin therapy when blood glucose control is inadequate with multi-oral therapy.
- Take into account possible poor adherence to the prescribed treatment.

Recommended Algorithm for DM type 2 management **Step 1 (life-style intervention and metformin):**

- Lifestyle changes to limit carbohydrate intake, decrease weight and increase activity is inexpensive and provides broad benefits. Unfortunately, it often fails in the first year, in part reacted to inadequate intervention or follow-up by practitioners as well as poor buy-in and adherence on the part of patients.
- Metformin is generally inexpensive and not associated with weight gain or hypoglycemia and has demonstrated benefits in numerous long-term studies making it the logical first-line pharmacotherapy in type 2 diabetes.
- It can be associated with gastrointestinal side effects and multiple contraindications (renal, hepatic or cardiac failure). However, it is rarely associated with lactic acidosis. Therefore, metformin generally should be initiated concurrently with lifestyle intervention at diagnosis.
- Average A1C reduction by metformin as monotherapy is often inadequate without lifestyle changes. Thus more attention by practitioners working collaboratively with patients towards effective lifestyle change is required.
- These interventions should be implemented by health care professionals with appropriate training and experience not only in diabetes, physical activity and nutrition but also in behavior modification principles, specifically registered dieticians and diabetes educators.

- Awareness and sensitivity to cultural issues is critical to success. Special attention must be directed to the type of food consumed, generally a diet high in carbohydrates. Special occasions like fasting in Ramadan among Muslims and avoidance of animal products during certain times of the year among Orthodox Christians should be considered in treatment strategies.
- The presenting glycemic status in newly diagnosed people with diabetes should also be considered. If the fasting glucose is greater than **250 mg/dl** or random glucose over **300 mg/dl**, it may be reasonable to consider using sulfonylurea instead of metformin, or combination of both, or the initiation of insulin therapy at diagnosis.
- Treatment of type 2 diabetes should be individualized and take account of individual's lifestyle, patient's wishes and technical abilities, local expertise of healthcare providers should also be considered.

Step 2 (additional medications) which includes either:

Sulfonylureas (SU)

- Are inexpensive but may give rise to weight gain and hypoglycemia. However, severe hypoglycemia is relatively uncommon with sulfonylurea therapy and the weight gain generally modest.
- Chlorpropamide and glibenclamide are more likely to cause hypoglycemia than glimepiride, gliclazide MR and glipizide. Average HbA1C reduction with SU monotherapy is ~ 1.5%.

The thiazolidinediones (TZD)

- Are insulin sensitizers, as they improve insulin sensitivity over time, are associated with average A1C reduction as monotherapy of 0.5 % to 1.4 % might improve the lipid profile, but may cause fluid retention and weight gain. They are contraindicated in patients with diabetes and coexisting heart failure as well as in the setting of active liver disease.
- Attention should be paid to the higher rate of bone fractures in women reported with use of TZD. Combination of Insulin with a TZD is particularly associated with more fluid retention.

Insulin

- Which has no dose limit, is inexpensive, and improves the lipid profile, particularly triglycerides? However, it requires injections, capillary glucose monitoring and may be associated with hypoglycemia and weight gain.
- Achieving treatment targets is important to avoid complications and insulin is arguably the most effective glucose lowering agent available. However, tight glycaemic control, particularly with insulin, may be associated with severe hypoglycemia.
- Patients initiating insulin therapy should be advised about the benefits of regular blood glucose monitoring, as well as the signs and the prevention and treatment of hypoglycemia. Insulin analogues although substantially more expensive than human insulin are associated with a modestly lower incidence of hypoglycemia.

Basal Insulin:

- The addition of basal insulin should be considered at diagnosis or immediately after treatment with metformin and lifestyle intervention if hyperglycemia is profound, or whenever oral antihyperglycemic agents fail to achieve or maintain glycaemic treatment targets.

- Reasonable options for adding bedtime basal insulin to oral agents include NPH human insulin or one of the long acting insulin analogues (glargine and detemir). NPH human insulin is relatively low cost option and is as effective as long-acting analogues in A1C reduction although glargine and detemir have the advantage of less hypoglycemia.

Step 3 (further adjustments):

Intensified Insulin:

- The combination of basal insulin together with pre meals rapid acting insulin [i.e. Basal bolus insulin regime] should be used in patients who are unable to achieve glycemic control on basal insulin with or without oral antihyperglycemic therapies.
- The type of insulin used should reflect the patient glycemic profile (postprandial and fasting) as well as the individual lifestyle.
- Patients can continue to take insulin with metformin but stop taking secretagogues when rapid acting insulin is added to the regimen.
- Basal-bolus insulin therapy provides the most physiological glycemic control and optimal flexibility for people with diabetes to adjust therapy to match lifestyle choices such as changes in physical activity or the timing or carbohydrate content of meals.
- Alternatively, premixed insulin (NPH plus regular human insulin) can be used in one or more daily doses, generally before supper, before breakfast and supper or prior to each meal.

Other drugs:

- Alpha-glycosidase inhibitors** diminishes intestinal absorption of glucose, are weight neutral but have frequent gastrointestinal adverse effects, generally require three times daily dosing, and are expensive. They are less effective in lowering glycemia than metformin, SU or TZD, reducing HbA1C by 0.5 – 0.8%.
- The Glinides** (Nateglinide and Repaglinide) (not available in Sudan) are short acting non SU insulin secreagogues, so should not be used concomitantly with SU. They are more expensive than SU and require three times daily dosing. Repaglinide is more effective at lowering A1C than is nateglinide which is the secretagogues with the lowest risk of severe hypoglycemia.
- The glucagon-like peptide 1 (GLP-1) agonist** (Exenatide “Byetta” & Liraglutide “Victoza”) (not available in Sudan) action is associated with modest weight loss in addition to glucose lowering but has the disadvantages of high cost, twice (Byetta) or once [Victoza] daily injections for administration. frequent gastrointestinal adverse effects at initiation of therapy, around 40% of patients experience intermittent nausea, vomiting or diarrhea which is generally mild to moderate in intensity. Exenatide is not indicated for use in monotherapy or combination with insulin.
- DDP-4 inhibitors [Gliptins]** (not available in Sudan) interfere with the degradation of GLP-1 by blocking the action of the DDP-4 enzyme [Dipeptidyle peptidase-4] and therefore raise GLP-1 levels 2- to 3- fold. Sitagliptin [Januvia] and Vildagliptin [Galvus] are administered orally and is generally well tolerated. They are more effective in combination with metformin but more expensive.
- Pramlintide, an amylin analogue,** (not available in Sudan) is only indicated for use in combination with rapid acting insulin, is modestly effective in reducing A1C as well as weight, but requires injections before each meal and is expensive. Furthermore, clinical experience is limited.

CVD ASSOCIATED WITH DM

5.1 Hypertension (7)

Hypertension is commonly associated with diabetes and may complicate it. Both conditions are important independent risk factors for cardiovascular, renal, cerebral and peripheral vascular disease.

5.1.1 Guidelines for the management of hypertension in diabetes

- Unless the blood pressure is severely elevated, diagnosis should usually be based on high blood pressure (BP) measurements made under standard conditions on least three occasions.
- BP should always be examined in the supine and standing positions to detect postural changes.
- The presence of target-organ damage (e.g. retinal, renal or cardiovascular) should be evaluated.
- Other modifiable cardiovascular risk factors should be checked. In general, the goal of blood pressure treatment should be to maintain BP at < 130 mmHg systolic and < 80 mmHg diastolic.
- Non-pharmacological therapy should be a part of any hypertension management plan and the initial treatment in prehypertensive patients.
- Antihypertensive drug treatment may be started already when BP is in the high normal range to achieve the goal.
- To lower BP, all effective and well tolerated drugs can be used; a combination of two or more drugs is frequently needed.
- Renin-angiotensin system blocker (either an angiotensin receptor antagonist or an ACE inhibitor) should be a regular component of combination treatment and the one preferred when monotherapy is sufficient.
- Microalbuminuria should prompt the use of antihypertensive drug treatment even when BP is in the normal range. Blockers of the renin-angiotensin system have a pronounced antiproteinuric effect and their use should be preferred.
- In patients with macroalbuminuria, careful follow-up of serum creatinine and potassium is recommended if diuretics, ACE inhibitors or ARBs are used.
- In the elderly, blood pressure should be lowered in a gradual fashion and over a longer period of time in order to avoid complications related to organ hypo perfusion.

5.2 Macrovascular diseases (7)

- Macrovascular diseases (coronary heart disease and strokes) are the leading causes of death in the diabetic population.
- Risk factors for the development of macrovascular disease are frequently found in people with diabetes.

5.2.1 Managing arterial risk

Arterial risk factors:

- Fasting lipid profile
- Blood pressure
- Albumin excretion rate
- Smoking
- Family history
- Arterial / heart symptoms

Review arterial risk factors:

- At diagnosis
- At 18 years of age
- Yearly
- More frequently if abnormal or treated
- Three yearly systems if all risk factors consistently normal

Educate people:

- About the risks of heart disease from the time of diagnosis
- About not smoking and smoking cessation programmes
- About healthy eating

Prescribe:

- A programme of regular physical exercise
- Healthy eating
- Lipid lowering therapy if profile is abnormal see diagram below
- ACE inhibitors if indicated by kidney damage
- Other anti – hypertensive if blood pressure remains > 130/ 80 mmHg (
- Low dose aspirin for those with known arterial problems
- Selective B – adrenergic blockers if known ischemic heart disease (4)

5.2.2 Lowering blood lipid

First step: Reinforcing a healthy lifestyle (adequate diet, weight loss, exercise)

- reduction of food items high in cholesterol, saturated fats and trans- fatty acids
- Increased physical activity
- weight reduction for obese patients
- increased intake of viscous (soluble) fibers

Treat by:

- Optimize blood glucose control as much as is possible (Improvement in glycaemic control can lead to a less atherogenic lipid profile.)
- Establish lipid profile before beginning a trial of therapy

Use

- A statin if: LDL cholesterol > 3.0 mmol/l (> 115 mg/ dl) (> 4.0 mmol/l(> 155 mg/dl) if low risk including thin elderly)
- A fibrate if: triglyceride > 2.2 mmol/l (> 200 mg/dl) And LDL cholesterol > 3.0 mmol/l (> 115 mg/dl)
- Bile acid sequestrants are considered second-line therapy for high LDL cholesterol, usually taken in combination with statins. They can be used as first-line therapy in patients who are allergic or intolerant of statins.
- Cholesterol absorption inhibitor is a new class of cholesterol-lowering medication, aimed at lowering LDL cholesterol. The compound in this class is typically used in combination with a statin when further LDL lowering is desired.

5.2.3 Target of the therapy:

- The main target of the therapy is LDL cholesterol, but if serum triglycerides are >500 mg/dL in this case triglyceride-lowering therapy should be started first and immediately because of the high risk of pancreatitis.
- If triglycerides levels are <500 mg/dL, the primary target of treatment is LDL cholesterol.
- The goal LDL an LDL cholesterol <100 mg/dL. When this is achieved, attention can then be focused on triglycerides.
- If triglycerides are <200 mg/dL, the sum of LDL plus very low density lipid (VLDL) cholesterol (also referred to as non-HDL cholesterol) becomes the secondary target, as VLDL, and especially its remnants, are considered atherogenic.
- For patients with low HDL cholesterol (<40 mg/dL), interventions to raise HDL cholesterol level may be considered but only after the goals for LDL cholesterol and non-HDL cholesterol have been met.

6

DIABETES MELLITUS IN PREGNANCY

6.1 Introduction: (5)

- During pregnancy, the carbohydrate metabolism is affected by hormonal changes, placental hormones; in particular human placental lactogen and cortisol are insulin antagonists, so a relative resistance to insulin develops in the mother.
- Worldwide, 5-10% of pregnancies are associated with diabetes, 90% of these cases involving gestational diabetes.
- DM in pregnancy is of two types:
 - **Pre-gestational DM (PGDM)**
Known diabetic lady who want to become pregnant
Women who are known to have diabetes mellitus and who subsequently become pregnant do not have gestational diabetes but have “diabetes mellitus and pregnancy” and should be treated accordingly before, during and after the pregnancy)
 - **Gestational DM (GDM)**
It is a DM which first diagnosed during pregnancy

6-2 Pre-gestational Diabetes care before and during pregnancy

- All diabetic women of child bearing age must be informed about the need to achieve good metabolic control before conception, because even mild rise in maternal blood sugar at time of embryonic organogenesis (first 16 weeks) increases the risk of fetal congenital anomalies dramatically.
- The risk of unscheduled pregnancy and the need to schedule conception with effective contraception methods.
- Every diabetic women who wishes to become pregnant must undergo screening and treatment for any complications (retinopathy, nephropathy, neuropathy, cardiovascular disease), and attend to any problem with them.
- Glycemic control must be optimized before the conception. The therapeutic goal is normal or near normal HbA1c levels, allowing for at most a 1% deviation from the upper normal limit.
- Insulin therapy must be readily established in all women who fail to achieve the glycemic goal with nutritional therapy.
- Oral hypoglycemic agents (OHAs) must not be administered during pregnancy, due to the lack of enough data on the absence of teratogenous effects. If the patient is on OHAs STOP these and control the diabetes with diet +/- insulin.
- Rapid acting insulin analogues- aspart and lys-pro-can be either maintained or added to treatment during pregnancy, but data on the use of long action analogues, which lack adequate safety data, is not recommended.
- The use of ACE-inhibitors, ARBs and statins is not allowed during pregnancy: hence, these drugs must be discontinued before conception.
- The glycemic goals that women with either gestational diabetes or presentational diabetes (type 1 or type 2) must achieve during pregnancy are listed below:
 1. < 95 mg/dl fasting blood glucose;
 2. < 140 mg/dl 1h after meals;
 3. < 120 mg/dl 2h after meals.

