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MINISTRY OF PUBLIC HEALTH AND SANITATION

KENYA NATIONAL DIABETES EDUCATORS MANUAL

FIRST EDITION

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Kenya National Diabetes Educators Manual

Funded by: Ministry of Public Health and Sanitation, World Diabetes Foundation and the International Diabetes Federation.

Process supported by: Ministry of Medical Services, Kenya Diabetes Management and Information Centre (DMI) and Diabetes Kenya Association (DKA)

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FOREWORD

The incidence of diabetes throughout the world, and in particular in sub-Saharan Africa, is increasing at an alarming rate and contributes significantly to the growing human and public health costs of diabetes. Such costs can be decreased by incorporating active participation of people with diabetes in their own treatment. That participation, however, can only be accomplished by adequate motivation and education of these people by well trained personnel in the health care team. As such, a parallel increase in the development of diabetes education, as a specialty, is essential to meet this growing demand. Thus, an urgent need exists for health professionals in Kenya to have access to first- class professional education in diabetes that is culturally relevant.

The Kenya Diabetes Educators Manual provides an up to date resource for all diabetes educators in all health facilities and at the community level. With this educational resource, diabetes healthcare professionals anywhere in Kenya can teach other health professionals about diabetes care using consistent, evidence-based research and information.

It is against this background that the Ministry of Public in collaboration with other line ministries with the support of local and international stakeholders developed this education manual for diabetes educators.

The adoption and utilization of this guideline will improve diabetes care in this country, particularly promoting self management which will eventually improve the lives of people living with diabetes.

The ministry appreciates the effort put by all players in coming with this important document. In the same spirit I would wish to see it adopted and implemented in all our health care outlets countrywide.

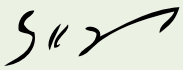
Hon. Beth W. Mugo, EGH, MP
Minister for Public Health and Sanitation

INTRODUCTION

The diabetes education in Kenya is an up-coming practice that is little known, and therefore underused. In countries where there is some awareness, diabetes educators are recognized as important members of the diabetes care team. These practitioners are well known in the developed world and the practice is governed by licensing authorities. In Kenya, the situation is quite different. The awareness and availability of diabetes educators need to be expanded and spread throughout the country to avail all people with diabetes and their families with the valuable services these professionals can offer.

Diabetes education has been shown to be effective, and is now considered an integral part of diabetes care interventions. The Ministries of Public Health recognizes the need for a structured diabetes education programme which culminates into a recognized diabetes educator status. Currently, diabetes educators' cadre in Kenya is almost non-existent or if it exists is not officially recognized. There is therefore a need to ensure that quality diabetes education-training programme is developed that will allow in built review processes and best practices to be identified. A clear role for diabetes educator within the country needs to be identified.

The public has a major role to play in the awareness and prevention of diabetes and its complications. The educator has to understand the community's beliefs, cultural and social values to enable promotion of community awareness of the disease. Intervention is only possible when communities undertake certain changes in lifestyle and social behaviour that promote diabetes.
The members of the diabetes care team help people with diabetes to monitor and manage their care, help them to set treatment goals and time lines to reach those goals. They can outline what treatment choices people with diabetes have, teach them self-care skills, help them solve problems and evaluate how their diabetes treatment plan is working.



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The Kenya Diabetes Educators Manual was prepared with the active participation of several diabetes experts from several organizations in Kenya. The participation of the following individuals and organization is gratefully appreciated

The manual is based on the Diabetes Educators Training Manual for Sub Sahara Africa developed by the International Diabetes Federation (IDF) Africa whom we owe thanks for allowing us to use the materials.

