CLINICAL PRACTICE GUIDELINES

May 2009 MOH/P/PAK/184.09(GU)

MANAGEMENT OF TYPE 2 DIABETES MELLITUS

(4th Edition)

Galega officinalis

MALAYSIAN ENDOCRINE & METABOLIC SOCIETY

MINISTRY OF HEALTH MALAYSIA

ACADEMY OF MEDICINE MALAYSIA

PERSATUAN DIABETES MALAYSIA

This is a revised and updated Clinical Practice Guidelines (CPG) on Management of Type 2 Diabetes Mellitus (T2DM). This CPG supersedes the previous CPG on Management T2DM (2004).

STATEMENT OF INTENT

This guideline is meant to be a guide for clinical practice, based on the best available evidence at the time of development. Adherence to this guideline may not necessarily guarantee the best outcome in every case. Every health care provider is responsible for the management of his/her unique patient based on the clinical picture presented by the patient and the management options available locally.

REVIEW OF THE GUIDELINE

This guideline was issued in May 2009 and will be reviewed in May 2013 or sooner if new evidence becomes available.

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Electronic version is available on the following websites:
http://www.moh.gov.my
http://www.acadmed.org.my
http://www.endocrine.my
http://www.diabetes.org.my

FOREWORD

Despite significant advances in Medicine, Diabetes Mellitus remains a major medical challenge in the 21st century.

It is common knowledge that urbanised lifestyle coupled with physical inactivity, together with a higher intake of saturated fats have impacted our population which appears to be genetically predisposed to Type 2 Diabetes. In Malaysia, the prevalence of diabetes continues to rise. What is even more worrying is the fact that almost half of our population with diabetes is unaware that they have the disease.

Diabetes is much easier to treat in its early stages, which underscores the critical need for screening at the primary care level. Lifestyle modification including weight loss, changes in diet and increased physical activity also plays a major role in controlling the disease. As more and more novel pharmacological anti-diabetic agents come into the market, we should not lose sight of the importance of patient empowerment to achieve behavioural modification.

I wish to congratulate all members of this committee for their hard work in producing the 4th edition of this Clinical Practice Guideline. This document will be an invaluable tool for all health practitioners in improving the delivery of care for our diabetic patients, particularly at the primary care level.

Thank you.

Tan Sri Dato' Seri Dr. Hj. Mohd. Ismail b. Merican
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PREFACE

The prevalence of T2DM continues to rise in an exponential rate around the world and much of the global burden of this disease is expected to come from the Western-Pacific as well as the South-East Asia regions. In Malaysia, the Third National Health and Morbidity Survey (3rd NHMS) showed that the prevalence of the T2DM for adults aged 30 years old and above now stood at a staggering 14.9% T2DM, upped by almost 79.5% in the space of 10 years from 1996 to 2006. The prevalence of T2DM is the highest among Indian ethnic at 19.9% for those aged 30 years and above.

The Clinical Practice Guidelines (CPG) was developed to provide a clear and concise approach to all health care providers on the current concepts in the management of T2DM. Since T2DM is managed by various health care professionals in Malaysia, attempts were made to ensure the different stakeholders will benefit from this CPG. This is reflected by the representation of the committee members which developed the guideline.

There were three previous guidelines on the Management of T2DM; in 1992, 1996 and 2004. This edition is the Fourth in the series and was deemed necessary due to the tremendous body of new evidence that has become available in the last 4-5 years that has major impact on T2DM management including new targets for control, new classes of pharmacological agents targeting novel pathways as well as major outcome studies. All these have changed the algorithms for the management of T2DM. This new edition of the CPG will address many of these changes. In addition, the emphasis and recognition that a cluster of cardiovascular risk factors that make up the metabolic syndrome in which T2DM is the cornerstone of this syndrome is vital. As such, the management of T2DM requires an integrated and holistic approach that also involves the management of hypertension, dyslipidaemia and overweight/obesity in order to reduce the risk of macrovascular complications. Furthermore, recent major outcome studies showed that early and aggressive reduction in blood glucose level to target decrease the risk of complications thereby reducing healthcare cost.

I hope this latest edition of the CPG for T2DM will help to address the current shortfalls in the management of T2DM and it will be fully utilized by all relevant health care professionals. Last but not least, I would like to express my gratitude to everyone involved in the development of this guideline and especially to the task force members for their immense support and contribution towards this guideline.

Professor Dato' Paduka Dr. Wan Mohamad Wan Bebakar
Chairperson
Clinical Practice Guideline Task Force

GUIDELINE DEVELOPMENT AND OBJECTIVES

Guideline Development

The guideline development task force consisted of endocrinologists, a nephrologist, an ophthalmologist, two family medicine specialists, a general physician, a neurologist, a paediatric endocrinologist, two public health physicians, a dieititan and a diabetic nurse educator.

The previous edition of the CPG for Management of T2DM (2004) was used as the basis for the development of this present guideline.

Literature search was carried out at the following electronic databases: PUBMED, Medline, Cochrane Databases of Systemic Reviews (CDSR), Journal full text via OVID search engine. In addition, the reference lists of all relevant articles retrieved were searched to identify further studies.

Reference was also made to other guidelines on the management of T2DM including American Diabetes Association (ADA), Position Statement on Standards of Medical Care in Diabetes, 2008; American Association of Clinical Endocrinologists (AACE) Medical Guidelines for Clinical Practice for the Management of Diabetes Mellitus, 2007; International Diabetes Federation (IDF), Global Guideline for Type 2 Diabetes, 2005; American Diabetes Association (ADA) and European Association for the Study of Diabetes (EASD), Management of Hyperglycaemia in Type 2 Diabetes: A Consensus Algorithm for the Initiation and Adjustment of Therapy, 2006; Malaysian CPG on Management of Obesity 2004; Canadian Diabetes Association 2008 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada; Medical Nutrition Therapy Guidelines for Type 2 Diabetes, Malaysian Dietitian Association, 2005.

This guideline is based largely on the findings of systemic reviews and meta-analyses in the literature, taking into consideration local practices.

The clinical questions were divided into major subgroups and members of the task force were assigned individual topics within these subgroups. The task force met a total of 9 times throughout the development of the guideline. All literature retrieved were critically appraised, presented and discussed during group meetings. All statements and recommendations formulated were agreed by the task force members. Where the evidence was insufficient, the recommendations were derived by consensus of the task force members.

The articles were graded using the criteria used by the United States/Canadian Preventive Services Task Force, while the grading of recommendation in this guideline was modified from the Scottish Intercollegiate Guidelines Network (SIGN).

The draft guideline was posted on the Ministry of Health Malaysia website for comment and feedback. This guideline had also been presented to the Technical Advisory Committee for Clinical Practice Guidelines and the Health Technology Assessment and Clinical Practice Guidelines Council, Ministry of Health Malaysia for review and approval.

Objectives

The aim of the guideline is to provide evidence-based recommendations to assist health care providers in the identification, diagnosis and management of people with T2DM. It also includes a section on pre-diabetes and prevention of progression in the high-risk population and Metabolic Syndrome.

Clinical Questions

The clinical questions of these guidelines are:

1. How can diabetes be prevented?
2. How to screen for glucose intolerance?
3. How is diabetes diagnosed?
4. How can people with diabetes be managed?

Target Population

This guideline is applicable to children, adolescents and adults with T2DM and also diabetes in pregnancy as well as those at risk of developing diabetes.

Target Group

This guideline is meant for all health care professionals involved in treating patients with T2DM which includes: medical officers, family medicine specialists, general practitioners, public health personnel, general physicians, endocrinologists, cardiologists, nephrologists, neurologists, geriatricians, obstetricians and gynaecologists, paediatricians, ophthalmologists, nurses, assistant medical officers, podiatrists, pharmacists, dietitians as well as diabetic nurse educators.

CLINICAL INDICATOR FOR QUALITY MANAGEMENT

Proportion of people with diabetes with HbA1c $< 6.5\%$

Numerator: Number of people with diabetes with HbA1c $< 6.5\%$

Denominator: Total number of people with diabetes on treatment sampled

The optimum achievable standard: $\geq 30\%$ for each facility

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a) It is a common chronic disorder
b) There is chronic hyperglycaemia together with other metabolic abnormalities
c) It is due to insulin resistance and/or deficiency as well as increased hepatic glucose output
d) It is a risk factor for CVD
e) Currently there is no known cure but the disease can be controlled enabling the person to lead a healthy and productive life
f) The aim of management is directed at reducing complications (microvascular & macrovascular)

Symptoms of Diabetes

Fourty eight percent (48%) of patients above the age of 30 years old are not aware that they have diabetes. [1 (Level III)] The majority are asymptomatic.

Acute Complications

a) Hypoglycaemia
b) Hyperglycaemia

Patients should be made aware of:

- Symptoms: Common symptoms include polyuria, polydipsia, tiredness and weight loss
- Precipitating factors (e.g. infection, intercurrent illness)
- Simple measures to avoid and manage the above

Chronic Complications

a) Macrovascular
(e.g. Cardiovascular, Cerebrovascular, Peripheral vascular systems)
b) Microvascular
(e.g. Nephropathy, Neuropathy and Retinopathy)

Inform patients regarding:

- Symptoms
- Preventive measures
- Coping strategies

Lifestyle Measures

Diet and physical activity form an integral part of the management of diabetes. Education on lifestyle modification should be initiated at diagnosis and reinforced regularly.

Medication

Emphasize that diet and physical activity are the mainstay of treatment. Medication can be given at diagnosis for appropriate patients.

Self-Care

Patients should be educated to practice self-care. This allows the patient to assume responsibility and control of his/her own diabetes management. Self-care should include:

- Blood glucose monitoring
- Body weight monitoring
- Foot-care
- Personal hygiene
- Healthy lifestyle/diet and physical activity
- Identify targets for control
- Stop smoking
- Alcohol intake

SECTION 2 SCREENING AND DIAGNOSIS

2.1 Objective

To detect pre-diabetes and diabetes in specific high risk population groups and to ensure timely and appropriate management

2.2 Strategy

- Screening for high risk group
- Selective screening according to criteria

2.3 Who should be screened

a. Any individual who has symptoms suggestive of DM (tiredness, lethargy, polyuria, polydipsia, polyphagia, weight loss, pruritis vulvae, balanitis) must be screened. [2]

b. Criteria for testing for pre-diabetes and diabetes in asymptomatic adult individuals

Testing should be considered in all adults who are overweight [body mass index (BMI) >23 kg/m^2 or waist circumference (WC) ≥80 cm for women & ≥90 cm for men] and have additional risk factors:

- Dyslipidaemia either high density lipoprotein (HDL) cholesterol <0.9 mmol/L or triglycerides (TG) >1.7 mmol/L
- History of cardiovascular disease (CVD)
- Hypertension (≥140/90 mmHg or on therapy for hypertension)
- Impaired Glucose Tolerance (IGT) or Impaired Fasting Glucose (IFG) on previous testing
- First-degree relative with diabetes
- Other clinical conditions associated with insulin resistance (e.g. severe obesity and acanthosis nigricans)
- Physical inactivity
- Women with polycystic ovarian syndrome (PCOS)

Adapted from American Diabetes Association (ADA). Position Statement on Standards of Medical Care in Diabetes – 2009 [2]

c. Pregnant women should be screened if they have any of the following risk factors:

- BMI >27kg/m^2
- Previous macrosomic baby weighing 4kg or above
- Previous gestational diabetes mellitus (GDM)
- First-degree relative with diabetes
- Bad obstetric history
- Glycosuria at the first prenatal visit
- Current obstetric problems (essential hypertension, pregnancy induced hypertension, polyhydramnios and current use of steroids)
- Age above 25 [2]

Screening is done using the 75g OGTT and performed at least once at ≥24 weeks of gestation. Screening at an earlier stage of gestation depends on the degree of suspicion and at the physician's/obstetrician's request.

d. Women with history of gestational diabetes should be screened for diabetes annually. [3]

e. In the absence of the above criteria, testing should begin at age ≥30 years. [1 (Level III)]

f. Children and adolescents who are overweight (BMI >85th percentile for age and sex, or weight >120% of ideal) and have any two of the following risk factors should be screened for pre-diabetes and diabetes.
   - Family history of T2DM in first- or second- degree relative
   - Maternal history of GDM
   - Ethnicity (those of Indian ethnic background are at higher risks of developing T2DM) [1 (Level III)]
   - Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidaemia, PCOS) [4 (Level III)]

2.4 Schedule

Screening should be done annually.

In children and adolescents, screen every two years starting at the age of 10 years old or at onset of puberty if puberty occurs at a younger age. [4 (Level III)]

2.5 Screening Test

Screening can be done by measuring random blood glucose (capillary blood), using glucose meters and strips.

Screening process is shown in Flow Chart 1 (Algorithm 1) and Flow Chart 2 (Algorithm 2)

In children and adolescents, follow the same screening procedure.

2.6 Diagnosis

Diagnosis must be confirmed by measurement of venous plasma glucose.

Venous sample for plasma glucose should be taken prior to initiating therapy.

Table 1: Values for Diagnosis

	Fasting	Random
Venous Plasma Glucose	≥ 7.0 mmol/L	≥ 11.1 mmol/L

In the symptomatic individual, one abnormal glucose value is diagnostic.

In the asymptomatic individual, 2 abnormal glucose values are required.

Table 2: Diagnostic values for Type 2 Diabetes Mellitus/Glucose Intolerance – oral glucose tolerance test (OGTT) [IDF 2005] [5 (Level III)]

OGTT Plasma Glucose Values (mmol/L)		
Category	0-hour	2-hour
Normal	< 6.1*	< 7.8
IFG	6.1* – 6.9	-
IGT	-	7.8 – 11.0
DM	≥ 7.0	≥ 11.1

* ADA uses 5.6 mmol/L [2]

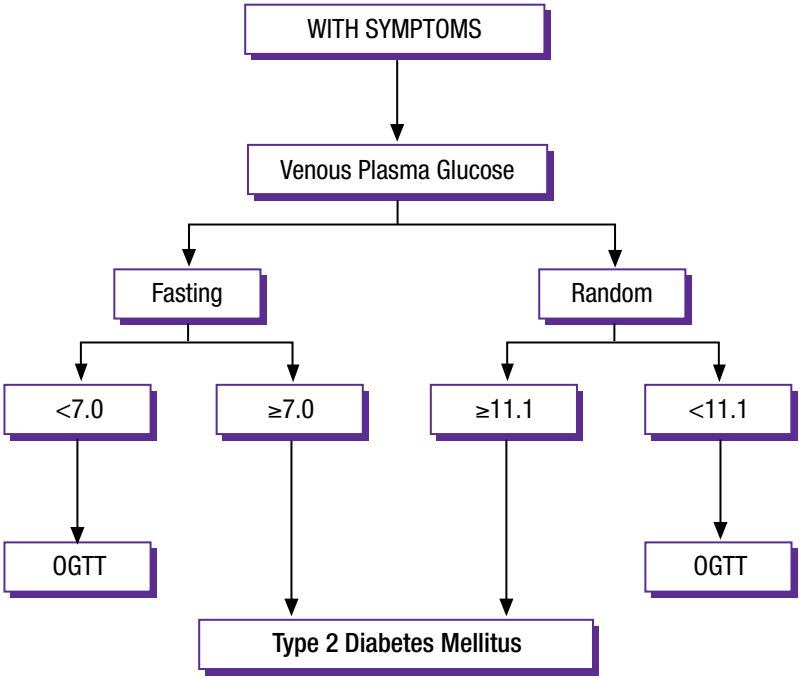
In children and adolescents, the glucose load in OGTT is based on body weight (1.75g per kg body weight, maximum of 75g).

Recommendations: Screening and Diagnosis

1. Screening for diabetes using fasting plasma glucose (FPG) should be performed annually in those with risk factors and those ≥30 years. *[Grade C]*
2. In children and adolescents at risk of developing diabetes, screening should be initiated at 10 years old or at onset of puberty if puberty occurs at a younger age. Screening is performed every two years. *[Grade C]*
3. More frequent and/or earlier testing with either a FPG or 2-hour plasma glucose in a 75g OGTT should be considered in people with additional risk factors for diabetes. *[Grade C]*
4. Testing with a 75g OGTT should be considered in individuals with a FPG of ≥6.1 to 6.9 mmol/L in order to identify individuals with IGT or diabetes. *[Grade C]* A glucose load of 1.75g/kg body weight (max.75g) is used for children and adolescents.
5. ALL newly diagnosed T2DM need to be reviewed by a medical doctor in which screening for other cardiovascular risk need to be done or planned. *[Grade C]*

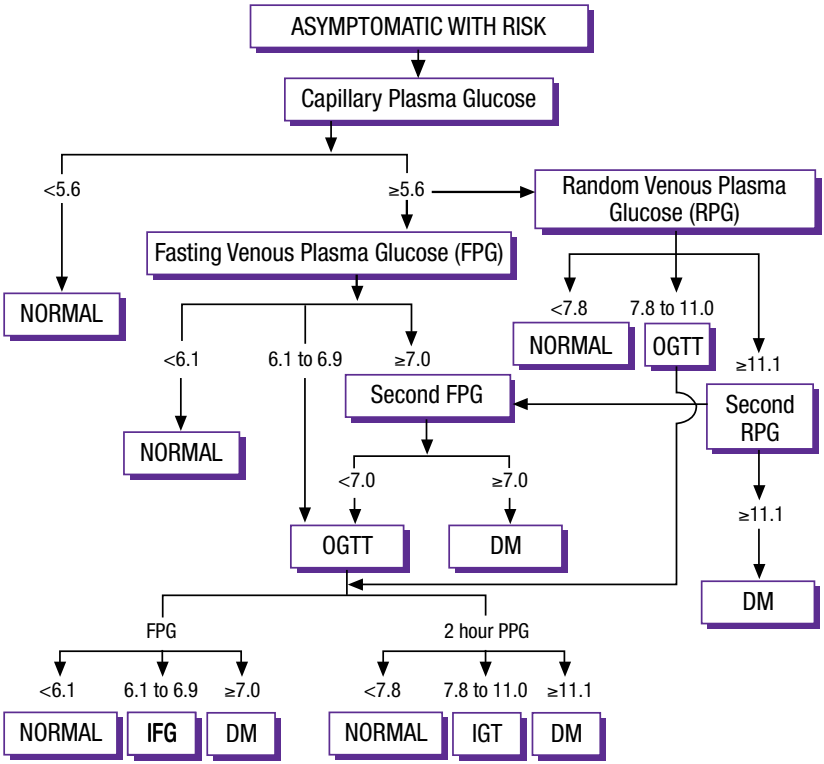
2.7 Screening Process

Algorithm 1: Screening for type 2 diabetes mellitus at primary care level – with symptoms



• All values in mmol/L. Capillary whole blood reading is 12% lower than venous plasma glucose.

Algorithm 2: Screening for type 2 diabetes mellitus at primary care level – without symptoms



- If FPG ≥7.0 mmol/L or 2 hour PPG ≥11.1 mmol/L, repeat OGTT is required to make the diagnosis of diabetes
- All values in mmol/L. Capillary whole blood reading is 12% lower than venous plasma glucose.
- For diagnosis of T2DM, venous plasma glucose value is required.

SECTION 3 MANAGEMENT FOR TYPE 2 DIABETES MELLITUS

3.1 Initial Assessment

At diagnosis a detailed history, physical examination (including fundoscopy) must be done to assess the risk factors and complications of diabetes. The following baseline investigations should be performed:

FPG
Glycosylated Haemoglobin (HbA1c)
Renal profile
Lipid profile
Urine analysis particularly for albuminuria
Electrocardiogram (ECG)

Management should be based on the initial assessment and baseline investigations.

Diabetes management involves lifestyle modification, medication and patient education to encourage self care. [6, 7 (Level III), 8, 9 (Level I)]

Assessment includes appraisal of cardiovascular risks and presence of end-organ damage.

A detailed assessment needs to be made at first diagnosis.

History

Specific symptoms	Polyuria, Polydipsia, Polyphagia, Weight loss, Nocturia, Hyperglycaemia, Malaise/fatigue, Altered vision
Predisposition to diabetes	Age over 35, Family history, Ethnic group, Overweight, Physical inactivity, Hypertension, Obstetric history of large babies or Gestational diabetes, Medication causing hyperglycaemia, Autoimmune disease (personal and/or family history of other autoimmune diseases e.g: hypo or hyperthyroidism
Risk factors for complications	Personal or family history of CVD, Smoking, Hypertension, Dyslipidaemia
General symptoms review	Cardiovascular symptoms, Neurological symptoms, Bladder and sexual dysfunction, Foot and toe problems, Recurrent infections (especially urinary and skin)
Lifestyle issues	Smoking, Alcohol, Occupation, Eating and physical activity

In children and adolescents, predisposing factors to T2DM include low birth weight (LBW), small for gestational age (SGA), large for gestational age (LGA), maternal diabetes during pregnancy, childhood obesity, sedentary lifestyle, increased calorie and fat intake, onset of puberty, ethnicity, insulin resistance, PCOS, T2DM in first- and second- degree relatives.[10-13] Symptoms include pruritis vulvae in girls, enuresis, polyuria, polydipsia, lethargy and weight loss. The majority of T2DM in children and adolescents are diagnosed incidentally.