- Insulin treatment must be readily started in women with gestational diabetes, if glycemic goals are not achieved after 2 weeks of nutritional treatment.
- Insulin patterns must be personalized in gestational diabetes: patterns include either 1 or 2 injections can be implemented, but intensive insulin treatment can be necessary to reach optimal blood glucose levels.
- Women with type 1 diabetes require multiple insulin injections. It is difficult to control.
- Intensive insulin treatment is usually required to reach glycemic targets, even in type 2 Pre-gestational diabetes.
- Women with diabetes during pregnancy must self-test blood glucose at home (4 – 8 test/day) with pre-prandial, postprandial (2 h after the meal) and night time tests. Simplified self monitoring patterns can be used in gestational diabetes treated only with the nutritional therapy.
- Ketosis must be avoided during pregnancy; hence, daily ketonuria testing on awakening is useful.
- Nutrition treatment during pregnancy must be personalized, taking into account both the diet habit of diabetic women and the BMI before the pregnancy. The goals are appropriate maternal and fetal nutrition, appropriate calorie, vitamin and mineral intake and optimal Glycemic control when there is no ketonuria.
- The diet should be constructed to allow for a gain of 11 Kg in normal weight lady.(Low weight ladies may be allowed to gain up to their ideal body weight plus 11Kg.whilst obese ladies should gain about 7 Kg) in the whole pregnancy.

6-3 Gestational diabetes

- Gestational diabetes is a state of carbohydrate intolerance resulting in hyperglycemia of variable severity, with onset or first recognition during pregnancy.
- It does not exclude the possibility that the glucose intolerance may antedate pregnancy but has previously gone unrecognized.
- The definition applies irrespective of whether or not insulin is used for treatment or whether the condition persists after pregnancy
- In case of gestational diabetes, resistance to insulin mainly occurs during the second and third trimesters. This is why somewhere between 24-28 weeks a pregnant woman is screened for the presence of gestational diabetes.
- Certain groups of women are at high risk and more likely to develop diabetes. having one or more of the following risk factors
 1. Old age
 2. Being overweight, obese or severely obese BMI 30% or more).
 3. Family history revealing first degree relative with diabetes mellitus.
 4. Previous baby 4 kg.
 5. Pre-diabetes (having impaired glucose tolerance or impaired fasting glucose).
 6. Pregnant women who has polycystic ovary syndrome (PCOs)
 7. Previous history of GDM before.
 8. Glucose in urine (glycosuria).
 9. High blood pressure
 10. Bad obstetric history .Repeated unexplained miscarriages
 11. Recurrent vulvovaginalis.
- Both underweight and obesity have implications for diabetes mellitus. Women who are under weight during pregnancy are more likely to have low birth weight infants who then face a high subsequent risk of cardiovascular diseases and diabetes in adulthood. (5)

6.3.1 Screening for GM (7)

- Screen for undiagnosed type 2 diabetes at the first prenatal visit in those with risk factors, using standard diagnostic criteria.
- In pregnant women not known to have diabetes, screen for GDM at 24 –28 weeks of gestation, using a 75-g 2-h OGTT and the diagnostic cut points in Table 6.
- Screen women with GDM for persistent diabetes 6–12 weeks postpartum.
- Women with a history of GDM should have lifelong screening for the development of diabetes or pre-diabetes at least every 3 years.
- **The screening test for GDM:**
 1. Give the lady 50 grams of glucose.
 2. After one hour check blood glucose level.
 3. Blood glucose level below? 130mg/dl, repeat test at 24-28 weeks of gestation. Blood glucose level 130 mg/dl or more; proceed to formal 75 grams OGTT

6.3.2 Diagnosis of GDM (7)

- Perform a 75-g OGTT, with plasma glucose measurement fasting and at 1 and 2 h, at 24–28 weeks of gestation in women not previously diagnosed with overt diabetes.
- The OGTT should be performed in the morning after an overnight fast of at least 8 h.
- The diagnosis of GDM is made when any of the following plasma glucose values are exceeded:
 1. Fasting _92 mg/dl (5.1 mmol/l)
 2. 1 h _180 mg/dl (10.0 mmol/l)
 3. 2 h _153 mg/dl

6.3.3 Adverse outcomes of diabetes with pregnancy:

Maternal adverse outcomes:

- Nowadays, due to advanced management of diabetic pregnancies, maternal morbidity and mortality are markedly reduced.
- The maternal morbidity is related to the severity of diabetic related complications preceding pregnancy. Women with co-existing renal nephropathy are at risk of developing preeclampsia.
- Pregnant women with diabetic retinopathy are at risk of progression of the disease.
- Other adverse maternal outcomes include: hypo- and hyperglycemia, exposure to C.S, developing type 2 diabetes.

Fetal and Neonatal adverse Outcomes

- Appropriate preconception control of diabetes reduces fetal and neonatal complications. Congenital malformation is the most important cause of morbidity and mortality in diabetic pregnancies.
- The mechanism of malformation is not fully understood.
- Apart from structural malformations, the following are adverse outcomes:
 1. Miscarriage.
 2. Macrosomia (big baby).
 3. Breathing problems, Respiratory distress syndrome (RDS).
 4. Neonatal Clinical manifestations of:
 - Hypoglycemia.
 - Hypomagnesaemia.
 - Polycythaemia.
 - Hyperbilirubinemia.
 5. Intrauterine fetal death.
 6. Neonatal death.

Delayed adverse outcomes:

- Childhood obesity.
- Adulthood risk for type 2 diabetes.
- Delayed psychomotor development.

6.3.4 Management of Gestational Diabetes

- The goal of management is to reduce the risks of GDM for mother and child, by early detection, and screening for high risk of GDM at 26-28 weeks or before.
- Scientific evidence is beginning to show that controlling glucose levels can result in less serious fetal complications (such as Macrosomia) and improved maternal quality of life.
- Counseling before pregnancy for pre-gestational diabetes, and about preventive folic acid supplements, with a multidisciplinary management is important for good pregnancy outcomes.

Both types of diabetes, PGDM and GDM can be treated by:

- 1) Lifestyle modification as diet, and exercise.
- 2) Insulin therapy

Diet modification

- Any diet needs to provide sufficient calories for pregnancy.
- The main goal of dietary modification is to avoid peaks in blood sugar levels. This can be done by spreading carbohydrate intake over meals and snacks throughout the day.

Women at high risk to develop GDM need to modify their life style and food habits :

- The meals should be small and frequent, 5-6 meals/day.
- The patient should take diet rich in proteins and fibers.
- The diet should be low in fat and salt.
- Milk and milk products are very necessary for mother and fetus.
- The carbohydrates content of food should not be less than 50% to 60% of the total daily calories.
- The total calories requirement is depending on the job and the type of domestic work of the patient.
- If the body mass index (BMI) of the patient is more than 30%, the energy requirement will be at 25 kcal/kg.
- The patient with GD can try the dietary control over 1-2 weeks.
- Failure of dietary modification necessitates insulin therapy when fasting blood is more than 110mg/dl or postprandial is more than 140 mg/dl.

Exercise

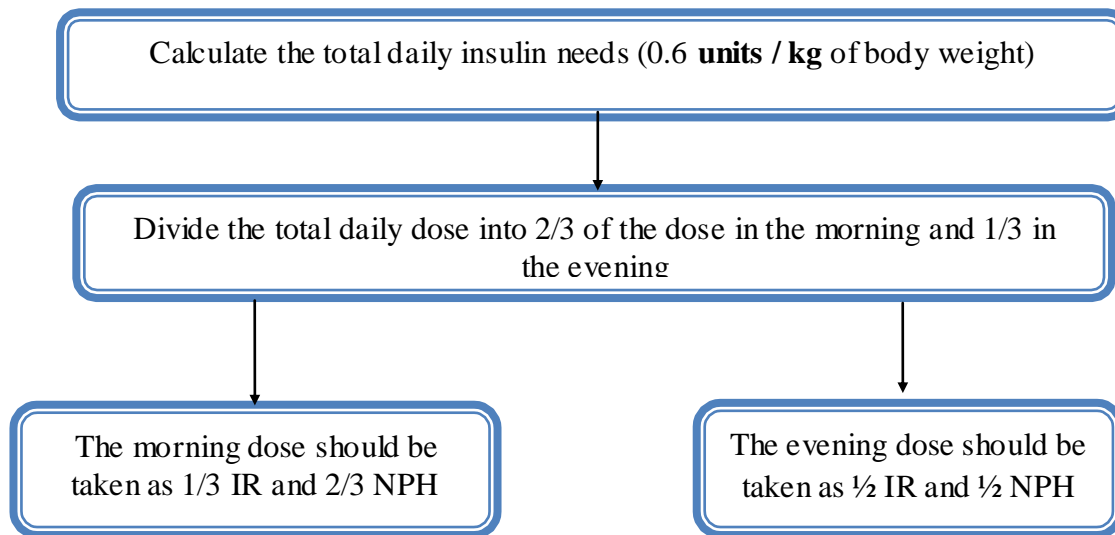
- Exercise lowers the blood sugar level by transporting sugar to the body cells.
- Exercise increase the body sensitivity to insulin, which means the body needs less insulin to transport sugar to the body cells.
- Exercise can help prevent some of the discomforts of pregnancy, such as muscle cramps, back pain and constipation. And control weight gain.
- Start exercise slowly and build up gradually.
- Walking is the best exercise. Ordinary activities such as housework also count.
- Suitable, quiet place with comfortable dress and shoes are needed

Insulin therapy

- Ladies with GD will be able to control their blood glucose levels sufficiently with diet and exercise alone, but some women will go on to need insulin at some points:
- Insulin has historically been the only option for pregnancy since it does not cross the placenta.
- The advised types of insulin to be used in GDM are insulin regular (IR) and NPH. IR is a short acting and NPH is longer acting.
- Your particular dosage may entail only one of these or a combination of two, and will probably change as pregnancy progresses.
- Hospitalization allows you to teach a mom with GD how to use insulin and managing hypoglycemia. In addition to that you can adjust the insulin dosages to get blood glucose into control.

INSULIN COMBINATIONS:

1-A combination of (IR) and (NPH)



2- Insulin regular alone

- Can be given in three divided doses, before the main meals. The dose can be adjusted according to blood sugar.
- If FBG not controlled with IR, you can add NPH at bed time (4-6 units)

3-Mixtard alone

- In case of using mixtard, estimate the total daily dose (0.6unit\kg bodyweight)
- Give 2\3 of the total dose in the morning and 1\3 In the evening

6.3.5 Good Metabolic control:

1. FBG<90mg/dl.
2. PPBG<135mg/dl.
3. Hb A1C<7%

Blood sugar monitoring

- Pregnant women with the diagnosis of gestational diabetes have to check for fasting and postprandial capillary blood glucose levels after meals using glucometer.
- Blood sugar level could be monitored every three days by glucometer, if that is affordable.
- It is recommended to investigate for HbA1C every 3 months (at least twice during pregnancy).
- growth scan for the fetus in Pregnant women with GD and on diet control, the targeted growth scan can be at 16-18 weeks, then Growth scans at 34, 36 and 38 weeks.
- Pregnant women with GD and on insulin, targeted scan can be at 16-18 weeks, Then every 4 weeks started at 26 weeks (growth scan)

6.3.6 Timing and Mode of Delivery

- Decision regarding timing and mode of delivery must balance the risks of prematurity with the risks of intrauterine death and Macrosomia.
- Depending on the patient's circumstances and the assessment of the care providers, it will be decided either to induce labour before the expected date of delivery or book the patient for C.S delivery. Some patients may go spontaneously into labour and allowed to continue if no contraindication to vaginal delivery.
- There are differences in timing and mode of delivery between obstetricians. Some are extremely aggressive about early elective delivery, while others allow the same patient to go further along the pregnancy without elective delivery particularly if blood glucose tests were reassuring.

But generally these are the options:

1) Women with GDM on diet:

- Have no complications and Blood glucose tests are reassuring, Induce labor at 39 – 41 weeks.
- Have complications (maternal or fetal). Elective delivery by induction or C.S after completion of 37 weeks gestation. Elective C.S is recommended if the fetal is 4000 gms or more

2) Women with GDM on insulin therapy:

- Have no complications and Blood glucose well controlled, Induction of labour at 38-40 weeks gestations.
- Have complications and Blood glucose uncontrolled, -Termination of pregnancy at completion of 37 weeks gestation. If termination is needed before 37 weeks, dexamethazone should be considered.

6.3.7 Intrapartum Management

- At admission, check blood glucose.
- Record the time of the last insulin dose she took (during labour insulin requirement is reduced and the insulin dose should be adjusted).
- Conduct continuous fetal monitoring.
- Start insulin drip.

Spontaneous Term Labour

- Avoid labour prolongation.
- Conduct continuous fetal monitoring.
- Perform C.S delivery if there is any delay in labour.

6.3.8 Induction of labour

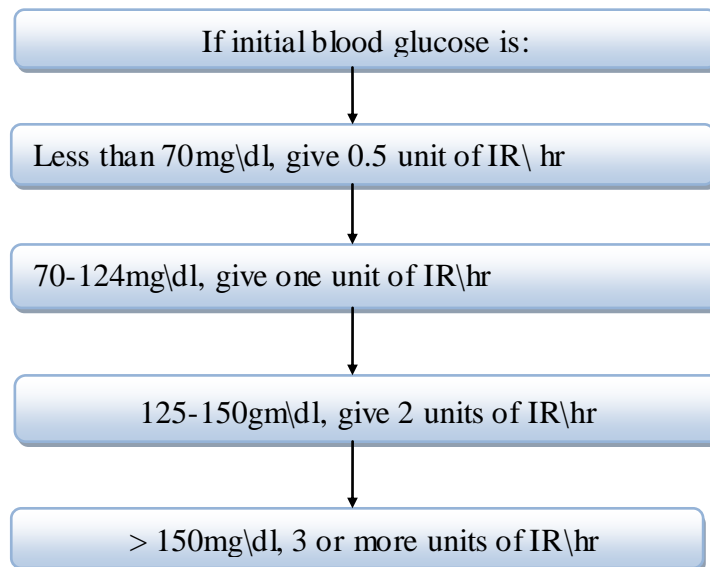
- The fetal and maternal conditions should be favorable for induction.
- Admit the patient a day before or early morning for induction.
- Patient should take the usual insulin dose at bed time.
- Check blood glucose level and start insulin drip.
- Perform artificial rupture of membranes (ARM) and start syntocinon IV.
- Conduct continuous fetal monitoring.
- Check blood glucose every 1-2 hours.