The collation of review materials was supported by Dr. Mohammed Gaman and Dr. Eva Njenga who are renowned diabetologists. Funding for the process of development of these Guidelines was provided by the World Diabetes Foundation (WDF) through the National Diabetes Comprehensive Care Project. The process received a lot of technical support from the Kenya Diabetes Management and Information Centre (DMI), Diabetes Kenya Association, the University of Nairobi and Kenyatta National Hospital. Dr. Joyce N. Nato of the World Health Organization, Kenya Country Office provided technical advice to the drafting team. We thank all our regional diabetes coordinators (Dr. L.N. Wagana-Central, Dr. C.Muyodi – Coast, Dr. H. Sultani – Western, Dr. Otepo – Nyanza, Dr. Sule – Nairobi, Dr. Njoroge – N. Eastern, Dr. Muli – Eastern, Mr. Kimonjino – R/Valley for their active participation in the process of developing the draft.

The development of the guidelines was carried out under the auspices of the Division of Non-communicable Diseases. In this regard, the support extended by Dr. William K. Maina, Head of the Division and the staff of the division, particularly Zachary Ndegwa, Edward Ndungu and Mrs. Scholastica Mwende is gratefully acknowledged.

MODULE 1

MODULE 1.1 THE ROLE OF THE DIABETES EDUCATOR

Overview

Diabetes educators are an integral part of the diabetes management team. The role of the educator is to enable people with diabetes to manage their condition to the best of their abilities, to allow them to make choices and take actions based on informed judgment that will enhance the quality of life of the person with diabetes. Diabetes educators may come from a variety of health professions and other backgrounds. Those trained as diabetes educators will have added skills which will improve their performance of their primary responsibilities promoting multi-tasking. Educators will understand that they are part of a team, which includes the person with diabetes at its centre, and that their role is to work with other team members to improve the health and quality of life of their patients.

Objectives

At the end of the module, the participant will understand the role of the diabetes educator within the diabetes management team.

Specifically, the participant will be able to:

1. Describe the role of the educator;
2. Describe knowledge and skills required of an educator;
3. Describe methods of maintaining and increasing skills and knowledge;
4. Discuss the expanding clinical role of the diabetes educator.

1. The role of the diabetes educator

- Facilitating empowerment of people with diabetes through teaching recommended/ accepted diabetes knowledge skills that translate into behaviour change.
- Being part of the interdisciplinary health-care team.
- Liaising with other health-care providers and referral services.
- Mentorship and its importance in development of new educators

2. Knowledge and skills required of a diabetes educator

- Broad-based knowledge of diabetes, pathogenesis, diagnosis, prevention, complications, and management.
- Technical skills such as injection technique, blood glucose monitoring, and foot care.
- Interpersonal skills, such as empathy, communication, assertiveness, flexibility, and resourcefulness.
- Presentation, writing, and interviewing skills, understanding the education process for adults and children.
- Understanding of behaviour change and education strategies.

3. Maintaining and increasing knowledge and skills

- Continuous practice in working with people with diabetes and the community.
- Attending training and update courses.
- Assess and evaluate knowledge, and practice.

- Potentially to be part of a research team (evidence-based for diabetes practice).
- Adapting knowledge and skills to local realities.

4. Expanding role of the diabetes educator

- Lobbying for the welfare of people with diabetes (policies cost of care, non discrimination).
- Encouraging support groups as well as diabetes associations.
- Increasing community awareness.
- Increasing awareness of the importance of diabetes education.
- Promoting diabetes education as an independent practice.
- Methods of collaboration with the interdisciplinary health care team

MODULE 1.2: TEAM MANAGEMENT

Overview:

This unit aims to provide participants with the opportunity to consolidate their understanding of the social, educational, dietary and psychological requirements of people with diabetes and how they need to be met using a multidisciplinary approach.

The unit focuses on the professional roles required for true multidisciplinary care. It emphasizes the need for team members to have blended rather than discrete roles and discusses the need to extend traditional roles if specialized team members, such as dieticians or podiatrists, are not available.

The unit also emphasizes the importance of ongoing education in diabetes care for all team members and establishing common protocols and management goals.

Objectives

At the end of the unit, the participant will have an understanding of the importance of multi-disciplinary care in the management of diabetes.

