OVER VIEW OF DIABETES MELLITUS (TYPE 1 AND 2): CURRENT TREND OF MANAGEMENT: PHARMACOLOGICAL AND NON PHARMACOLOGICAL

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Abstract: Diabetes mellitus (DM) is a major medical problem throughout the world. Diabetes cause an array of long-term systemic complications that have considerable impact on the patient as well as society, as the disease typically affects individuals in their most productive years. An increasing prevalence of diabetes is occurring throughout the world. In addition, this increase appears to be greater in developing countries. The etiology of this increase involves changes in diet, with higher fat intake, sedentary lifestyle changes, and decreased physical activity.

Key Words: Glucose, insulin, polydipsia, polyuria, blood pressure, diabetic ketoacidosis, insulin dependent, non-insulin dependent, ACE Inhibitor Angiotensin-converting Enzyme Inhibitor, BMI Body Mass Index, FPG Fasting Plasma Glucose, HbA1c Glycated (or glycosylated) Haemoglobin

1.0 INTRODUCTION:

Diabetes prevalence has been increasing in most countries of the region of the Americas. It is estimated that more than 1 in 10 of the adult population of the region is affected; rising to 1 in 5 in persons over 40 years of age. With current trends and without effective interventions, this prevalence is expected to rise. This has swollen in sub Saharan Africa with the affluent emulating sedentary life styles from developed nations, more especially their eating and drinking habits and kind of food comprising about 70 percent of poly saturated fats, junk foods.

Diabetes mellitus is one of the leading health problems in the world and gaining much freedom and stability in sub Saharan Africa, contributing significantly to morbidity and mortality.

2.0 METHOD:

Sample research where taken from scientific data from other works done and published in peer reviewed journals. They were analysed, criticized constructively, appraised and some which the writers deem fit was taken as a reference on this work. Stratified and probity of empirical data and cross sectional surveys done on the subject matter was also revised by the authors in bringing out the final write up.

3.0 DISCUSSION:

BASICS OF DIABETES MELLITUS

Diabetes mellitus is defined by the World Health Organization as a metabolic disorder characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both.

The symptoms of marked hyperglycaemia include:

• Polyuria

• Polydipsia

• Weight loss which may sometimes be associated with polyphagia.

• Blurred vision

There are several types of diabetes mellitus which may be classified as follows:

3.1 Type 1 Diabetes Mellitus

Type 1 diabetes occurs in young people. The onset of illness is usually abrupt and associated with ketoacidosis. These patients require insulin and must be referred urgently to a diabetes specialist or emergency department when acutely ill.

3.2 Type 2 Diabetes Mellitus

Type 2 diabetes occurs mainly in older persons and is associated with overweight and lack of physical activity. There is also a marked family history in persons with this disease. Type 2 diabetes is associated with the metabolic syndrome.

3.3 Gestational Diabetes

Gestational diabetes refers to glucose intolerance developing during pregnancy. Persons with this condition must be referred for specialist care. This condition is a recognized risk factor for the subsequent development of diabetes. Other types of Diabetes Mellitus Specific genetic defects or diseases of the exocrine pancreas such as complications of pancreatitis, endocrinopathies, or exposure to specific drugs or chemicals can lead to other types of diabetes mellitus.

3.4 Presentation of Types 1 and 2 Diabetes Mellitus

Features of Type 1 (Formerly insulin-dependent diabetes- IDDM)

Accounts for about 5% of cases, Auto-immune pancreatic beta cell destruction, Relative insulin deficiency and insulin resistance, it happens Usually before age 30 years, it has an abrupt onset, Insulin therapy required for survival, mainly Ketosis prone, it has a minor family history incidence.

Type 2 (Formerly non-insulin-dependent diabetes- NIDDM)

Accounts for about 95% of cases, Relative insulin deficiency and insulin resistance, it happens at age 45 years and above (but diagnosis at an earlier age appears to be increasing), it has a gradual onset, May initially be managed by lifestyle changes and oral glucose-lowering agents, but eventually may require insulin for control, Ketosis resistant except with severe stress, has marked family history incidence.

3.5 Screening and diagnosis of diabetes mellitus

Overall, at least 50% of those with diabetes do not know that they have the condition.

In developing countries the proportion with undiagnosed diabetes is considerably higher.

At the time of diagnosis, every second person with diabetes has already developed one or more

Micro- or macrovascular complications (Diabetes Voice, Dec 2003 Diagnosis of Diabetes Mellitus)

3.6 Risk Factors for Type 2 Diabetes Mellitus

• Overweight (Body Mass Index ≥25 kg/m2)

• Age 45 years and older

• Physical inactivity

• Diabetes in a first-degree relative

• Prior gestational diabetes or history of delivering a baby >4 kg (9 lb)

• Polycystic ovary syndrome

• History of Impaired Glucose Tolerance (IGT) or Impaired Fasting Glucose (IFG)

• HDL-C level ≤ 35 mg/dL (≤ 0.90 mmol/L) and/or Triglyceride level ≥250

mg/dL (≥2.82 mmol/L)

• Race/ethnicity (e.g. persons of Asian and African descent)

• Presence of coronary artery disease and/or hypertension (blood pressure

≥140/90 mm Hg)

• Presence of other vascular complications

3.7 Screening for type 2 Diabetes Mellitus

Screening involves the testing of individuals who are at risk of having the disease.

Population-based screening is expensive and therefore priority should be given to persons with identifiable risk factors. However, where possible and affordable, population-based screening should be encouraged.

Screening and the Diagnosis of Diabetes Mellitus Reasons for screening include:

• There is a rising prevalence in sub Saharan Africa.

• Diabetes is an important public health problem as African populations are, by definition, high-risk.

• There is a long, latent asymptomatic period in which the condition can be detected

• At the time of diagnosis, significant numbers of individuals already have evidence of the micro-vascular complications of diabetes and may also have macrovascular disease.

• There is evidence that early treatment improves long-term outcome.

3.8 THE SCREENING TEST

The fasting plasma glucose (FPG) is the recommended screening test. The 75 gm Oral Glucose Tolerance Test (OGTT) is more sensitive for detecting glucose intolerance but is not recommended for screening as it is more expensive and less practical.

Testing of glucose in the urine is not recommended for screening. Blood glucose testing by glucometers may play a role in initial screening but cannot be used for diagnosis. Any abnormal results must be confirmed by measurement of plasma glucose.