6.3.9 Elective Cesarean Section

- Book the patient for C.S at 38 -39 complete gestational weeks.
- Admit the patient a day before C.S.
- On admission check blood glucose.
- Patient should take the usual insulin dose at bed time.
- Keeps the patient fasting at least 6 hours before C.S. Do fasting blood glucose.
- Omit the dose of insulin at the morning.
- Epidural and Spinal anesthesia are preferred.
- Start insulin drip.
- If unable to perform C.S immediately or patient in poor control. Perform C.S after 4 – 6 hours euglycemia.

6.3.10 Insulin infusion in Labour

- Add 5-8units of insulin regular to 500 ml of glucose 5% solution.
- For every 500 ml of glucose add 20 mmol of potassium (one vial of potassium).
- Keep I.V fluids at 125ml\hour (30 drops per minute).
- Use short acting insulin (IR) and adjust accordingly:

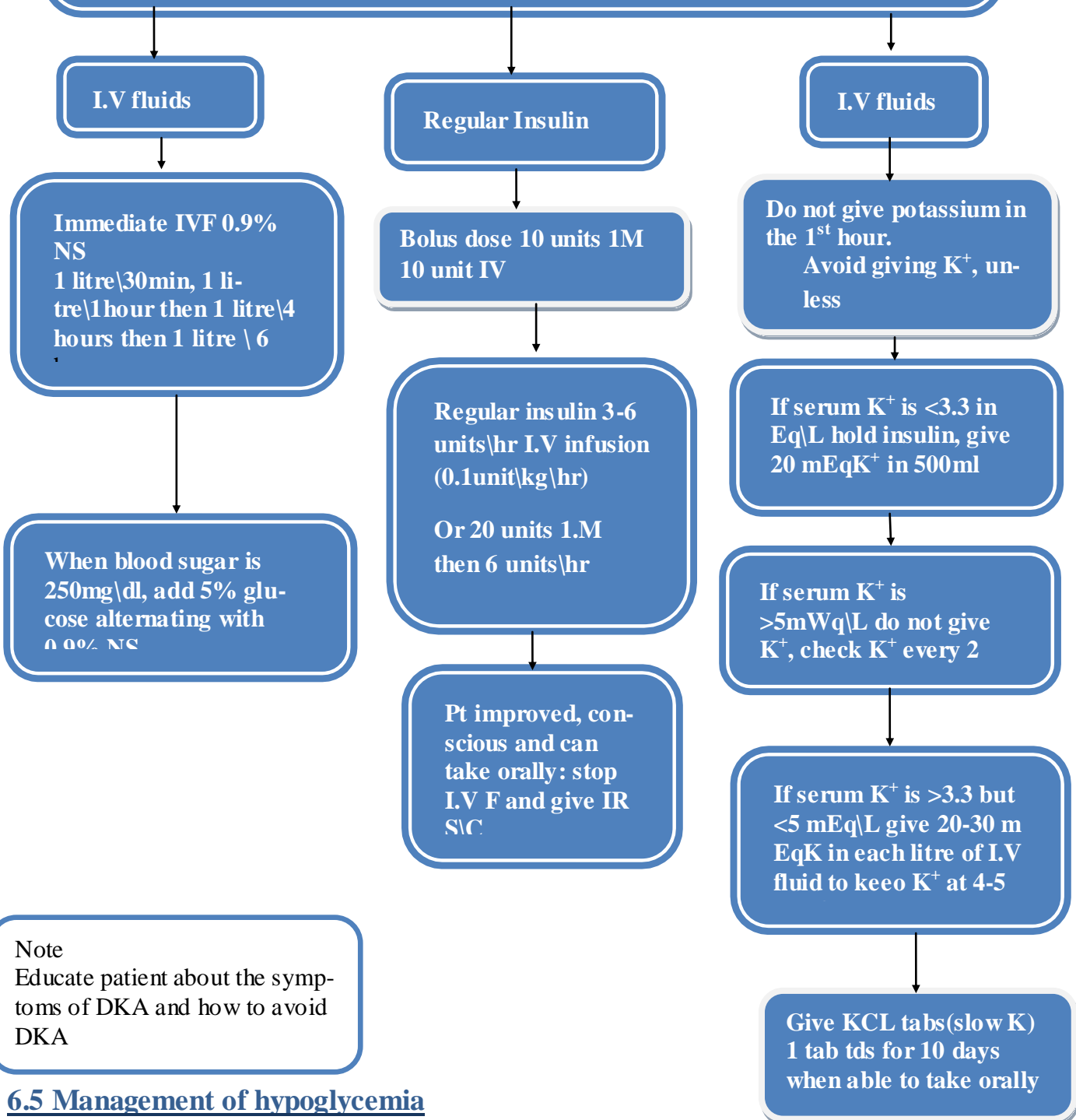


- Check blood glucose at every 1-2 hours.
- Keep target blood glucose between 70-100 mg\dl.

- Check urine for sugar and acetone every 4 hours.

6.4 Management of DKA at Hospital

- The diagnosis can be clinically, by symptoms such as abdominal pain, vomiting, dehydration, smell of acetone, acidotic breathing.
- Lab investigations such as urine for sugar and acetone, blood sugar $>300\text{mg/dl}$, serum K^+ , Na^+ , Hco_3 , ECG, WBC.



Note
Educate patient about the symptoms of DKA and how to avoid DKA

6.5 Management of hypoglycemia

- If you are in doubt treat as hypoglycemia.
- Symptoms of hypoglycemia is same, educate patient about the symptoms and how to avoid it.
- Check blood glucose, levels less than 70mg/dl is diagnostic.
- If conscious, give cup of juice, 3cubes of sugar or sweets or dates followed by meal.
- If unconscious, general management of coma, give IV dextrose 50%.

6.7 Postpartum management of GDM

- After delivery discontinue insulin drip infusion since the insulin requirements fall after delivery.
- Early mobilization postpartum is recommended for all patients because they are prone to develop thromboembolism.
- In case of GDM patient on diet only, continue on diet control for diabetes.
- In case of GDM, patient on insulin, keep on diet too, and Check blood glucose hourly for 2-4 hours after delivery, if the level is less than 150mg\dl there is no need for insulin.??if it is high
- In case of type 1 DM ended by C.S, give DSNS at 125 cc\hr and check blood glucose every ??4 hrs.
- In case of type 1 DM ended by vaginal delivery, regular diet + half the dose of insulin used in pregnancy,
- In case of type 2 DM give diet, check postprandial blood glucose, if >150mg\dl start treatment
- Among women with GD, postpartum screening for type 2 diabetes(OGTT) at:
 1. Six weeks or more after delivery.
 2. One year after delivery.
 3. Every three years is recommended.

6.8 Breast feeding:

- If the diabetic women wants to breast feed they must be controlled with diet ± insulin(OHAs are not recommended for lactating women).
- It may be possible to prevent or slow progression to type 2 diabetes among women with GDM.
- For example, breast feeding has also been associated with reduced blood glucose levels and reduced incidence of type 2 diabetes for women.
- Children who are breastfed may also have lower rates of type 2 diabetes.
- Women at risk of developing type 2 diabetes can decrease the risk of type 2 diabetes substantially, through exercising and eating mainly fruits, vegetables and whole grains

7 FOOT CARE

7.1 Classification (7, 17)

The main types of foot lesions are:

1. **Neuropathic foot**
2. **Ischemic foot**
3. **Neuro-ischaemic: Both neuropathy and ischemia.**

7.2 Aetiology

A) Neuropathy

1. Sensory neuropathy Loss of pain and temp (small c fibers) and vibration sense (Posterior tracts)
2. Motor neuropathy (weak small muscles of the foot like interossei and lumbricals, strong action of long flexors leading to foot deformity)
3. Autonomic neuropathy (loss of sweat which has antibacterial effect, dry foot and cracks allows bacterial entry, hyperkeratosis, A-V shunt and Charcot joint)

B) Ischaemia

Major vessel disease, atherosclerosis. The limb circulation is affected: posterior tibial & dorsalis pedis pulsations are weak or absent

c) Mechanical Factors

(Vertical Load and Longitudinal shearing forces) High load on the base of the 1st metatarsal which the commonest site of the ulcer)

d) Connective tissue changes

Increased stiffness of planter skin due to abnormal glycosylation of keratin and collagen proteins in addition to the high weight load at certain sites)

e) Other factors

- Blood flow Stiff vessels , reduced transit time, A-V shunt affects tissue nutrition and bone rarefaction
- Micro angiopathy: thick basement membrane
- Haematological: Increase viscosity
- Wound healing defect: Defective inflammation and healing in hyperglycaemic patients.
- Infection: Bacterial invasion (mainly Staph aureus, Coliform, pseudomonas, MR)
- Psychological: self neglect carelessness in dietary intake

7.3 Foot care for diabetics (7, 17)

A foot care is essential for any diabetic. All physicians must inspect the feet of diabetics and advise the patient on:

- Shoes: Broad front to accommodate the toes. The heel should be less than 5 cm high. Smooth inner lining. Well-padded insole.
- Nails: Cutting the nails horizontally not very short and smoothens the edges. Never cut the corners, always apply antiseptic with nail cutting..
- Care about minor foot problems: e.g blisters opened & cleaned, hard keratin shave, Warts treated, Wash the feet & inspect them daily.
- Control diabetes: in all stages, stop smoking.

The high risk foot is the one with either of the following 5 signs

1. Neuropathy
2. Ischemia
3. Deformity
4. Callus
5. Swelling

7.4 The High Risk Foot (7, 17)

- Has one or more of the above mentioned risk factors
- The two main risk factors are neuropathy & ischaemia
- Other less risk factors are deformity, callus & oedema.
- Callus: Need sharp careful shaving by an expert. Repeated callus formation needs proper shoes with soft-padded insole.
- Deformities: Need proper shoes for each type of deformity
- Unilateral foot swelling without sepsis: Needs diagnosis & management in form of elevation, diuretics, if needs & anti-coagulant in case of DVT (Exclude uraemia).
- If Bilateral: exclude heart failure or uraemia. It can be due to autonomic neuropathy.
- Early vascular ischaemia needs utmost foot care
- Nail or callus should be nursed carefully
- Any wound carries a high risk of propagation
- Aspirin (anti-platelet) is helpful in marginal ischaemia.
- Absent pulses is an early indication & a vascular surgeon is to be consulted.

7.5 Foot ulcer

- Any skin break carries a high risk of serious outcome.
- Aim in neuropathic ulcer to redistribute the plantar pressure while in the neuroischaemic ulcer is to protect the margins of the foot.
- Wound debridement is the main thing, using scalpel to allow free drainage.
- Swab is taken for culture & sensitivity. The wound is probed to see if it reaches the bone, which indicates osteomyelitis. Saline wash & dressing applied. If the foot is ischaemic, then a vascular assessment is needed. Palpation of the posterior tibial & dorsalis pedis arteries & measuring the ankle/brachial index (A/B index). This calculated by dividing the systolic pressure of posterior tibial artery over the brachial artery. The normal value is > 1 . Values < 0.5 is serious ischaemia.
- Blister: this is fluid collection as a result of pressure, irritation or heat. It can result from new shoes (tight). Better opened and dressed with normal saline. It will heal in 1 or 2 weeks unless it is deep burn. Small blisters can be left and cleaned daily with normal saline. Never use alcohol in wounds only on healthy intact skin..
- Nail or Thorn prick in sole: Take this very seriously: clean with spirit, dress with sterile gauze and give antibiotics. You may give IV cephalosporin for rusty nail prick and follow the patient DAILY for up to one week.
- Remember: Diabetic with severe neuropathy will not feel any throbbing pain in presence of pus nor fever. They present with foot and leg swelling, tender calf muscles on palpation and may be more tender along the lymphatic pathways (early lymphangitis) , distended leg veins. These are serious signs.

7.6 Cellulitic Foot:

The two main points

A) Is this an ischaemic or neuropathic foot (if posterior tibial and dorsalis pedis arteries are palpable then it is neuropathic)

B). Is it septic (fever or ill health, OR unilateral warm foot and/or leg OR elevated TWBC Or a combination).

- The ulcer is infected: color is yellow or grey, pus discharge, smelly, sinuses develop and tendons or bones are exposed
- In mild form, the foot is slightly warm without leg affection
- In severe cases, there is warm swollen leg and signs of systemic sepsis (fever & ill health).
- Tissues or bone fragments (not Swab) is taken for culture & systemic antibiotic given empirically, better intravenously (preferred third generation cephalosporin) for 2 –3 days followed by oral antibiotics for 10 – 14 days when the result of the culture is available. Make sure of the antibiotic brand to be sound. USE FULL DOSE IV 8 or 12 hourly and NOT a single dose/day.
- X-ray the bones .If there is osteomyelitis; dead bones need to be removed during debridement. Any ulcer exceeding 10 – 14 days will need an X ray if still infected. In open sinuses you can probe and feel necrotic bone without a need for an X ray if it is not easily available. Do not postpone the debridement of an open wound till the X ray is available.
- The wound is laid open to drain, Unhealthy tissue is removed
- Daily dressing using normal saline is carried out.
- Any wound dressing needs 2 persons, sterile towel, gloves, sterile gauze, normal saline, 2 artery forceps, scissors, toothed tissue forceps, scalpel .
- All sinuses or deep cavities should be laid open.
- Any wound dressing that is wet from outside should be changed.

Remember:

- Antibiotics alone are useless in presence of pus or necrotic tissues. Adequate debridement is the main key to clean wound.
- Fever or general feeling of ill health indicates systemic sepsis. This is very serious and needs urgent IV antibiotics and debridement.
- Warm, tender and swollen leg is the other serious sign indicating cellulites.
- Smelly wound is very serious and needs utmost urgency for debridement.