Specifically, the participant will be able to:

1. Discuss the team approach to diabetes care;
2. List ideal members of the team;
3. Understand the different roles of members of the team;
4. Describe how to function within a team;
5. Demonstrate the use of the team approach in different settings;
6. Illustrate the ability to refer as necessary;
7. Discuss the importance of interdisciplinary communication, including team meetings;
8. Identify the need for continued education for team members.

1. The team care approach

- Person with diabetes at the centre.
- Team concept: group of professionals working with people with diabetes and their families for their care.
- Identify professional attitudes and behaviours that are helpful or harmful to people with diabetes.
- Recognize difficulties/barriers, attitudes/biases, team interactions/friction.
- Overcoming barriers through communication, education, and demonstration of abilities.

2. Ideal members of a diabetes care team

- Physician/general practitioners /Clinical officers
- Diabetes specialist e.g. Endocrinologist, diabetologist.
- Diabetes Nurse /educator
- Dietician/Nutritionist.
- Social worker/psychologist.
- Pharmacist.
- Physiotherapist/ Occupational Therapist
- Pediatrician
- Dentist
- Ophthalmologist.

- Podiatrist/Foot care Nurse/ Specialist.
- Nephrologist.
- Urologist.
- Cardiologist.
- Dermatologist/skin specialist

3. The roles of different members of the team

- Professional abilities of different members of the team.
- Respect limitations of team members.

4. How to function with available team members

- The need to adapt to new situations.
- Expanded roles according to the situation.
- Acquisition of knowledge and skills.

5. Use of the team approach in different settings

- Community services.
- Health centers.
- Hospitals.
- Private practice.

6. Referral Patients

- Recognition of personal ability and limitations.
- Knowledge of the patient's situation
- Understand the referral process

7. The importance of interdisciplinary communication,

- Harmonize protocol to ensure that all members of the team work towards the same goal and use a common framework to avoid confusing a person with diabetes, duplicating care, or miscommunication.
- Establish methods for communication and documentation.

8. Continuing education needs of team members

- Awareness of available training/in-service courses in locations for different professionals and non-professionals.
- Auditing of diabetes service

MODULE 1.3: TEACHING AND LEARNING

Overview:

Teaching skills are integral to the role of the diabetes educator. Diabetes educators should do more than hand out information; they should have a good understanding of the principles of the education process and apply these principles in practice.

Diabetes education is an ongoing process that involves assessment, planning, implementation, and evaluation. This process is not dependant on the availability of 'high-tech' resources, but requires a knowledgeable person with excellent communication skills.

The aim of this module is to provide the participant with the knowledge and skills of the diabetes education process.

Objectives

1. Explain the benefits of patient education.
2. Differentiate between teaching and learning.
3. Discuss barriers to teaching and learning.
4. Discuss the three domains of learning: cognitive, affective, and psychomotor.
5. Discuss learning styles and methods.
6. Discuss adult learning.
7. Discuss of learning.
8. Discuss the different teaching methods.
9. Discuss the advantages and disadvantages of different teaching methods.
10. Discuss learning in children and adolescents – Refer to Module 4-1.

1. The benefits of patient education.

> Said but not heard
> Heard but not understood
> Understood but not accepted
> Accepted but not put into practice
> Put into practice but for how long
>
> **KONRAD LORENZ**

An important advance in diabetes care has been the recognition that the most important person in the health-care team involved in care giving is the person with diabetes. The purpose is not to force patients into taking a particular course of action, but rather to advise what, in the light of current knowledge and experience, would be the best course for the patient's well being. If the person with diabetes is to accept responsibility for his or her own health care rather than to rely on others, a new responsibility falls upon the health-care team and diabetes educator, i.e. to provide educational facilities matched to the abilities of those people with diabetes and their capacity to learn.

Although patient education does not necessarily produce behavioural change, education coupled with support from the health-care team can improve glycaemic control; achieve reductions in hospital admission rates, and keto-acidosis and amputation rates.

The value or aims of patient education would therefore be to:
Encourage and empower the person with diabetes to accept responsibility for his own health care.

Empower the person with diabetes to acquire the necessary information.
Empower and motivate the person with diabetes to change his/her behaviour and attitude and successfully manage their diabetes.