If the test result is normal but the client is 45 years or older (particularly if overweight) re-screening would be appropriate at 3-yearly intervals. If the person is overweight and has additional risk factors such as a positive family history or co-morbid disorders, re-screening should be done more frequently.

4.0 ANALYSIS:

4.1 Diagnostic Criteria and Classification of Diabetes Mellitus

The diagnosis of diabetes mellitus must be based on laboratory venous blood test results.

Glycosuria and finger-prick glucose measurements using a glucometer should not be used for the diagnosis of diabetes.

The HbA1c test is not recommended for diagnostic purposes.

We recommend that the diagnosis of diabetes mellitus be made using the criteria of the American Diabetes Association (ADA).

4.2 Criteria for the Diagnosis of Diabetes Mellitus

1. Symptoms of diabetes plus casual plasma 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

2. FPG ≥126 mg/dL (≥7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h.

Or

3. 2-h post-load glucose ≥200 mg/dL (≥11.1 mmol/L) during an OGTT. The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.

In the absence of unequivocal hyperglycemia, these criteria should be confirmed by repeat testing on a different day. The third measure (OGTT) is not recommended for routine clinical use.

4.3 Diagnostic criteria for impaired fasting glucose and impaired glucose tolerance

If the FPG ranges from 100–125 mg/dL (5.6-6.9 mmol/L) or the blood sugar 2 hours after a 75 gm glucose load is between 140-199 mg/dL (7.8-11.1 mmol/L), an individual is considered to have impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) respectively, and is classified as 'pre-diabetes'.

Such persons are at high risk of developing diabetes and cardiovascular disease. Indeed impaired fasting glucose and impaired glucose tolerance frequently co-exist with other cardiovascular risk factors giving rise to the Metabolic Syndrome.

4.4 The Metabolic Syndrome

The metabolic syndrome is characterized by the co-occurrence of obesity (especially central obesity), dyslipidaemia (especially high levels of triglycerides and low levels of high density lipoprotein cholesterol), hyperglycaemia and hypertension. The diagnosis of metabolic syndrome is made if an individual has three or more of the characteristics.

4.5 Effective Delivery of Care

The establishment of a practice which puts the person at the centre of care will require a change in the attitudes and beliefs of health professionals and people with diabetes . (Diabetes Voice May 2004)

Requirements for the Effective Delivery of Care

Some of the requirements for the effective delivery of care are adequate personnel, facilities, equipment and supplies.

Good information and referral systems are also essential elements.

4.6 Personnel

The management of diabetes depends on the functioning of a multidisciplinary team. The composition of the team will depend on the country's resources but should include:

• Medical Doctor either physician or surgeon, physician's assistant, Nurse Practitioner

• Nurses, eith public health nurses, registered general nurses, health assistants

• Diabetes Educator

• Nutritionist/Dietitian

• Podiatrist/Chiropodist

• Pharmacist, dispensary technicians, medica counter assitansts etc

Medical laboratory officers, biomedical scientist, Laboratory assistants

• Social Worker

Since diabetes at its terminal stage affects sveral systems in the human body, there should be access to other health professionals such as an endocrinologist or diabetes specialist, physiotherapist, psychologist, ophthalmologist and nephrologist. The staff should be trained to ensure that the services are patient-centered and to accept the patient as an important member of the team who should be fully involved in his/her care.

4.7 Facilities

The facilities should be easily accessible to persons with disabilities. Adequate space should be provided for:

• Registration of the patient

• Education and counselling

• Physical examination

There should be access to laboratory services.

4.8 BASIC TOOLS AND APPARATUS

Equipment related to the management of diabetes should be available. These include:

• Glucose monitors

• Testing materials such as glucometers strips, lancets, etc

• Beam balance scale and stadiometer

• Measuring tape (non-stretch), tuning fork, ophthalmoscope, 10G monofilament

• Audiovisual equipment and printed material for patient and staff education

Cardiac monitors, electrocardiograms, renal dialysis machine, sphygmanometers etc.

4.9 Patient Visits

The person with diabetes should have regular contact with the health system. The following is a suggested schedule of visits and activities.

4.9.1 Medical History

A comprehensive medical history should be elicited to determine the client's baseline information. This includes:

• Symptoms

• History of other medical conditions

• Medications being used

• Risk factor assessment: Smoking, Alcohol intake, Exercise patterns, Nutrition, Family history of diabetes, hypertension, vascular disease, Psychosocial assessment

• Identify factors that may affect management of diabetes : Cultural, Educational, Socio-economic

If patient is already being treated:

• Obtain results of previous test results

• Obtain information about previous treatments

4.9.2 Physical Examination

A thorough physical examination should be done paying special attention to:

Height and weight to determine BMI , Waist circumference, cold and cyanosed skin, shape of finger and toe nails, wound if any and the healing process, eye colour and vision, skin for evidence ulcers, etc. if patient is a known diabetic on insulin regiment, check injection sites for inflammation, pain etc. Feet for evidence of peripheral artery disease and neuropathy: Appearance- colour, evidence of atrophy.

• Blood pressure (including checks for orthostatic hypotension)

• Eyes for evidence of diabetic retinopathy (such as microaneurysms, haemorrhages and exudates), visual acuity

• Mouth for gingivitis, periodontitis

• Heart for cardiomegaly and murmurs

• Abdomen for hepatomegaly

• Neurological system for evidence of cranial and peripheral neuropathy

Laboratory Tests

The following laboratory tests should be conducted:

• Blood: Full blood count, Fasting Plasma glucose, HbA1c, lipid profile- low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), Triglycerides (TG), Serum creatinine

If clinically indicated: Thyroid function tests, Liver function tests, Urine for Ketones, Proteins, microalbuminuria

Radiologic investigations like: Electrocardiogram, Echocardiogram, Doppler could also be done by a specialist to check for pathologies that may arise as a result of complications of undiagnosed diabetes mellitus.

5.0 FINDINGS:

5.1 Achieving Glycaemic Control Non Pharmacological Management of Hyperglycaemia

Weight management, diet and physical exercise should be the first line of treatment for diabetes mellitus and should be maintained throughout the course of the disease.

In addition to improving glycaemic control, these interventions also slow progression of impaired glucose tolerance to overt diabetes.

5.2 Nutritional management

Assess

Nutritional status using BMI or waist circumference

• Body mass index (BMI) has been the traditional index of obesity and usefully identifies the risk of diabetes and cardiovascular disease in a given population.