Remember:

- Diabetics are anaesthetic and might not need even local anaesthesia. So check for sensation and you can proceed with debridement under local or NO anaesthesia. Do not use local anaesthesia containing adrenalin.
- Large size toe without an ulcer indicates chronic osteomyelitis.

7.8 Necrotic foot (gangrene)

- In case of dry gangrene without spread, careful debridement is needed in ischaemic foot
- Reconstructive surgery or angioplasty is the only means to save the limb.
- Careful assessment of the patient general condition besides the foot is needed. A major amputation may be the best offer in some patients. Explain the whole picture to the patient early and the possible outcome.
- The presence of a gangrenous toe in a well-vascularised foot is due to delay in incision of cellulites or an abscess. All gangrene has to be excised under systemic antibiotics, daily dressing and with normal saline wash.
- Ray amputation of the toe is good procedure in non-ischaemic foot

7.9 Major Amputation Indication:

- Acute overwhelming sepsis that is life-threatening
- Chronic protracted sepsis destroying the foot and affecting general health of the patient (anaemia, uraemia etc). Repeated blood transfusion with elevated creatinine)

7.10 Major limb ischaemia

General Management:

- Metabolic control using regular insulin in three divided doses is important with frequent blood sugar assay and potassium correction.
- Microbiological control according to swaps & culture results. Usually for 2 – 3 weeks unless you are treating osteomyelitis with antibiotics which needs 2 – 3 months. Be cautious in case of: Pseudomonas and MRSA mostly sensitive to Vancomycine and Impenem.
- Education of the patient about foot care & wear. All patients to be referred for the foot care clinic.
- Nutritional advice: Refer to the concerned department.
- Mechanical : Proper shoes as described
- Treatment of other allied diseases looks for allied diseases hypertension, uraemia & retinopathy.

7.11 The Practical Approach to a DSF patient:

Local examination in steps:

1. Check the sensation to get an idea about pain feeling using pin prick or a 10 gram monofilament nylon.
2. Check the vessels: Posterior tibial artery & Dorsalis pedis. In case of oedema it will be difficult to palpate the vessels without a Doppler. Examining the other foot will give an idea of limb circulation. If absent it means ischaemic component. This should be confirmed by the ankle brachial ration index: A/B index (occluding systolic pressure of the posterior tibial artery divided by the brachial artery occluding pressure. If it is <0.5 it is serious. The normal value is >1.0. This is not absolutely correct esp. when the readings are above 1.2. A toe pressure is ideal but not available in our clinic. This will ultimately need a vascular surgeon to do either angioplasty or vascular bypass surgery.
3. If the limb circulation is adequate then see for unilateral leg oedema and feel for warmth and tenderness which means a degree of cellulites. If there is fever as well, this is septicaemia. In both conditions start intravenous antibiotics (3rd generation cephalosporins) plus incision drainage and surgical debridement in most cases.
4. Now you open and see the wound. Probing is important using sterile forceps. If you reach the bone; this is mostly osteomyelitis. Swabs are taken in all cases or better take pus/tissues or bone for culture and sensitivity. A plain X ray foot must be done for any sepsis lasting one week or more with pus discharge.
5. The patient should be followed closely daily. Fever and pus discharge should not be tolerated more than 24 hours.
6. Wound should be laid open like an open book. All deep tracks should be laid open.

Wound packing is forbidden.

Only allow after major surgical debridement to stop bleeding.

Most cases will need insulin therapy using short acting (Actrapid) in 3 divided doses.

Euglycaemia should be the goal postprandial blood sugar in the range of 120 mg%. HbAc should be checked with lipid profile.

Early cases

1. A patient presenting with a blister. If small and on dorsum of the foot it can be observed with external cleaning using antiseptic solution like povidone iodine. If large or in the planter surface that can rupture, it can be laid open and dressed daily with normal saline.,
2. A planter injury with nail or needle or thorn prick should be taken seriously. Dressing and antibiotic is important and daily examination for deep sepsis. In case of nails an intravenous 3rd generation antibiotic may be necessary.
3. Interdigital fungal infection: Usually presents with white laceration and wet site. Clean daily with normal saline and apply antifungal spray or powder. Avoid ointment if possible.

Systemic Tips

1. Retinopathy: Refer for early Fundal examination

2. Nephropathy: Blood urea and serum creatinine, micro-albuminuria. Avoid nephrotoxic antibiotics if possible and monitor the renal function during administration. Always check creatinine before giving systemic antibiotics esp. the aminoglycosides. (7, 17)

8

ACUTE METABOLIC COMPLICATIONS

8.1 Hypoglycemia**8.1.1 Definition (18)**

Hypoglycemia is a common complication of drug treatment and a particular risk in insulin-treated patients. Severe episodes can lead to serious complications and may be potentially fatal if left untreated. Hypoglycemia is likely to occur under the following circumstances:

- Omission of meals or inadequate food intake
- With unaccustomed physical exercise.
- Over treatment with insulin or sulphonylurea
- Ingestion of alcohol particularly without food
- Diminishing insulin requirements due to impaired renal function

8.1.2 Hypoglycemia as a result of physical activity

For sporadic physical activity departing from the patient's usual daily routine, action needs to be taken to avert hypoglycemia. Such action might include:

- Consumption of extra carbohydrate food to cover the increased activity. Initially, this may be 10–15 g of carbohydrate every 30–45 minutes during increased activity.
- Another option is to reduce the dose of insulin either in addition to, or instead of, giving dietary carbohydrate supplements. All patients should have quick-acting, rapidly-absorbed carbohydrate available when exercising in case of hypoglycemia.

8.1.3 Prevention strategies

- Education of patients and their families about the prevention, recognition and treatment of hypoglycemia is essential and is, therefore, the most important approach.
- Health care workers, particularly emergency medical personnel, should be familiar with the recognition and treatment of hypoglycemia.
- To facilitate prompt assessment, patients receiving insulin treatment should wear or carry appropriate identification.
- Blood glucose targets must be individualized for each patient
- Patients who no longer experience the usual warning symptoms should be carefully instructed in subtle clues to hypoglycemia (e.g. minor changes in mental function, perioral paraesthesia) besides having their glycaemic targets raised.
- There should be a careful balance of food intake, activity and insulin dosage in both quantity and timing, taking into consideration the eating and other lifestyle habits of the individual
- Meals should be consumed on time, and appropriate changes made in insulin dosage if meals have been omitted.
- Between-meal and bedtime snacks may be necessary to reduce the risk of hypoglycemia.
- Energy intake should meet the needs of usual daily activity.
- Patients should carry rapidly absorbable carbohydrate with them at all times.
- It may be desirable to measure blood glucose before driving a motor vehicle or operating potentially dangerous equipment, both at leisure and in the workplace.
- When hypoglycemia arises in patients treated with sulphonylurea, it should be recognized that these agents persist in the circulation for a long time, and that hypoglycemia may recur after its initial correction. Such patients should be monitored for an appropriate period after therapy is changed, depending on the sulphonylurea originally used.

- Any changes in insulin preparation, formulation, concentration or species should be accompanied by appropriate education of individuals with diabetes, health professionals and all other people involved in diabetes health care.

8.1.4 Treatment of Hypoglycaemia

- Hypoglycemia is a medical emergency and should always be treated promptly.
- Blood glucose should be measured, using glucose – sensitive reagent strips to confirm the diagnosis in suspected cases. But if this measurement is not immediately available, treat **it** as hypoglycemia.
- In mild cases, the person with diabetes should be instructed to deal with such episodes by having a rapidly absorbable carbohydrate or sweetened drink, which may have to be repeated as necessary.
- If the patient is confused and uncooperative or unconscious, give **him/her** 10 – 20 grams or mls of 20 % or 50 % glucose intravenously. When intravenous therapy is not available or possible, give glucagons, 1 mg, intramuscularly or subcutaneously.
- Hypoglycaemia due to sulphonylureas and long acting insulin's may be prolonged. Therefore it is important that frequent measurements of blood glucose are made to assess the effectiveness of therapy and to safeguard against recurrence of hypoglycemia.

8.2 Diabetic ketoacidosis (19)

Diabetic ketoacidosis (DKA) is a serious and potentially life-threatening complication of diabetes mellitus. It occurs most commonly in patients with type 1 diabetes.

The diagnosis of DKA rests on identifying the classic triad of

1. Hyperglycaemia
2. Ketosis and
3. Acidosis

The management of DKA focuses on:

- Correcting
 - Dehydration,
 - Hyperglycemia
 - Electrolytes imbalances. and
- Treating the precipitating factors

Diagnosis

- No specific clinical signs that confirm or refute the diagnosis of DKA
- Serious diagnostic difficulties may exist where;
- the patient is unconscious, or
- DKA is the first presentation of diabetes
- The history of diabetes is always very helpful.
- Consider DKA or other metabolic acidosis on a patient with hyperventilation
- It is always essential to measure blood glucose early in the resuscitation of any unconscious patient
- Symptoms and signs of hyperglycaemia are always present
- Nausea, vomiting or abdominal pain may predominate
- Increased depth and rate of respiration (Kuss mal respiration)
- Patients may smell of ketones (unreliable)

On arrival:

Perform complete initial assessment; history and clinical examination

1. Check capillary blood glucose (bed – side)
2. Urine for ketones
3. Insert a cannula (better wide-bored), and obtain a specimen of blood, at the same time, for serum glucose, electrolytes, blood urea nitrogen and creatinine and liver functions
4. Obtain urine for general examination
5. Test for ketones in urine and serum
6. The hallmark laboratory findings in DKA are
7. hyperglycaemia (serum glucose >250 mg/dl),
8. ketosis(positive serum and/ or urine ketones) and
9. acidosis (arterial pH < 7.30 and or serum bicarbonate< 18 mEq/L)

Management**The main lines of management of DKA are:**

1. Fluid resuscitation
2. Insulin therapy
3. Correction of the metabolic acidosis and electrolyte imbalance
4. Identifying and treating precipitating factors
5. Frequent monitoring to achieve these goals and avoid complications
6. The use of a flow chart to track the metabolic progress of the patient

N.B:

- Follow the fluid resuscitation in elderly patients more closely to prevent volume overload
- Fluid Resuscitation
- Fluid, water, loss in DKA could be tremendous; approximately up to 9 liters.
- However, the requirement of each patient should be estimated individually and the plan for replacement **must** be drawn accordingly. Otherwise, isotonic saline (0.9% NaCl) at 15 to 20 ml per kg per hr for the first hour is recommended for all patients.
- Fluid therapy, should, thereafter, be tailored based upon volume status and serum sodium concentration.
- Continue infusion of 0.9% NaCl and consider adding plasma expander in patients with hypovolemic shock.
- Aim to correct the total body water loss during the first 24 hrs
- Monitor blood glucose and serum osmolality closely.
- Add 5% dextrose to the NaCl infusion when blood glucose falls below 250 mg/dl
- Maintain blood glucose concentration between 150 and 250 mg/dl as long as insulin infusion is required to treat acidosis.
- Beware of complications of rapid fluid shifts.
- Change to a lower salt content infusion form, such as 0.45% NaCl, if sodium levels are normal to high.

Insulin Therapy

- The optimal choice for the treatment of DKA is regular insulin.
- Low dose insulin effectively corrects metabolic acidosis without precipitating rapid declines in plasma osmolality, glucose and potassium.
- Give an intravenous bolus of 0.1 units/kg followed by a continuous infusion of 0.1 units/kg
- Monitor blood glucose hourly, using a bedside Glucometer.

- If blood glucose fails to drop 50 to 75 mg/dl in the first hour, double the rate of the insulin infusion every hour until the goal reduction is achieved.
- Decrease the rate of insulin infusion once blood glucose level is less than 200 mg/dl.
- Continue insulin infusion till acidosis resolves.
- Start the transition to subcutaneous insulin once DKA has resolved.
- Overlap basal subcutaneous insulin and regular insulin infusion for 1-2 hours to prevent rebound hyperglycemia or recurrence of DKA.
- Return known diabetics to their previous home insulin regimen; adjust as necessary to control hyperglycemia
- Devise a plan of long-acting and short-acting subcutaneous insulin for the newly diagnosed.

Electrolyte Replacement

- Patients in DKA may have total body potassium loss of 305 mEq/L
- Defer insulin administration if serum potassium is less than 3.3 mEq/L at presentation.
- Potassium should be depleted to prevent complications of hypokalaemia, which could be life-threatening (cardiac arrhythmia and respiratory muscle weakness).
- If serum potassium is between 3.3 and 5.3 mEq/L, add 20-40 mEq of potassium to each liter of intravenous fluids, once good urine output is noted.
- If serum potassium is more than 5.3 mEq/L, potassium replacement is unnecessary; monitor potassium levels closely to a target level of 4-5 mEq/L during the management of DKA.

Bicarbonate supplementation

- There is no consensus on the benefit of bicarbonate supplementation in DKA.
- Bicarbonate levels will rise without supplementation.
- However, 50-100 mmol of NaHCO₃ in 200-400 ml of water with 10-20 mEq of KCL can be given over 1-2 hrs if pH is at or below 6.9. This can be repeated every 2 hours as needed until the Ph is above 7.0.

Prevention of DKA

- Effective communication and patient education can help prevent DKA.
- Counsel patients on appropriate management of their diabetes, particularly during illness.

9

CHRONIC DIABETES COMPLICATIONS**9.1 Eye complications (7, 19)**

- Diabetic retinopathy is a leading cause of visual disability.
- Significant retinopathy is rarely encountered in the first five years of insulin- dependent diabetes mellitus, nor before puberty.
- Almost everyone with type 1 diabetes will develop retinopathy after 20 years of the disease onset. And 75% will develop diabetic retinopathy over the subsequent of two decades.
- In those suffering from type 2 diabetes, up to 20 % may be found to have retinopathy at the time of first diagnosis of diabetes and about 60% develop it over subsequent decades. In addition 10% will develop proliferative retinopathy and 2 % develop blindness.
- Good control of diabetes results in reduction in the occurrence of retinopathy. Timely laser photocoagulation must be demonstrated to prevent a major proportion of severe visual loss associated with proliferate retinopathy. It also shown to be of considerable benefit to patients with macular oedema.
- Since retinopathy is not the only manifestation of diabetic eye disease, attention should also be given to glaucoma, cataract and other abnormalities likely to occur in diabetes.