Examination

Weight/waist	BMI = weight (kg) divided by height^2 (m^2), WC
Cardiovascular	Blood pressure (lying and standing), Peripheral neck and abdominal system vessels
Eye	Visual acuity (with corrected vision), Cataract, Retinopathy (examine with pupils dilated)
Feet	Sensation and circulation, Skin condition, Pressure areas, Interdigital problems, Abnormal bony architecture
Peripheral Nerves	Tendon reflexes, Sensation: touch (e.g: with 10G monofilament), vibration (e.g: with 128Hz tuning fork)

Investigations

Baseline	Urinalysis: albumin, microalbuminuria Renal profile: plasma urea and creatinine Lipids: Low density lipoprotein (LDL) cholesterol, HDL cholesterol, total cholesterol, triglyceride Glycaemia: FPG, HbA1c
Others	ECG Thyroid function tests if there is a family history or clinical suspicion

Plan of continuing care

- Relief of acute symptoms
- Optimize control of glycaemia and other risk factors for complications
- Treat existing complications

Priorities of management

Patient and carer counselling includes identifying and addressing concerns which may be causing distress and adversely affecting management.

If the patient is symptomatic then treatment for hyperglycaemia needs to be prompt but if the patient is asymptomatic initial treatment can be less urgent.

Control of blood pressure is as important as glycaemic control in preventing complications. For example the United Kingdom Prospective Diabetes Study (UKPDS) indicates that every 10mmHg reduction in systolic blood pressure accounted for a 15% reduction in diabetes related deaths. [14 (Level I)]

The overall aims of management are to improve quality of life and prevent premature death:

Short term:

- Relief of symptoms and acute complications

Long term:

- Achievement of appropriate glycaemia
- Reduction of concurrent risk factors
- Identification and treatment of chronic complications

The team approach

- Consider referral to diabetes educator and dietitian for consolidation of education

In the team management of diabetes the **patient** is the central member.

For the patient to accept responsibility for self care they must understand the condition, its effect on health and the practicalities of management. Good communication between team members is important so that advice is consistent and not confusing for the patient.

The following professionals are important team members in the management of diabetes:

Primary Care Practitioner

Primary care practitioner plays a central role in coordinating management of person with diabetes and in providing patient education as well as counselling. Primary care practitioner is the point of first contact with people with diabetes and usually assumes the responsibility for their overall management.

In some instances where the diabetes educator or dietitian is not available primary care practitioner and/or the paramedics must undertake the responsibility to give detailed education to the patient.

Diabetes Educator

The diabetes educator can often spend more time than the primary care practitioner in facilitating knowledge and skills regarding healthy eating, physical activity, self-monitoring, medication usage, setting goal, problem solving, risk reduction practices such as foot care, smoking cessation and keeping with medical appointment.

Dietitian

The role of the dietitian in the management of diabetes is paramount. Lifestyle changes alone (healthy food and regular exercise with ensuing weight loss) are sufficient for glycaemic control in the majority of patients with newly diagnosed T2DM. Recommendation should be individualized to maximize cooperation. Referral to a dietitian is desirable to ensure detailed education on this important aspect of management. The other team members must understand the principles of dietary advice to reinforce the dietary recommendations for the patient.

Physician/Endocrinologist/Diabetologist

The advice of a specialist physician may be valuable for people with complicated problems related to diabetes. A shared care approach by the primary care practitioner and specialist will provide the best combination of expertise and continuity of care to the patient.

Ophthalmologist/optometrist

Referral to an ophthalmologist/optometrist is required for further assessment and management of retinopathy and other eye problems.

Oral health professional

Dental and periodontal problems are common in people with diabetes who need to see a dentist regularly.

3.2 Targets for Control

Table 3: Targets for Type 2 Diabetes Mellitus

	Levels
Glycaemic Control*	
Fasting	4.4 – 6.1 mmol/L
Non-fasting	4.4 – 8.0 mmol/L
HbA1c	<6.5 %
Lipids	
Triglycerides	≤1.7 mmol/L
HDL cholesterol	≥1.1 mmol/L
LDL cholesterol	≤2.6 mmol/L#
Exercise	150 mins/week
Blood Pressure	
Normal Renal Function [15, 16 (Level III)]	≤130/80 mmHg§
Renal Impairment/Gross Proteinuria	≤125/75 mmHg

* Glycaemic target should be individualized to minimize risk of hypoglycaemia.[17 (Level I)] The taskforce acknowledges the increased CVD death in the intensive group of the ACCORD study. [17 (Level I)] However, the taskforce believes it is due to the overall treatment strategies that were employed to achieve the HbA1c target rather than the reduction in HbA1c. This is also collaborated by the ADVANCE study. [18 (Level I)]

\# In Individuals with overt CVD, LDL cholesterol target is <1.8 mmol/L.

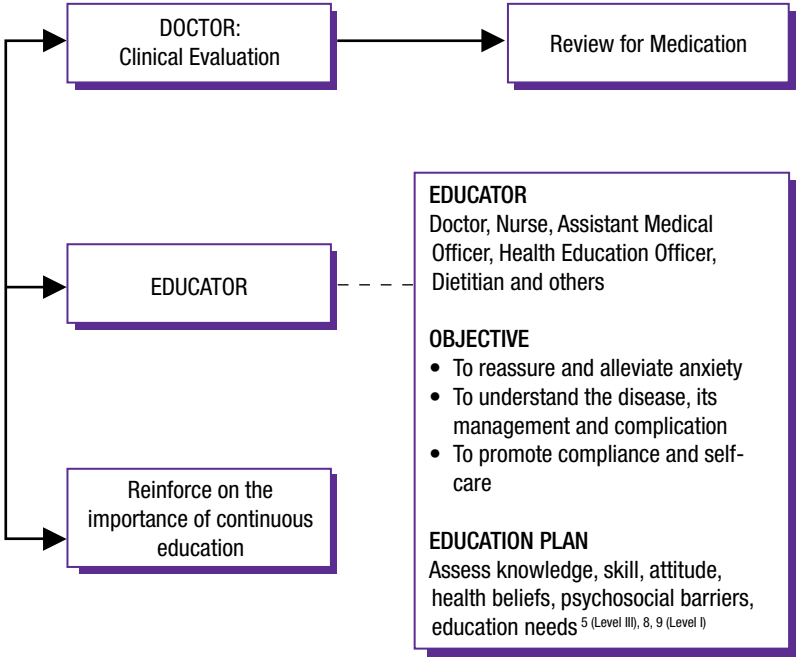
§ In children and adolescents, blood pressure (BP) should be <95th percentile for age and sex. [19 (Level III)]

Modified from the International Diabetes Federation Western Pacific Region (IDF-WPR) Type 2 Diabetes Practical Targets and Treatment, Fourth Edition, 2005.[20]

3.3 Diabetes Education

Diabetes education is effective for improving clinical outcomes and quality of life. Hence it should be advocated to all patients with T2DM regardless of treatment mode. [21-23 (Level I)]

Algorithm 3: Education Strategies



Health education, diet therapy and exercise must be reinforced at follow-up. [8, 23 (Level I)]

3.4 Lifestyle Modification

3.4.1 Medical Nutrition Therapy

Medical nutrition therapy (MNT) is important in preventing diabetes, managing existing diabetes, and delaying complications. Proper diet is crucial at any stage of management of diabetes including those on medication.

The goals of MNT together with medication are to attain and maintain blood glucose, blood pressure and lipid profile as close to normal as safely as possible. These goals can be achieved through healthy food choices.

General recommendations:

1. Nutrition counseling by a dietitian is recommended. [29 (Level I)]

2. Dietary counseling should be individualized according to nutritional needs, severity of disease, cultural preferences and willingness to change. [30 (Level III)]

Specific recommendations

A. Prevention of diabetes:

1. Weight loss of 5 to 10% of initial body weight over a 6 month period is recommended for all overweight or obese individuals who have or are at risk for diabetes. [31, 32 (Level I)]

   This can be achieved by:

   - a reduced calorie diet (20-25 kcal/kg body weight)
   - increasing physical activity (at least 150 mins/week), and
   - behavioural modification

2. A balanced diet consisting of 50-60% energy from carbohydrate, 15-20% energy from protein and 25-30% energy from fats are encouraged. [30 (Level III)] These recommendations must be individualized based on glucose and lipid goals. However, total caloric intake must be appropriate for weight management goals.

3. A high fibre diet (20-30g fibre/day or 5-7 servings/day) consisting of vegetables, fruits, legumes and whole grain cereals is encouraged. [33 (Level II-2)]

In children and adolescents: maintenance of weight is associated with a reduction in BMI (as height increases), significant improvement in body composition, insulin resistance and inflammatory markers. [34 (Level I)]

B. Management of Diabetes

In addition to the above recommendations:

1. Meal timings should be regular (avoid missing meals) and synchronised with medication time actions.

2. The diet should consist of carbohydrate from cereals (preferably whole grain), fruits, vegetables, legumes, and low-fat or skimmed milk. Total carbohydrate intake should be consistent and evenly distributed throughout the day i.e. 3 main meals with 1 or 2 snacks in between without incurring any excess calorie intake. (Please refer to APPENDIX 1)

3. Monitoring the total daily carbohydrate intake (by carbohydrate exchange) is the primary strategy in achieving glycaemic control. [35 (Level I)]

4. The use of glycaemic index (GI) and load of foods may provide additional benefit in modulating postprandial response [36 (Level I)] but is not recommended as the primary strategy in meal planning. GI may be used to guide food choices while keeping to the calories and carbohydrate prescription. There are limited databases on the GI and load of local foods. (Please refer to APPENDIX 2)

5. Sucrose (e.g. table sugar) intake must be counted as part of the total carbohydrate intake. [37 (Level III)] Excess sucrose intake contributes to calories and may cause weight gain. [38 (Level I)]

   Artificial sweeteners (aspartame, acesulfane K) are allowed.

6. Individuals with diabetes should be encouraged to test pre- and postprandial glucose in order to evaluate and achieve postprandial glucose goals with a variety of foods.

7. Individuals with diabetes should limit intake of saturated fatty acids, *trans* fatty acids, and cholesterol [39 (Level I)] to reduce risk of CVD. Saturated fats are usually found in animal fats (skin of poultry, fatty meats, full cream dairy products) and coconut milk.

8. In normotensive and hypertensive individuals, a reduced sodium intake (<2,400 mg sodium/day or 6 g of salt a day) with a diet high in fruits, vegetables, and low-fat dairy products lowers blood pressure. [40 (Level I)]

   Sodium restriction can be achieved through avoiding high sodium foods (soya sauce, ketchup & other sauces, pre-mixed cooking paste, monosodium glutamate, salt preserved foods and processed foods), reducing the frequency of eating out and limiting salt in cooking to ¼ to ½ teaspoonful of salt per person per day. [40 (Level I)]

9. Individuals with diabetes have the same vitamin & mineral requirements as the general population. There is no clear evidence of benefit from the use of antioxidant vitamins A,C,E, selenium and herbs in diabetes management. [41 (Level I)]

3.4.2 Physical Activity

Increased physical activity can improve glycaemic control, assist with weight maintenance, and reduce the risk of CVD. [25] (Level I)

Before beginning a program of physical activity more vigorous than brisk walking, people with diabetes should be assessed for complications that may preclude vigorous exercise (CVD, retinopathy, neuropathy and foot injury). The patient's age and previous physical activity level should be considered.

General recommendations:

1. Individuals should exercise 5 days a week, preferably most days of the week and with no more than 2 consecutive days without physical activity.
2. Brisk walking is recommended for all.
3. The duration of exercise should be at least 150 min/week of moderate-intensity aerobic physical activity and/or at least 90min/week of vigorous aerobic. [25] (Level I) Please refer to APPENDIX 3 for examples of exercise.
4. Overweight and obese individuals should gradually increase physical activity to 60 – 90 minutes per day for long term major weight loss.
5. Any increase in daily energy expenditure is beneficial e.g. gardening, walking up stairs, washing the car, mopping the floor.
6. In order to prevent hypoglycaemia, medication doses can be reduced or extra carbohydrate can be consumed before or during physical activity.

3.5 Non-Achievement of Glycaemic Target with Lifestyle Modification Therapy

If glycaemic targets are not achieved (HbA1c <6.5%, FPG <6 mmol/L) with lifestyle modification within 3 months, ORAL ANTI-DIABETIC (OAD) agents should be initiated. [42] (Level I)

3.6 Medication

3.6.1 Oral Agent Monotherapy

Recommendations: Oral Agent Monotherapy

1. If glycaemic targets are not achieved (HbA1c < 6.5%, FPG < 6 mmol/L) with lifestyle modification within 3 months, OAD agents should be initiated. *[Grade A]*

2. In the presence of marked hyperglycaemia in newly diagnosed T2DM (HbA1c 6.5 – 8%, FPG 6 – 10 mmol/L), OAD agents should be considered at the outset together with lifestyle modification. *[Grade C]*

3. Patients should be follow-up within 2-4 weeks to monitor the symptoms, to assess the compliance and side effects of OAD and review the blood investigations including fasting lipid profile. *[Grade C]*

As first line therapy:

- Metformin is the preferred choice.[43] (Level III) Other OAD agents are acceptable alternatives.
- Use of thiazolidinediones (TZDs) as first line has been found to have greater durability in glycaemic control compared to metformin and sulphonylurea (SU).[44] (Level I)
- If monotherapy fails, combination of other agents is recommended. [45-50] (Level I, III)

3.6.2 Combination of Oral Agents

Recommendation: Combination of Oral Agents

1. Combination of oral agents is indicated in:
   - Newly diagnosed patients with HbA1c 8 – 10%, FPG 10 – 13 mmol/L. *[Grade C]*
   - Patients who are not reaching targets (HbA1c <6.5%) after 3 – 6 months on monotherapy. *[Grade C]*

3.6.3 Combination of Oral Agents and Insulin

Combining insulin and the following OAD agents has been shown to be effective in people with T2DM:

- Biguanide (metformin). [51-53] (Level I)
- Insulin secretagogues (SUs). [54] (Level I)
- Insulin sensitizers (TZDs) [55] (Level I) (the combination of a TZD plus insulin is not a recommended indication).
- α-glucosidase inhibitor (AGI). [56-57] (Level I)

Insulin dosage can be increased until target FPG is achieved. If HbA1c targets are not achieved despite of normal FPG, then monitor post-prandial plasma glucose (PPG). In children and adolescents: Long-acting or intermediate acting insulin may be added at a dose of 0.5u/kg at bed-time. [11,58]

Recommendation: Combination of Oral Agents and Insulin

1. Combination of oral agents and insulin is indicated in:
   - Newly diagnosed patients with HbA1c >10%, FPG > 13 mmol/L. *[Grade C]*
   - Patients who are not reaching targets (HbA1c <6.5%) after 3 – 6 months on optimal doses of combination therapy. *[Grade C]*

3.6.4 General Guidelines for Use of Oral Anti-Diabetic (OAD) Agents in Diabetes

- In elderly non-obese patients, short acting insulin secretagogues can be started but long acting SUs are to be avoided. Renal function should be monitored.
- Compliance may be improved with daily dosing OAD agents.
- OAD agents are not recommended for diabetes in pregnancy.
- OAD agents are usually not the first line therapy in diabetes diagnosed during stress, such as infections. Insulin therapy is recommended.
- Targets for control are applicable for all age groups. However, in patients with comorbidities, targets are individualized.
- When indicated, start with a minimal dose of OAD agent, while reemphasizing diet and physical activity. An appropriate duration of time (2 – 16 weeks depending on agents used) between increments should be given to allow achievement of steady state blood glucose control.

3.6.5 Oral Anti-Diabetic (OAD) Agents

There are currently five classes of OAD agents:

a) AGIs
b) Biguanides
c) Dipeptidyl peptidase-4 (DPP-4) Inhibitors
d) Insulin Secretagogues – SUs
– Non-SUs or Meglitinides
e) Thiazolidinediones (TZDs)

a) α-glucosidase inhibitors (AGIs)

- AGIs e.g. acarbose, act at the gut epithelium, to reduce the rate of digestion of polysaccharides in the proximal small intestine by inhibiting α-glucosidase enzymes. They should be taken with main meals.
- AGIs primarily lower postprandial glucose without causing hypoglycaemia.
- They are less effective in lowering glycaemia than metformin or SU, reducing HbA1c by 0.5–0.8%.[56 (Level I)]
- They can have synergistic effects when used with other OAD agents and may be combined with insulin.
- If hypoglycaemia occurs when used in combination with SUs or insulin, advise patients to take monosaccharides, e.g. glucose.
- The commonest side effects are bloating, abdominal discomfort, diarrhea and flatulence.

Dosage

Formulation	Minimum Dose	Maximum Dose
Acarbose 50mg / 100mg tablet	Initial dose 50mg OD Usual dose 50mg – 100mg during main meals	Maximum dose 100mg TDS

b) Biguanides (Metformin)

- Metformin does not stimulate insulin secretion, and lowers blood glucose by decreasing hepatic glucose production.
- Metformin monotherapy is usually not accompanied by hypoglycaemia.
- It can lower plasma glucose by up to 20% as first line drug treatment especially in overweight/obese patients.
- Metformin monotherapy will lower HbA1c by about 1.5%.
- Metformin used in combination with other OAD agents have a synergistic effect to further reduce blood glucose. Metformin can increase insulin sensitivity and reduce insulin requirements.
- Generally well tolerated. Most common adverse effects are nausea, anorexia and diarrhea. These adverse effects are significantly less with the use of metformin extended release formulation.
- Lactic acidosis is quite rare (<one case per 100,000 treated patients). [59 (Level I)]
- The major nonglycaemic effect of metformin is either weight stability or modest weight loss, in contrast to many of the other blood glucose-lowering medications.
- The UKPDS demonstrated a beneficial effect of metformin therapy on CVD outcomes. [60 (Level I)]

Dosage

Formulation	Minimum Dose	Maximum Dose
Metformin 500mg tablet	Initial dose 500mg OD Usual dose 500mg TDS The side effects can be further reduced by taking it with food	Maximum dose 1000mg BD
Metformin retard 850 mg tablet (slow release formulation)	Initial dose 850mg OD Usual dose 850mg BD	Maximum dose 1700mg OM / 850 mg ON
Metformin extended release 500mg tablet	Initial dose 500mg OD	Maximum dose 2000mg OD
Glibenclamide and metformin fixed dose combination 1.25mg / 250mg tablet 2.5mg / 500mg tablet 5mg / 500mg tablet	Initial dose one 1.25mg / 250mg tablet OD or BD	Maximum dose two 5mg / 250mg tablets BD

Caution:

- Should not be used in patients with impaired renal function (serum creatinine >150 µmol/l or creatinine clearance <30 mL/min), liver cirrhosis, congestive cardiac failure (CCF), recent myocardial infarction, chronic respiratory disease, vascular disease and severe infections or any conditions that can cause lactic acid accumulation.
- Vitamin B12 deficiency may occur if metformin is given to patients who have had partial gastrectomy and terminal ileal disease.

c) Incretins

- The incretin effect is markedly decreased in T2DM, [61 (Level II-1)] resulting in delayed and reduced insulin release as well as lack of suppression of glucagon release, after a meal.
- After meals, incretins [glucagon-like peptide 1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP)] [62-63 (Level II-1)] are released; these augment glucose-induced insulin secretion and glucagon release is suppressed, reducing hepatic glucose output - in a glucose dependent manner, i.e. normoglycaemia does not stimulate insulin secretion and glucagon release resumes.
- Agents that increase the effect of incretins have been proven to improve glucose control - 2 classes of drugs have recently been developed: DPP-4 inhibitor (incretin enhancer) and GLP-1 analogue or GLP-1 receptor agonist (incretin mimetic).

DPP-4 inhibitor (Sitagliptin)

- It lowers HbA1c by 0.5 – 0.8%, [64-66 (Level I)] its efficacy improves when used at higher HbA1c baselines. [67 (Level I)]
- It can be combined with cumulative efficacy with other OAD agents e.g. metformin, [68 (Level I)] TZDs, [69 (Level I)] and SU. [70 (Level I)]
- Data comparing it with glipizide suggest equivalent glycaemic efficacy. [71 (Level I)]
- Other benefits include is the minimal risk of hypoglycaemia and weight neutrality. [71 (Level I)]
- It is excreted unchanged by the kidneys and a reduction of dose is recommended with renal impairment (25mg to 50mg). [72 (Level II-1)]
- It is generally well tolerated.