• Waist Circumference

The waist circumference is a marker of visceral adiposity and a strong predictor of diabetes and cardiovascular disease risk.

5.3 Elicit Information on dietary practices

Advice on Nutrition

• Overweight patients should reduce calorie intake i.e. eat smaller portions and increase physical activity.

• Limit intake of fats and oils; avoid deep fried foods

• The intake of saturated fat, margarine and hydrogenated oils should be reduced to the barest minimum.

• Consumption of red meat should be limited and increased intake of fish, white meat, fruits, vegetables and legumes encouraged.

• Increased intake of complex carbohydrates and high fiber foods.

• The intake of refined carbohydrates (sugars) should be reduced to the barest minimum.

• The intake of salt and high sodium foods should be reduced.

• Eat a variety of foods and include fresh fruits and vegetables.

• Meals should be evenly distributed throughout the day. Breakfast, lunch and dinner should be taken at fairly regular times with mid morning, mid afternoon and avoid late night eating.

Patients treated with insulin could take in some recommended nuts or fruits at bed time to prevent post prandial attacks.

5.4 Physical Activity

Physical inactivity and over nutrition leading to obesity, are major contributors to the increasing levels of Type 2 Diabetes worldwide. Physical activity is therefore a key factor both in the prevention and management of Type 2 diabetes.

Assess Physical activity levels while Advise clients about the benefits of regular physical activity which include:

• Improvement in glycaemic control

• Prevention of cardiovascular disease

• Reduction in hypertension

• Reduction in levels of VLDL and increase in HDL cholesterol levels

• Enhancement of weight loss or maintenance of weight

• Improvement in mental health (helps counter anxiety and depression)

Meeting the requirements for physical activity does not require a formal exercise regime. Physical activity can be incorporated into the activities of daily living.

Regular aerobic activity should be sustained for 30-60 minutes at least 5 times weekly. The level and intensity of physical activity should be guided by the age and ability of the patient.

5.5 Guides to Physical Activity Levels

Light Level of Activity: Office work, cleaning house, playing golf, walking

Moderate: Walking briskly, gardening, cycling, tennis, dancing, swimming, light weight training, climbing stairs

Strenuous: Jogging, competitive swimming and tennis, aerobic workout, vigorous dancing

Very Strenuous: Running, intense aerobic workout, intense weight training, football

Note: These are simply a few examples. Physical activity levels will be determined by the degree of exertion. Before commencing a physical activity program, persons with diabetes should be assessed by a medical doctor.

5.6 Elicit medical history including:

• Present status of disease including, symptoms, treatment, complications

• Cardiac history

• Family history

Conduct physical examination including:

• Measurement of BMI, waist circumference

• Cardiac assessment

• Identification of complications of diabetes

• Foot examination

The history and physical examination should reveal any precautions that must be taken.

5.7 Contraindications to exercise

• Uncontrolled hyperglycaemia • Unstable angina

• BP >200/100 mmHg • Acute heart failure

• Febrile illness

5.8 Patient Advice about Exercising

• Warm up before and cool down after exercise

• Wear proper footwear

• Monitor feet closely for blisters or any other damage to feet

• If exercising away from home, wear identification and inform family or relatives the route you are using and where you would like to end.

• Ensure adequate intake of fluids

• Eat appropriately and modify insulin as necessary

5.9 Pharmacological Management of hyperglycaemia

Currently, the main therapeutic options for the treatment of Type 2 Diabetes are:

• Biguanides - Increase insulin sensitivity

• Thiazolidinediones - Increase insulin sensitivity

• Sulfonylureas- Increase insulin release

• Meglitinides - Increase insulin release

• Alpha - glucosidase inhibitors - Modify intestinal absorption of carbohydrates

• Insulins - Replace insulin

Combinations of these classes of drugs are frequently required for optimum control.

Low dose combination therapy could be considered early in the disease as it improves the efficacy of therapy and minimizes side effects.

5.9.1 Oral Glucose-Lowering Agents

Therapy with oral agents should be introduced when the blood sugar is not controlled by diet and exercise after 4-6 weeks.

The majority of persons with diabetes, even if initially controlled on non-pharmacological measures, will eventually require drug therapy in increasing dosages and often in multiple drug regimens. Many subsequently require the addition or substitution of insulin for glycaemic control, the so-called secondary failure.

A subset of patients with apparent Type 2 Diabetes Mellitus may require insulin for control somewhat earlier than expected- primary failure of response to oral therapy.

5.9.2 Insulin

The indications for insulin treatment are:

• All Type 1 patient

• Patients with Type 2 diabetes, whose metabolic control is chronically inadequate evidenced by an HbA1c > 6.5% despite adequate diet, weight reduction, exercise and maximum dosages of oral hypoglycaemic agents

• To cover acute illness, surgery or pregnancy

• Treatment of diabetic ketoacidosis or hyperglycaemic/hyperosmolar non-ketotic diabetic states

• Post–myocardial infarction

Patients with Type 2 Diabetes who are failing or have failed oral therapy can be safely and effectively started on insulin in the outpatient setting, with proper advice and training by the health care team.

Note: • Regular insulin should be injected subcutaneously 15-30 minutes before a meal for the onset of action to coincide with food absorption.

• Humalog (analogue insulin) can be given at the start of the meal.

• Glargine is given once daily, preferably on mornings, either alone or in combination with short-acting insulin or oral agents.

5.9.3 Mixing of Insulins:

• If Lente or Ultralente is mixed with Regular insulin in a syringe, it should be injected immediately, or the action of the Regular insulin becomes impaired.

• Glargine should not be mixed in the syringe with other insulins or injected at the same site as other insulins.

• If it is necessary to mix short and long acting insulin, then NPH is preferable to Lente in mixing with Regular insulin.

• When insulins are mixed, the Regular insulin should be drawn up first before the Lente or Ultralente.

5.9.4 Possible Insulin Regimens in Type 2 Diabetes Mellitus

1) Combined oral agents and insulin:

• Morning: Oral agents e.g. Metformin or Sulphonylureas or Thiazolidinediones

• Bedtime: Glargine or NPH insulin: Start with 10 - 15 units and adjust to achieve target fasting values.