Screening:

- Adults with type 1 diabetes and children aged 10 years or older should have an comprehensive eye examination 5 years after the onset of diabetes.
- Patients with type 2 diabetes should have a comprehensive eye examination at the time of establishing the diagnosis of diabetes.
- Subsequent examinations for type 1 and type 2 diabetic patients should be repeated annually; less frequent exams (every 2–3 years) can be considered following one or more normal eye exams. More frequent (3-6 months) eye examination is required if retinopathy is progressing or when the blood glucose control recently improved
- During pregnancy eye examination should be done more frequently (3-6 months),the eye should be examined in the first trimester with close follow-up has to be provided throughout pregnancy and for 1 year postpartum.

Annual check-up should include: (7)

- Visual acuity (glasses or pinhole)
- The lens and vitreous (ophthalmoscopy)
- The retina (dilated pupils, retinal photography or skilled ophthalmoscopy)
- Related factors (smoking blood pressure)

Eye disease management**Refer to ophthalmologist if:**

1. Sever non- proliferative retinopathy
2. Proliferative retinopathy
3. Macular oedema or oxidative maculopathy
4. Visual disability from cataract
5. Unexplained deterioration of visual acuity
6. Other eye disease of visual significance
7. Unrecognized eye lesions

Laser photocoagulation therapy is indicated to reduce the risk of vision loss in the patients with:

- High-risk PDR
- Clinically significant macular edema
- Some cases of severe NPDR. (A)

Review and intensify management of:

1. Diabetic kidney disease
2. Blood pressure (target < 135/ 85 mmHg, or lower if kidney damage)
3. Blood glucose control
4. Blood lipid control (if hard exudates)
5. Smoking

Note:

The presence of retinopathy is not a contraindication to aspirin therapy for cardio-protection, as this therapy does not increase the risk of retinal hemorrhage. Attend to the psychological and social aspects of visual impairment where it develops

The primary management of diabetic eye disease is by careful attention to blood glucose control targets from the time of diagnosis and blood pressure control

9.2 Nephropathy

9.2.1 Natural course of diabetic nephropathy:

- The earliest clinical evidence of nephropathy is the appearance of low microalbuminuria, and patients with microalbuminuria are referred to as having incipient nephropathy.
- Without specific interventions, >80% of subjects with type 1 diabetes who develop sustained microalbuminuria have their urinary albumin excretion increase at a rate of 10–20% per year to the stage of overt nephropathy or clinical albuminuria (>300 mg/24 h or > 200 µg/min) over a period of 10–15 years, with hypertension also developing along the way.
- Once overt nephropathy occurs, without specific interventions, the glomerular filtration rate (GFR) gradually falls over a period of several years at a rate that is highly variable from individual to individual (2–20 ml · min⁻¹ · year⁻¹).
- ESRD develops in 50% of type 1 diabetic individuals with overt nephropathy within 10 years and in >75% by 20 years.
- Without specific interventions, 20–40% of type 2 patients with microalbuminuria progress to overt nephropathy, but by 20 years after onset of overt nephropathy, only 20% will have progressed to ESRD.
- As therapies and interventions for coronary artery disease continue to improve, however, more patients with type 2 diabetes may be expected to survive long enough to develop renal failure.
- In addition the finding of microalbuminuria is an indication for screening for possible vascular disease and aggressive intervention to reduce all cardiovascular risk factors (e.g., lowering of LDL cholesterol, antihypertensive therapy, cessation of smoking, institution of exercise, etc.).
- In addition, there is some preliminary evidence to suggest that lowering of cholesterol may also reduce the level of proteinuria.

9.2.2 Screening for microalbuminuria/nephropathy (7)

- A routine urinalysis should be performed at diagnosis in patients with type 2 diabetes.
- If the urinalysis is positive for protein, a quantitative measure is frequently helpful in the development of a treatment plan.
- If the urinalysis is negative for protein, a test for the presence of microalbuminuria is necessary.
- Microalbuminuria rarely occurs with short duration of type 1 diabetes; therefore, screening in individuals with type 1 diabetes should begin after 5 years' disease duration because of the difficulty in precise dating of the onset of type 2 diabetes, such screening should begin at the time of diagnosis.
- After the initial screening and in the absence of previously demonstrated microalbuminuria, a test for the presence of microalbumin should be performed annually.

Screening for microalbuminuria/nephropathy can be performed by four methods:

1. Measurement of the albumin-to-creatinine ratio in a random spot collection.
2. 24-h collection with creatinine, allowing the simultaneous measurement of creatinine clearance.
3. Timed urine collection (e.g., 4-h or overnight).
4. Measurement of serum creatinine annually.

Table 3. Definitions of abnormalities in albumin excretion (7)

Category	24-h collection (mg/ 24h)	Timed collection (ug / min)	Spot collection (ug /m creatinine)
Normal	< 30	< 20	<30
Microalbuminuria	30 – 299	20 – 199	30 – 299
Clinical albuminuria	> 300	> 200	> 300

Nephropathy can be prevented and progression can be slowed by:

1. Strict glycaemic control.
2. Vigorous treatment of hypertension.
3. Avoidance of nephrotoxic drugs and early and effective treatment of infection.
4. Full assessment of renal function should be performed periodically.

9.2.3 Management if raised albumin excretion rate:

If serum creatinine normal:

- Monitor albumin excretion rate yearly to detect progression suggestive of specific diabetic kidney damage.
- Intensify management of modifiable arterial risk factors (glucose, lipids, blood pressure).

If serum creatinine abnormal:

- Review other possible causes of renal impairment (recurrent infection, renal arterial/ hypertensive damage, loop diuretic therapy/ cardiac failure, Glomerulonephritis).
- Monitor albumin excretion and serum creatinine more frequently to detect progression of renal damage.

If specific diabetic kidney damage (diabetic nephropathy) suspected:

- Treat blood pressure aggressively with a target of < 130/80 mmHg.
- Reduce salt intake.
- Use ACE – inhibitors as first – line drug therapy.
- Add loop diuretics, other agents if necessary.
- Reduce protein intake with target of < 0.8 g/kg.
- Maintain good blood glucose control and tight arterial risk factor control.
- Treat urinary infections aggressively; consider papillary necrosis if recurred.
- Arrange evaluation by a nephrologists before creatinine rises to 250umol/l (3.0 mg/dl).

9.3 Neuropathy (7)

- Neuropathy is a common complication of diabetes.
- It causes clinical manifestations and disabilities of diverse spectrum and considerable severity.
- Both peripheral nerves (sensory and motor) and the autonomic nervous system can be affected.
- Patients present with distal symmetrical polyneuropathy, focal neuropathy or manifestations of autonomic involvement such as gastro paresis, constipation, diabetic diarrhea, bladder dysfunction, impotence and orthostatic hypotension.
- Screening for autonomic neuropathy involvement is particularly important prior to general anesthesia
- Neuropathic involvement can be prevented or delayed by good glycaemic control.
- Pain due to neuropathy can be severe and distressing and often requires attention. If it persists in spite of good blood glucose control, drug treatment may be indicated.
- There is a little evidence of any treatment being useful in reducing peripheral anesthesia once established.
- Diabetic gastropathy, caused by autonomic involvement, is often manifested by troublesome gastrointestinal symptoms such as heartburn, nausea and vomiting. Symptoms may be relieved by agents promoting gastric emptying such as metoclopramide or domperidone.

Screening for neuropathy:

- All patients should be screened for distal symmetric polyneuropathy at diagnosis and at least annually thereafter.
- Screening for autonomic neuropathy should be started at diagnosis of type 2 diabetes, and five years after the diagnosis of type 1 diabetes.

Enquire for other manifestations of autonomic neuropathy if:

- Other complications (especially kidney).
- Before anesthesia.
- Erratic blood glucose control.

Management of painful neuropathy:

Counsel for the depressing and disabling nature of the condition

Consider initially:

- Bed foot cradles for night –time problems.
- Simple analgesia taken in advance of diurnal symptoms.
- Contact dressings.

Consider therapeutic trials of:

Class	Example	Typical doses*
Tricyclic drugs	Amitriptyline Nortriptyline Imipramine	10-75 mg at bedtime 25-75 mg at bedtime 25-75 mg at bedtime
Anticonvulsants	Gabapentine Carbamaepine Pregabalin*	300-1.200 mg at bedtime 200-400 mg t.i.d 100 mg t.i.d
5-hydroxytryptamine and norepinephrine uptake inhibitor	Duloxetine*	60-120 mg daily fs
Substance P inhibitor	Capsicin cream	0.025-0.075% applied t.i.d –q.i.d

*Dose response may vary; initial doses need to be low and titrated up. *Has FDA indication for treatment of painful diabetic neuropathy.

9.4 Erectile dysfunction:

- Sildenafil may be helpful if not contraindicated.
- Intracavernosal alprostadil can be useful in some men.
- Referral to professionals with specialist expertise can be useful for:
 1. Advise on mechanical or surgical prostheses
 2. Vascular investigation and reconstruction.
 3. Psychological assistance.

9.5 Gastroparesis:

- Investigation using radiological or radioisotope methods may help in diagnosis.
- Investigation of cardiovascular autonomic neuropathy may help diagnosis.

9.6 Diabetic nocturnal diarrhea:

- Investigation must exclude other causes of intestinal upset.
- Codeine, loperamide, or diphenoxylate in high doses may help.

9.7 Gustatory sweating:

- Explanation and counseling are often required.
- Try oral anticholinergic agents.

10 PREVENTION

10.1 Basic principles (7, 20-23)

- Diabetes mellitus prevention needs the effort of Health decision makers and health care professionals, to avail resources and educate the community.
- **Changing lifestyle** could be a big step towards diabetes prevention. And it is never too late to start.
- Making few simple **changes in life-style**, help to avoid the health complications of diabetes as nerve, kidney and heart damage.

10.2 Prevention Strategies:

10.2.1 Primary prevention

- It aims to reduce the incidence of diabetes.
- The goal is to reduce the prevalence of causative risk factors before the disease develops. The modifiable risk factors are common to most of non- communicable diseases; integrated risk management is cost effective.
- Primary prevention is done through population approach, or high risk approach.
- While the most important factor in the development of diabetes is genetics, which we have no control over, there are environmental risk factors which can be controlled to lower the risk of developing diabetes.
- The risks for developing type 2 diabetes include genetics as family history, and ethnicity. While the environmental factors are obesity, physical inactivity, dietary factors, low birth weight, smoking, and stress. Gestational diabetes is also a risk factor for developing type 2 diabetes later in life.
- **Prevention of type 2 diabetes can be achieved through**
 1. A healthy diet,
 2. Exercise,
 3. Weight control,
 4. Not smoking,
 5. Sometimes medicines.
- The primary health care facilities should play a major role in prevention and early detection of diabetes. This can be achieved by building the knowledge and ability of the health care providers to teach and treat the patients
- Diabetes is a lifelong disease, its management require commitment to life-style changes, taking regular medication and regular follow-up .Diabetes self-management education is needed at the time of diagnosis and thereafter.

The target groups for diabetes prevention:

1. The normal population. (Community approach, primordial prevention)
2. High risk people.(Risk approach)
3. Undetected diabetes (undiagnosed).
4. Diagnosed diabetic patients.(individual approach)

High risk groups:

1. Individuals with family history of diabetes in a first degree relative.
2. Previously identified impaired glucose tolerance (IGT) or impaired fasting glucose (IFG)
3. History of gestational diabetes (GDM)
4. Delivery of big baby, with weight more than 4KG.
5. Body mass index more than 25 Kg/m².
6. Hypertension and/or heart disease.
7. Individuals with risk factors (e.g. smoking, sedentary life, dyslipidemia)
8. Age over 40 years.

10.2.2 Secondary prevention:

- It covers activities such as opportunistic screening which aims at early detection of diabetes and prompt and effective management to reverse the condition or to halt its progression.
- It can detect undiagnosed cases .
- It can be population or high risk, facility based approach.

Screening for diabetes:

- The purpose of screening is to identify asymptomatic individuals who are likely to have diabetes.
 - Type 2 DM is frequently not diagnosed until complications appear Approximately one third of all people with diabetes may be undiagnosed.
- **Approaches for screening:**
- **Screening the entire population regularly** not practical and costly.
 - **Selective or targeted screening** performed in a subgroup of subjects who have already been identified as being at relatively high risk in relation to age, body weight
 - **Opportunistic screening** carried out at a time when people are seen, by health care professionals, for a reason other than the disorder in question.(5)
- To test for diabetes or to assess risk of future diabetes, HbA1C, FBG, or 2-h 75-g OGTT is appropriate to
1. Individuals without risk factors, Screening can be considered at age of 45 years and repeated at 3 years intervals, if was normal.
 2. Individuals at high risk should be screened for diabetes and prediabetes at any age. Testing should be at a younger age (30 years) and more frequent.
 3. Screening for type 2 DM in children can be started at age of 10, or at onset of puberty in the presence of obesity, family diabetes, and insulin resistance. The fasting plasma glucose or oral glucose tolerance test is used.
 4. 4-Pregnant women should be screened at the first prenatal visit if at high risk(e.g. Obesity, family history, GDM , glycosuria ,big baby, IGT, and bad obstetric history).If not at high risk for GDM, screening can be done at 24-28 weeks of pregnancy .Oral glucose tolerance test (OGTT)is used. Women with GDM should be screened for diabetes 6 weeks post- partum and followed up with subsequent screening.(4)

10.2.3 Tertiary prevention;

- These are measures taken to prevent complications in individuals who have already developed diabetes.
- It means early detection of complications, effective management, education and metabolic control, with screening and early treatment of complications.
- Tertiary prevention has three stages;
 1. Prevention of development of complications
 2. Prevention of progression of a complication to organ disease.
 3. Prevention of progression of an organ disease to organ failure and disability.(6-7)

Screening for diabetes complications

Long term diabetes complications are

1. Micro vascular complication as retinopathy, neuropathy, and nephropathy .
2. Macro-vascular complications are peripheral vascular disease, cerebrovascular disease, and coronary heart disease.