Dosage

Formulation	Minimum dose	Maximum dose
Sitagliptin 100mg / 50mg / 25mg tablet	100mg OD	100mg OD
Sitagliptin and metformin fixed dose combination 50mg / 500mg tablet 50mg / 850mg tablet 50mg / 1000mg tablet	50mg / 500 mg BD	50mg / 1000mg BD

d) Insulin Secretatogues – SUs

- SUs lower plasma glucose by increasing insulin secretion. They can lower plasma glucose by up to 25% and lower HbA1c by about 1.5%.
- The major adverse side effect is hypoglycaemia. The risk is higher in renal impairment, liver cirrhosis and the elderly.
- Second generation SUs (glimepiride, gliclazide MR) cause less risk of hypoglycaemia and less weight gain.
- SUs can be combined with other OAD agents or insulin to improve glucose control, if indicated.
- SUs should be taken 30 minutes before meals, except glimepiride and gliclazide MR which can be taken just before the meal.
- Combining 2 different SUs / insulin secretagogues is not recommended.
- Side effects are rare and include hepatitis, syndrome of inappropriate antidiuretic hormone (SIADH), blood dyscrasias.

Dosage

Formulation	Minimum dose	Maximum dose	Duration
Glibenclamide 5mg tablet	2.5mg OM	10mg BD	Long
Glibenclamide and Metformin Fixed Dose Combination 1.25mg / 250mg tablet 2.5mg / 500mg tablet 5mg / 500mg tablet	Initial dose one 1.25mg / 250mg tablet OD or BD	Maximum dose two 5mg / 500mg tablets BD	Long
Gliclazide 80mg tablet	40mg OM	160mg BD	Medium
Gliclazide MR 30mg tablet	30mg OM	120mg OM	Long
Glipizide 5mg tablet	2.5mg OM	10mg BD	Medium
Glimepiride 2mg / 3mg tablet	1mg OM	6mg OM	Long

Note:

- Glibenclamide is metabolised by the liver but its metabolites are active and excreted by the kidney. The drug should be stopped if renal impairment develops and should not be used in the elderly (>65 years). Other second generation SUs (glimepiride, gliclazide and glipizide) may still be used with caution.
- First line treatment with glibenclamide results in earlier monotherapy failure compared to metformin and rosiglitazone. [44 (Level I)]

Caution:

- SUs increase insulin secretion and therefore, increase the risk of hypoglycaemia. SUs increase appetite and promote weight gain. A weight gain of about 2kg is common with initiation of SUs therapy.
- SUs should be used with caution in patients known to be allergic to sulpha drugs.
- SUs are highly protein bound. Administration of drugs that can displace them (e.g. non-steroidal anti-inflammatory drugs (NSAIDs), antithyroid drugs, sulpha drugs, anticoagulants and -blockers) can increase the risk of hypoglycaemia.
- All patients taking SUs must be taught to recognize symptoms of hypoglycaemia and its management.

Insulin Secretagogues – Non-SUs or Meglitinides

- These are short acting insulin secretagogues which stimulate insulin secretion, although they bind to a different site within the SU receptor.
- It has a shorter circulating half life than SUs, and is rapidly absorbed from the GI tract with peak level 1-hour post administration and eliminated within 4 – 6 hours.
- It must be administered more frequently.
- It should be taken within 10 minutes before main meals.
- It can be combined with metformin, TZDs or AGIs, when indicated.
- It is associated with a similar risk of weight gain as the SUs but hypoglycaemia may be less frequent.
- It may be useful to control PPG.

Dosage

Formulation	Minimum dose	Maximum dose
Repaglinide 0.5mg / 1mg / 2mg tablet	0.5mg with main meals	4mg with main meals (not exceeding 16mg daily)
Nateglinide 120mg tablet	60mg with main meals	120mg with main meals (not exceeding 360mg daily)

Caution:

There is a higher risk of prolonged hypoglycaemia when repaglinide is combined with gemfibrozil. [73 (Level I)] This combination is contraindicated.

e) Thiazolidinediones (TZDs)

- Thiazolidinediones are peroxisome proliferator-activated receptor-gamma (PPAR-γ) agonists and act primarily by increasing insulin sensitivity of muscle, adipose tissue and liver to endogenous and exogenous insulin (insulin sensitizers).
- When used as monotherapy, TZDs have demonstrated a 0.5–1.4% decrease in HbA1c.
- Improvement in glycaemic control may only be seen after six weeks and maximal effect up to six months.
- They can be combined with other OAD agents (SUs, metformin or DPP-4 inhibitors) to improve glucose control, when indicated.
- Side effects include an increase in adiposity, largely subcutaneous (S/C), with redistribution of body fat, weight gain, fluid retention, and haemodilution. The fluid retention usually manifests as peripheral oedema, although new or worsened heart failure can occur.
- Recent long term studies have found that both TZDs have been associated with an increased risk of fractures, particularly in women. The majority of these fractures were in the distal upper or lower limb, as opposed to the classic sites of osteoporotic fractures. [44 (Level I), 74 (Level II-2)]
- TZDs are contraindicated in patients with CCF [75] and liver failure.
- Use of TZDs with insulin is not recommended.

Dosage

Formulation	Minimum dose	Maximum dose
Rosiglitazone 4mg / 8mg tablet	4 mg OD	4mg BD
Rosiglitazone and Metformin fixed dose combination 2mg / 500mg tablet 2mg / 1000mg tablet 4mg / 500mg tablet 4mg / 1000mg tablet	2mg / 500mg BD	4mg / 1000mg BD
Pioglitazone 15mg / 30mg tablet	15 mg OD	45 mg OD

3.6.6 GLP-1 Analogue (Exenatide)

- It is given parenterally, just before breakfast and dinner.
- It reduces HbA1c by 0.5 – 1.0%, sustained efficacy over 2 years. [76-77 (Level I)]
- It can be added to metformin [78 (Level I)] and/or SU [79-80 (Level I)] if glycaemic targets are not achieved.
- Progressive weight loss is seen in a proportion of patients [78-80 (Level I)] – because of its effect on satiety and delay in gastric emptying. [81-82 (Level II-1), 83 (Level I)]
- The main adverse effects are gastrointestinal symptom, notably nausea – this can be minimized by starting at a low dose with an increase of dose after 1 month. [84 (Level I)]
- Starting dose is 5µg BD and should be increased to10µg BD after 4 weeks. [76-77 (Level I)]
- Incretin mimetic is not a substitute for insulin.

Dosage

Formulation	Minimum Dose	Maximum Dose
Exenatide 5µg/20µL / 10µg/40µL pre-filled pen for injection	5µg BD	10µg BD

3.6.7 Combination of Oral Agents and Insulin Therapy

Combining insulin and the following OAD agents has been shown to be effective in T2DM:

- Biguanide (metformin) [51-53 (Level I)]
- Insulin secretagogues (SUs) [54 (Level I)]
- Insulin sensitizers (TZDs) [55 (Level I)] (the combination of a TZD plus insulin is not a recommended indication).
- AGI [56-57 (Level I)]

If targets have not been reached after optimal OAD therapy, consider adding

- Pre-bed intermediate-acting or
- Pre-bed long-acting insulin or
- Pre-dinner premixed insulin

Dose of the above insulin can be increased every third or fourth day (2-4 units each time) until target FPG is achieved - ***'fix the fasting first'***. Long-acting insulin can be injected at any time as long as it is the same time daily. If HbA1c target is not achieved in 3-6 months, intensify insulin regime by adding prandial insulin with the biggest meal initially or adding premixed insulin at breakfast. Insulin secretagogues should be stopped and metformin continued.

a) Reaching Glycaemic Targets

To control	Adjust
Pre breakfast glucose	Pre bed intermediate acting insulin or long acting analogue or pre-dinner premixed
2 hour post breakfast	Breakfast intake or pre breakfast rapid acting or morning premixed insulin analogue
Pre lunch glucose	Morning tea or pre breakfast short acting insulin or morning premixed insulin
2 hour post lunch	Lunch intake or pre lunch rapid acting or morning premixed insulin
Pre dinner morning	Afternoon tea intake or pre lunch short acting insulin or premixed insulin
Post dinner/pre bed	Dinner intake or pre dinner rapid acting or pre dinner premixed analogue or pre dinner premixed insulin*

* may cause hypoglycaemia in the middle of sleep.

b) Types of Insulin Regimes

- OAD agents + basal insulin or premixed insulin once a day
- Metformin + premixed insulin more than once a day
- Metformin + basal insulin + prandial insulin

c) Short-term use of Insulin

Short-term insulin therapy should be considered in the following conditions:

- Acute illness, surgery, stress and emergencies (Please refer to page 28)
- Pregnancy (Please refer to page 29)
- Breast-feeding
- Insulin may be used as initial therapy in T2DM particularly in marked hyperglycaemia [5]
- Severe metabolic decompensation (diabetic ketoacidosis, hyperosmolar hyperglycaemic state)

d) General Guidelines for Long-term Use of Insulin

Please refer to page 30.

Recommendation: Combination of Oral Agents and Insulin Therapy

1. Combination of insulin and OAD agents has been shown to improve glycaemic control in those not achieving target despite optimal OAD agents. *[Grade A]*

3.7 MONITORING

3.7.1 Self Blood Glucose Monitoring

Self blood glucose monitoring (SBGM) is the method of choice in monitoring glycaemic control. SBGM should be carried out for patients on insulin and is desirable for those on OAD agents. [2]

Frequency of blood glucose testing depends on the glucose status, glucose goals and mode of treatment.

Although self blood glucose monitoring has not been shown to have a significant impact on outcome measures such as HbA1c and body weight, it is recommended as part of a wider educational strategy to promote self-care.

Monitoring provides information on the effects of therapy, diet and physical activity. The Position Statement from ADA, 2009 [2] recommends:

- SBGM should be carried out 3 or 4 times daily for patients using multiple insulin injections or insulin pump therapy
- For patients using less frequent insulin injections, non-insulin therapies or MNT alone, SBGM may be useful in achieving glycaemic goals

To achieve postprandial glucose targets, postprandial SBGM may be appropriate.

Table 4: Recommendations for Self Blood Glucose Monitoring

Mode of	Breakfast		Lunch		Dinner	
Treatment	Pre	Post	Pre	Post	Pre	Post/Pre-bed
Diet Only	✔	✔		✔		✔
Oral anti-diabetic agent	✔	✔		✔		✔
Insulin	✔	✔	✔	✔	✔	✔

Note:
✔ Recommended timing of SBGM
✔ Optional timing of SBGM

3.7.2 Insulin Treated

Those on replacement insulin therapy need to check glucose levels before each meal and before bed (10-11 pm) (Please refer to Targets for Control, page 10) [Pre-meal (breakfast, lunch, dinner) and pre-bed glucose levels]. Once pre-meal glucose levels are achieved, PPG testing is recommended for fine-tuning of insulin dose. This information will allow adjustments of insulin dosage after taking into account the effect of diet and physical activity.

Glucose Monitoring in Relation to Insulin Therapy

Oral Agents + Bedtime Insulin

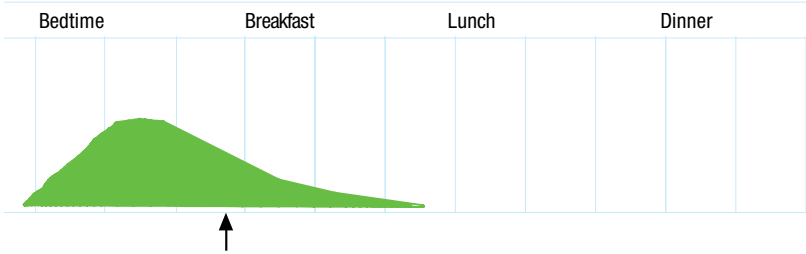


Figure 1a: Oral Agent(s) + Bedtime Insulin – Intermediate Acting Insulin

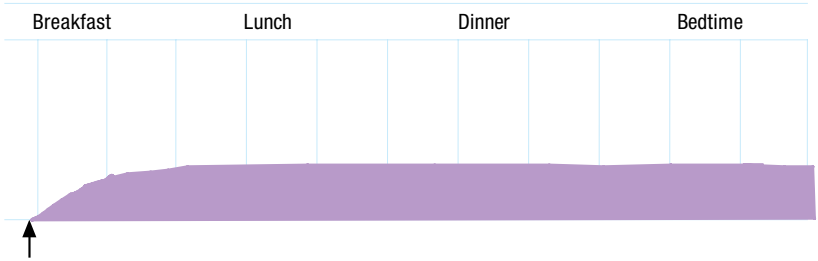


Figure 1b: Oral Agent(s) + Once Daily Basal Long Acting Insulin

- Values before breakfast give information about bedtime insulin (Refer to Figure 1a) or once daily basal long acting insulin (Refer to Figure 1b)

Note:

↑ Recommended timing of SBGM

Basal Bolus Insulin Regimen

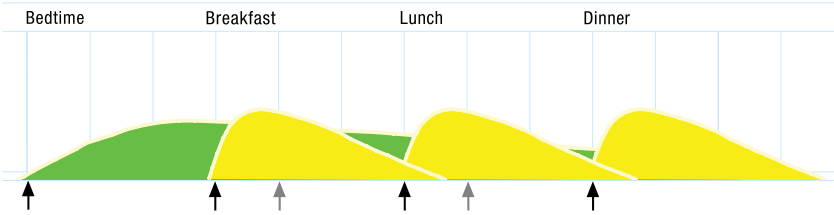


Figure 2: Basal Bolus Insulin Regimen

- Values before breakfast give information about pre-dinner or pre-bed intermediate acting insulin
- Insulin glargine or detemir may be used in place of neutral protamine hagedorn (NPH). Pre-breakfast values are used for dose titration
- Values before other main meals (pre-lunch or pre-dinner) reflect short acting insulin taken at the previous meal
- Once pre-meal glucose levels are achieved, PPG testing is recommended for fine-tuning of insulin dose
- Values at pre-bed give information about short acting insulin given before dinner
- Rapid acting insulin analogues can be given in place of the short acting insulin. It should be given at the start or immediately after the meal. 2-hour PPG values are used for dose titration

Note:
↑ Recommended timing of SBGM
↑ Optional timing of SBGM

Twice Daily Premixed or Combination Intermediate Acting with Short Acting Insulin

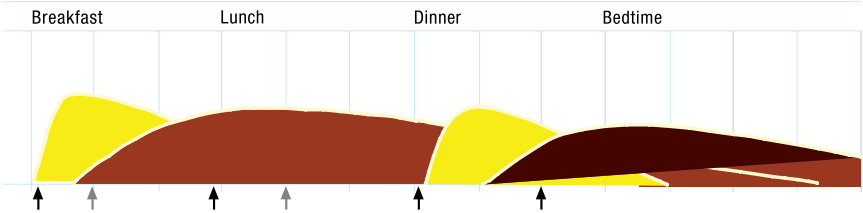


Figure 3: Intermediate Acting with Short Acting Insulin

- Values before breakfast give information about pre-dinner or pre-bed intermediate or long acting insulin
- Values at pre-lunch give information about short acting insulin given before breakfast
- Values at pre-dinner give information about the intermediate acting insulin given before breakfast
- Values at pre-bed give information about short acting insulin given before dinner
- Once pre-meal glucose levels are achieved, PPG testing is recommended for fine-tuning of insulin dose

Ideally these tests should be done on a daily basis or if possible at least one 24–hour cycle per week.

Note:
↑ Recommended timing of SBGM
↑ Optional timing of SBGM

* SBGM
Patients should be taught to use SBGM to adjust food, physical activity and insulin dosage.

3.7.3 Diet or Oral Anti-Diabetic (OAD) Agents

Those on OAD agents or diet need to check fasting and 2-hour PPG levels.

3.7.4 HbA1c

HbA1c should be measured approximately every 3 to 6 months to ensure that glycaemic targets are being met.

This reflects overall glucose control over a 3 month period with recommended target level of 6.5% (IDF 2005). [5]

Glycaemic targets must be individualized. Therapy in most patients with T2DM should be targeted to achieve a HbA1c <6.5%. Reduction in HbA1c has been shown to decrease the risk of microvascular [85 (Level I)] and macrovascular complications.

Recommendations: HbA1c Target

1. Glycaemic targets must be individualized. Therapy in most patients with T2DM should be targeted to achieve a HbA1c <6.5%. Reduction in HbA1c has been shown to decrease the risk of microvascular *[Grade A]* and macrovascular complications. *[Grade C]*

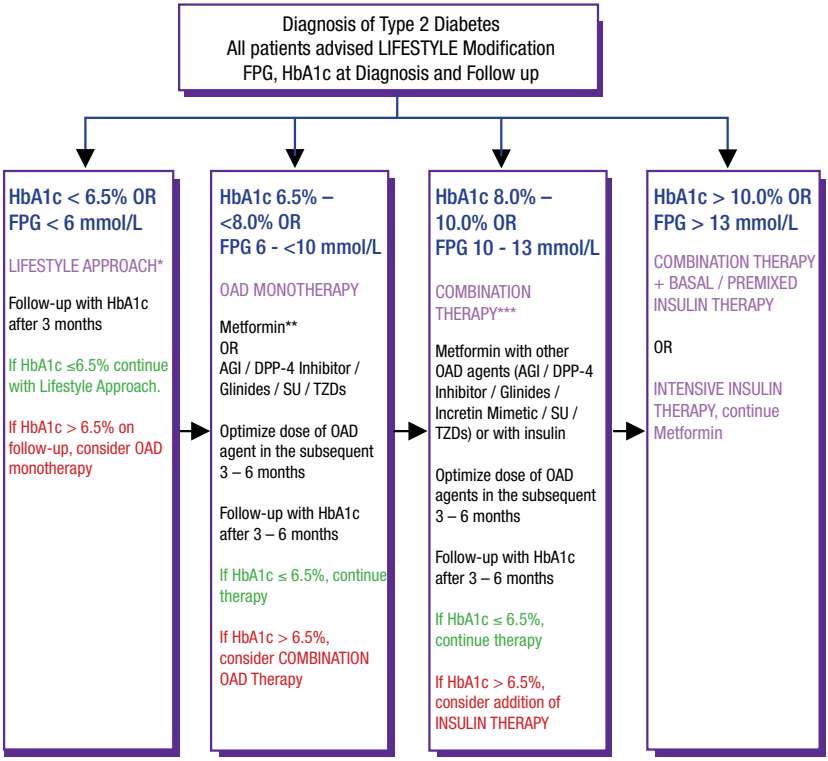
2. To achieve a HbA1c <6.5%, aim for FPG or pre-prandial plasma glucose targets of 4.4 to 6.1 mmol/L and 2-hour PPG targets of 4.4 to 8.0 mmol/L. *[Grade B]*

3.7.5 Monitoring of Other Risk Factors

- Blood pressure and body weight should be monitored at each visit.
- Fasting lipids and urine for albuminuria/microalbuminuria need to be checked annually.
- If cardiovascular or renal complications are present or patients are on lipid-lowering and/or anti-hypertensive therapy, lipids and renal function may need to be checked more often.

3.8 Treatment Algorithm for the Management of Type 2 Diabetes Mellitus

Algorithm 4:



Footnote:
If symptomatic (weight loss, polyuria, etc) at any HbA1c and FPG level, consider insulin therapy
Try to achieve as near normal glycaemia without causing hypoglycaemia

* Consider metformin/AGI/other insulin sensitizer in appropriate patients

** Metformin is preferred 1st line agent, and SU should preferably not be used as 1st line

*** Although 3 oral agents can be used, initiation and intensification of insulin therapy is preferred based on effectiveness and expense

3.9 Management of Type 2 Diabetes Mellitus in Acute Illness, Surgery, Stress and Emergencies

- OAD agents may not be adequate in maintaining euglycaemia during stress and emergency situations (e.g. infection, myocardial infarction and surgery)
- In any form of stress, if glycaemic control is inadequate, OAD therapy should be replaced by insulin
- Diabetic ketoacidosis (DKA) may develop during stress
- OAD regimen may be resumed when stress has resolved
- If the patient develops DKA during stress and the patient is young, consider long term insulin therapy

Table 5: Management of Diabetes During Stress and Emergency Surgery

Status of Control	Minor Surgery	Major surgery
Acceptable control FPG <8.0 mmol/L RPG <11.0 mmol/L	• Stop OAD agent • Resume OAD agent post-op, once taking orally	• Stop OAD agent • Glucose-Insulin-Potassium (GIK) regimen during op • s/c insulin post-op, once taking orally
Poor Control FPG ≥8.0 mmol/L RPG ≥11.0 mmol/L	• Stop OAD agent • GIK regimen (pre- and intra-op) • s/c insulin post-op, once taking orally	

- In elective surgery, delay operation until glycaemic control is achieved. Control with insulin or OAD agents as indicated
- GIK regimen can be continued until food intake after surgery
- Maintain insulin therapy post-surgery until stress is resolved and satisfactory wound healing is achieved

3.10 Management of Type 2 Diabetes Mellitus in Pregnancy

Women with T2DM who are planning pregnancy should be referred to physician/ diabetologist for further management.