2) Twice Daily Regimen of Both 'Regular' and 'NPH' Insulin

• Use the 'Rule of Thirds'

• 1/3 short-acting insulin and 2/3 long-acting insulin

• 2/3 of daily dose in morning and 1/3 in evening

3) Multiple Dosing Regimens:

Short-acting analogue e.g. Regular analogue immediately before each main meal together with long acting analogue insulin at bedtime e.g. Glargine

This regimen is useful in patients with little control or those who desire flexibility due to their lifestyles. High levels of motivation, frequent testing and adjustment of dosages are necessary for good control on this regimen.

Whenever possible, it may be useful to get input from a diabetes specialist.

6.0 RESULTS:

6.1 Monitoring of Blood Glucose (self-monitoring of blood glucose)

Self-monitoring of blood glucose (SMBG) is a major component in the achievement of good glycaemic control. SMBG is particularly useful in persons with Type 1 diabetes but may also play a critical role in the management of persons with Type 2 Diabetes.

The main functions of SMBG are:

• To provide persons with diabetes with information about their response to therapy. This information can be used to make adjustments to diet, medication and physical activity

• To foster the partnership between the patient and the health care team as results obtained by the patient may be used to modify treatment regimens

• To detect hypoglycaemia especially in those who may be ill or unaware of relevant symptoms

• To allow persons with diabetes to be aware of the status of their blood glucose control without being solely dependent on health care professionals

• To empower persons with diabetes

An individualized home monitoring plan is required and must be agreeable to the patient and health care workers. The plan should include the timing and frequency of tests. Frequency will vary according to the type of diabetes, the medication prescribed and the level of glycaemic control.

Testing should be done in the fasted state as well as before and after meals. For persons with Type 1 Diabetes and pregnant women on insulin, SMBG should be done at least three times per day. Recorded results should be presented to health care professionals at clinic visits.

The person's ability to adjust treatment, food and physical activity according to the results should also be monitored.

SMBG may not be suitable for everyone with diabetes. The patient should be able to perform the test accurately, following the manufacturer's instructions, and must know what results to expect and what action to take if the results are outside the desired range.

Major limitations of SMBG are:

• The cost of the testing strips and

• Difficulties experienced by some persons in pricking themselves (needle phobia).

6.2 Blood Glucose Monitors

There is usually a reasonable correlation between glucose concentrations measured in capillary blood by glucose meters and those from serum or plasma glucose measured by clinical laboratory procedures.

Blood Glucose Testing

The technique of testing should be taught by members of the health care team who should ensure that the test is being done accurately.

It is important to ensure that strips match the machine.

Strips must be stored according to recommendations of the manufacturers.

HbA1c

This test is used in combination with self-monitoring of blood glucose to assess long-term control.

Testing should be done as a minimum once every 6 months.

6.3 Urine testing

• Urine testing for glucose is not recommended for evaluating control. In settings where this may be the only available option for monitoring glycaemic control, persistent glycosuria highlights the need for the patient to seek further medical attention.

• Urine testing for ketones is important during sick days especially for Type 1 diabetes.

6.4 Hypoglycaemia

Hypoglycaemia/Hypo is used to describe blood sugar levels below 3 mmol/L.

Possible causes:

• More exercise than normal

• Too little food

• Missed or late meals

• Too much insulin/tablets

• Alcohol consumption

• Menses

• Hot weather

Signs and symptoms include:

a. Sweating b. Hunger

c. Shaking d. Blurred vision

e. Dizziness f. Headaches

g. Tiredness h. Tingling lips/finger tips

May also notice:

• Glazed eyes

• Mood changes

• Unusually aggressive behavior

6.5 The Three Stages of Hypoglycaemia

a. Mild Hypoglycaemia

Characterized by shaking, sweating, hunger, weakness and anxiousness

Treatment: Self-treatment of 10 to 15 grams of pure glucose, wait 10 minutes and follow with a protein such as 8 oz. of milk or cheese and crackers or bread. If untreated, it progresses to moderate hypoglycemia.

b. Moderate Hypoglycaemia :

Characterized by confusion, slurred speech, glassy eyes, poor coordination and lack of concentration

Treatment: Assistance may be required. Take a 20 to 30 gram dose of pure glucose, wait 10 minutes then follow with a protein such as 8 oz. milk or cheese and crackers or bread. If untreated, it progresses to severe hypoglycaemia.

c. Severe Hypoglycemia

Characterized by unresponsiveness, combativeness, agitation, convulsions and unconsciousness

Treatment: This is an acute medical emergency. Seek medical assistance.

Severe hypoglycemia can be life threatening if not treated promptly and thoroughly. Emergency measures are required, including injection of glucagon or intravenous dextrose, followed by oral glucose or sweetened drinks.

Hospital admission is indicated for severe or prolonged hypoglycaemia, co-existing renal disease or illness associated with use of long acting oral glucose lowering agents. The usual dose of insulin/diabetic medication may need to be modified, once the hypo episode has been treated.

Encourage patients to carry glucose and snacks at all times.

6.6 Conditions in Diabetes Mellitus Requiring Hospital Admission

• Newly diagnosed diabetes in children and adolescents or in pregnancy

• Uncontrolled diabetes

- Chronic refractory hyperglycaemia associated with metabolic deterioration

- Inability to obtain glycaemic control with outpatient therapy

- Recurrent hypoglycaemia

- Metabolic instability characterized by frequent swings between hypoglycaemia and hyperglycaemia

- Recurrent diabetic ketoacidosis in the absence of trauma and infection

- Uncontrolled diabetes in pregnancy

• Institution of intensive insulin regimes including insulin-pump therapy

• Potentially life-threatening acute complications of diabetes

- Diabetic ketoacidosis characterized by hyperglycemia, acidosis and ketones in the urine and/or blood

- Hyperglycemic hyperosmolar state characterized by severe hyperglycemia and elevated serum osmolality often with concomitant alterations in mental status

- Hypoglycemia with neuroglycopenia characterized by altered consciousness, seizures, coma, or disturbances of motor or language function, where there has not been prompt full recovery following glucose therapy, a sulfonylurea drug has been implicated, or there is concern about patient supervision or monitoring.

6.7 Hypertension Management in Adults with Diabetes

There is a higher prevalence of hypertension among persons with diabetes compared with non-diabetics. In the Caribbean diabetes is present in about one-third of hypertensive patients. This co-existence is often a result of:

• The high prevalence of both conditions in the Region

• The relationship between insulin resistance and hypertension

• The higher prevalence of chronic renal disease among diabetic patients

Hypertension increases the risk of strokes, ischaemic heart disease, retinopathy and nephropathy in persons with diabetes.