The risk factors for type2 DM complications are:

1. Persistent hyperglycemia
2. Hypertension
3. Dyslipidaemia
4. Obesity
5. Smoking.

Complication screening leads to detection of the earliest signs which can abort progression.

Screening should be done at diagnosis and then annually in all. It includes;

1. Weight, BMI
2. Blood pressure.
3. Eye examination.
4. Foot examination.
5. Blood tests; HbA1c, lipid profile, creatinine.
6. Urine test for micro-albuminuria, proteinuria.
7. Assessment of smoking status

11

MANAGEMENT OF DIABETES IN CHILDREN

11.1 Types of diabetes seen in childhood (24- 37)

- Type I diabetes mellitus the commonest
- Type 2 diabetes.
- Others such as MODY and neonatal diabetes are rare.

11.2 Clinical presentation:

- Symptoms: polyuria, polydipsia, weight loss, fatigability, poor school performance, vaginal Candidiasis, secondary nocturnal enuresis
- Symptoms and signs of diabetic ketoacidosis including abdominal pain, vomiting, drowsiness and eventually coma (see section on DKA).

NB: In small infants and young children hyperventilation of acidosis can be misdiagnosed as pneumonia and dehydration with vomiting as gastroenteritis

11.3 Criteria for diagnosis:

Classical symptoms and random plasma glucose of > 200 mg/d (11.1 mmol/L).

11.4 How to differentiate type I from type 2 diabetes in children and adolescents:

- History: type 2 patients are obese, with family history of obesity and or type 2 diabetes, hypertension and hyperlipidemia.
- Examination: might show Acanthosis nigricans.
- Laboratory test: they have normal or high C peptide level and negative pancreatic auto-antibodies.
NB: IF doubt treat as type I diabetes mellitus till patient seen by an expert.

11.5 Goals of management:

1. Elimination of acute symptoms
2. Prevention of acute and chronic complications,
3. Normal growth and development
4. Normal psychosocial life.

11.6 Health education:

- Refer all newly diagnosed cases after stabilization to a center where there is a diabetes team for health education, including survival skills.
- NB: The curriculum for health education in Arabic is available in the Arabic book of "Our children and diabetes" provided by Sudan childhood Diabetes Association or one of its centers in all the states.

11.7 Insulin therapy:

11.7.1 Types of insulin:

- Start with premixed insulin, or NPH plus regular.
- In Infants and young children you can start with NPH insulin alone.
- Supply all families with short-acting insulin for emergency management.

11.7.2 Dose of insulin:

- For children start with a total daily dose of 0.5 – 0.75 units/kg/day.
- For infants and younger children start with 0.5 μ /kg/day.
- NB: 2/3 of the dose is given pre-breakfast and 1/3 pre-dinner.

11.7.3 Frequency:

- Put patient on 2-3 injections/day.
- Put adolescents on 3-4 injection/day e.g. premixed before breakfast and dinner and short-acting before lunch.

NB: Some selective cases are put on multiple daily injections using basal bolus regimen with e.g. Glargine plus rapid or shorting acting or NPH plus short acting.

11.7.4 Injecting device:

Put patients on:

- Syringes without dead space.
- Syringes where each line is equal to one unit are preferred.
- Syringes can be reused 2-4 times without increasing risk of infection.

NB: Some patients are put on pens particularly adolescents and young infants. Pumps are available for those who can afford and to cope with it.

11.7.5 Insulin storage:

- Insulin is best stored in fridges.
- If not Ice - containers clay-pots (zeer), leather water bags (Girbbas') can be used.

11.8 Nutritional Management:

The basic concepts of nutritional management in children and adults are the same.

Base-line information including:

- The concept of diabetic diet
- Target normal growth without complications
- Consider family and patients, culture, religion, beliefs, eating habits, income, local foods and misconcepts.
- Regularity of meals and snacks.
- Festivals and occasions (where children can be allowed to eat free with addition of extra dose of regular insulin).
- Children below 3-4 years are put on free diet.
- Very poor people who can only afford the minimum (sometimes 1-2 meals/day should be allowed to eat free and tune insulin accordingly).
- The total calorie requirement is 1000 kcal for the first year and 100 Kcal for each therefore = even more calories for the malnourished.

11-9 Exercise and Diabetes:

It helps in improving glyce mic control and weight loss.

- Encourage children to exercise
- Aerobic exercise such as jogging and swimming are very good.
- When adequate insulin levels are present muscular activity lowers BG during, immediately after/or several hours after exercise.
- When BG levels are high (> 240 mg) because of inadequate insulin levels, exercise may lead to further rise in BG. Therefore insulin should be given to lower BG before starting exercise.
- A small intake of rapidly absorbed carbohydrate is usually recommended before light or brief exercise.
- For intensive, strenuous or prolonged exercise (e.g. football match) BG should be monitored before, immediately after and many hours later. Bed-time snack should be taken at bed time after such exercise in the evening or late afternoon.
- Children should always carry a sugary drink or sugar in case the symptoms of hypoglycemia develop at any time.
- The morning dose of insulin can be adjusted if there is a plan for strenuous afternoon exercise.
- Young people with diabetes should perform strenuous exercise (or swimming) in presence of a companion or supervisor familiar with the recognition and treatment of hypoglycemia and with the immediate supply of rapidly absorbed carbohydrate.

11.10 School and Diabetes:

- Overall diabetic children attain normal academic performance like other children.
- They should participate in all normal school activities and should be disciplined like others.
- Parents should inform the school authorities about the diabetes & the patient and the management that the patient is on.
- School teachers and/or school nurse, class-mates and school bus driver should be trained on symptoms and treatment of hypoglycemia.
- Children should carry snacks; sugar or sugary drinks in their cases or lunch boxes and/or should be easily accessible in the school.
- Teachers should allow children to take snacks or drinks in the class if they develop symptoms of hypoglycemia.
- Children should be allowed to go to the toilet if they develop polyuria.
- Children who feel unwell should not be allowed to go to the bath-room or go home alone.
- Telephone contact number of the parents should be made available to the school.

11.11 Travelling and Diabetes:

- Children can join school camps or visits and/or travel with their families and mates.
- They should carry a diabetes ID card.
- When travelling they should carry their insulin, syringes, SBGM (glucometer and strips); urine testing strips and snacks.
- Companions should be aware and trained on hypoglycemia recognition and management

11.12 Self Blood Glucose Monitoring (SBGM):

- We recommend that all children with type I DM should have facilities for SBGM
- Meters with locally available strips are preferable.
- SBGM is essential in management because it:

1. Helps to monitor immediate and daily levels of control.
 2. Detect hypoglycemia
 3. Assists in recognition and safe management of hyperglycemia.
 4. Has educational value in assessing BG responses to insulin, food and exercise.
- The number and regularity of SBGM should be individualized depending on:
 1. Availability and affordability of strips
 2. Acceptance and cooperation of the patient and family.
 3. The type of insulin regimen.
 - Generally we recommend it being done before three meals and bed time 2-3 times per week, and at any time if patient is unwell.
 - 2 hours postprandial is done when HBA1C level doesn't match with premeal SBGM and with patients on basal-bolus regimen.

Table: (1): Target of blood glucose levels in mg/dl:

Age group	Before meals	Post meals (2 hr)	Bed time overnight
Infants and preschool (0 – 6)	100 – 180 – 200	< 200	100 – 200 mg
School age (6 – 12)	80 – 180	100 - < 180	100 – 180
Adolescents (13 – 18)	80 – 140	90 - < 180 80 – 150	

- Blood sugar is considered to be low if the level is below 80 mg/dl for preschool age and below 70 mg/dl (for others).
- Blood sugar is considered to be high if level is above 200 mg, particularly above 240 mg/dl.

11.13 Urine Testing:

- Urine should be tested for ketones as follows:
- If the patient is well: Two consecutive readings of blood sugar at 4-6 hours interval shows a level above 300 mg/dl.
- If the patient is sick: Blood sugar level is above 240 mg/dl.
- To obtain urine in young infants squeeze the napkin.

11.14 Adjusting Insulin Dose:

11.14.1 Soon after diagnosis:

- Parents under supervision of care team can be trained on how to make graduated after hours of insulin dose based on SBGM results.
- Insulin adjustment should be made until target BG levels are achieved.

11.14.2 Later insulin adjustment:

On twice daily regimens: insulin dosage adjustment is usually based on recognition of daily patterns of BG levels over the whole day or a number of days or in recognition of glycemic response to food intake, exercise & stressful factors.

Table (2): Shows some basic principles for adjustment of insulin dose. Usually adjustments are made by 10-20% after observing for 3-7 days.

Time of abnormal test	Change this insulin
2-3 injections:	
Before breakfast	Evening intermediate or long-acting
Before lunch	Morning rapid or short acting
Before dinner	Morning intermediate or long acting
Before bed-time	Evening rapid or short acting
At night	Evening intermediate or long acting
Multiple Insulin Injection:	
The same as above except	
Before dinner	Launch short or rapid acting

NB In patients (particularly adolescents) with early morning hyperglycemia, do 3 AM blood glucose to find the etiology and act accordingly:

1. High blood glucose: increase evening NPH or long acting
2. Low blood glucose means Somogyi phenomenon: Reduce evening NPH or long acting insulin
3. Normal blood sugar: means Dawn phenomenon then delay injection time of NPH or change to long-acting insulin analogue.

11.14.3 Insulin therapy during Ramadan:

- Pubertal children and adolescents can fast Ramadan if they wish to do so but after discussion with the care team.
- Generally the morning dose is given at sun-set and 1/3 – 1/2 morning dose at “Sahoor”
- SHBGGM should be done during the day, and patients should break the fast if they develop symptoms of hypoglycemia at any time.
- Some recent data show good results with the use of long-acting insulin analogues plus rapid-acting insulin at sunset and sahoor time.

11.14.4 Insulin therapy during sick days:

The following guidelines are recommended during sick days:

- Never stop insulin
- More frequent SBGM (4-6 hourly) and adjusting insulin dose as shown in table (3)
- With poor appetite replace meals with easily digestible food and fluids (even sugary if necessary).
- Maintain hydration by excessive fluid drinking (small and frequent).
- Extra dose of insulin as suggested in table (3) with urine testing.
- Seek medical help for the diagnosis and treatment of acute problem and or if symptoms of keto-sis persists e.g. vomiting and abdominal pain.

Table (3): Sick day insulin tuning

Blood glucose	13 mmol 240 – 300	17 mmol 300 mg	17 mmol 300 mg	< 6 mmol 100 mg
Urine for ketone	Negative or small	Moderate or large	Negative or small	Negative or positive
Extra short & rapid acting	Usual dose No extra	10-20% of total Daily dose	10 – 20% of total daily dose	Less 10-20% of daily dose + sugary fluids

11.15 Hypoglycemia:

- It is the most frequent acute complication in type 1 diabetes mellitus.
- It can be mild or severe; if unrecognized and ill-managed can lead to serious problems including permanent CNS impairment and even secondary epilepsy.

11.15.1 Grading of hypoglycemia:

1. Mild: child or adolescent is aware of, responds to and self-treats the hypoglycemia.
2. Moderate: child cannot respond to and requires help from someone else, but oral treatment is possible.
3. Severe: child needs help from somebody else but requires parental therapy.

11.15.2 Symptoms:

- Early sympathetic (tremors, palpitations, sweating, blurred vision, pallor)
- Late glyco-genic symptoms (irritability, drowsiness, convulsion and coma).
- During night patient might develop confessional conditions, nightmares or seizures.
- Impaired thinking, lethargy, altered mood or headache are experienced on waking.
- Some patients particularly those who are on tight control may not develop the early symptoms (hypoglycemic unawareness).
- NB: Symptoms usually develop when blood glucose level is below 80 mg/dl in young children or 70 mg/dl in older children, but can develop at higher levels when the patient is poorly controlled and acquainted to high blood glucose readings.

11.15.3 Aetiology:

- Missed or erratic meals
- Change in physical activity change
- Errors in insulin dose or absorption
- Defective counter-regulatory hormones
- Mal-absorption syndromes.

11.15.4 Complications:

1. CNS insult
2. Self-injury
3. Hypophobia by parents with consequent deterioration in glycaemic control.

11.15.5 Treatment:

Mild or moderate:

1. 10-15 grams of glucose or sucrose or 100 ml sweet drink – repeat if no response in 10-15 minutes. Then give a complex carbohydrate meal (fruit, bread, cereal)
2. Check blood glucose 15-30 minutes thereafter.

Severe: treat urgently with:**1. At home**

- Apply honey or jam into oral mucosa repeatedly.
- Don't give oral drinks to avoid aspiration pneumonia

2. At hospital

- Give 10% dextrose 4 ml/kg I.V. followed by IV infusion of 10% dextrose till patient is conscious.
- Or (if available) glucagon 0.5 mg (for those below 12 years) and 1 mg (for those over 12 years) SC or 1/m.
- This should be followed by a drink and a meal and patient is conscious and not vomiting.

11.15.5 Preventive measures for hypoglycemia include

1. Education
2. Regularity of meals
3. Carrying snacks
4. Insulin therapy techniques
5. Exercise and diabetes.

11.16 Outpatient Management:

Children should be cared at the outpatient by a multidisciplinary team, essential members being a Pediatrician, Diabetic Educator, Dietician and A Social Worker. Other members including Psychologists, Psychiatrists should be accessible. These in addition to the family and community.

General aims of the diabetes care team should be to provide:

1. Expert practical guidance and skill training
2. Health education
3. Psychosocial support.

Frequency:

- After initial discharge patient can be seen every one to two weeks till the patient is stable. Contact could also be by telephone or other methods (e.g. net).
- Once stable patients can be seen every 2-4 months.