Pre-pregnancy:
- Counseling is important
- Pregnancy should be planned
- Achieve good glycaemic control before conception, aim for HbA1c <6.5%
- Insulin therapy may be necessary before conception

During Pregnancy:
- Achieve and maintain ideal glucose levels (Refer to Table 6)
- Close SBGM is required (individualize frequency of monitoring)
  - On diet therapy: pre-breakfast,1 hour PPG levels (weekly – fortnightly) [3]
  - On insulin therapy: premeal (breakfast, lunch, dinner) and pre-bed glucose levels (weekly – fortnightly). Once premeal glucose levels are achieved, PPG testing is recommended for fine-tuning of insulin dose.
- HbA1c (4-6 weekly)
- Insulin therapy is indicated when diet fails. Insulin lispro and aspart may be used. Although published data suggests that metformin and glibenclamide are safe, OAD agents are not generally recommended as they are not registered for use during pregnancy. [3]
- GIK regimen can be used during delivery/lower segment caesarean section (LSCS)

Post-partum:
- Insulin requirement drops immediately after delivery by 60 -75%
- In breast-feeding, if glycaemic control is inadequate with diet therapy alone, insulin therapy should be continued at a lower dose.
- In non-breast-feeding mothers, OAD agents can be continued.

Table 6: Targets for Pregnant Women

Timing	Glucose Level* (mmol/L)
Pre-breakfast	3.5 – 5.9
Pre-prandial	3.5 – 5.9
1 hour post prandial	< 7.8
2 hour post prandial	4.4 – 6.7
0200 – 0400 hours	> 3.9

* Plasma calibrated values (Capillary whole blood reading is 12% lower than venous plasma glucose)

Adapted from the National Institute for Health and Clinical Excellence (NICE), Diabetes in Pregnancy, March 2008 (revised reprint July 2008). [3]

3.11 General Guidelines for Long-Term Use of Insulin

- Persistent hyperglycaemia in spite of optimal OAD agents with stable or loss of weight suggests beta cell failure. However, it is important to exclude chronic infections, malignancies or medications as cause of weight loss.
- The basal intermediate acting insulin should be administered pre-bed because of the risk of hypoglycaemia in the early hours of the morning if given earlier.
- It is not necessary to have an extra meal or snack after intermediate or long acting insulin.
- Requirements of high dose of insulin (>1.5 unit/kg per day) should prompt a search for an underlying cause/secondary problems such as non-compliance, incorrect dosing and administration timing, hypertrophy of injection area, inter meal hypoglycaemia with rebound hyperglycaemia pre meal, expired insulin or expired strips and occult infections.
- There is no limitation of insulin dose.
- The rate of absorption from the injections depend on the site and 'exercise activity' of the 'site'. Patients should be encouraged to rotate all their injection sites in the abdomen region.
- Assessment of pancreatic reserve (e.g. glucagon stimulation test, insulin/C-peptide estimations) prior to insulin use is unnecessary.

Table 7: Human Recombinant Insulins and Analogues

Insulin Preparation	Onset of Action	Peak Action	Duration of Action	Timing of Insulin
Fast Acting				
Rapid Analogue Aspart (Novorapid) Lispro (Humalog)	5 – 15 minutes	1 – 2 hours	4 – 6 hours	5 to 15 minutes before or immediately after meals
Human Regular Actrapid Humulin R	30 – 60 minutes	2 – 4 hours	6 – 10 hours	30 to 60 minutes before or immediately after meals
Intermediate Acting				
Human NPH Insulin Insulatard Humulin N	1 – 2 hours	4 – 8 hours	10 – 16 hours	Pre-breakfast/ Pre-bed
Long Acting				
Basal Long Acting Analogue Glargine Detemir	1 – 2 hours	Flat	~ 24 hours	Same time everyday at anytime of the day
Premixed Insulins				
Mixtard 30/70 Humulin 30/70	Biphasic onset and peak		10 – 16 hours	30 – 60 minutes before meals
BIAsp 30/70 Humalog mix 25/75				5 – 15 minutes before meals

Note:
The time course of action may vary in different individuals, or at different times in the same individual. Because of these variations, time periods indicated above should be considered as general guidelines only. The higher the dose of the insulin, the longer is the duration of action.

The long acting insulin analogue (glargine [86 (Level I)] and detemir [87 (Level I)]) which are peakless have less hypoglycaemic episodes and less weight gain compared to conventional insulin. The new rapid acting insulin analogues (lispro and insulin aspart [88-91 (Level I)]) have the added advantage (besides the above) of the ability to inject immediately pre meal. In some patients at higher doses the long acting insulin may have a peak.

Both the long acting insulin analogues (glargine and detemir) have not been licensed for use in pregnancy.

3.12 Hypertension and Diabetes Mellitus

The prevalence of hypertension in T2DM is reported to be around 40-80%.[92, 93 (Level I) 94, 95 (Level II)]

Hypertension should be detected and treated early in the course of DM to prevent CVD and to delay the progression of renal disease and diabetic retinopathy.

Pharmacological treatment should be initiated in patients with diabetes when the BP is persistently >130 mmHg systolic and/or >80 mmHg diastolic. [96 (Level I)]

People with diabetes should also be screened for proteinuria or microalbuminuria. The presence of microalbuminuria strongly predicts overt nephropathy and CVD. The presence of microalbuminuria or overt proteinuria should be treated even if the BP is not elevated. An angiotensin converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) is preferred. [2, 97-104 (Level I)] In a proportion of patients, microalbuminuria may be normalised by higher doses of ACEIs [102] and ARBs. [102, 103 (Level I)] Normalisation of microalbuminuria is associated with a reduction in the rate of decline in glomerular filtration rate. [105]

Tight BP control should take precedence over the class of antihypertensive drug used. [106-107 (Level I)] This often will require combination therapy. There are suggestions that a lower target BP may be necessary to maximally protect against the development and progression of cardiovascular and diabetic renal disease. In general, the SBP should be targeted to <130 mmHg and diastolic pressure <80 mmHg. [108 (Level I)] The BP should be lowered even further to ≤125/75 mmHg in the presence of proteinuria of >1g/24 hours. [96-98, 99-110 (Level I)]

The treatment of hypertension in diabetes should follow the guidelines for the treatment of hypertension in general (Malaysian Clinical Practice Guidelines for the Management of Hypertension 2008 [111 (Level III)]).

Non-pharmacological management cannot be over emphasised. Dietary counselling should target at optimal body weight and take into consideration glycaemic control and the management of concomitant dyslipidaemia. Moderate dietary sodium restriction is advisable. It enhances the effects of BP lowering drugs especially ACEIs and ARBs. Further sodium restriction, with or without a diuretic, may be necessary in the presence of nephropathy or when the BP is difficult to control. [18 (Level I)]

Certain classes of antihypertensive drugs may be disadvantageous in diabetes. Please refer to Table 8.

ACEIs are drugs of choice based on extensive data. [112-113 (Level I)] If an ACEI is not tolerated, an ARB should be considered. [114 (Level I)] ARBs have been reported to be superior to conventional non-ACEI antihypertensive drugs in terms of slowing the progression of nephropathy at the microalbuminuric and overt nephropathy stage. [103-105, 114 (Level I)]

Diuretics, calcium channel blockers (CCBs), beta-blockers and peripheral alpha blockers may be used as add-on therapy.

Recommendations: Hypertension and Diabetes Mellitus

1. ACEIs are the agents of choice for patients with diabetes *without* microalbuminuria or proteinuria *[Grade A]*
2. ARBs or ACEIs are the agents of choice for patients with diabetes *and* microalbuminuria or proteinuria *[Grade A]*

Table 8: Choice of antihypertensive drugs in diabetes patients with concomitant conditions (Adapted from Malaysian Clinical Practice Guidelines for the Management of Hypertension 2008 [111 (Level III)])

Concomitant Disease	Diuretics	β-blockers	ACEIs	CCBs	Peripheral α-blockers	ARBs
DM (without nephropathy)	+	+/-	+++	+	+/-	++
DM (with nephropathy)	++	+/-	+++	++*	+/-	+++
Gout	+/-	+	+	+	+	+
Dyslipidaemia	+/-	+/-	+	+	+	+
Coronary heart disease	+	+++	+++	++	+	+
Heart failure	+++	+++#	+++	+@	+	+++
Asthma	+	-	+	+	+	+
Peripheral vascular disease	+	+/-	+	+	+	+
Non-diabetic renal impairment	++	+	+++	+*	+	++
Renal artery stenosis	+	+	++$	+	+	++$
Elderly with no co-morbid conditions	+++	+	+	+++	+/-	+

The grading of recommendation from (+) to (+++) is based on increasing levels of evidence and/or current widely accepted practice

+/- Use with care
- Contraindicated
* Only non-dihydropyridine CCB
# Metoprolol, bisoprolol, carvedilol – dose needs to be gradually titrated
@ Current evidence available for amlodipine and felodipine only
$ Contraindicated in bilateral renal artery stenosis

3.13 Diabetic Dyslipidaemia

DM is a coronary heart disease (CHD) risk equivalent. Control of hyperglycaemia in T2DM has not been associated with significant decrease in CVD events [17, 115, 116 (Level I)] except in overweight people with diabetes who were given metformin. [60 (Level I)] Thus, efforts must also be directed to control other risk factors such as dyslipidaemia, hypertension and other new emerging risk factors.

Screening

In adult patients, test for lipid disorders at least annually and more often if needed to achieve goals. In adults with low-risk lipid values (LDL cholesterol <2.6mmol/L, HDL cholesterol >1.0mmol/L in males and >1.3 mmol/L in females and TG <1.7mmol/L), lipid assessments may be repeated every year.

In people with diabetes:

a) Primary target: LDL cholesterol
   i) In individuals without overt CVD
      - All patients over the age of 40 years should be treated with a statin regardless of baseline LDL cholesterol levels. [117-118 (Level I)]

   ii) In individuals with overt CVD
      - All patients should be treated with a statin. [119 (Level I)]
      - The target of LDL cholesterol level is 1.8mmol/L. [118-120(Level I)]

b) Secondary target: Non-HDL cholesterol, HDL cholesterol and TG
   i) Non-HDL cholesterol <3.4mmol/L (when TG >2.3mmol/L)
   ii) HDL cholesterol >1.0 mmol/L for males
   >1.2 mmol/L for females
   iii) TG <1.7 mmol/L

In children and adolescents with T2DM, screening for lipid disorders should be done at diagnosis after glycaemic control is achieved. If normal lipid values are obtained, screening should be repeated every TWO years. [121-124]

Lifestyle modification focusing on the reduction of saturated fat, *trans* fat, and cholesterol intake; weight loss (if indicated) and increased physical activity have been shown to improve the lipid profile in patients with diabetes.

Table 9: Drug Therapy for Diabetic Dyslipidaemia

Lipid Goal	Initial Drug	Suggested Addition in Order of Preference
1) Lower LDL cholesterol	Statins	
2) Increase HDL cholesterol	Fibrate or Nicotinic Acid*	
3) Lower TG	Fibrates	Statins**
4) Treat Combined Hyperlipidaemia	Statins**	Fibrates Resin plus Fibrates Nicotinic Acid

* with careful monitoring and keeping dose <1.5 g/day
** high dose may be required

In patients with very high TG, reduction of carbohydrate intake is emphasised.

Lowering TG in patients with clinical CVD and normal LDL cholesterol level with a fibrate is associated with a reduction in cardiovascular events. [125 (Level I)]

Combination therapy using statins and other lipid-lowering agents may be necessary to achieve lipid targets but has not been evaluated in outcome studies for either CVD event reduction or safety. [126 (Level I)]

Statin therapy is contraindicated in pregnancy.

Treatment strategies in children and adolescents are no different with regards to dietary and glycaemic control. Lipid lowering medications should only be initiated in those >10 years old. [121]

Recommendations: Diabetic Dyslipidaemia

1. All patients *without* overt CVD over the age of 40 years should be treated with a statin regardless of baseline LDL cholesterol levels. *[Grade A]*
2. All patients *with* overt CVD should be treated with a statin. *[Grade A]*

SECTION 4 Metabolic Syndrome

The metabolic syndrome is a clustering of features which puts an individual at high risk of cardiovascular disease and T2DM. [127-130 (Level I)]

4.1 Definition

There have been various attempts to define the metabolic syndrome. The World Health Organisation (WHO) 1999 and the National Cholesterol Education Program (NCEP) (Adult Treatment Panel III) 2001 for instance, provide two different definitions. [122, 131 (Level III)] This has led to confusion and the lack of applicability in different ethnic populations. [132 (Level III)]

The IDF consensus worldwide definition of the metabolic syndrome [127 (Level III)]

Based on the IDF definition, a person has the metabolic syndrome when they have:

Central obesity [defined as WC 90cm for men and 80cm for women (ethnicity specific values)]. A practical approach in the clinic would be to use the WC as a means of identifying those at risks of CVD and diabetes.

Plus any two of the following four factors:

- Raised TG level: >1.7 mmol/L, or specific treatment for this lipid abnormality
- Reduced HDL cholesterol: <1.0 mmol/L) in males and <1.3 mmol/L in females, or specific treatment for this lipid abnormality
- Raised blood pressure: systolic BP ≥130 mmHg or diastolic BP ≥85 mmHg, or on treatment of previously diagnosed hypertension
- Raised FPG ≥5.6 mmol/L, or previously diagnosed T2DM. If FPG >5.6 mmol/L, OGTT is strongly recommended but is not necessary to define presence of the syndrome.

4.2 Management

The main aim of therapy is to reduce the risk of CVD and the development of T2DM. [127 (Level III)] In those who have established T2DM, refer to appropriate section.

Management should encompass the following:

Lifestyle changes (Please refer to Lifestyle Modification section, pages 12-14)

In individuals who do not achieve targets (Please refer to Targets for Control, page 10) through lifestyle changes, individual component of the syndrome should be treated pharmacologically.

Obesity in Type 2 Diabetes Mellitus

In obese patients with diabetes, a weight loss of 5 – 10% of initial body weight improves insulin sensitivity, reduces blood pressure and improves dyslipidaemia. [133 (Level III), 134-137 (Level I)] The optimal rate of weight loss is 1 – 2 kg/month. [138 (Level I)]

In children and adolescents who are still growing in stature, maintenance of weight results in reduction in BMI, insulin sensitivity and metabolic profile. However weight loss would be desirable if there are associated severe co-morbidities or obstructive sleep apnoea syndrome (OSAS).

Management should include the following:

a) Lifestyle intervention [139-141 (Level I)] (Please refer to Lifestyle Modification section, pages 12-14)
b) Use of pharmacological agents if lifestyle measures fail to achieve the desired weight loss after an adequate trial of 3 to 6 months [127-128 (Level III)]
   - Appropriate choice of anti-diabetic agent
     - Incretin mimetics/analogues usually cause weight loss [76-80 (Level I)]
     - Metformin, acarbose and DPP-4 inhibitors are weight neutral [71, 140-143 (Level I)]
     - SUs, TZD and insulin can result in significant weight gain [42, 75 (Level I)]
   - Pharmacological treatment of obesity
     - Can only be justified when combined with diet, lifestyle changes and behaviour modifications
     - Adjustments to OAD agents may be required as the individual with diabetes loses weight to reduce the risk of hypoglycaemia
   - Anti-obesity agents proven for use in people with diabetes include orlistat [144 (Level I)] and sibutramine [145 (Level I)]
c) Bariatric surgery may be an option in patients with BMI >35 kg/m^2

Anti-obesity agents and bariatric surgery are not recommended in children.

Recommendations: Metabolic syndrome

1. The metabolic syndrome is a clustering of features, which puts an individual at high risk of cardiovascular disease and T2DM. *[Grade A]*
2. 5 -10% body weight reduction reduces insulin resistance. *[Grade C]*
3. Individual components of the syndrome should be treated to target values. *[Grade C]*
4. T2DM should be managed to current recommended standards. *[Grade A]*

SECTION 5 MANAGEMENT OF CHRONIC COMPLICATIONS

5.1 Introduction

- People with diabetes should be screened for complications at diagnosis and thereafter at yearly intervals. [2]
- The UKPDS data confirmed that in T2DM, improvement of glycaemic control by lowering the HbA1c lowers the risk of developing both macrovascular and microvascular complications. [42, 60 (Level I)]

5.2 Detection and Treatment of Diabetes Complications

Microvascular complications

5.2.1 Retinopathy

Introduction

The initial assessment should be conducted at the time of diagnosis of T2DM and annually thereafter.

Pregnant women with T2DM (not gestational diabetes) should have retinal examination during each trimester. [146 (Level II-3)]

Eye Examination

Visual acuity is assessed with a Snellen chart and any refractive error corrected with a pinhole in addition to asking the patient to wear his bifocals or glasses for presbyopia.

Fundus examination **must** be conducted through a **dilated pupil** (tropicamide 0.5% or 1.0%) by using a direct ophthalmoscope to improve sensitivity. Photography with a non-mydriatic fundus camera may be used to screen a large number of people with diabetes.

Treatment

Achieve and maintain tight glycaemic and blood pressure control. [42, 97, 147-150 (Level I)]

Patients with pre-proliferative or proliferative retinopathy may experience a temporary worsening of retinopathy when the blood glucose level is rapidly lowered. [151 (Level I)]

Referral to an ophthalmologist is necessary for the following situations: [152-153 (Level III)]

1. Unexplained poor vision
2. Diabetic retinopathy greater than occasional microaneurysms
3. Macular oedema or hard exudates within the macula

Refer *urgently* to an ophthalmologist if the following findings are noted

1. Sudden visual deterioration
2. New vessels on fundoscopy
3. Rubeosis iridis
4. Vitreous haemorrhage
5. Retinal detachment

Recommendations: Retinopathy

1. The initial assessment should be conducted at the time of diagnosis of T2DM and annually thereafter. *[Grade C]*
2. Refer to ophthalmologist as indicated above. *[Grade C]*

5.2.2 Nephropathy

Introduction

Diabetic Nephropathy (DN) is a major cause of chronic kidney disease (CKD) contributing to 57% of new patients requiring dialysis in 2007 in Malaysia. [154 (Level III)] DN is also a major risk factor for cardiovascular morbidity and mortality. The diagnosis of DN is made clinically by the presence of proteinuria (either microalbuminuria or overt proteinuria). Progression to end stage renal disease (ESRD) requiring renal replacement therapy occurs in the majority of patients, particularly those with poor diabetic and blood pressure control.

Screening

Screening allows early diagnosis and intervention.

Microalbuminuria refers to the presence of a small amount of albumin in the urine which cannot be detected with the usual urine dipstick. It is defined as a urinary albumin:creatinine ratio (ACR) >2.5 mg/mmol in men and >3.5 mg/mmol in women or a urinary albumin concentration >20mg/l. Microalbuminuria is the earliest sign of diabetic nephropathy and predicts increased cardiovascular mortality and morbidity and end-stage renal failure. [16, 155 (Level III)]

Recommendations for Screening

1. Screening for proteinuria should be performed at diagnosis and annually. *[Grade C]*
2. Urine should be screened for proteinuria with conventional dipstick on an early morning urine specimen. *[Grade C]*
3. If urine dipstick for proteinuria is negative, screening for microalbuminuria should be performed on an early morning urine specimen. *[Grade C]*
4. If microalbuminuria is detected, confirmation should be made with 2 further tests within 3 to 6 months. *[Grade C]*
5. If microalbuminuria is not detected, re-screening should be performed annually. *[Grade C]*

Management

If proteinuria is detected a 24 hour urine collection for protein (or a urine protein-creatinine ratio) or overnight timed urine collection should be performed to rule out postural proteinuria.

Blood pressure and glycaemic control are crucial in preventing or retarding progression of diabetic nephropathy. [14, 85 (Level I)]

In people with diabetes the target BP is ≤130 mmHg/80 mmHg [109 (Level III)] but in patients with proteinuria of >1 gram a day, the target is ≤125 mmHg/75 mmHg.[2, 96 (Level III), 97,110-111 (Level I)] Several anti-hypertensive agents will be needed to achieve these targets.

Renin-angiotensin blockers reduce microalbuminuria or proteinuria and slow the progression of diabetic nephropathy. These effects have been shown to be independent of their effects on BP control. Thus ACEIs or ARBs should be initiated unless contraindicated. [103-104 (Level I), 105 (Level III), 111, 156-157 (Level II-1)]

Other measures include lipid control, stopping smoking, weight reduction and moderate protein and salt restriction.

Referral to Nephrologist

Referral should be made if the serum creatinine exceeds 200 µmol/L [16 (Level III)] and earlier in patients with haematuria, nephritic syndrome, absence of retinopathy (where the diagnosis of diabetic nephropathy may be in doubt), difficult to control blood pressure and worsening renal function.

Recommendations: Nephropathy

1. Screening for proteinuria should be performed at diagnosis and annually. *[Grade C]*
2. Referral to nephrologist should be made if the serum creatinine exceeds 200 µmol/L and earlier in patients with haematuria, nephritic syndrome, absence of retinopathy (where the diagnosis of diabetic nephropathy may be in doubt), difficult to control blood pressure and worsening renal function. *[Grade C]*
3. Target BP in diabetics should be ≤130/80 and ≤125/75 in patients with proteinuria >1g/day. *[Grade A]*
4. ACEIs or ARBs should be initiated in patients with microalbuminuria or proteinuria. *[Grade A]*

5.2.3 Neuropathy

Introduction

Diabetic peripheral neuropathy may be defined as "the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes". [158 (Level III)]

Diabetic peripheral neuropathy may be asymptomatic in a large proportion of cases (up to 50%) [159 (Level III)] and requires clinical examination to document/unveil its existence. It causes or contributes to significant morbidity and mortality. [158-159 (Level III)]

There are 5 neuropathies in diabetes: distal symmetrical polyneuropathy, proximal asymmetrical neuropathy (diabetic amyotrophy), autonomic neuropathy, radiculopathy and mononeuritis multiplex.