The target blood pressure should be <130/80 mm Hg. However, attaining systolic pressures of < 120 mm Hg is desirable.

Such targets may be difficult to achieve in the elderly and more modest goals may have to be set.

Management

Non-drug Treatment

• Weight management must be recommended for all persons with diabetes. Caloric restriction and any degree of weight loss are beneficial for the overweight or obese patient.

The intake of potassium and calcium must be adequate and sodium intake limited. Increased consumption of fruits and vegetables is to be encouraged as well as the use of low fat dairy products. A balanced diet will provide all the essential nutrients and vitamins without the need for supplementation.

• Smoking cessation is critical for reducing the risk of vascular complications of hypertension and diabetes.

• Alcohol intake should be limited as it compromises the control of both diabetes and hypertension.

• Physical activity should be continued unless specifically contraindicated.

Drug Treatment

• Most persons with hypertension and diabetes will need 2 or more drugs for control, in addition to lifestyle changes.

• Low-dose Thiazides e.g. Bendrofluazide or Hydrochlorthiazide can be used safely in the majority of diabetics. Thiazides, used in low doses, rarely affect glucose, lipids or electrolyte balance and should be the antihypertensives of first choice.

• Diuretics, ACE inhibitors, Angiotensin Receptor Blockers (ARBs) and Calcium Channel Blockers (CCBs) have all been shown to reduce the risk of cardiovascular events.

• ACE inhibitors have been shown to improve cardiovascular outcomes in high-risk patients with or without hypertension and there is compelling evidence for earlier use in persons with diabetes.

• ACE inhibitors or ARBs are the drugs of choice for renal protection in diabetics with proteinuria. In persons who are allergic to ACE/ARBs, the use of the calcium channel blocker Diltiazem has provided similar benefits.

• Beta-blockers have a place in the management of persons with diabetes but should be used with caution in persons with peripheral vascular disease. Water soluble forms e.g. Atenolol are preferable.

6.8 Lipid Management in Adults with Diabetes

Type 2 Diabetes mellitus is associated with increased prevalence of lipid abnormalities (viz. increased low density liproproteins (↑LDL-C), decreased high density liproproteins (↓HDL - C) and increased triglycerides (↑TG), which contribute to macrovascular disease (heart attacks and strokes). Lowering LDL cholesterol and triglycerides and raising HDL cholesterol have been shown to reduce macro vascular disease events as well as mortality.

Treatment

LDL-cholesterol

• Aim for LDL-cholesterol < 70 mg/dL (< 1.8 mmol/L). Statins are the drug of choice.

HDL-cholesterol

• Aim for >40 mg/dL (>1.0 mmol/L)

• Nicotinic acid (Niacin) is the most effective drug for raising HDL-C but has limited usage in clinical practice, as a result of an unpleasant flushing reaction. When used, doses should be restricted (e.g. 500 –1000 mg per day) to reduce the likelihood of hyperglycaemia.

Hypertriglyceridaemia

• Aim for <150mg/dL (<1.7 mmol/L)

• This derangement frequently responds to calorie and alcohol restriction. Adequate glycaemic control also contributes to reductions in triglyceride levels.

• Fibrate therapy (e.g. Gemfibrozil) may be necessary if these measures fail.

Statin therapy

• Patients with diabetes who have other cardiovascular risk factors (such as hypertension, smoking or microalbuminuria), may benefit from the addition of a statin irrespective of initial LDL-cholesterol levels.

• All diabetic patients with cardiovascular disease (angina, myocardial infarction, transient ischaemic attack, stroke, and claudication) should be on cholesterol-lowering medication.

• Combination therapy with a statin and fibrates may be used for mixed lipid disorders but the risk of rhabdomyolysis is increased.

• Note that liver function should be evaluated before commencement of statin therapy

Other Therapeutic Interventions

The following therapies may be considered in the management of diabetes and associated conditions.

• Anti-thrombotics

Aspirin (75 - 325 mg daily) should be given to all persons with diabetes over age 40 years who do not have a contra-indication to aspirin therapy and who have two or more risk factors for cardiovascular disease.

Note: Higher doses will increase the possibility of gastric mucosal injury and gastrointestinal haemorrhage.

Aspirin is not recommended for persons under age 21 years because of increased risk of Reye's syndrome. Alternative therapies include the combination of aspirin with an H2 antagonist or proton pump inhibitors or the use of Clopidogrel.

• Anti-obesity drugs

These drugs should only be used when absolutely necessary. Current choices include Orlistat and Sibutramine.

.6.9 RETINOPATHY

Diabetic retinopathy is an important cause of blindness. In the initial stages of diabetic retinopathy, patients are generally asymptomatic, but in more advanced stages of the disease patients may experience symptoms that include floaters, distortion, and/or blurred vision. Micro aneurysms are the earliest clinical sign of diabetic retinopathy. Renal disease, as evidenced by proteinuria and elevated blood urea nitrogen (BUN) creatinine levels, is an excellent predictor of retinopathy; both conditions are caused by DM - related micro angiopathies, and the presence and severity of one reflects that of the other. Aggressive treatment of the nephropathy may slow progression of diabetic retinopathy and neovascular glaucoma.

Contributing Factors

• Duration of the disease (usually > 10 years)

• Poor glycaemic control

• Poor blood pressure control

Screening

Refer all persons with Type 2 diabetes mellitus to an ophthalmologist as soon as possible after initial diagnosis and then annually for dilated fundoscopy. Patients with Type 1 diabetes should have an initial eye examination 3-5 years after the onset of the disease. According to The Diabetes Control and Complications Trial controlling diabetes and maintaining the HbA1c level in the 6 -7% range can substantially reduce the progression of diabetic retinopathy.

Signs and symptoms

In the initial stages of diabetic retinopathy, patients are generally asymptomatic; in the more advanced stages of the disease, however, patients may experience symptoms that include floaters, blurred vision, distortion, and progressive visual acuity loss. Signs of diabetic retinopathy include the following:

Micro - aneurysms: The earliest clinical sign of diabetic retinopathy; these occur secondary to capillary wall out pouching due to pericyte loss; they appear as small, red dots in the superficial retinal layers

Dot and blot hemorrhages: Appear similar to micro - aneurysms if they are small; they occur as micro - aneurysms rupture in the deeper layers of the retina, such as the inner nuclear and outer plexiform layers.