In each chronic visit the following should be assessed:

1. General health and wellbeing
2. Height, weight, pubertal status
3. Dental hygiene
4. Thyroid size
5. B.P.
6. Injection sites (for hypertrophy avoids injection into that site for 2-3 months & inject insulin around the lesion for lipotrophy).
7. Skin for hygiene, necrobiosis-lipoidica-diabeticonum and joints for contractures
8. Abdomen for hepatomegaly
9. Foot hygiene
10. Ophthalmic examination.
11. Review SBGM records.
12. Laboratory results which have been ordered.
13. Socioeconomic problems
14. Diabetes education
15. Any queries or questions by parents or patient

11.17 Screening and management of chronic complications in children and adolescents with type 1 DM:

11.17.1 Nephropathy

- Annual screening for microalbuminuria
- Random spot urine sample for albumin to creatinine ratio in early morning urine should be done once patient is 10 years or more and has diabetes for 5 years. Normal (ACR) 2.5 – 25 mg/mmol or albumin concentration 30-300 mg/L
- Confirmed persistently elevated microalbumin levels on two additional urine samples should be treated with ACE inhibitors in addition to tight control of diabetes.

11.17.2 Hypertension:

- BP above the 90th centile for age, sex and height should be treated by reducing weight and physical activity
- If BP persists after 3-6 months consider pharmacological therapy.
- ACE inhibitors.

11.17.3 Dyslipidaemia:

- Screen all children over 2 years for hyperlipidemia if there is family history of hypercholesterolemia (total cholesterol > 200 mg/dl) or cardiovascular event below 55 years.
- Screen all children diagnosed with diabetes at or after puberty.
- If lipids are abnormal monitor annually.
- If normal repeat every 5 years.
- Treatment: If LDL cholesterol is > 100 mg/dl try diet therapy first and add statins for those over 10 years.

11.17.4 Retinopathy:

- Do first examination when child is 10-years-old and has had diabetes for 5 years or within 2 years if onset was at puberty and at diagnosis for type 2 patients.
- There after repeat annually.

11.17.5 Coeliac disease:

- Screen with anti-tissue transglutaminase or anti-endomysial antibodies (if available) soon after diagnosis
- If shows signs and symptoms suggestive of coeliac confirm diagnosis by jejunal biopsy.
- If positive put on gluten – free diet for life.

11.17.6 Hypothyroidism:

- Screen all children with thyroid peroxidase and thyroglobulin antibodies at diagnosis (if available).
- If positive do TSH. If normal recheck every year. If abnormal measure + Free T4.

11.19 Type 2 Diabetes Mellitus in children and adolescents:

- All patients should have B.P measurement, fasting lipid profile, micro albuminuria assessment and ophthalmic evaluation at diagnosis.
- Management of these problems is as mentioned in the section on type 2 DM in children and adolescents.
- Look for other obesity co-morbidities such as obstructive sleep apnoea, polycystic ovary syndrome orthopaedic problems, hepatosteatosi s and psychological diseases.

11.19.1 Treatment modalities include:

1. Improve physical activity
2. Diet control to reduce weight
3. Metformin
4. Metformin plus insulin

11.19.2 Transition to Adult Clinics:

- The age of transfer to adult clinics is 18 years.
- In certain circumstances cases can be transferred earlier or later.
- It is recommended to have a joint adolescent clinic with adult specialty colleagues so that cases can be transferred gradually and smoothly.

11.19.3 Psychological Issues:

- Attention should not be focused only on metabolic control with neglect of psychosocial influences.
- Poor metabolic control is commonly associated with psychological and social difficulties.
- The diabetes care team should assess and provide age-appropriate advice and education on how to cope with psychological stress e.g. feeling different, jealousy, peer group pressure and discrimination and coping with diabetes on the school and after daily-life activities.
- At diagnosis parents and other close care-givers often pass through stages of grief, tear, guilt, anger, denial, resentment, bargaining and depression before adapting to the requirements of the condition. These feelings may re-emerge at later dates particularly when faced with crises such as hypoglycemia, DKA, intercurrent illness, schooling, or financial problems etc...
- Parents (particularly of young children) fear both hypoglycemia and long-term consequences of hyperglycemic.
- Parents worry about balance between retaining responsibility, being over protective and allowing increasing independence.
- Siblings of diabetic children may exhibit different and strong emotions about their brothers/sisters with diabetes including guilt, tear, jealousy, embarrassment or sadness. Therefore these issues should be observed for and addressed.

11.19.4 Social and financial provision:

- Many diabetic children in Sudan come from poor families.
- All diabetic children and their families should have continuous social evaluation.
- Those who can't afford should have treatment and financial support including: provision of insulin and other medications, strips, meters, free investigations, this in addition to clothing, food, school fees (need it be).
- Home and school visits by the diabetic team are important under certain circumstances.
- Support can be provided through charity groups such as Sudanese Childhood Diabetes Association and Zakkat departments.

11.20 Diabetic ketoacidosis in children (38)

11.20.1 Definition:

- DKA is defined as significant hyperglycemia (blood glucose > 17 mmol/L or 300 mg/dl ketonemia and metabolic acidosis (pH < 7.3, HCO₃ < 15 mmol/L coupled with severe disturbance in fluid and electrolytes balance. (Severe DKA = PH > 7.1 HCO₃ > 5 mmol/L).
- In absence of these lab facilities consider the patient to have DKA if he is symptomatic for diabetes and is dehydrated with hyperglycemia and glycosuria with ketonuria.

11.20.2 Diagnosis and Assessment (see appendix 1):

Think of DKA in a known diabetic child or any child who presents with either of or a combination of the following:

1. Classical symptoms of diabetes.
2. Acute abdomen.
3. Dehydration.
4. Acidotic breathing/smells acetone.
5. Disturbed level of consciousness.

History:

- Precipitating factors including insulin omission, accuracy of dose, stressful conditions including infections, trauma or home conflict.
- History of recent weight and weight loss.

Examination:

- Signs and complications of fluid, electrolyte and acid base imbalance including shock, hypotension with acidosis, and CNS status.
- Establish degree of dehydration (mild, moderate and severe).
- Look of signs of hidden infection and trauma.
- Obtain accurate weight before starting treatment if possible.

11.20.3 Principles of Management:

- Treatment of Shock.
- Correction of dehydration and replacement of losses with.
- Provision of maintenance and deficit
- Correction of electrolyte deficit.
- Correction of hyperglycemia.
- Correction of acidosis.
- Treatment of precipitating factors including sepsis.
- Observation for and treatment of cerebral oedema.
- Prevention of further attacks.

11.20.4 Immediate Management:

- Coma care if child is comatose (gastric tube if abdomen distended).
- Assess and control breathing and circulation (including oxygen therapy and shock management).
- Start two IV lines. Line one is for fluid and electrolyte replacement and line 2 for insulin infusion.

Investigations

- Blood for: glucose, urea, creatinine, electrolytes gases, CBC + differential, (culture: if indicated), others of needed e.g. BF for malaria.
- Urine: urinalysis + culture (if indicated).
- Notes: If a child is comatose, urine can be obtained by catheter. In infants you can squeeze the napkin urine.
- Both hyperglycemia (using Glucometer) and glycosuria and ketonuria (with strip) should be performed by the doctor in the ER without waiting for the laboratory results to take action.

Fluids:

- If patient is shocked give 20 ml/kg of normal saline (or Ringer lactate) as quickly as possible (20 – 30 minutes)> Repeat these doses till circulation is restored in the emergency room. This should not later be subtracted from fluid therapy.
- If not shocked but severely dehydrated he can be given 10 ml/kg over 1-2 hours of normal saline or Ringer lactate.
- No need to give bolus saline if the patient is not shocked or hypotensive (severely dehydrated).

Insulin:

- No need to give IV insulin bolus but start I.V. insulin infusion 0.1 unit/kg/hour (if you have a pump) or 0.3 units/kg/s.c. 1/2 - 1 hour after starting of fluids or 0.1 unit/kg/hour S.C 2 hours after starting I.V fluids and hydrating the patient.

Disposition:

- PICU: Those with coma, young infants, cardiovascular instability, and those who deteriorate in the ward.
- Ward: other cases (but on 1:1 observation basis).
- Home: Some known cases with mild ketoacidosis or ketonuria can be managed at home (see later →)

11.20.5 Further Management During Ketoacidosis (see Appendix 2)

B.1 Fluid Replacement

- Fluid repair should extend over 48 hours to achieve a slower correction of serum hyperosmolality to prevent cerebral oedema.
- Therefore deficit should be given over 48 hours (i.e. give 1/2 the deficit + daily maintenance over 24 hours).
- For fluid volume to be given over 24 hours and rate/hour seen appendix 1.
- Or calculate as follows:
 - Maintenance needed for 24 hours.
 - 100 ml/kg for first 10 kgm.
 - 50 ml/kg for second 10 kgm.
 - 20 ml/kg for every kg thereafter.

Deficit:

- For practical purposes, the usual deficit in most DKA patients is 10 % (100 ml/kg).

Rate of Infusion:

- Add 24 hours maintenance plus half of the calculated deficit and divide by 24 to obtain the hourly rate. (Never give the 8 hourly calculated fluid volumes as pushes over few hours).

Fluid used:

- Use normal saline till blood glucose reaches 14-17 mmol/L (250-300) mg/dl) then change to 5% dextrose with 0.45 normal saline.

Potassium:

- Commence when the child starts to pass urine (practically after the first hour) or if he is already passing urine and or K is below 5 mmol/L).
- Add 40 mmol/L of potassium chloride (i.e. 20 mmol/bottle of 500 ml).
- Monitor by EKG, clinically & biochemically (if available).
- If serum potassium is > 6 mmol/L withhold potassium temporarily till potassium is < 6 mmol/L.

Bicarbonate:

- Give only if pH is less than 7 and there is circulatory instability Generally it is preferable to avoid it completely.
- Dose: 1-2 mmol/kg; give over 60 minutes.
- Check blood gas (venous or capillary sample in non-shocked patient) every 6 hours.
- Unless child is critically ill avoid giving bicarbonate during first hour or two of resuscitation then repeat blood gas if PH is still ≤ 7 offer bicarbonate (if necessary).

Phosphorous:

- We don't use it as a routine. Consider using it (after discussion with a senior) in comatose patients or if phosphate level < 0.5 mmol/L. give 1/2 the dose as potassium phosphate and half as potassium chloride.
- Monitor calcium levels every 4-6 hours as patient might develop hypocalcaemia. Always check serum calcium level before phosphate is infused.
- If there are no facilities for I. V. fluids:
- Start patient on ORS 5 ml/kg/hour orally or by N/G tube till you arrange for transfer to the nearest health facility – even without insulin. Avoid giving insulin without fluids in significantly dehydrated patients as this may cause shock.

B.2 Insulin Therapy:**Preparation:**

- Use regular (or rapid acting) insulin only.
- Infuse into a separate IV line using a syringe pump (see above).
- Add 100 units in 100 ml (or 50 units in 50 ml) (or smaller volumes for young children) of normal saline in a syringe pump (or burette of the normal infusion pump) each ml will contain 1 unit.
- This solution should be changed every 6 hours.

Infusion rate:

- Unit/kg/hour i.e. 0.1 ml/kg/hour of the above mentioned preparation. Aiming to reduce blood glucose at rate of 2-5 mmol/hr (80 – 90 mg/hour). Usually there is a rapid drop after one hour of starting i.v. fluids.
- Continue this insulin infusion till.
- Bicarbonate continuous infusion till the patient is clinically stable. (fully conscious acidosis is cleared i.e. either pH > 7.3, HCO₃ > 19 mmol or normal anion gap (Na⁺ - (cl + HCO₃) normal = 12 + 2 mmol/L or no ketone in serum.
- Notes: Discontinuation of insulin infusion is not dictated by blood sugar level, but by clearance of acidosis.
- If there is no facility to monitor blood gases or serum, well hydrated, doesn't look acidotic and taking orally well with no or trace of ketone in freshly voided urine.
- If there is no facility for a pump initially give regular insulin 0.3 units/kg s/c as start dose then 0.1 units/kg subcutaneously hourly till acidosis is cleared or you start insulin 0.1 unit/kg/hr subcutaneously 2 hours after hydrating the patient then continue 0.1 unit/kg/hour S.C. without giving the initial 0.1 unit/kg.

B.3 Monitoring:

- Blood glucose with a meter hourly during insulin infusion (at least hourly for 1st 4-6 hours then 2 hourly if needed) then every 6 hours thereafter.
- Blood gases, blood glucose, urea and electrolytes 4-6 hourly (if available) and urine for ketone is 2 hourly. Or on each voided urine.
- Vital signs (EKG monitor if available) and neuroobservation (initially hourly till stable then every 4-6 hours). Also watch for headache, vomiting or behaviors change and other signs of cerebral oedema.
- Use the Flow sheet in (Appendix 2) to record: vital signs, blood workup, intake and output, doses of insulin, and urinalysis for glucose ketone. Adequate urine output + ≥ 1.5 ml/kg/hr in addition to vital signs.

Problem Solving During Monitoring:

1. After resuscitation, the typical aim of rate of blood glucose fall is 4-5 mmol/hour. (80-90 mg/dl).
2. When blood glucose falls to 14-17 mmol/L (250-300 mg) change fluid to 5% dextrose with 0.45 saline with potassium to maintain blood glucose in the desired range of 120-200 mg/dl.
3. If blood glucose rises again above 17 mmol/L (300mg/dl) increase the insulin infusion by 25%.
4. If blood glucose falls below 100 mg/dl or falls too rapidly increases the concentration of glucose to 7.5% (or more).
5. The insulin infusion rate should only be decreased if blood glucose levels remains below the target range despite glucose supplementation.
6. Don't stop insulin infusion or hourly s/c if the patient is still acidotic.

11.20.6 Management Following Clearance of Acidosis:**C.1 Fluids/Diet:**

If the child is alert conscious, hasn't vomited for 4-6m hours, fluids including juices could be introduced gradually and IV fluid volume reduced gradually till child is able to eat and drink well.