Screening

Diabetic peripheral neuropathy may be diagnosed reasonably accurately (>87% sensitivity) by bedside clinical methods namely: [160 (Level II)]

a. 10-g Semmes-Weinstein monofilament pressure sensation
b. 128 Hz tuning fork vibration perception (on-off or absolute)
c. ankle jerks (deep tendon reflexes)
d. pin prick

These bedside tests should be performed at least annually.

Prevention

Diabetic peripheral neuropathy can be prevented by maintaining good glycaemic control.[161-162 (Level I)]

Treatment

1. Relief of symptoms includes the use of anticonvulsant agents [163 (Level II)] e.g. gabapentin [164 (Level I)], lamotrigine [165 (Level I)], carbamazepine or tricyclic antidepressants e.g. amitriptyline [166 (Level II)].

2. Achieve tight glycaemic control.

Recommendations: Neuropathy

1. Assessment for peripheral neuropathy should be performed at diagnosis and annually. *[Grade C]*
2. The sensory symptoms of painful diabetic peripheral neuropathy may be treated with anticonvulsants like gabapentin, lamotrigine, carbamazepine or tricyclic antidepressants like amitriptyline. *[Grade B]*

Macrovascular complications

5.2.4 Coronary Heart Disease (CHD)

Introduction

The major concern of T2DM is its increased risk (two to four fold) for CHD, manifested as angina, myocardial infarction (MI), CCF and sudden death. In addition T2DM, independent of CHD, may lead to diabetic cardiomyopathy. CHD accounts for up to two-third of deaths in T2DM. The increased risk of CHD in patients with diabetes is only partly explained by concomitant risk factors such as hypertension, obesity, dyslipidaemia, and smoking. It has been shown that hyperglycaemia itself and its consequences are very important for the increased risk for CHD and related mortality.[151 (Level 1), 167, 168 (Level II-1),]

CHD in T2DM is characterized by its early onset, extensive disease at the time of diagnosis, and higher morbidity and mortality after MI. Angiographically the disease is more diffuse, involving multiple coronary arteries including small and distal vessels.[169 (Level II-2), 170, 171 (Level I)]

The similar occurrence of MI in patients with T2DM and those without T2DM who had previous MI has given rise to the notion that T2DM is a CHD-defining disease. As such, we should manage cardio-metabolic risks associated with T2DM and CHD in T2DM aggressively. The challenge faced by doctors is to accurately identify patients with asymptomatic CHD. [172, 173 (Level II-2)]

Screening

Typical symptoms of CHD warrant a prompt referral to a cardiologist for further assessment. However it is quite common for patients with T2DM to have atypical symptoms or even 'silent' CHD. Atypical symptoms include dyspnoea, fatigue, and gastrointestinal symptoms associated with exertion. [174 (Level II-1)]

When it comes to screening asymptomatic patients with T2DM for CHD we propose the following approach:

A. Performance of a resting ECG [175]

AND

B. Application of an established cardiovascular risk assessment tool (Framingham Risk Score [176] or UKPDS Risk Engine [177]) [178,179]

Patients with an abnormal resting ECG or those having high risk score based on either one of the two risk assessment tools should be referred to a cardiologist for further evaluation. It is important to note that a normal resting ECG does not exclude CHD. [174 (Level II-1), 180, 181 (Level I)]

The cardiovascular risk assessment tools such as the Framingham Risk Score and NCEP III Risk Assessment Tool can be applied to persons with or without diabetes. Both these scores have been analysed in different populations and the conclusion is that, while the absolute risk may differ from population to population, the proportionate risk ranking provided by these scores is consistent across populations. [182, 183 (Level II-2)]

On the other hand, the diagnosis of metabolic syndrome identifies people at a higher risk of CHD than those in the general population. However it does not provide a better or even equally good prediction of cardiovascular risk than the risk assessment tools mentioned above which are based on the major cardiovascular risk factors. [184 (Level III)]

In addition, the following patients with T2DM should also be considered for screening for CHD:

1. Those with peripheral or cerebrovascular disease. [172, 173 (Level I)]

2. Those leading a sedentary lifestyle, age ≥35 years and plan to begin a vigorous exercise program.

3. Those with two or more of the risk factors listed below. [185, 186 (Level I)]

    a) Total cholesterol >4.0 mmol/L, LDL cholesterol >2.0 mmol/L, or HDL cholesterol <1.0 mmol/L for males and <1.2 mmol/L for females.
    b) Blood pressure >130/85 mmHg
    c) Smoking
    d) Family history of premature CHD
    e) Positive micro/macroalbuminuria test

Recommendations: Coronary Heart Disease

1. Normal resting ECG does not exclude CHD. *[Grade B]*
2. The risk stratification tools and ECG are part of risk assessment. *[Grade B]*

Aspirin for Primary Prevention of Cardiovascular Disease in People with Diabetes

There is strong evidence that aspirin is effective for secondary prevention of cardiovascular events. However, it is unclear whether it prevents primary cardiovascular events in people who are at high risk of CVD, such as those with T2DM.

The American Heart Association (AHA) and ADA guidelines recommended aspirin for primary prevention in diabetes based on a reduction of events in a mixed group of patients with and without CVD in the Early Treatment of Diabetic Retinopathy Study (ETDRS).[187(Level I)] The assumption is that the positive findings of aspirin in patients with symptomatic CVD can be extended to those high-risk patients without clinical evidence of CVD. However six other well-controlled trials, including the Women's Health Study and Physicians' Health Study, have shown no benefit of aspirin in primary prevention even for at risk patients.[188, 189(Level I)]

The two most recent randomised controlled trials which addressed this issue are the Prevention of Progression of Arterial Disease and Diabetes (POPADAD)[190(Level I)] and the Japanese Primary Prevention of Atherosclerosis with Aspirin for Diabetes (JPAD)[191(Level I)] studies, did not show any significant benefit.

In general, the decision to start patients on low dose aspirin as a primary prevention of CVD should be individualised. However, based on detailed examination of current evidence we recommend that asymptomatic people with diabetes who have a high risk of developing CVD based on the Framingham Risk Assessment Score (>10% risk over a 10 year period) be treated with low dose aspirin [192(Level I)]. In doing so, it is essential that the risk of gastrointestinal bleeding in individual patients be taken into consideration.

Recommendation: Aspirin for Primary Prevention of Cardiovascular Disease in People with Diabetes

1. Primary prevention of CVD with low dose aspirin (75mg-100mg) is not recommended in people with diabetes *[Grade A]* unless they are at high risk based on Framingham Risk Assessment Score *[Grade C]*

5.2.5 Cerebrovascular Disease

(Refer to Malaysian Clinical Practice Guidelines on the Management of Stroke, 2006)

[Note: The above guideline is also available electronically at the following websites: www.moh.gov.my; www.acadmed.org.my; www.neuro.org.my]

Combination of Micro- and Macrovascular complications

5.2.6 Diabetic Foot

Introduction

Foot ulcerations and amputations are major causes of morbidity and mortality in patients with diabetes. In the 2006 Third National Health Morbidity Survey, the prevalence of lower limb amputation among patients with diabetes was 4.3%.[1] (Level III) Peripheral neuropathy predisposes to ulcerations and vasculopathy retards the healing process.

Prevention of foot ulcers:

Foot ulcers usually precede amputated digits and limbs. Hence preventing the first ulcer would reduce the incidence of amputations. Prevention starts with examination of the feet (shoes and socks removed) and identifying those at high risk of ulceration. Those patients at risk are then given relevant education to reduce the likelihood of future ulcers. The feet should be examined at least once annually or more often in the presence of risk factors. [193] (Level III)

Risk factors for Foot Ulcers [194] (Level III)

1) Previous amputation
2) Past foot ulcer history
3) Peripheral neuropathy
4) Foot deformity
5) Peripheral vascular disease
6) Visual impairment
7) Diabetic nephropathy (especially patients on dialysis)
8) Poor glycaemic control
9) Cigarette smoking

Neuropathy should be assessed with a 10g monofilament and one other modality i.e. pin prick, vibration sense using a 128Hz tuning fork, ankle reflexes or vibration perception threshold testing using a biothesiometer. Loss of protective sensation (LOPS) would be considered present if one or more of the tests are abnormal.

Vasculopathy is assessed by asking for symptoms of claudication and examining the dorsalis pedis and posterior tibial for pulses.

Relevant education for patients: [195] (Level III)

- In the presence of feet with reduced sensation, look at feet daily using a mirror to detect early ulcerations.
- Wear flat, soft and well fitted shoes to avoid callosities.
- Ensure no foreign objects in the shoes before putting feet in.
- Have one pair of shoes for indoor use as well.

An ulcer in a patient with any of the above risk factors will warrant an early referral to a specialist for shared care. Ulcers with cellulitis will require antibiotics. Trauma induced ulcers with no other risk factors will require the standard wound care and close follow - up until full recovery.

Recommendations: Diabetic Foot

1. Examine feet of patients at least once every year to identify individuals who would then require intensive education on self care to avoid ulcers and amputations.[196] *[Grade B]*
2. To detect clinically relevant neuropathy, at least use a 10g monofilament. *[Grade C]*

5.2.7 Erectile Dysfunction

Introduction

Erectile Dysfunction (ED) is defined as the consistent or recurrent inability of a male to attain and/or maintain a penile erection sufficient for sexual performance.[197 (Level I)] ED affects approximately 34 to 45% of men with diabetes.[197 (level I), 198 (Level III)] ED results from vasculopathy and/or autonomic neuropathy and/or psychological factors. Risk factors include increasing age, increasing duration of diabetes, poor glycaemic control, smoking, hypertension, dyslipidaemia and CVD. [199 - 208]

Screening

All adult males over the age of 40 should be asked about ED since they usually do not volunteer problems with ED. Preservation of early morning erection suggests a psychological cause. Screening can be done using the 5-item version of the International Index of Erectile Function (IIEF) questionnaire [209] (APPENDIX 5).

Treatment

Avoid medications (if possible) that may cause ED

- Antihypertensives (thiazides, beta blockers, methyldopa, spironolactone)
- Antidepressants and tranquilisers
- NSAIDS
- H2 antagonists (cimetidine)
- Narcotics
- Miscellaneous drugs (ketoconazole, anti-cancer agents)

Psychosexual counselling is recommended in functional ED.

Phosphodiesterase-5 (PDE-5) inhibitors e.g. sildenafil, tadalafil and vardenafil [210-213 (Level I)] can be used to treat ED and should be offered as first-line therapy to men with diabetes wishing treatment. PDE-5 inhibitors are contraindicated in unstable angina, poor exercise tolerance or nitrate medication.

Referral to a urologist may be necessary for those not responding to PDE-5 inhibitors.

Other therapies include intracavernosal injections, intraurethral alprostadil, vacuum devices with constricting band and surgery.

Recommendations: Erectile Dysfunction

1. All adult males with diabetes over the age of 40 should be asked about ED. *[Grade C]*
2. PDE-5 inhibitor should be offered as first-line therapy if there are no contraindications. *[Grade A]*
3. Referral to a specialist in ED should be considered for men who do not respond to PDE-5 inhibitors or for whom the use of PDE-5 inhibitors is contraindicated. *[Grade C]*

SECTION 6 PREVENTION OF TYPE 2 DIABETES MELLITUS

6.1 For healthy and people at risk

There are many risk factors that predispose an individual or population to developing glucose intolerance and finally diabetes. There is ample evidence that lifestyle related changes are the main factors influencing the explosion of diabetes in modern times. As diabetes is an endpoint in the glucose tolerance continuum in the general population, it is possible to halt this slide from normal to IGT and subsequently T2DM.

6.2 Prediabetes

There is evidence that interventions can reduce the conversion of IFG/IGT to frank T2DM.

- Diet and physical activity are the mainstay of therapy [5, 32, 214-216 (Level I)]

In addition to lifestyle intervention, metformin should be considered for those at very high risk (combined IFG & IGT plus other risks factors) or for those who fail lifestyle therapy after 6 months. [2,32,217 (Level I)]

Other pharmacological interventions listed below have also been shown to prevent/delay the onset of T2DM. [218-220 (Level I)]

- Acarbose
- Orlistat
- Rosiglitazone

* All the above drugs including metformin have not yet been approved for the treatment of prediabetes. Use of these agents is at the discretion of the doctor as off label use.

The use of other agents like ACEIs, ARBs and statins are not recommended solely for the purpose of primary prevention.

It must be noted that most of the subjects in the studies above were either overweight or obese and were at high risk for developing DM. The reduced conversion rate from IGT to frank T2DM is associated with weight loss. Thus weight loss remains a priority in the prevention of DM. Those at risk include those with IGT or IFG but also those with a family history of diabetes (1st degree relatives), GDM, hypertension, vascular disease, dyslipidaemia, obesity or overweight with central obesity and PCOS.

It must be emphasised that while pharmaceutical intervention is available, lifestyle intervention programmes have greater efficacy [5 (Level I)] and are practical and cost effective making its implementation possible in any primary health care setting.[2,5,133,214,215] Longstanding positive behavioural adaptation and lifestyle modification will provide the answers to our fight against the impending epidemic of T2DM.

Recommendation: Prevention of Type 2 Diabetes Mellitus

1. In individuals with IGT, a structured program of lifestyle modification that includes moderate weight loss and regular physical activity has been shown to reduce the risk of T2DM. *[Grade A]*

REFERENCES

1. The Third National Health Morbidity Survey (NHMS III) Diabetes Group. Ministry of Health Malaysia, 2006.
2. American Diabetes Association (ADA). Position Statement on Standards of Medical Care in Diabetes - 2009. *Diabetes Care* 2009; 32: S13 – S61.
3. National Institute for Health and Clinical Excellence (NICE). Diabetes in Pregnancy, March 2008 (revised reprint July 2008). Available at: http://www.nice.org.uk/nicemedia/pdf/DiabetesFullGuidelineRevisedJULY2008.pdf (Accessed: 4 May 2009).
4. American Diabetes Association (ADA). Consensus Statement on Type 2 Diabetes in Children and Adolescents. *Diabetes Care* 2000; 23: 381 – 389.
5. International Diabetes Federation (IDF). Global Guidelines for Type 2 Diabetes, 2005. Available at: http://www.idf.org/webdata/docs/IDF%20GGT2D.pdf (Accessed: 4 May 2009).
6. Australian Diabetes Educator Association (ADEA). Position statement: The Role of Accredited Practicing Dietitians and Diabetes Educators in The Delivery of Nutrition And Diabetes Self-Management Education Services for People with Diabetes. ADEA, Canberra 2003.
7. Funnell MM, Anderson RM, Austin A, et al. American Association Diabetes Educator Position Statement: Individualization of Diabetes Self-Management Education. *Diabetes Educ* 2007; 33: 45-49.
8. Funnell MM, Brown TL, Childs BP, et al. National Standards for Diabetes Self-Management Education. *Diabetes Care* 2008; 31: S97 - S104.
9. Martin C, Daly A, McWhorter LS, et al. American Association Diabetes Educator Position Statement: The Scope of Practice, Standards of Practice and Standards of Professional Performance for Diabetes Educators. *Diabetes Educ* 2005; 31: 487 – 512.
10. Kaufman FR. Type 2 Diabetes in Children and Youth. *Endocrinol Metab Clin North Am* 2005; 34: 659 – 676.
11. Hannon TS, Arslanian SA. Obesity and Type 2 Diabetes Mellitus in Adolescents: What is New? *Curr Opin Endocrinol Diabetes* 2006; 13: 111 – 118.
12. Kaufman FR. Obesity and Type 2 Diabetes in Children and Youth. *Curr Opin Endocrinol Diabetes* 2006; 13: 332 – 333.
13. Shaw J. Epidemiology of Childhood Type 2 Diabetes and Obesity. *Pediatr Diabetes* 2007; 8: 16 – 27.
14. Adler AI, Stratton IM, Neil HAW et al. Association of Systolic Blood Pressure with Macrovascular and Microvascular Complications of Type 2 Diabetes (UKPDS 36): Prospective Observational Study. *Br Med J* 2000; 321: 412 – 419.
15. Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report. *JAMA* 2003; 289: 2560 – 2572.
16. Malaysian Clinical Practice Guidelines for the Management of Diabetic Nephropathy, 2004. Available at: http://www.moh.gov.my/MohPortal/cpgDetail.jsp?action=view&id=17 (Accessed: 4 May 2009).
17. Action to Control Cardiovascular risk in Diabetes (ACCORD) Study Group. Effects of Intensive Glucose Lowering in Type 2 Diabetes. *New Engl J Med* 2008; 358: 2545 – 2559.
18. ADVANCE Collaborative Group. Effects of A Fixed Combination of Perindopril and Indapamide on Macrovascular and Microvascular Outcomes in Patients with Type 2 Diabetes Mellitus (ADVANCE Trial): A Randomised Controlled Trial. *Lancet* 2007; 370: 829 – 840.
19. The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents. *Pediatrics* 2004; 114: 555 – 576.
20. International Diabetes Federation Western Pacific Region (IDF-WPR) Type 2 Diabetes Practical Targets and Treatment, Fourth Edition, 2005. Available at: http://www.idf.org/webdata/docs/T2D_practical_tt.pdf (Accessed: 4 May 2009).
21. Norris SL, Lau J, Smith SY, et al. Self-Management Education for Adults with Type 2 Diabetes: A Meta-analysis of The Effect on Glycaemic Control. *Diabetes Care* 2002; 25: 1159 – 1171.

22. Ellis SE, Speroff T, Dittus RS, et al. Diabetes Patient Education: A Meta-analysis and Meta-regression. *Patient Educ Couns* 2004; 52: 97 – 105.
23. Gary TL, Genkinger JM, Guallar E, et al. Meta-analysis of Randomized Educational and Behavioural Interventions in Type 2 Diabetes. *Diabetes Educ* 2003; 29: 488 – 501.
24. Boule N, Kenny G, Haddad E, et al. Meta-analysis of The Effect of Structured Exercise Training on Cardiorespiratory Fitness in Type 2 Diabetes. *Diabetologia* 2003; 46: 1071 – 1081.
25. Boule N, Haddad E, Kenny G, et al. Effects of Exercise on Glycaemic Control and Body Mass in Type 2 Diabetes Mellitus: A Meta-analysis of Controlled Clinical Trials. *JAMA* 2001; 286: 1218 – 1227.
26. Skovlund SE, Peyrot M. DAWN International Advisory Panel Lifestyle and Behaviour: The Diabetes Attitude, Wishes and Needs (DAWN) Program. A New Approach to Improving Outcomes of Diabetes Care. *Diabetes Spectrum* 2005; 18: 136 – 142.
27. Lustman P, Anderson RJ, Freedland KE, et al. Depression and Poor Glucose Control: A Review of The Literature. *Diabetes Care* 2000; 23: 934 – 942.
28. Hill-Briggs F, Gemmell L. Problem Solving in Diabetes Self-management and Control - A Systematic Review of The Literature. *Diabetes Educ* 2007; 33: 1032 – 1050.
29. Franz MJ, Monk A, Barry B, et al. Effectiveness of Medical Nutrition Therapy Provided by Dietitians in The Management of Non-insulin-dependent Diabetes Mellitus: A Randomized, Controlled Clinical Trial. *J Am Diet Assoc* 1995; 95: 1009 - 1017.
30. Medical Nutrition Therapy Guidelines for Type 2 Diabetes. Malaysian Dietitians' Association, 2005.
31. Tuomilehto J, Lindstrom J, Eriksson JG, et al. Prevention of Type 2 Diabetes Mellitus by Changes in Lifestyle Among Subjects with Impaired Glucose Tolerance. *N Engl J Med* 2001; 344: 1343 – 1350.
32. Knowler WC, Barrett-Connor E, Fowler SE, et al for the Diabetes Prevention Program (DPP) Research Group. Reduction in The Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. *N Engl J Med* 2002; 346: 393 – 403.
33. Schulze MB, Liu S, Rimm EB, et al. Glycemic Index, Glycemic Load and Dietary Fiber Intake and Incidence of Type 2 Diabetes in Younger and Middle-aged Women. *Am J Clin Nutr* 2004; 80: 348 – 356.
34. Balagopal P, George D, Patton N, et al. Lifestyle-only Intervention Attenuates the Inflammatory State Associated with Obesity: A Randomised Controlled Study in Adolescents. *J Pediatr* 2005; 146: 342 – 348.
35. The Diabetes Control and Complications Trial Research Group. The Effect of Intensive Treatment of Diabetes on The Development and Progression of Long-term Complications in Insulin-dependent Diabetes Mellitus. *N Engl J Med* 1993; 329: 977 - 986.
36. Brand-Miller J, Hayne S, Petocz P, et al. Low-glycemic Index Diets in The Management of Diabetes: A Meta-analysis of Randomized Controlled Trials. *Diabetes Care* 2003; 26: 2261 – 2267.
37. Sheard NF, Clark NG, Brand-Miller JC, et al. Dietary Carbohydrate (Amount and Type) in The Prevention and Management of Diabetes: A Statement of The American Diabetes Association. *Diabetes Care* 2004; 7: 2266 – 2271.
38. Malik VS, Schulze MB, Hu FB. Intake of Sugar-sweetened Beverages and Weight Gain: A Systematic Review. *Am J Clin Nutr* 2006; 84: 274 – 288.
39. Yu-Poth S, Zhao G, Etherton T, et al. Effects of The National Cholesterol Education Program's Step I and Step II Dietary Intervention Programs on Cardiovascular Disease Risk Factors: A Meta-analysis. *Am J Clin Nutr* 1999; 69: 632 - 646.
40. Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on Blood Pressure of Reduced Dietary Sodium and the Dietary Approaches to Stop Hypertension (DASH) Diet: DASH-Sodium Collaborative Research Group. *N Engl J Med* 2001; 344: 3 –10.
41. Yeh GY, Eisenberg DM, Kaptchuk TJ, et al. Systematic Review of Herbs and Dietary Supplements for Glycemic Control in Diabetes. *Diabetes Care* 2003; 26: 1277 – 1294.