Flame-shaped hemorrhages: Splinter hemorrhages that occur in the more superficial nerve fiber layer.

Retinal edema and hard exudates: Caused by the breakdown of the blood-retina barrier, allowing leakage of serum proteins, lipids, and protein from the vessels.

Cotton-wool spots: Nerve fiber layer infarctions from occlusion of precapillary arterioles; they are frequently bordered by micro - aneurysms and vascular hyperpermeability

Venous loops and venous beading: Frequently occur adjacent to areas of non-perfusion; they reflect increasing retinal ischemia, and their occurrence is the most significant predictor of progression to proliferative diabetic retinopathy (PDR).

Intra - retinal microvascular abnormalities: Remodeled capillary beds without proliferative changes; can usually be found on the borders of the non-perfused retina.

Macular edema: Leading cause of visual impairment in patients with diabetes.

Nonproliferative diabetic retinopathy

Mild: Indicated by the presence of at least 1 micro - aneurysm

Moderate: Includes the presence of hemorrhages, micro - aneurysms, and hard exudates

Severe (4-2-1): Characterized by hemorrhages and micro - aneurysms in 4 quadrants, with venous beading in at least 2 quadrants and intra - retinal microvascular abnormalities in at least 1 quadrant.

Proliferative diabetic retinopathy

Neovascularization: Hallmark of PDR

Pre retinal hemorrhages**:** Appear as pockets of blood within the potential space between the retina and the posterior hyaloid face; as blood pools within this space, the hemorrhages may appear boat shaped.

Hemorrhage into the vitreous: May appear as a diffuse haze or as clumps of blood clots within the gel.

Fibrovascular tissue proliferation: Usually seen associated with the neovascular complex; may appear avascular when the vessels have already regressed

Traction retinal detachments: Usually appear tented up, immobile, and concave.

Macular edema

Recommendations to Reduce Risk of Retinopathy

• Aim for tight metabolic and blood pressure control • Refer for specialty care

6.10 NEUROPATHY

Diabetic neuropathy occurs mainly in persons with poor glycaemic control. Diabetic neuropathy is the most common complication of diabetes mellitus (DM), affecting as many as 50% of patients with type 1 and type 2 DM. Diabetic peripheral neuropathy involves the presence of symptoms or signs of peripheral nerve dysfunction in people with diabetes after other possible causes have been excluded.

Signs and symptoms

In type 1 DM, distal polyneuropathy typically becomes symptomatic after many years of chronic prolonged hyperglycemia, whereas in type 2, it may be apparent after only a few years of known poor glycemic control or even at diagnosis. Symptoms include the following:

Sensory – Negative or positive, diffuse or focal; usually insidious in onset and showing a stocking-and-glove distribution in the distal extremities

Motor – Distal, proximal, or more focal weakness, sometimes occurring along with sensory neuropathy (sensorimotor neuropathy)

Autonomic – Neuropathy that may involve the cardiovascular, gastrointestinal, and genitourinary systems and the sweat glands

Physical examination should include the following assessments:

Peripheral neuropathy testing – Gross light touch and pinprick sensation; vibratory sense; deep tendon reflexes; strength testing and muscle atrophy; dorsal pedal and posterior tibial pulses; skin assessment; Tinel testing; cranial nerve testing

Autonomic neuropathy testing – Objective evaluation of cardiovagal, adrenergic, and sudomotor function in a specialized autonomic laboratory; may be preceded by bedside screening to assess supine and upright blood pressure and heart rate, with measurement of sinus arrhythmia ratio

Two classification systems for diabetic neuropathy are the Thomas system and the symmetrical-versus-asymmetrical system. **The Thomas system (modified) is as follows:**

Hyperglycemic neuropathy Generalized symmetrical polyneuropathies

Sensory neuropathy Sensorimotor neuropathy

Autonomic neuropathy Focal and multifocal neuropathies

Superimposed chronic inflammatory demyelinating polyneuropathy

Distal symmetrical sensorimotor polyneuropathy is commonly defined according to the following 3 key criteria:

The patient must have diabetes mellitus consistent with a widely accepted definition

Severity of polyneuropathy should be commensurate with duration and severity of diabetes

Other causes of sensorimotor polyneuropathy must be excluded

Pure autonomic diabetic neuropathy is rare.

Asymmetrical neuropathies include the following:

Median neuropathy of the wrist (carpal tunnel syndrome)

Other single or multiple limb mono - neuropathies

Thoracic radiculoneuropathy

Lumbosacral radiculoplexus neuropathy

Cervical radiculoplexus neuropathy

Diabetic polyneuropathy is commonly staged as follows:

NO - No neuropathy

N1a - Signs but no symptoms of neuropathy

N2a - Symptomatic mild diabetic polyneuropathy; sensory, motor, or autonomic symptoms; patient is able to heel-walk

N2b - Severe symptomatic diabetic polyneuropathy; patient is unable to heel-walk)

N3 - Disabling diabetic polyneuropathy

Diagnosis

Laboratory tests that may be helpful include the following:

Fasting plasma glucose

Hemoglobin A1C

Complete blood count

Complete metabolic panel (electrolytes and liver function panel)

Vitamin B-12 and folate levels

Thyroid function tests

Erythrocyte sedimentation rate

C-reactive protein

Serum protein electrophoresis with immunofixation electrophoresis

Antinuclear antibody

Anti-SSA and SSB antibodies

Rheumatoid factor

Paraneoplastic antibodies

Rapid plasma reagin

Genetic screens

Hematology screen (for anemia)

Sequential multiple analysis-7 (renal function and electrolyte imbalances)/complete metabolic panel (CMP)

Other diagnostic modalities that may be considered are as follows:

Electromyography and nerve conduction velocity testing

Electrophysiologic studies

Magnetic resonance imaging

Computed tomography (including single-photon emission computed tomography)

Nuclear imaging

Doppler imaging

Microdialysis

Electrocardiography

Nerve and skin biopsy (now rarely recommended for clinical purposes)

Management

Key components of the management of diabetic neuropathy include the following:

Foot care including regular follow-up, patient education, and referral as appropriate.