C.2 Insulin:

Once the patient has recovered from DKA i.e. (PH more than 7.3, HCO³ more than 15 or no ketonemia If no lab facilities the patient is fully conscious, drinking and eating well, well hydrated not clinically acidotic and freshly voided urine contains no or one cross of acetone then do the following:

If it is the usual meal time (breakfast or prelaunch)

1. Start insulin at a dose of 0.5 – 0.75 units /kg/day 2/3 in morning and 1/3 in the evening (either premixed or NPH + regular (2/3 as NPH and 1/3 as regular) and discontinue the infusion one hour later – or if he is on hourly S.C just give the dose – then give his meal 20-30 minutes later.
2. No need to give regular insulin on 6 hourly basis for few days to calculate the average dose.
3. If he is an old case give him his usual dose of insulin (NPH + regular) and discontinue the hourly insulin.

If the time is not pre-breakfast or pre-dinner:

1. Continue either I.V. fluids and I.V infusion of insulin at rate of 0.05 units/kg/hour till it is meal time (if patient is sleeping).
2. Or give regular insulin 0.2 – 0.3 units/kg S.C followed by snack and drinks till it is main meal time and then start his NPH and regular.

Infants below 3 years

1. Can be managed with BID NPH 0.5 u/kg/day without regular.
2. In either case small additive dose of regular insulin can be given S/C between the main insulin doses i.e. lunch time and midnight according to these guidelines:

Blood sugar (mg)	Urine ketone	Insulin dose Units/kg
240 or more	++ or more	0.2
240 or more	+ or negative	0.1
< 240	negative	none

C.3 Monitoring:

- Blood sugar and freshly voided urinary ketones before main meals, and midnight. Please note that ketonuria alone in an otherwise well child doesn't mean that he has DKA.
- Electrolyte once daily (if necessary). And available
- Vital sign and neuro-observation 4-6 hourly at least for the first 24 hours.

11.20.6 Other Problems and Complications:

11.6.1 Cerebral Oedema:

Warning signs and symptoms:

1. Headache and decreasing of heart rate (not necessarily bradycardia).
2. Vomiting.
3. Change in neurological status (restlessness, irritability increased drowsiness, incontinence) or specific neurological signs (e.g. cranial nerve palsies).
4. Rising blood pressure decreased oxygen saturation. More dramatic changes such as convulsions, papilloedema and respiratory arrest are late signs and are associated with extremely poor prognosis.

Diagnosis of cerebral oedema can be made clinically in presence of one diagnostic criteria, or two major criteria or one major and two minor criteria as follows: (see appendix 4).

Diagnostic Criteria:

1. Abnormal motor or verbal response to pain.
2. Decorticate or decelerate positive.
3. Cranial nerve palsy (especially, 3, 4, 6).
4. Abnormal respiration (chyne-stokes, apnoea).

Major criteria:

1. Abnormal mental/function of level of consciousness.
2. Sustained heart rate deceleration (decrease more than 20 beats/minute) not attributable to sleep or improved intravascular volume.
3. Age inappropriate incontinence.

Minor criteria:

1. Vomiting.
2. Headache.
3. Lethargy or not easily arousable.
4. Diastolic B.P. > 90 mm.
5. Age < 5 yrs.

Action:

1. Exclude hypoglycemia. Give immediate mannitol 1 gm/kg over 20 minutes (i.e. 0.5 ml/kg of 20% solution)) or 3% saline 5-10 ml/kg i.v. over 30 minutes can be used if no mannitol is available.
2. Reduce fluid infusion rate by one third until situation improves.
3. Nurse Child head elevated 30°.
4. Move to PICU (or even earlier if possible).
5. Call you senior.
6. If assisted ventilation required maintain PCO₂ at 23.5 K pa (25-30 mmHg).
7. Consider continuation of mannitol at 0.25 gm/kg every 6 hours to prevent rebound increase in ICP or repeat bolus every 4-6 hours.
8. Cranial imaging should only be considered after child is stabilized as other intracranial events such as thrombosis, hemorrhage and infarcts may occur. Note: a normal CT doesn't exclude cerebral oedema. It is a clinical diagnosis.

Look and treat all precipitating factors of DKA particularly infections.

11.20.8 Patients with ketonuria, hyperglycemia not Satisfying Criteria of DKA:

- These patients if they are otherwise okay and drinking well don't need to be admitted to the hospital. Just give a dose of regular insulin 0.1 – 0.2 units/kg or a dose equal to 10-20% of their usual daily dose as regular insulin subcutaneously.
- In addition to their usual dose (if it's dose time) or alone (e.g. lunchtime), encourage them to have fluids (small volumes) frequently of any fluid or juice, or ORS and to repeat blood sugar and fresh urinalysis after 4 hours and to continue this till blood sugar is normalized and one plus or no ketone in urine.
- **All new cases** and those with social problems or uncertainly about diagnosis on assessment should be admitted and not sent home before discussing the case with the senior.
- These cases can be started on NPH + regular or premixed insulin with extra doses of regular insulin as in the sliding scale above and they don't need to be put on IV fluids.

12 ANNEX

Annex 1 DKA fluid Therapy per 24 hours (Maintains + 1/2 deficit)

Body wt	Maintenance ml/24 hours	Deficit ml/24 hours	m/hour (approx)
4	400	200	25
5	500	250	30
6	600	300	35
7	700	350	40
8	800	400	50
9	900	450	55
10	1000	500	60
11	1050	550	65
12	1100	600	70
13	1150	650	75
14	1200	700	80
15	1250	750	85
16	1300	800	85
17	1350	850	90
18	1400	900	95
19	1450	950	100
20	1500	1000	105
22	1540	110	110
24	1580	1200	115
26	1620	1300	120
28	1660	1400	125
30	1700	1500	130
32	1740	1600	140
34	1780	1700	145
36	1820	1800	150
38	1860	1900	155
40	1900	2000	160
45	2000	2250	175
50	2100	2500	190
55	2200	2850	200
60	2300	3000	220
56	2400	3250	235
70	2500	3500	250
75	2600	3750	265
80	2700	4000	280

Annex 2 : Diabetic Ketoacidosis Flow sheet

Addressograph

Date:

TIME																				
Hours since admission																				
Weight(Daily)																				
Mental status*																				
Temperature																				
Pulse																				
Respiration Depth**																				
∩Blood Pressure																				
Dextrostic																				
Urine ketones																				
Blood ketones																				
ELECTROLYTES																				
Na+ mmol/l																				
K mmol/L																				
Cl mmol/L																				
HCO3 mmol/L																				
Urea mmol/L																				
Creatinine mmol/L																				
Blood glucose																				
Effective osmality (2 x Na mmol+) (glucose mmol)																				
Phosphate mmol/L																				
Calcium mmol/L																				
BLOOD GASES																				
PH																				
HCO3																				
B.E.																				
O2 Sat																				
PO2																				
PCO2																				
INSULIN																				
Units Past Hour																				
Route																				
INTAKE																				
I.V. (volume type)																				
P.O. (volume type)																				
Dextrose																				
SalinKCl1e																				
Phosphate																				
Bicarbonate																				
OUTPUT																				
Urine (ml)																				
Other																				

Annex 3 management of DKA in children

DKA IN CHILDREN

A child who is known diabetic or new case

Have symptoms of diabetes +
Dehydration, Abdominal pain, vomiting, acidotic breathing, smells acetone from mouth, drowsy or comatose

Check:
Blood glucose +- Urine for ketoni
Urea + electrolytes - Blood gases (venous)
Blood Ketone
Others according to situation

Diagnosis by :
B.G. usually 300 mg/d/or more PH < 7.3
HCO₃ < 15 mmol/L Urine positive for acetone

Coma care

Airway

O₂

Gastric aspiration -

Treat shock with 20ml/kg of saline or Ringer lactate

If no lab facilities you can rely on clinical + high blood glucose + ketonuria

Annex 4 : Antidiabetic drugs (39)

	Brand name	Generic	Pack size
1.	Glucar 50mg Tab.	Acarbose	100 Tab.
2.	Aminil 5mg Tab.	Glibenc lamide	30 Tab.
3.	Betanase 5mg Tab.	Glibenc lamide	150 Tab.
4.	Cimanil 5mg Tab.	Glibenc lamide	24 Tab.
5.	Daonil 5mg Tab.	Glibenc lamide	500 Tab.
6.	Epoclamide 5mg Tab.	Glibenc lamide	1000 Tab.
7.	Euglucon 5mg Tab.	Glibenc lamide	100 Tab.
8.	Gliban 5mg Tab.	Glibenc lamide	100 Tab.
9.	Gliben 5mg Tab.	Glibenc lamide	50 Tab.
10.	Glibenc lamide 5mg Tab.	Glibenc lamide	28 Tab.
11.	Glibesyn 5mg Tab.	Glibenc lamide	1000 Tab.
12.	Glibeton 5mg Tab.	Glibenc lamide	10 Tab.
13.	Glibil 5mg Tab.	Glibenc lamide	100 Tab.
14.	Glicon 5mg Tab.	Glibenc lamide	60 Tab.
15.	Glitol 5mg Tab.	Glibenc lamide	40 Tab.
16.	Wafranil 5mg Tab.	Glibenc lamide	10 Tab.
17.	Diabend 80mg Tab.	Gliclazide	60 Tab.
18.	Diabyl 80mg Tab.	Gliclazide	20 Tab.
19.	Diamicron 80mg Tab.	Gliclazide	20 Tab.
20.	Diamicron MR 30mg Tab.	Gliclazide	30 Tab.
21.	Glaze 80mg Tab.	Gliclazide	60 Tab.
22.	Glycinorm 80mg Tab.	Gliclazide	100 Tab.
23.	Reclide 80mg Tab.	Gliclazide	20 Tab.
24.	Amarax 1mg Tab.	Glimepiride	20 Tab.
25.	Amarax 2mg Tab.	Glimepiride	20 Tab.
26.	Amaryl 2mg Tab.	Glimepiride	10 Tab.
27.	Amaryl 3mg Tab.	Glimepiride	10 Tab.
28.	Azulix 2mg Tab.	Glimepiride	30 Tab.
29.	Diapride 2mg Tab.	Glimepiride	30 Tab.
30.	Diapride 4mg Tab.	Glimepiride	10 Tab.
31.	Dolcyl 1mg Tab.	Glimepiride	10 Tab.
32.	Dolcyl 2 mg Tab.	Glimepiride	10 Tab.
33.	Euglim 2mg Tab.	Glimepiride	30 Tab.
34.	Glimadel 1mg Tab.	Glimepiride	30 Tab.
35.	Glimadel 2mg Tab.	Glimepiride	20 Tab.
36.	Glimadel 3mg Tab.	Glimepiride	10 Tab.
37.	Glimaryl 2mg Tab.	Glimepiride	30 Tab.
38.	Glimaryl 4 mg Tab.	Glimepiride	30 Tab.
39.	Glimulin 2mg Tab.	Glimepiride	10 Tab.
40.	Gluconorm 4mg Tab.	Glimepiride	30 Tab.
41.	Mixtard 30 HM 100IU/ml Inj.	Biphasic Isophane Insulin	10 ml/Vial
42.	Mixtard 30 HM Penfill 100IU/ml Inj.	Biphasic Isophane Insulin	Penfil.
43.	Humulin 70/30 Inj.	Human Insulin (Isophane insulin + Soluble insulin)	10 ml/Bott.
44.	Lantus 100IU/ml Inj.	Insulin Glargine	10 ml/Bott.
45.	Humulin Lente Inj.	Insulin Soluble Human	10 ml/Bott.

46.	Humulin Regular Inj.	Insulin Soluble Human	10 ml/Bott.
47.	Humulin NPH Inj.	Isophane Human Insulin	10 ml/Bott.
48.	Insulatard HM 100IU/ml Inj.	Isophane Human Insulin	10 ml/Vial
49.	Insulatard HM Penfil 100IU/ml Inj.	Isophane Human Insulin	Penfil.
50.	Actrapid HM 100IU/ml Inj.	Soluble Human Insulin	10 ml/Vial
51.	Actrapid HM Penfill 100IU/ml Inj.	Soluble Human Insulin	Penfil.
52.	Amiformin 500mg Tab.	Metformin HCl	50 Tab.
53.	Amiformin 850mg Tab.	Metformin HCl	50 Tab.
54.	Cidophage 500mg Tab.	Metformin HCl	20 Tab.
55.	Cidophage Retard 850mg Tab.	Metformin HCl	60 Tab.
56.	Diaphage 500mg Tab.	Metformin HCl	50 Tab.
57.	Formit 500mg Tab.	Metformin HCl	50 Tab.
58.	Formit 850mg Tab.	Metformin HCl	60 Tab.
59.	G.M Dybis 500mg Tab.	Metformin HCl	50 Tab.
60.	Glucophage 500mg Tab.	Metformin HCl	50 Tab.
61.	Glycomet 500mg Tab.	Metformin HCl	100 Tab.
62.	Glycomet 850mg Tab.	Metformin HCl	100 Tab.
63.	Glyformin 850mg Tab.	Metformin HCl	100 Tab.
64.	Metformin 500 mg Tab.	Metformin Hcl	500 Tab.
65.	Xmet 500mg Tab.	Metformin HCl	10 Tab.
66.	Xmet 850mg Tab.	Metformin HCl	10 Tab.
67.	Rosicon MF Tab.	Rosiglitazone 2mg+Metformin HCl 500mg	10 Tab.
68.	Glitaz 15mg Tab.	Pioglitazone HCl	30 Tab.
69.	Glitaz 30mg Tab.	Pioglitazone HCl	30 Tab.
70.	Pio 30mg Tab.	Pioglitazone HCl	10 Tab.
71.	Pionorm 15mg Tab.	Pioglitazone HCl	100 Tab.
72.	Pionorm 30mg Tab.	Pioglitazone HCl	100 Tab.

Note:

- Rosiglitazone have been revoked (withdrawn) from the market.
- Repaglinide is registered but not available in the mark (5)

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