42. United Kingdom Prospective Diabetes Study (UKPDS) 33 Group. Intensive Blood-glucose Control with Sulphonylureas or Insulin Compared with Conventional Treatment and Risk of Complications Inpatients with Type 2 Diabetes. *Lancet* 1998; 352: 837 - 853.
43. Nathan DM, Buse, JB, Davidson MB, et al. Management of Hyperglycemia in Type 2 Diabetes: A Consensus Algorithm for The Initiation and Adjustment of Therapy. A Consensus Statement Form the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care* 2006; 29: 1963 – 1972.
44. Kahn SE, Haffner SM, Mark AH, et al for the A Diabetes Outcome Progression Trial (ADOPT) Study Group. Glycemic Durability of Rosiglitazone, Metformin or Glyburide Monotherapy. *N Engl J Med* 2006; 355: 2427 – 2443.
45. Lebovitz HE, Dole JF, Patwardhan R, et al for the Rosiglitazone Clinical Trials Group. Rosiglitazone Monotherapy is Effective in Patients with Type 2 Diabetes. *J Clin Endocrinol Metab* 2001; 86: 280 – 288.
46. Jones TA, Saulter M, Van Gaal LF, et al. The Addition of Rosiglitazone to Metformin Is Most Effective in Obese, Insulin Resistant Patients with Type 2 Diabetes. *Diabetes Obes Metab* 2003; 5: 163 – 170.
47. Fonseca V, Rosenstock J, Patwardhan R, et al. Effect of Metformin and Rosiglitazone Combination Therapy in Patients with Type 2 Diabetes: A Randomized Control Study. *JAMA* 2000; 283: 1695 – 1702.
48. Hanefeld M, Brunetti P, Guntram H, et al. One year Glycaemic Control with Sulphonylurea Plus Pioglitazone Versus A Sulphonylurea Plus Metformin in Patients with Type 2 Diabetes. *Diabetes Care* 2004; 27: 141 – 147.
49. Lebovitz HE, Benerji MA. Insulin Resistance and Its Treatment with Thiazolidinediones. *Recent Prog Horm Res* 2001; 56: 265 – 294.
50. American Association of Clinical Endocrinologists (AACE) Medical Guidelines for Clinical Practice for the Management of Diabetes Mellitus, 2007. Available at: http://www.aace.com/pub/pdf/guidelines/DMGuidelines2007.pdf (Accessed: 4 May 2009).
51. Yki-Järvinen H, Ryysy L, Nikkilä K, et al. Comparison of Bedtime Insulin Regimens in Patients with Type 2 Diabetes Mellitus. A Randomized, Controlled Trial. *Ann Intern Med* 1999; 130: 389 – 396.
52. Ponssen HH, Elte JWF, Lehert P, et al. Combined Metformin and Insulin Therapy for Patients with Type 2 Diabetes Mellitus. *Clin Ther* 2000; 22: 709 – 718.
53. Avilés-Santa L, Sinding J, Raskin P. Effects of Metformin in Patients with Poorly Controlled, Insulin Treated Type 2 Diabetes Mellitus. A Randomized, Double-blind, Placebo-controlled Trial. *Ann Intern Med* 1999; 131: 182 – 188.
54. Wright A, Burden ACF, Paisey RB, et al. Sulphonylurea Inadequacy: Efficacy of Addition of Insulin Over 6 Years in Patients with Type 2 Diabetes in The United Kingdom Prospective Diabetes Study (UKPDS 57). *Diabetes Care* 2002; 25: 330 – 336.
55. Raskin P, Rendell M, Riddle MC, et al. A Randomized Trial of Rosiglitazone Therapy in Patients with Inadequately Controlled Insulin-treated Type 2 Diabetes. *Diabetes Care* 2001; 24: 1226 – 1232.
56. Chiasson J-L, Josse RG, Hunt JA, et al. The Efficacy of Acarbose in The Treatment of Patients with Non-insulin-dependent Diabetes Mellitus. A Multicenter Controlled Clinical Trial. *Ann Intern Med* 1994; 121: 928 – 935.
57. Coniff RF, Shapiro JA, Seaton TB, et al. A Double-blind Placebo Controlled Trial Evaluating The Safety and Efficacy of Acarbose For The Treatment of Patients with Insulin-requiring Type II Diabetes. *Diabetes Care* 1995; 18: 928 – 932.
58. Lorenz RA. Modern Insulin Therapy for Type 1 Diabetes Mellitus. *Primary Care: Clinics in Office Practice* 1999; 26: 917-929.
59. Salpeter S, Greyber E, Pasternak G, et al. Risk of Fatal and Nonfatal Lactic Acidosis with Metformin Use in Type 2 Diabetes Mellitus. *Cochrane Database Syst Rev* 2006; CD002967.
60. United Kingdom Prospective Diabetes Study (UKPDS) Group. Effect of Intensive Blood Glucose Control with Metformin on Complications in Overweight Patients with Type 2 Diabetes (UKPDS 34). *Lancet* 1998; 352: 854 – 865.

61. Nauck M, Stockmann F, Ebert R, et al. Reduced Incretin Effect in Type 2 (Non-insulin-dependent) Diabetes. *Diabetologia* 1986; 29: 46 – 52.
62. Gautier JF, Fetita S, Sobngwi E, et al. Biological Actions of The Incretins GIP and GLP-1 and Therapeutic Perspectives in Patients with Type 2 Diabetes. *Diabetes Metab* 2005; 31: 233 – 242.
63. Nauck MA, Kleine N, Orskov C, et al. Normalisation of Fasting Hyperglycaemia by Exogenous Glucagon-like Peptide 1 (7-36 amide) in Type 2 (Non-insulin dependent) Diabetic Patients. *Diabetologia* 1993; 36: 741 – 744.
64. Raz I, Hanefeld M, Xu L, et al. Sitagliptin Study 023 Group: Efficacy and Safety of The Dipeptidyl Peptidase-4 Inhibitor Sitagliptin As Monotherapy In Patients with Type 2 Diabetes Mellitus. *Diabetologia* 2006; 49: 2564 – 2571.
65. Nonaka K, Kakikawa T, Sato A, et al. Efficacy and Safety of Sitagliptin Monotherapy in Japanese Patients with Type 2 Diabetes. *Diabetes Res Clin Pract* 2008; 79: 291 – 298.
66. Aschner P, Kipnes MS, Lunceford JK, et al. Effect of The Dipeptidyl peptidase-4 Inhibitor Sitagliptin As Monotherapy on Glycemic Control in Patients with Type 2 Diabetes. *Diabetes Care* 2006; 29: 2632 – 2637.
67. Goldstein BJ, Feinglos MN, Lunceford JK, et al for The Sitagliptin 036 Study Group. Effect of Initial Combination Therapy with Sitagliptin, A Dipeptidyl Peptidase-4 Inhibitor and Metformin on Glycemic Control in Patients with Type 2 Diabetes. *Diabetes Care* 2007; 30: 1979 – 1987.
68. Charbonnel B, Karasik A, Liu J et al for The Sitagliptin Study 020 Group. Efficacy and Safety of The Dipeptidyl Peptidase-4 Inhibitor Sitagliptin Added to Ongoing Metformin Therapy in Patients with Type 2 Diabetes Inadequately Controlled with Metformin Alone. *Diabetes Care* 2006; 29: 2638 – 2643.
69. Rosenstock J, Brazg R, Andryuk PJ, et al for The Sitagliptin Study 019 Group. Efficacy and Safety of The Dipeptidyl Peptidase-4 Inhibitor Sitagliptin Added to Ongoing Pioglitazone Therapy in Patients with Type 2 Diabetes: A 24-week, Multicenter, Randomized, Double-blind, Placebo-controlled, Parallel-group Study. *Clin Ther* 2006; 28: 1556 -1568.
70. Hermansen K, Kipnes M, Luo E, et al. Efficacy and Safety of The Dipeptidyl Peptidase-4 Inhibitor, Sitagliptin, in Patients with Type 2 Diabetes Mellitus Inadequately Controlled on Glimepiride Alone or on Glimepiride and Metformin. *Diabetes Obes Metab* 2007; 9: 733 – 745.
71. Nauck MA, Meininger G, Sheng D, et al for The Sitagliptin Study 024 Group. Efficacy and Safety of The Dipeptidyl Peptidase-4 Inhibitor, Sitagliptin, Compared with The Sulfonylurea, Glipizide, in Patients with Type 2 Diabetes Inadequately Controlled on Metformin Alone: A Randomized, Double-blind, Non-inferiority Trial. *Diab Obes Metab* 2007; 9: 194 – 205.
72. Bergman AJ, Cote J, Yi BM, et al. Effect of Renal Insufficiency on the Pharmacokinetics of Sitagliptin, A Dipeptidyl Peptidase-4 Inhibtor. *Diabetes Care* 2007; 30: 1862 – 1864.
73. Niemi M, Blackman JT, Neuvonen M, et al. Effects of Gemfibrozil, Itraconazole and Their Combination on The Pharmacokinetics and Pharmacodynamics of Repaglinide: Potentially Hazardous Interaction Between Gemfibrosil and Repaglinide. *Diabetologia* 2003; 46: 347 – 351.
74. Schwartz AV, Sellmeyer DE, Vittinghoff E, et al. Thiazolidinedione Use and Bone Loss in Older Diabetic Adults. *J Clin Endocrinol Metab* 2006; 91: 3349 – 3354.
75. Nesto RW, Bell D, Bonow RO, et al. Thiazolidinedione Use, Fluid Retention and Congestive Heart Failure: A Consensus Statement From The American Heart Association and American Diabetes Association. *Diabetes Care* 2004; 27: 256 - 263.
76. Keating GM. Exenatide. *Drugs* 2005; 65: 1681 – 1692.
77. Barnett AH. Exenatide. Drugs of Today 2006; 41: 563 – 578.
78. DeFronzo RA, Ratner RE, Han J, et al. Effects of Exenatide (Exendin-4) on Glycaemic Control and Weight Over 30 Weeks in Metformin-Treated Patients With Type 2 Diabetes. *Diabetes Care* 2005; 28: 1092 – 1100.
79. Buse JB, Henry RR, Han J, et al for The Exenatide-113 Clinical Study Group. Effects of Exenatide (Exendin-4) on Glycaemic Control and Weight Over 30 Weeks in Sulfonylurea-Treated Patients with Type 2 Diabetes. *Diabetes Care* 2004; 27: 2628 – 2635.

80. Kendall DM, Riddle MC, Rosenstock J, et al. Effects of Exenatide (Exendin-4) on Glycaemic Control and Weight Over 30 Weeks in Patients With Type 2 Diabetes Treated with Metformin and A sulfonylurea. Diabetes Care 2005; 28: 1083 – 1091.
81. Edwards CMB, Stanley SA, Davis R, et al. Exendin-4 Reduces Fasting and Postprandial Glucose and Decreases Energy Intake in Healthy Volunteers. *Am J Physiol Endocrinol Metab* 2001; 281: E155 – E161.
82. Kolterman OG, Buse JB, Fineman MS, et al. Synthetic Exendin-4 (exenatide) Significantly Reduces Postprandial and Fasting Plasma Glucose in Subjects with Type 2 Diabetes. *J Clin Endocrinol Metab* 2003; 88: 3082 – 3089.
83. Kolterman OG, Kim DD, Shen L, et al. Pharmacokinetics, Pharmacodynamics and Safety of Exenatide in Patients with Type 2 Diabetes Mellitus. *Am J Health Syst Pharm* 2005; 62: 173 - 181.
84. Fineman MS, Shen LZ, Taylor K, et al. Effectiveness of Progressive Dose-escalation of Exenatide (exendin-4) in Reducing Dose-limiting Side Effects in Subjects with Type 2 Diabetes. *Diabetes Metab Res Rev* 2004; 20: 411 – 417.
85. Stratton IM, Adler AI, Neil HA, et al. Association of Glycaemia with Macrovascular and Microvascular Complications of Type 2 Diabetes (UKPDS 35): Prospective Observational Study. *Br Med J* 2000; 321: 405 – 412.
86. Rosenstock J, Dailey G, Massi-Benedetti M, et al. Reduced Hypoglycemia Risk With Insulin Glargine. A Meta-analysis Comparing Insulin Glargine with Human NPH Insulin in Type 2 Diabetes. *Diabetes Care* 2005; 28: 950 – 955.
87. Garber AJ, Clauson P, Pedersen CB, et al. Lower Risk of Hypoglycemia with Insulin Detemir than with Neutral Protamine Hagedorn Insulin in Older Persons with Type 2 Diabetes: A Pooled Analysis of Phase III Trials. *Journal of the American Geriatrics Society* 2007; 55: 1735 – 1740.
88. Boehm B O, Vaz J A, Bronstedt L, et al. Long-term Safety and Efficacy of Biphasic Insulin Aspart in Patients with Type 2 Diabetes. *Eur J Intern Med* 2004; 15: 496 – 502.
89. Bretzel R G, Arnolds S, Medding J, et al. A Direct Efficacy and Safety Comparison of Insulin Aspart, Human Soluble Insulin, and Human Premix Insulin (70/30) in Patients with Type 2 Diabetes. *Diabetes Care* 2004; 27: 1023 – 1027.
90. Bott U, Ebrahim S, Hirschberger S, et al. Effect of the Rapid-acting Insulin Analogue Insulin Aspart on Quality of Life and Treatment Satisfaction in Patients with Type 1 Diabetes. *Diabet Med* 2003; 20: 626 – 634.
91. Heller SR, Colagiuri S, Vaaler S, et al. Hypoglycaemia with Insulin Aspart: A Double-blind, Randomised, Crossover Trial in Subjects with Type 1 Diabetes. *Diabet Med* 2004; 21: 769 – 775.
92. Mohamed M for The Diabcare-Asia 2003 Study Group. An Audit on Diabetes Management in Asian Patients Treated By Specialists: The Diabcare-Asia 1998 and 2003 Studies. *Curr Med Res Opin* 2008; 24: 507 – 514.
93. Hypertension in Diabetes Study (HDS). I. Prevalence of Hypertension in Newly Presenting Type 2 Diabetic Patients and The Association with Risk Factors for Cardiovascular and Diabetic Complications; II. Increased Risk of Cardiovascular Complications in Hypertensive Type 2 Diabetic Patients. The Hypertension in Diabetes Study Group. *J Hypertens* 1993; 11: 309 – 325.
94. Rampala L, Rampal S, Azhar MZ, et al. Prevalence, Awareness, Treatment and Control of Hypertension in Malaysia: A National Study of 16,440 subjects. *Public Health* 2008; 122: 11 – 18.
95. The Third National Health and Morbidity Survey (NHMS III) Hypertension & Hypercholesterolemia Group. Ministry of Health Malaysia, 2006.
96. Guidelines Subcommittee. 1999 World Health Organization-International Society of Hypertension Guidelines for The Management of Hypertension. *J Hypertens* 1999; 17: 151 – 183.
97. Schrier RW, Estacio RO, Esler A, et al. Effects of Aggressive Blood Pressure Control in Normotensive Type 2 Diabetic Patients On Albuminuria, Retinopathy and Strokes. *Kidney Int* 2002; 61: 1086 – 1097.

98. Lewis EJ, Hunsicker LG, Bain RP, et al. The Effect of Angiotensin Converting Enzyme Inhibition On Diabetic Nephropathy. *N Engl J Med* 1993; 329: 1456 – 1462.
99. Ravid M, Lang R, Rachmani R, et al. Long-term Renoprotective Effect of Angiotensin Converting Enzyme Inhibition in Non-insulin Dependent Diabetes Mellitus. A 7-year Follow-up Study. *Arch Intern Med* 1996; 156: 286 – 289.
100. Kasiske BL, Kalil RS, Ma JZ, et al. Effect of Antihypertensive Therapy on The Kidney in Patients With Diabetes: A Meta-regression Analysis. *Ann Intern Med* 1993; 118: 129 – 138.
101. Heeg JE, de Jong PE, van der Hem GK, et al. Efficacy and Variability of The Antiproteinuric Effect of ACE Inhibition by Lisinopril. *Kidney Int* 1989; 36: 272 – 279.
102. Parving HH, Lehnert H, Brochner-Mortensen J, et al. The effect of Irbesartan on The Development of Diabetic Nephropathy in Patients with Type 2 Diabetes. *N Engl J Med* 2001; 345: 870 – 878.
103. Brenner BM, Cooper ME, de Zeeuw D, et al. Effects of Losartan on Renal and Cardiovascular Outcomes in Patients with Type 2 Diabetes and Nephropathy. *N Engl J Med* 2001; 345: 861 – 869.
104. Lewis EJ, Hunsicker LG, Clarke WR, et al. Renoprotective Effect of The Angiotensin Receptor Antagonist Irbesartan in Patients with Nephropathy due to Type 2 Diabetes. *N Engl J Med* 2001; 345: 851 – 860.
105. Gaede P, Tarnow L, Vedel P, et al. Remission to Normoalbuminuria During Multifactorial Treatment Preserves Kidney Function in Patients with Type 2 Diabetes and Microalbuminuria. *Nephrol Dial Transplant* 2004; 19: 2784 – 2788.
106. Bakris GL, Williams M, Dworkin L, et al. Preserving Renal Function in Adults with Hypertension And Diabetes: A Consensus Approach. *Am J Kidney Dis* 2000; 36: 646 – 661.
107. United Kingdom Prospective Diabetes Study Group (UKPDS). Tight Blood Pressure Control and Risk of Macrovascular and Microvascular Complications in Type 2 Diabetes: UKPDS 38. *Br Med J* 1998; 317: 703 – 713.
108. Tjoa HI, Kaplan NM. Non Pharmacological Treatment of Hypertension in Diabetes Mellitus. *Diabetes Care* 1991; 14: 449 – 460.
109. Klahr S, Levey AS, Beck GJ, et al. The Effects of Dietary Protein Restriction and Blood Pressure Control on The Progression of Chronic Renal Disease. *N Engl J Med* 1994; 330: 877 – 884.
110. Lazarus JM, Bourgoignie JJ, Buckalew VM, et al. Achievement and Safety of A Low Blood Pressure Goal in Chronic Renal Disease. The Modification of Diet in Renal Disease Study Group (MDRD). *Hypertension* 1997; 29: 641 – 650.
111. Malaysian Clinical Practice Guidelines for the Management of Hypertension, 2008. Available at: http://www.moh.gov.my/MohPortal/cpgDetail.jsp?action=view&id=51 (Accessed: 4 May 2009).
112. Heart Outcomes Prevention Evaluation (HOPE) Study Investigators. Effects of Ramipril on Cardiovascular and Microvascular Outcomes in People with Diabetes Mellitus: Results of The HOPE Study and MICRO-HOPE Substudy. *Lancet* 2000; 355: 253 – 259.
113. Ruggenenti P, Fassi A, Ilieva AP, et al. Preventing Microalbuminuria in Type 2 Diabetes. *N Engl J Med* 2004; 351: 1941 – 1951.
114. Barnett AH, Bain SC, Bouter P, et al. Angiotensin-receptor Blockade Versus Converting Enzyme Inhibition in Type 2 Diabetes and Nephropathy. *N Engl J Med* 2004; 351: 1952 – 1961.
115. Action in Diabetes and Vascular Disease: Preterax and Diamicron MR Controlled Evaluation (ADVANCE) Collaborative Group. Intensive Blood glucose and Vascular Outcomes in Patients with Type 2 Diabetes. *New Engl J Med* 2008; 358: 2560 – 2572.
116. Duckworth W, Abraira C, Moritz T, et al for the Veterans Affairs Diabetes Trial (VADT) Investigators. Glucose Control and Vascular Complications in Veterans with Type 2 Diabetes. *New Engl J Med* 2009; 360: 129 – 139.
117. Heart Protection Study Collaborative Group: MRC/BHF Heart Protection Study of Cholesterol - Lowering with Simvastatin in 5963 People with Diabetes: A Randomised Placebo-controlled Trial. *Lancet* 2003; 361: 2005 - 2016.