Tight, stable glycemic control (most important for slowing progression of neuropathy)

Pain management (eg, with pregabalin, gabapentin, sodium valproate, dextromethorphan, morphine sulfate, tramadol, oxycodone, duloxetine, topical capsaicin, transdermal lidocaine)

Treatment of diabetic gastroparesis (eg, with erythromycin, cisapride [not available in the United States], metoclopramide, polyethylene glycol 3350, tegaserod [currently available only on an emergency basis])

Experimental therapies include aldose reductase inhibitors, alpha-lipoic acid, actovegin, and spinal cord stimulators.

Treatment of autonomic dysfunction must address the following:

Erectile dysfunction

Orthostatic hypotension

Gustatory sweating

Surgical treatment may be considered as follows:

Aggressive debridement or amputation for recalcitrant foot necrosis or infection

Jejunostomy for intractable gastroparesis

Implantation of a penile prosthesis for ongoing impotence

Bracing, special boots, or, in some cases, surgery for Charcot foot

Pancreatic transplantation for diabetes with end-stage renal disease

Symptoms usually start at the periphery (fingers and toes) and move up the limbs.

If the autonomic nervous system is affected, abnormalities of bladder and bowel function and penile erectile dysfunction (ED) may also occur.

6.10.1 DIABETIC NEPHROPATHY

Diabetic nephropathy is a clinical syndrome characterized by the following:

Persistent albuminuria (>300 mg/d or >200 μg/min) that is confirmed on at least 2 occasions 3-6 months apart.

Progressive decline in the glomerular filtration rate (GFR)

Elevated arterial blood pressure

Proteinuria was first recognized in diabetes mellitus in the late 18th century. In the 1930s, Kimmelstiel and Wilson described the classic lesions of nodular glomerulosclerosis in diabetes associated with proteinuria and hypertension.

By the 1950s, kidney disease was clearly recognized as a common complication of diabetes, with as many as 50% of patients with diabetes of more than 20 years having this complication.

Currently, diabetic nephropathy is the leading cause of chronic kidney disease in the United States and other Western societies. It is also one of the most significant long-term complications in terms of morbidity and mortality for individual patients with diabetes. Diabetes is responsible for 30 - 40% of all end-stage renal disease (ESRD) cases in the United States.

Generally, diabetic nephropathy is considered after a routine urinalysis and screening for micro -albuminuria in the setting of diabetes. Patients may have physical findings associated with long - standing diabetes mellitus.

Good evidence suggests that early treatment delays or prevents the onset of diabetic nephropathy or diabetic kidney disease. This has consistently been shown in both type1 and type 2 diabetes mellitus.

Regular outpatient follow - up is key to managing diabetic nephropathy successfully.

Recently, attention has been called to atypical presentations of diabetic nephropathy with dissociation of proteinuria from reduced kidney function. Also noted is that micro - albuminuria is not always predictive of diabetic nephropathy. Nevertheless, a majority of the cases of diabetic nephropathy presents with proteinuria, which progressively gets worse as the disease progresses, and is almost uniformly associated with hypertension.

6.10.2 CARE OF THE FOOT

Foot lesions are common in persons with diabetes.

Factors that Contribute to Foot Lesions

• Neuropathy

• Ischaemia

• Injury/Infection

• Incorrect foot wear

Recommendations to Reduce the Risk of Foot Problems

• Aim for tight metabolic and blood pressure control

• Encourage smoking cessation

• Encourage routine daily self-examination of feet

• Encourage use of correct foot wear. Where available, a chiropodist or podiatrist should be consulted when necessary

• Examine peripheral pulses for peripheral vascular disease

• Test feet routinely for peripheral neuropathy

• Refer for specialty care as appropriate

6.10.3 CARDIOVASCULAR DISEASE

Persons with diabetes are at significantly increased risk of developing cardiovascular disease, which is the major cause of mortality and chronic morbidity.

Cardiovascular disease includes:

• Coronary heart disease, which can lead to angina and myocardial infarction

• Cerebrovascular disease leading to transient ischaemic attacks and strokes

• Peripheral vascular disease

In terms of risk stratification, persons with diabetes should be treated in an identical manner to persons without diabetes who have previously had a heart attack.

In addition to glycaemic and blood pressure control and correction of dyslipidaemias, the following are strongly advised:

• Smoking Cessation: Successful smoking cessation is the most effective intervention for both primary and secondary prevention of cardiovascular disease.

• Use of Anti-Platelet Agents: Primary prevention with an anti-platelet agent should be considered in all patients over the age of 40 years, especially those with multiple risk factors. Aspirin use is beneficial for secondary prevention following myocardial infarction, stroke, peripheral vascular disease, and angina or following surgery for any of these conditions

6.10.4 Gestational Diabetes Mellitus (GDM)

Gestational diabetes mellitus is defined as any degree of glucose intolerance with onset or first recognition during pregnancy (American diabetes association guidelines 2005). Gestational diabetes mellitus (GDM) is a common medical complication associated with pregnancy. GDM is defined as any degree of glucose intolerance that occurs with pregnancy or is first discovered during pregnancy. GDM imposes risks on both mother and fetus. Some of these risks continue throughout the lifetime of mother and child. Maternal complications include pre - eclampsia, hyperglycemic crisis, urinary tract infections that may result in pyelonephritis, need for cesarean sections, and morbidity from operative delivery, increased risk of developing overt diabetes, and possibly cardiovascular complications later in life, including hyperlipidemia and hypertension.

Mothers with GDM have a 50% chance of developing type 2 diabetes mellitus (T2DM) for 20 years following their diagnosis of GDM. Maternal hyperglycemia causes increased glucose delivery to the fetus, resulting in fetal

hyperinsulinemia and increased fetal growth. Complications of excessive fetal growth include birth trauma, increased cesarean deliveries, and the long-term risk of glucose intolerance and obesity. Other immediate fetal complications include hypoglycemia, hyperbilirubinemia, respiratory distress syndrome, cardiomyopathy, and hypocalcemia. This plethora of risks demonstrates the importance of early risk stratification with appropriate screening and diagnosis and of therapeutic interventions that maintain optimal glycemic control.

The main pathophysiologic defects that occur in GDM are the same as those observed with T2DM: marked insulin resistance and impairment of insulin secretion. The exact mechanisms responsible for these defects in GDM are not known.