118. Colhoun HM, Betteridge DJ, Durrington PN, et al. Primary Prevention of Cardiovascular Disease with Atorvastatin in Type 2 Diabetes in the Collaborative Atorvastatin Diabetes Study (CARDS): Multicentre Randomised Placebo-Controlled Trial. *Lancet* 2004; 364: 685 – 696.
119. Grundy SM, Cleeman JI, Merz CN, et al. Implications of Recent Clinical Trials for the National Cholesterol Education Program Adult Treatment Panel III Guidelines. *Circulation* 2004; 110: 227 – 239.
120. Cannon CP, Braunwald E, McCabe CH, et al. Intensive Versus Moderate Lipid Lowering with Statins After Acute Coronary Syndromes. *N Engl J Med* 2004; 350: 1495 – 1504.
121. American Diabetes Association (ADA) Consensus Statement on The Management of Dyslipidemia in children and Adolescents with Diabetes. *Diabetes Care* 2003; 26: 2194 – 2197.
122. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Executive Summary of The Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA* 2001; 285: 2486 – 2497.
123. National Cholesterol Education Program (NCEP) Expert Panel on Blood Cholesterol Levels in Children and Adolescents. Highlights of the Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. *Pediatrics* 1992; 89: 495 – 501.
124. Williams C, Hayman L, Daniels S, et al. Cardiovascular Health in Childhood: A Statement for Health Professionals From the Committee on Atherosclerosis, Hypertension, and Obesity in the Young (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation* 2002; 106: 143 – 160.
125. FIELD study investigators. Effects of Long-term Fenofibrate Therapy on Cardiovascular Events in 9795 People with Type 2 Diabetes Mellitus (the FIELD study): Randomised Controlled Trial. *Lancet* 2005; 366: 1849 – 1861.
126. Ballantyne CM, Grundy SM, Oberman A, et al. Hyperlipidemia: Diagnostic and Therapeutic Perspectives. *J Clin Endocrinol Metab* 2000; 85: 2089 – 2112.
127. International Diabetes Federation (IDF). The IDF Consensus World Wide Definition of Metabolic Syndrome 2006. Available at: http://www.idf.org/webdata/docs/IDF_Meta_def_final.pdf (Accessed: 4 May 2009).
128. Galassi Andrea, Reynolds K, He J. Metabolic Syndrome and Risk of Cardiovascular Disease: A Meta-analysis. *Am J Med* 2006; 119: 812 – 819.
129. Wilson PW, D'Agostino RB, Praise H, et al. Metabolic Syndrome As a Precursor of Cardiovascular Disease and Type 2 Diabetes Mellitus. *Circulation* 2005; 112: 3066 – 3072.
130. Lorenzo C, Okoloise M, Williams K, et al. The Metabolic Syndrome As Predictor of Type 2 Diabetes: The San Antonio Heart Study. *Diabetes Care* 2003; 26: 3153 – 3159.
131. World Health Organization (WHO). Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Report of A WHO Consultation 1999.
132. Alberti KGMM, Zimmet P, Shaw J, et al. The Metabolic Syndrome - A New Worldwide Definition. *Lancet* 2005; 366: 1059 – 1061.
133. Malaysian Clinical Practice Guidelines for the Management of Obesity, 2004. Available at: http://www.moh.gov.my/MohPortal/cpgDetail.jsp?action=view&id=20 (Accessed: 4 May 2009).
134. Dattilo AM, Kris-Etherton PM. Effects of Weight Reduction on Blood Lipids and Lipoproteins: A Meta-analysis. *Am J Clin Nutr* 1992; 56: 320 – 328.
135. Goldstein DJ. Beneficial Health Effects of Modest Weight Loss. *Int J Obes Relat Metab Disord* 1992; 16: 397 – 415.
136. Elmer PJ, Grimm R Jr, Laing B, et al. Lifestyle Intervention: Results of the Treatment of Mild Hypertension Study (TOMHS). Prev Med 1995; 24: 378 – 388.
137. Tuomilehto J, Lindström J, Eriksson JG, et al. Prevention of Type 2 Diabetes Mellitus by Changes In Lifestyle Among Subjects with Impaired Glucose Tolerance. *N Engl J Med* 2001; 344: 1343 – 1350.
138. National Institutes of Health. Clinical Guidelines on The Identification, Evaluation and Treatment of Overweight and Obesity in Adults — The Evidence Report. *Obes Res* 1998; 6: S51 - S209.

139. Pavlou KN, Krey S, Steffee WP. Exercise as An Adjunct to Weight Loss and Maintenance in Moderately Obese Subjects. *Am J Clin Nutr* 1989; 49: 1115 – 1123.
140. Wing RR, Hill JO. Successful Weight Loss Maintenance. *Annu Rev Nutr* 2001; 21: 323 – 341.
141. Wing RR, Goldstein MG, Acton KJ, et al. Behavioral Science Research in Diabetes: Lifestyle Changes Related to Obesity, Eating Behavior and Physical Activity. *Diabetes Care* 2001; 24: 117 – 123.
142. Golay A. Metformin and body weight. *Int J Obes* 2008; 32: 61 – 72.
143. Scheen AJ. Is There a Role for -Glucosidase Inhibitors in the Prevention of Type 2 Diabetes Mellitus? *Drugs* 2003; 63: 933 – 951.
144. Hollander PA, Elbein SC, Hirsch IB, et al. Role of Orlistat in The Treatment of Obese Patients with Type 2 Diabetes. A 1-year Randomized Double-blind Study. *Diabetes Care*. 1998; 21: 1288 – 1294.
145. Finer N, Bloom SR, Frost GS, et al. Sibutramine Is Effective for Weight Loss and Diabetic Control In Obesity with Type 2 Diabetes: A Randomised, Double-blind, Placebo-controlled Study. *Diabetes Obes Metab* 2000; 2: 105 – 112.
146. Diabetic retinopathy. *Diabetes Care*. 2000; 23: S73 - S76.
147. Mohamed Q, Gillies MC, Wong TY. Management of Diabetic Retinopathy: A Systematic Review.
148. Stratton IM, Kohner EM, Aldington SJ, et al. UKPDS 50: Risk Factors for Incidence and Progression of Retinopathy in Type II Diabetes Over 6 years from Diagnosis. *Diabetologia* 2001; 44: 156 - 163.
149. Wang PH, Lau J, Chalmers TC. Meta-analysis of Effects of Intensive Blood-glucose Control on Late Complications of Type I Diabetes. *Lancet* 1993; 341: 1306 - 1309.
150. Schrier RW, Estacio RO, Jeffers B. Appropriate Blood Pressure Control in NIDDM (ABCD) Trial. *Diabetologia* 1996; 39: 1646 – 1654.
151. The DCCT Research Group. The Effect of Intensive Treatment of Diabetes on The Development and Progression of Long-term Complications in IDDM. *New Engl J Med* 1993; 329: 977 – 986.
152. Management of Diabetic Retinopathy. Clinical Practice Guidelines. Canberra Commonwealth Department of Health and Family Services. 1997; 1 – 94.
153. National Institute for Clinical Excellence. Diabetic Retinopathy - Early Management and Screening. National Institute for Clinical Excellence (NICE), London, United Kingdom, 2001.
154. Lim TO, Lim YN. 15th Report of the National Dialysis and Transplant Registry, Malaysia 2007.
155. Scottish Intercollegiate Guidelines Network (SIGN) 55. Management of Diabetes. November 2001. Available at: http://www.sign.ac.uk/pdf/sign55.pdf (Accessed: 4 May 2009).
156. Viberti G, Wheeldon NM; MicroAlbuminuria Reduction with VALsartan (MARVAL) Study Investigators. Microalbuminuria Reduction with Valsartan in Patients with Type 2 Diabetes Mellitus: A Blood Pressure-independent Effect. *Circulation* 2002; 106: 672 – 678.
157. Lebovitz HE, Wiegmann TB, Cnaan A, et al. Renal Protective Effects of Enalapril in Hypertensive NIDDM: Role of Baseline Albuminuria. *Kidney Int Suppl* 1994; 45: S150 – S155.
158. Boulton AJM, Gries FA, Jervell JA. Guidelines for The Diagnosis and Outpatient Management of Diabetic Peripheral Neuropathy. *Diabet Med* 1998; 15: 508 – 514.
159. Boulton AJM, Vinik AI, Arezzo JC, et al. Diabetic Neuropathies: A Statement by The American Diabetes Association. *Diabetes Care* 2005; 28: 956 – 962.
160. Perkins BA, Olaleye D, Zinman B, et al. Simple Screening Tests for Peripheral Neuropathy in The Diabetes Clinic. *Diabetes Care* 2001; 24: 250 – 256.
161. Reichard P, Pihl M, Rosenqvist U, et al. Complications of IDDM Are Caused by Elevated Blood Glucose Levels, The Stockholm Diabetes Intervention Study At 10 Year Follow-up. *Diabetologia* 1996: 1383 – 1488.
162. The DCCT Research Group. The effect of Intensive Diabetes Therapy on The Development and Progression of Neuropathy. *Ann Intern Med* 1995; 122: 561 – 568.
163. Jensen TS. Anticonvulsants in Neuropathic Pain: Rationale and Clinical Evidence. *Eur J Pain* 2002; 6: 61 – 68.
164. Backonja M, Beydoun A, Edwards KR, et al. Gabapentin for the Symptomatic Treatment of Painful Neuropathy in Patients with Diabetes Mellitus: A Randomized Controlled Trial. *JAMA* 1998; 280: 1831 – 1836.
165. Eisenberg E, Luri Y, Braker C, et al. Lamotrigine Reduces Painful Diabetic Neuropathy: A

Randomized, Controlled Study. *Neurology* 2001; 57: 505 – 509.
166. Kumar D, Alvaro Ms, Julka IS. Diabetic Peripheral Neuropathy: Effectiveness of Electrotherapy and Amitriptyline for Symptomatic Relief. *Diabetes Care* 1998; 21: 1322 – 1325.
167. Stamler J, Vaccaro O, Neaton JD, et al. Diabetes, Other Risk Factors, and 12-yr Cardiovascular Mortality for Men Screened in the Multiple Risk Factor Intervention Trial. *Diabetes Care* 1993; 16: 434 – 444.
168. Adlerberth AM, Rosengren A, Wilhelmsen L. Diabetes and Long-term Risk of Mortality from Coronary and Other Causes in Middle-aged Swedish Men. *Diabetes Care* 1998; 21: 539 – 545.
169. Criqui MH, Langer RD, Fronek A, et al. Mortality Over 10 Years in Patients with Peripheral Arterial Disease. *N Engl J Med* 1992; 326: 381 – 386.
170. Van Belle E, Bauters C, Hubert E, et al. Retenosis Rates in Diabetic Patients: A Comparison of Coronary Stenting and Balloon Angioplasty in Native Coronary Vessels. *Circulation* 1997; 96: 1454 – 1460.
171. The Bypass Angioplasty Revascularization Investigation (BARI) Investigators. Influence of Diabetes on 5-year Mortality and Morbidity in A Randomized Trial Comparing CABG and PTCA in Patients with Multi-vessel Disease. *Circulation* 1997; 96: 1761 – 1769.
172. Haffner SM, Lehto S, Ronnemaa T, et al. Mortality from Coronary Heart Disease in Subjects with Type 2 Diabetes and in Nondiabetic Subjects With and Without Prior Myocardial Infarction. *N Engl J Med* 1998; 339: 229 – 234.
173. Lee CD, Folsom AR, Pankow JS, et al. Atherosclerosis Risk in Communities (ARIC) Study Investigators. Cardiovascular Events in Diabetic and Nondiabetic Adults With or Without History of Myocardial Infarction. *Circulation* 2004; 109: 855 – 860.
174. Scognamiglio R, Negut C, Ramondo A, et al. Detection of Coronary Artery Disease in Asymptomatic Patients with Type 2 Diabetes Mellitus. *J Am Coll Cardiol* 2006; 47: 65 – 71.
175. Rajagopalan N, Miller TD, Hodge DO, et al. Identifying High Risk Asymptomatic Diabetic Patients Who Are Candidates For Screening Stress Single Photon Emission Computed Tomography Imaging. *J Am Coll Cardiol* 2005; 45: 43 – 49.
176. National Cholesterol Education Program. Third Report of the Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adults Treatment Panel III). Risk Assessment Tool for Estimating Your 10-year Risk of Having a Heart Attack. Available at: http://hp2010.nhlbihin.net/atpiii/calculator.asp?usertype%20_%20prof (Accessed: 4 May 2009).
177. Diabetes Trial Unit, The Oxford Centre for Diabetes, Endocrinology and Metabolism. UKPDS Risk Engine. Available at: http://www.dtu.ox.ac.uk/riskengine (Accessed: 4 May 2009).
178. Stevens RJ, Kothari V, Adler AI, et al for the United Kingdom Prospective Diabetes Study (UKPDS) Group. The UKPDS Risk Engine: A Model for the Risk of Coronary Heart Disease in Type II Diabetes (UKPDS 56). *Clin Sci (Lond)* 2001; 101: 671 – 679. [erratum in *Clin Sci (Lond)* 2002; 102: 679.]
179. Wilson PW, D'Agostino RB, Levy D, et al. Prediction of Coronary Heart Disease Using Risk Factor Categories. *Circulation* 1998; 97: 1837 – 1847.
180. Caracciolo E, Chaitman BR, Forman SA, et al. Diabetics with Coronary Disease Have A Prevalence of Asymptomatic Ischemia During Exercise Treadmill Testing and Ambulatory Ischemia Monitoring Similar to That of Nondiabetic Patients: An ACIP Database Study. *Circulation* 1996; 93: 2097 – 2105.
181. Wackers FJ, Young LH, Inzucchi SE, et al. Detection of Silent Myocardial Ischemia in Asymptomatic Diabetic Subjects: The DIAD Study. *Diabetes Care* 2004; 27: 1954 – 1961.
182. Guzder RN, Gatling W, Mullee MA, et al. Prognostic value of the Framingham cardiovascular risk equation and the UKPDS risk engine for coronary heart disease in newly diagnosed type 2 diabetes: results from a United Kingdom study. *Diabet Med* 22: 554–562, 2005.
183. Eddy DM, Schlessinger L. Archimedes: A Trial-validated Model of Diabetes. *Diabetes Care* 26:3093–3101, 2003.

184. Kahn R, Buse J, Ferrannini E, et al. The Metabolic Syndrome: Time for A Critical Appraisal: Joint Statement from The American Diabetes Association and The European Association for the Study of Diabetes. *Diabetes Care* 2005; 28: 2289 – 2304.
185. The Multiple Risk Factor Intervention Trial Research Group. Mortality After 16 Years for Participants Randomized to The Multiple Risk Factor Intervention Trial. *Circulation* 1996; 94: 946 – 951.
186. Gaede P, Vedel P, Larsen N, et al. Multifactorial Intervention and Cardiovascular Disease in Patients with Type 2 Diabetes. *N Engl J Med* 2003; 348: 383 – 393.
187. Early Treatment of Diabetic Retinopathy Study (ETDRS) Investigators. Aspirin Effects on Mortality and Morbidity in Patients with Diabetes Mellitus. *JAMA* 1992; 268: 1292 -1300.
188. Ridker PM, Cook NR, Lee IM, et al. A Randomized Trial of Low-dose Aspirin in the Primary Prevention of Cardiovascular Disease in Women. *N Engl J Med* 2005; 352: 1293 -1304.
189. Steering Committee of the Physicians' Health Study Research Group. Final Report on the Aspirin Component of the Ongoing Physicians Health Study. *N Engl J Med* 1989; 321: 129 – 135.
190. Belch J, MacCuish A, Campbell I, et al. The Prevention of Progression of Arterial Disease and Diabetes (POPADAD) Trial: Factorial Randomised Placebo Controlled Trial of Aspirin and Antioxidants in Patients with Diabetes and Asymptomatic Peripheral Arterial Disease. *Br Med J* 2008; 337: a1840.
191. Ogawa H, Nakayama M, Morimoto T, et al for the Japanese Primary Prevention of Atherosclerosis With Aspirin for Diabetes (JPAD) Trial Investigators. Low-dose Aspirin for Primary Prevention of Atherosclerotic Events in Patients with Type 2 Diabetes: A Randomized Controlled Trial. *JAMA* 2008; 300: 2134 – 2141.
192. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), Final Report. *Circulation* 2002; 106: 3143 – 3421.
193. King LB. Impact of a Preventive Program on Amputation Rates in the Diabetic Population. *J Wound Ostomy Continence Nurs* 2008; 35: 479 – 482.
194. Comprehensive Foot Examination and Risk Assessment: A report of the Task Force of the Foot Care Interest Group of the American Diabetes Association, with Endorsement by the American Association of Clinical Endocrinologists. *Diabetes Care* 2008; 31: 1679 – 1685.
195. Viswanathan V, Madhavan S, Rajasekar S, et al. Amputation Prevention Initiative in South India. *Diabetes Care* 2005; 28: 1019 – 1021.
196. Singh N, Armstrong D, Lipsky BA. Preventing Foot Ulcers in Patients With Diabetes. *JAMA* 2005; 293: 217 -228.
197. National Institute of Health (NIH) Consensus Development Panel on Impotence. *JAMA* 1993; 270: 83 – 90.
198. Montagne DK, Barada JH, Belker AM, et al. Clinical Guidelines Panel on Erectile Dysfunction. Summary Report on the Treatment of Erectile Dysfunction. *J Urol* 1996; 156: 2007 – 2011.
199. Feldman HA, Goldstein I, Hatzichristou DG, et al. Impotence and its Medical and Psychosocial Correlates: Results of the Massachusetts Male Aging Study. *J Urol* 1994; 151: 54 - 61.
200. Jonler M, Moon T, Brannan W, et al. The Effect of Age, Ethnicity and Geographical Location on Impotence and Quality of Life. *Br J Urol* 1995; 75: 651 – 655.
201. Bacon CG, Hu FB, Giovannucci E, et al. Association of Type and Duration of Diabetes with Erectile Dysfunction in A Large Cohort of Men. *Diabetes Care* 2002; 25: 1458 – 1463.
202. Vinik AI, Richardson D. Erectile Dysfunction in Diabetes. *Clin Diabetes* 1996; 14: 111 – 124.
203. Shiri R, Hakama M, Hakkinen J, et al. Relationship Between Smoking and Erectile Dysfunction. *Int J Impot Res* 2005; 17: 164 – 169.
204. Teng TO, Osgood ND. The Link Between Smoking and Impotence: Two Decades of Evidence. *Prev Med* 2001; 32: 447 – 452.
205. Zemel P. Sexual Dysfunction in the Diabetic Patient with Hypertension. *Am J Cardiol* 1988; 61: 27H - 33H.

206. Esposito K, Giugliano F, Martedi E, et al. High Proportions of Erectile Dysfunction in Men with the Metabolic Syndrome. *Diabetes Care* 2005; 28: 1201 – 1203.
207. Sasayama S, Ishii N, Ishikura F, et al. Men's Health Study: Epidemiology of Erectile Dysfunction and Cardiovascular Disease. *Circ J* 2003; 67: 656 – 659.
208. Kolodny L. Erectile Dysfunction and Vascular Disease. *Postgrad Med* 2003; 114: 30 – 40.
209. Lim TO, Das A, Rampal S, et al. Cross-cultural Adaptation and Validation of the English Version of the International Index of Erectile Function (IIEF) for use in Malaysia. *Int J Impot Res* 2003; 15: 329 – 336.
210. Wright PJ. Comparison of Phosphodiesterase Type 5 (PDE5) Inhibitors. *Int J Clin Pract* 2006; 60: 967 – 975.
211. Rendell MS, Rajfer J, Wicker PA, et al. Sildenafil for Treatment of Erectile Dysfunction in Men with Diabetes: A Randomized Controlled Trial. *JAMA* 1999; 281: 421 – 426.
212. Goldstein I, Young JM, Fischer J, et al. Vardenafil, A New Phosphodiesterase Type 5 Inhibitor, in the Treatment of Erectile Dysfunction in Men with Diabetes: A Multicenter Double-blind Placebo-controlled Fixed-dose Study. *Diabetes Care* 2003; 26: 777 – 783.
213. Saenz de Tejada I, Anglin G, Knight JR, et al. Effects of Tadalafil on Erectile Dysfunction in Men with Diabetes. *Diabetes Care* 2002; 25: 2159 – 2164.
214. Lindstrom J, Louheranta A, Mannelin, et al for The Finish Diabetes Prevention Study Group. The Finish Diabetes Prevention Study (DPS). *Diabetes Care* 2003; 26: 3230 – 3236.
215. Pan XR, Li GW, Hu YH, et al. Effects of Diet and Exercise in Preventing NIDDM in People with Impaired Glucose Tolerance. The Da Qing IGT and Diabetes Study. *Diabetes Care* 1997; 20: 537 – 544.
216. Eriksson KF, Lindgarde F for the 6-year Malmo Feasibility Study. Prevention of Type-2 (non-insulin-dependent) Diabetes Mellitus by Diet and Physical Exercise. *Diabetologia* 1991; 34: 891 - 898.
217. Ramachandran A, Snehalatha C, Mary S, et al for the Indian Diabetes Prevention Programme (IDPP). The Indian Diabetes Prevention Programme Shows That Lifestyle Modification and Metformin Prevent Type 2 Diabetes in Asian Indian subjects with Impaired Glucose Tolerance (IDPP-1). *Diabetologia* 2006; 49: 289 – 297.
218. Chiasson JL, Gomis R, Hanefeld M, et al. The STOPNIDDM Trial: An International Study on the Efficacy of An Alpha-glucosidase Inhibitor to Prevent Type 2 Diabetes in a Population with Impaired Glucose Tolerance: Rationale, Design, and Preliminary Screening Data. Study to Prevent Non-Insulin-Dependent Diabetes Mellitus. *Diabetes Care* 1998; 21:1720 – 1725.
219. Torgerson JS, Hauptman J, Boldrin MN, et al. Xenical in the Prevention of Diabetes in Obese Subjects (XENDOS) Study: A Randomized Study of Orlistat As An Adjunct to Lifestyle Changes for the Prevention of Type 2 in Obese Patients. *Diabetes Care*. 2004; 27: 155 – 161.
220. Gerstein HC, Yusuf S, Bosch J, et al for the Diabetes Reduction Assessment with Ramipril and Rosiglitazone Medication (DREAM) Trial Investigators. Effect of Rosiglitazone on the Frequency of Diabetes in Patients with Impaired Glucose Tolerance or Impaired Fasting Glucose: A Randomized Controlled Trial. *Lancet* 2006; 368: 1096 – 1105.
221. Tee ES, Mohd Ismail N, Mohd Nasir A, et al. Nutrient Composition of Malaysian Foods. Institute for Medical Research (IMR). Kuala Lumpur, 1997.
222. Foster-Powell K, Holt SHA, Brand Miller JC. International Table of Glycemic Index and Glycemic Load Values. *AM J Clin Nutr* 2002; 76: 5 – 56.
223. World Health Organization (WHO), International Obesity Task Force (IOTF), International Association for the Study of Obesity (IASO). The Asia Pacific Perspective: Redefining Obesity and its Treatment. Hong Kong, 2000.
224. Medical Nutrition Therapy Guidelines for Type 2 Diabetes. Malaysian Dietitians' Association, 2005.

Carbohydrate Content of Common Malaysian Foods [221]

Foods	Serving	Calories (kcal)	Carbohydrate content (g)	Approx. Carbohydrate Exchanges* *1 carbohydrate food exchange = 15 g
Cooked rice	1 bowl (159g)	207	48	3
Roti canai	1 piece (95g)	301	46	3
Chappati	1 piece(100g)	300	47	3
Curry mee	1 bowl (450g)	549	55	4
Fried noodles (mee/mee hoon)	1 plate (170g)	281	41	3
Bread (white/wholemeal)	1 slice (30g)	70	15	1
Biscuits, unsweetened	2 pieces (18g)	80	14	1
Curry puff	1 piece (40g)	128	17	> 1
Potato	1 medium (90g)	90	16	1
Dhall (raw)	½ cup (98g)	98	64	4
Full cream milk	1 cup (250 ml)	187	18	1
Low fat milk	1 cup (250 ml)	131	12	1
Skim milk powder	4 tablespoon (28g)	100	16	1
Condensed milk, sweetened	2 tablespoon (40g)	126	21	1.5
Apple/orange	1 medium (114g)	40	9	< 1
Banana (pisang mas)	1 small (50g)	40	9	< 1
Star fruit	1 medium (260g)	56	11	1
Durian local	5 small seeds (189g)	64	12	1
Langsat/grapes/longan	8 small (233 g)	52	12	1
Guava	½ fruit (100g)	50	11	1
Watermelon/papaya/ pineapple	1 slice (160g)	56	11	1
Mango	1 small (100g)	50	11	1

Glycaemic Index of Foods [222]

Low GI (<55)	Intermediate GI (56-70)	High GI (>70)
Sponge cake, plain	Pastry	Waffles, doughnut
Unsweetened apple/carrot/orange juice	Soft drinks (carbonated & sugar) Cordial drink	Sports drink
All bran breakfast cereal	Instant porridge Wheat biscuits	Cornflakes
Brown rice	White rice Basmati rice Capati Idli	Jasmine rice Glutinous rice
Full fat milk Skim milk Low fat milk Yogurt Soymilk	Ice cream Sweetened condensed milk	
Apple Banana Grapes Mango	Papaya Pineapple	Dates Lychee Watermelon
Baked beans Chickpeas Lentils Mung bean		
Fructose Lactose	Honey Sucrose	Glucose

Examples of Physical Activity [223]

Mild Activities	Moderate activities	Strenuous activities
Brisk walking on flat surfaces	Faster walking	Jogging
Cycling on level surface	Walking down stairs	Climbing stairs
Gardening, weeding	Cycling	Football
House painting	Doing heavy laundry	Squash
Mopping the floor	Ballroom dancing (slow)	Swimming
Cleaning windows	Badminton (non-competitive)	Tennis
Golf – walking & pulling	Aerobics (low impact)	Jumping rope
Bowling		Basketball

Food Exchange List[224]

Cereals, Grain Products and Starchy Vegetables (Each item contains 15g carbohydrate)	
Cereals, Grain & Bread	
Rice, white unpolished (cooked)	1/3 Chinese bowl or ½ cup
Rice porridge (thick)	2/3 Chinese bowl or 1 cup
Kuey teow	1/3 Chinese bowl or ½ cup
Mee hoon	
Tang hoon	
Spaghetti	
Macaroni	
Loh see fun	
Yellow mee	1/3 piece
Wanton Mee	
Egg noodle	
Idli	1 piece
Putu mayam	
Tosai	½ piece
Chappati	1/3 piece
Bread (wholemeal, high fiber, white/brown)	1 slice
Plain roll	1 small piece
Burger bun	½ piece
Pita bread, diameter 6”	
Oatmeal, cooked	¼ cup
Oats, uncooked	
Muesli	
Flour (wheat, rice, atta)	3 rounded tablespoons
Biscuits (plain, unsweetened)	3 pieces
Small thin, salted biscuits (4.5X4.5cm)	6 pieces

Starchy Vegetables	
* Baked beans, canned	1/3 Chinese bowl or ½ cup
* Lentils	2/3 Chinese bowl or 1 cup
* (Contains more protein than other foods in the list i.e. 5g/serve)	
Corn kernel (fresh/canned)	½ cup
Peas (fresh/canned)	
Breadfruit (sukun)	½ cup
Carrot	
Sweet Potato	
Tapioca	
Yam	
Pumpkin	1 cup (100g) / ½ cup
Corn on the cob, 6 cm length	1 small
Potato	1 small or ½ cup
Waterchestnut	4 pieces
All other leafy vegetables can be freely eaten	
Fruits (Each item contain 15g carbohydrate)	
Apple	1 medium
Custard apple (buah nona)	
Orange	
Star Fruit	
Pear	
Peach	
Persimmon	
Sapodilla (ciku)	
Kiwi	
Banana (emas)	1 small
Banana (except for emas)	½ whole

Hog plum (kedondong)	6 whole
Mangosteen	2 small
Plum	
Duku Langsat	8 pieces
Grapes	
Langsat	
Grapes	
Langsat	
Longan	
Water apple (jambu air), small	
Water apple (jambu air), big	4 whole
Lychee	5 whole
Rambutan	
Pamelo	5 slices
Papaya	1 slice
Pineapple	
Watermelon	
Soursop (durian belanda)	
Guava	½ whole
Jackfruit (cempedak)	4 pieces
Jack fruit (nangka)	
Prunes	3 pieces
Dates (kurma), dried	2 pieces
Raisin	1 dessert spoon
Durian	2 medium seeds
Mango	½ small

Lean Meat, Fish and Meat Substitute [Each serving of meat and substitutes contain 7g protein. These foods contain varying amounts of fat and energy, but negligible carbohydrate except for Beans & lentils (*).]	
Lean Meat	
Chicken (raw, without skin)	½ drumstick
Lean meat (beef/mutton/pork etc)	1 matchbox size
Poultry (chicken/duck)	½ drumstick
Egg (hen)	1 medium
Soya bean curd (taukua)	½ piece (60g)
Soya bean curd (soft, tauhoo)	¾ piece (90g)
Soya bean curd, sheet (Fucok)	1 ½ sheets (30g)
Tempeh	1 piece (45g)
Cheese, cheddar	2 thin slices (30g)
Cottage cheese	¼ small cup
Fish, Shellfish	
Fish (e.g. ikan kembong, selar)	½ piece
Fish cutlet	¼ piece
Squid	1 medium
Crab meat	¼ cup
Lobster meat	
Prawn meat	
Cockles	20 small
* Dried red bean/mug bean	1/3 cup cooked
* Dhal gravy	1 cup cooked
* Taukua (soya bean hard)	½ piece
* Soft tauhu	¾ piece
* Fucuk	1 ½ sheet
* Tempeh	1 piece
Fat (Each item contains 5g of fat. Nuts and seeds also contain small amount of carbohydrate and protein besides fat)	
Oil (all types)	1 level teaspoon (5g)
Butter, margarine	
Cooking oil (all types)	

Mayonnaise	1 level teaspoon
Shortening, lard	
Peanut butter (smooth or crunchy)	2 level teaspoons
Cream, unwhipped (heavy)	1 level tablespoon
Cream cheese	
Salad dressing	
Cream, unwhipped (light)	2 level tablespoons
Coconut, shredded	
Coconut milk (santan)	
Non diary creamer, powder	
Almond	6 whole
Cashew nut	
Walnut	1 whole
Peanut	20 small
Sesame seed	1 level tablespoon
Watermelon seed (kuaci with shell)	¼ cup
Milk [These foods contain varying amount of carbohydrate (12 - 15g CHO per exchange)]	
Fresh cow's milk	1 cup (240 ml)
UHT fresh milk	
Powdered milk (skim, full cream)	4 rounded tablespoons or 1/3 cup
Yogurt (plain/low fat)	¾ cup
Evaporate (unsweetened)	½ cup
Cheese	2 slices
Grated cheese	2 tablespoon

The 5-Item Version of the International Index of Erectile Function (IIEF-5)[209]

Please choose the appropriate column for each question about your sexual abilities over the past 4 weeks.

1. *How do you rate your confidence that you could get and keep an erection?*		Very low 1	Low 2	Moderate 3	High 4	Very high 5
2. *When you had erections with sexual stimulation, how often were your erections hard enough for penetration (entering your partner)?*	No sexual activity 0	Never or almost never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always or always 5
3. *During sexual intercourse, how often were you able to maintain your erection after you had penetrated (entered) your partner?*	Did not attempt intercourse 0	Never or almost never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always or always 5
4. *During sexual intercourse, how difficult was it to maintain your erection to completion of intercourse?*	Did not attempt intercourse 0	Extremely difficult 1	Very difficult 2	Difficult 3	Slightly difficult 4	Not difficult 5
5. *When you attempted intercourse, how always or was it satisfactory for you?*	Did not attempt intercourse 0	Never or almost never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than time) 4	Almost often always 5

- All questions are preceded by the phrase 'Over the past 4 weeks'
- Add the scores for each item 1-5 (total possible score = 25). ED Severity Classification: Total score 1-7 (severe ED); 8-11 (moderate ED); 12-16 (mild to moderate ED) 17-21 (mild ED); 22-25 (no ED)

Indeks Fungsi Seks Antarabangsa (IIEF-5) [209]

Soalan-soalan ini bertanya tentang kesan ke atas kehidupan seks (kemampuan seks) anda akibat masalah ketegangan zakar (kemaluan atau 'batang' keras) di sepanjang 4 minggu yang lalu. Sila jawab soalan-soalan berikut dengan sejujur dan sejelas mungkin. Bagi menjawab soalan-soalan itu, definisi berikut
adalah berkaitan:

- **Kegiatan seks** meliputi persetubuhan, belaian (rabaan, usapan), cumbuan dan perlancapan
- **Persetubuhan** ditakrif sebagai kemasukan zakar (kemaluan) ke dalam faraj (pintu rahim) pasangan (zakar anda memasuki alat kelamin pasangan anda)
- **Rangsangan seks (naik nafsu seks)** meliputi keadaan seperti mencumbui pasangan, melihat gambargambar erotik atau lucah, yang menaikkan rasa nafsu seks, dll.
- **Terpancut** pemancutan air mani daripada zakar (atau perasaan seolah-olah berlaku pemancutan)

1. *Bagaimanakah anda menentukan kadar keyakinan yang kemaluan anda berfungsi dan dapat mengekalkan ketegangannya.*		Sangat rendah 1	Rendah 2	Sederhana 3	Tinggi 4	Sangat Tinggi 5
2. *Apabila anda mengalami ketegangan zakar (kemaluan atau 'batang' keras) menerusi rangsangan seks, berapa kerap ketegangan itu cukup keras untuk persetubuhan?*	Tidak rangsangan seks 0	Langsung tidak pernah/ hampir tidak pernah 1	Beberapa kali (kurang daripada 50%) 2	Kadang-kadang (kira-kira 50%) 3	Sering kali (lebih dari 50%) 4	Setiap kali/ Hampir setiap kali 5
3. *Sewaktu bersetubuh, berapa kerap anda dapat mengekalkan ketegangan kemaluan sehingga selesai persetubuhan?*	Tidak mencuba persetubuhan 0	Langsung tidak pernah/ hampir tidak pernah 1	Beberapa kali (kurang daripada 50%) 2	Kadang-kadang (kira-kira 50%) 3	Sering kali (lebih dari 50%) 4	Setiap kali/ Hampir setiap kali 5
4. *Sewaktu bersetubuh, berapa sukarkah untuk mengekalkan* ketegangan kemaluan sehingga selesai persetubuhan?	Tidak mencuba bersetubuh 0	Tersangat sukar 1	Sangat sukar 2	Sukar 3	Sukar sedikit 4	Tidak sukar 5
5. *Apabila anda cuba melakukan persetubuhan, berapa kerap anda berasa puas hati?*	Tidak mencuba persetubuhan 0	Langsung tidak pernah/ hampir tidak pernah 1	Beberapa kali (kurang daripada 50%) 2	Kadang-kadang (kira-kira 50%) 3	Sering kali (lebih dari 50%) 4	Setiap kali/ Hampir setiap kali 5

- Semua soalan, bermula dengan "Disepanjang 4 minggu yang lalu,"
- Jumlahkan skor pada setiap item 1-5 (Jumlah skor yang mungkin = 25).
- Klasifikasi Keterukan ED : Jumlah skor 1-7 (sangat teruk); 8-11 (sederhana); 12-16 (ringan hingga sederhana); 17-21 (ringan); 22-25 (tidak ada masalah ED)

Dosage of Antidiabetic Agents in Renal Failure [16]

Generic Name	Usual Dose	Dose adjustment in renal failure		
		Mild (GFR 60 - 90ml/min)	**Moderate** (GFR 30 - 60ml/min)	**Severe** (GFR <30ml/min)
Sulphonylureas				
Chlopropamide	250mg od – 500mg od	Avoid	Avoid	Avoid
Glibenclamide	5mg od – 10mg bd	25-50%	Avoid	Avoid
Gliclazide	80mg od – 160mg bd	50-100%	25-50%	Avoid
Glimepiride	1mg od – 4mg od	100%	50%	Avoid
Glipizide	2.5mg od – 15mg od	100%	50%	Avoid
Others				
Acarbose	25mg tds – 100mg tds	50-100%	50-100%	Avoid
Exenatide	5mcg bd – 10 mcg bd	100%	100%	Avoid
Insulin	Variable	100%	75%	50%
Metformin	500mg bd – 1g bd	50%	25%	Avoid
Nateglinide	120mg tds	100%	100%	50-100%
Pioglitazone	15mg od – 30mg od	100%	100%	50-100%
Repaglinide	0.5mg tds – 4mg tds	100%	100%	50-100%
Rosiglitazone	4 – 8 mg od	100%	100%	50-100%
Sitagliptin	100mg od	100mg	50mg	25mg

od = once daily; bd = twice daily; tds = three time daily

Modified from the Malaysian Clinical Practice Guidelines for the Management of Diabetic Nephropathy, 2004.

Clinical Monitoring Protocol [20]

Test	Initial Visit	Follow-up visit	Quarterly visit	Annual visit
Eye: visual acuity fundoscopy				
Feet: pulses neuropathy				
Weight				
BMI				
Blood Pressure				
Blood Glucose				
HbA1c				
Cholesterol/HDL cholesterol				
Triglycerides				
Albuminuria*				
Creatinine/BUN				
ECG				
Urine microscopy				

= Conduct test
= No test required
= Conduct test if abnormal first visit

* Microalbuminuria if resources are available

Adapted from the International Diabetes Federation Western Pacific Region (IDF-WPR) Type 2 Diabetes Practical Targets and Treatment, Fourth Edition, 2005.

GLOSSARY OF TERMS

ACEI	Angiotensin Converting Enzyme Inhibitor
ADA	American Diabetes Association
AGI	α-glucosidase inhibitor
AHA	American Heart Association
ARB	Angiotensin II Receptor Blocker
BD	Twice Daily *(Bis Die)*
BMI	Body Mass Index
BP	Blood Pressure
BUN	Blood Urea Nitrogen
CCB	Calcium Channel Blocker
CCF	Congestive Cardiac Failure
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
DCCT	Diabetes Control and Complications Trial
DKA	Diabetes Ketoacidosis
DM	Diabetes Mellitus
DN	Diabetic Nephropathy
DPP-4	Dipeptidyl peptidase-4
ECG	Electrocardiogram
ED	Erectile Dysfunction
ETDRS	Early Treatment of Diabetic Retinopathy Study
FPG	Fasting Plasma Glucose
GDM	Gestational Diabetes Mellitus
GI	Glycaemic Index
GIK	Glucose Insulin Potassium
GIP	Glucose-dependent Insulinotropic Polypeptide
GLP-1	Glucagon-like Peptide 1
HbA1c	Glycosylated Haemoglobin
HDL	High Density Lipoprotein
IDF	International Diabetes Federation
IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
JPAD	Japanese Primary Prevention of Atherosclerosis with Aspirin for Diabetes

LBW	Low Birth Weight
LDL	Low Density Lipoprotein
LGA	Large for Gestational Age
LPOS	Loss Of Protective Sensation
LSCS	Lower Segment Caesarean Section
MNT	Medical Nutrition Therapy
NCEP	National Cholesterol Education Program
NPH	Neutral Protamine Hagedorn
NSAIDs	Non-steroidal Anti-inflammatory Drugs
OAD	Oral Anti-diabetic
OD	Once Daily *(Omni Die)*
OGTT	Oral Glucose Tolerance Test
OM	On Morning *(Omni Mane)*
ON	On Night *(Omni Nocte)*
OSAS	Obstructive Sleep Apnoea Syndrome
PCOS	Polycystic Ovarian Syndrome
PDE-5	Phospodiesterase-5
POPADAD	Prevention of Progression of Arterial Disease and Diabetes
PPAR-γ	Peroxisome Proliferator-Activated Receptor-Gamma
PPG	Post-prandial Plasma Glucose
RPG	Random Plasma Glucose
S/C	Subcutaneous
SBMG	Self Blood Monitoring Glucose
SGA	Small for Gestational Age
SIADH	Syndrome of Inappropriate Antidiuretic Hormone
SU	Sulphonylurea
T2DM	Type 2 Diabetes Mellitus
TDS	Three Times Daily *(Ter Die Sumendus)*
TG	Triglycerides
TZD	Thiazolidinedione
UKPDS	United Kingdom Prospective Diabetes Study
WC	Waist Circumference
WHO	World Health Organisation

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LEVELS OF EVIDENCE SCALE

The definition of types of evidence and the grading of recommendation used in this guideline originate from the U.S./Canadian Preventive Services Task Force and are set out in the following tables:

I	Evidence obtained from at least one properly randomized controlled trial
II – 1	Evidence obtained from well-designed controlled trials without randomization
II – 2	Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group
II – 3	Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence
III	Opinions of respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees

SOURCE: U.S./CANADIAN PREVENTIVE SERVICES TASK FORCE

GRADES OF RECOMMENDATIONS

A	At least one meta analysis, systematic review, or RCT, or evidence rated as good and directly applicable to the target population
B	Evidence from well conducted clinical trials, directly applicable to the target population, and demonstrating overall consistency of results; or evidence extrapolated from meta analysis, systematic review, or RCT
C	Evidence from expert committee reports, or opinions and/or clinical experiences of respected authorities; indicates absence of directly applicable clinical studies of good quality

SOURCE: MODIFIED FROM SCOTTISH INTERCOLLEGIATE GUIDELINES NETWORK (SIGN)