All pregnancies are associated with an increase in insulin resistance and increased pancreatic insulin secretion as the pregnancy progresses. Skeletal muscle is the body's main site of glucose disposal and becomes insulin resistant during pregnancy. This insulin resistance begins in mid pregnancy and continues until the end of gestation. Pregnancies are also associated with a 200% to 250% increase in insulin secretion to maintain euglycemia in the mother. These metabolic changes are normal and provide adequate nourishment to the fetus. The cause for pancreatic beta-cell dysfunction and accompanying decrease in insulin secretion in GDM is categorized into three groups.

The three groups are: 1) autoimmune, 2) monogenic, and 3) occurring on the background of insulin resistance. Additional maternal factors such as obesity also contribute to this insulin resistance. The exact maternal influences and the extent of their contribution are still poorly understood.

Placental hormones contribute to insulin resistance and secretion as well. The placenta is capable of producing a milieu of hormones and cytokines independently. Placental cytokines such as tumor necrosis factor alpha (TNFa), resistin, and leptin are known to contribute to the insulin resistance of GDM. Important placental hormones include human chorionic somatomammotropin (HCS), cortisol, estrogen, progesterone, and human placental growth hormone (hPGH). HCS increases throughout pregnancy and stimulates maternal pancreatic insulin release. Placental overexpression of hPGH results in severe peripheral insulin resistance.

It is thought that the cumulative effects of maternal and placental influences result in abnormalities in insulin signaling pathways, which lead to decreased glucose uptake and an increase in insulin resistance.

The following categories of patients are at increased risk of GDM:

• > 25 years of age

• Overweight

• First degree family history of diabetes

• Previous history of abnormal glucose metabolism

• Glycosuria

• Previous poor obstetric history

• Ethnicity associated with high prevalence of diabetes mellitus

• A previous large baby weighing more than 4.0 kg (9lbs)

Gestational diabetes poses a high-risk for both the woman and the child.

Complications of GDM include:

Fetus/Child

• Congenital malformations

• Increased birth weight

• Shoulder dystocia

• Elevated risk of perinatal mortality

Mother

• Hypertension in pregnancy and placental insufficiency may occur more frequently

• Increased insulin resistance

• Development of diabetes-related complications

• Abortion

Protocol for Testing for Gestational Diabetes Mellitus

1) Screen with questions related to risk factors as above

2) High-risk patients should be tested with the Oral Glucose Tolerance Test

If the first test is normal, retest high-risk patients at 24-28 weeks gestation.

Diagnostic Criteria

There are two main glucose tolerance tests used for diagnosing gestational diabetes.

The test using 100 g glucose is also widely used for detection of at risk infants and mothers.

Note: Clinical practice includes the use of a screening 50g glucose load (fasting not required). If the one hour value is ≥140 mg/dL (≥ 7.8 mmol/L), proceed to a diagnostic OGTT.

The alternative is the single step approach using the diagnostic GTT.

7.0 RECOMMENDATIONS

1. If insulin is not available or does not work properly, explain to the patient and help refer him or her to a physician specialist – endocrinologist for further and better management

2. Explain how the prescribed meal and exercise plan and blood glucose monitoring are essential for management of the disease.

3. List the risk factors for diabetes and educate patient or public on the need to avoid sedentary life style and emphasis on intake of more fruits and veggies and incorporating appropriate nutritional management

4. State how the diagnosis of diabetes is established and allay fears and anxiety from the public

5. State the importance and benefits of good diabetes control the effects of oral hypoglycaemic agents if patient is known diabetic.

6. Health care providers should identify appropriate body weight (BMI) and factor it in the diagnosis and treatment of diabetes mellitus

7. Advise on salt intake to little or no salt since it's a contributing factor that can complicate issues with hypertension.

8. Educate the patient on the need for regular exercise, at least 30 minutes every day to help burn down calories and help regulate the blood glucose levels. But it will be more appropriate if patient does the exercises with a well-trained person.

9. Advise patient on the need to visit his or her physician promptly to discuss any changes in life pattern for early management.

10. Advice patient on the need to continue with any medications given by the physician regular until the physician verbalizes improved condition.

TABLES

There is a large overlap between the Metabolic Syndrome and pre-diabetes. Persons with the metabolic syndrome are at increased risk of developing diabetes.

Table 1:

Criteria for Identification of the Metabolic Syndrome	
Feature	
Criterion (1) abdominal obesity (waist circumference)	
- Men	- Women
>102 cm (40 in)	> 88 cm (35 in)
(2) Fasting Plasma Lipids, Triglycerides, HDL Cholesterol	
- Men	- Women
≥ 150 mg/dL (≥1.69 mmol/L)	< 40 mg/dL <1.03 mmol/L)
(3) Blood Pressure	
Both men and women	≥ 130/85 mm Hg
(4) Fasting Blood Glucose	≥ 110 mg/dL (≥6.1 mmol/L)

Source: Executive summary of the third report of the 2001 National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel {ATP}) III

Table 2

Control of Blood Glucose, Blood Pressure and Blood Lipids	
Metabolic, Blood Pressure and Nutritional Targets for Control in Diabetes Mellitus and Associated Conditions	
Blood glucose:	
Preprandial	Postprandial
90 -130 mg/dL (5.0-7.2 mmol/L)	180 mg/dL (10.0 mmol/L)
HbA1c 6.5%	

Total cholesterol	200 mg/dL (5.2 mmol/L)
HDL cholesterol	40 mg/dL (1.0 mmol/L)
LDL cholesterol	70 mg/dL (1.8 mmol/L)
Fasting triglycerides	150 mg/dL (1.7 mmol/L)
Blood Pressure	130/80 mmHg
Body Mass Index for both	18.5 - 25 kg/m2
Waist circumference:	
Women	Men
80 cm (32 inc)	94 cm (37 inc)

Table 3

Types of Insulin Available

Type of Insulin	Examples
Rapid-acting	Insulin lispro
	Insulin aspart
Short-acting	Regular
	Humalog
Intermediate	NPH, Lente
	Ultralente
Long-acting	Glargine
	Detamir
Pre-mixed	70% Lente: 30% Regular
	80% Lente: 20% Regular

8.0 CONCLUSION:

With improvement in research and training of medical doctors , nurses, biomedical scientist and other health care workers, diabetes mellitus and its complications can now be managed properly using international standards of care worldwide and this has also led to sub Saharan Africa progressing in the treatment, prevention and management of the disease and its complications.

It is the writers prayer and hope that more pharmaceutical research centers about diabetes be established in all developing countries to help cut down the cost of drugs and laboratory investigations in managing the disease.

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