2. Differences between Teaching and Learning.

Learning can be defined as the acquiring of knowledge to achieve a change in behaviour/ attitude of the individual/s, which makes them more capable of dealing with their environment.

Learning Can Thus Be Described As:

- Acquiring knowledge and skills.
- Committing to memory.
- A change in behaviour.
- The development of new knowledge, or old knowledge to acquire new qualities.

Teaching or education could be defined as "the activities directed at providing the knowledge, skills, moral values, and understanding required in the normal course of life". Teaching or education tends to prepare the individual for life, as seen in the long term.
Education/teaching refers to the basic knowledge or facts in a specific field or activity. Knowledge refers to the cognitive or thinking process that a participant is engaged in when acquiring new knowledge.

Education/teaching concentrates on literacy and numeric tuition, as well as subject knowledge, life skills, natural laws, personal development, creativity, communication skills, etc. Education/ teaching, therefore, is viewed as a basis on which to build skills and from where an individual can develop.

SKILLS refer to the psychomotor activities of an individual, which involves the coordination between the limbs and the brain.
As can be seen from the above explanation, diabetes education requires the skills of learning and teaching, in order to equip the person with diabetes with the knowledge and skills to manage their life with diabetes effectively.

3. Potential barriers to teaching and learning

a) Lack of Motivation and negative attitude:

- Motivation is the first and very vital step on the road to self-care and self-sufficiency. The person with diabetes should be motivated to achieve a healthy and happy life.

b) Physical barriers:

- Poor eyesight, hearing, and physical handicaps could act as barriers in the teaching and learning process.
- Poor health could result in a reduced attention span, and education needs to be limited to shorter sessions.

c) Emotional barriers:

- The person newly diagnosed with diabetes might not be ready for the learning process, because of not coming to terms to living with diabetes.
- It is common for the person with diabetes to go through the different stages of the grieving process: denial, anger, depression, and then adaptation. While this person is still entrapped

in the phases of denial, anger and depression, the learning process becomes a challenge to both educator and the person in question.

d) Fear:

- Fear and worries about the long-term effects of diabetes apply. The person might think of diabetes as a disaster or burden, and might not feel able to cope with the required change in behaviour and lifestyle

e) Financial concerns:

- Economic concerns on how to deal with financial barriers in the management of diabetes, e.g. costs involved in buying special foods, medication and insulin.
- Lack of transport to medical facilities, managing doctors and hospital expenses.
- Concerns about the possible impact of diabetes on the ability to continue with an existing job or career.

f) Social concerns:

- Lack of family or social support at home or fear of social stigma on being diagnosed with diabetes could act as a barrier to learning.

g) Cultural differences and myths:

- Strict religious or cultural codes could dictate the behaviour of the person with diabetes.
- The attitude of the educator towards cultural differences can act as a barrier to teaching.

h) Language and social class differences:

- Do not assume or take for granted that all words have the same meaning to all people – be aware of attitudes towards social differences.
- Differences in language could be a barrier to both teaching and learning.

i) Age differences:

- Education methods need to be individualized to match the age and experience of the person being educated.

j) Educational skills:

- Lack of reading and numerical skills could act as a barrier to teaching and learning

k) Poor memory:

- Education methods and material must be carefully designed to provide back up to education.
- Develop strategies to assist participants with memory differences.

l) Self-image:

- Some people with poor self-image may need frequent confirmation of their competence.
- Lack of confidence could result in unwillingness to participate in training sessions with groups.
- Diabetes educators should offer sympathetic management and awareness of these difficulties.
- Confidence boosting exercises could be introduced, highlighting the good points of such participants.

m) Personality differences:

- A flexible education and management style is required to cater for the different personality styles, different interest, and boredom levels.

4. The Three Domains of Learning.

There are three domains of learning:

- Cognitive domain: focuses on thinking and knowledge.
- Affective domain: focuses on feelings or attitudes.
- Psychomotor domain: focuses on doing things or manual skills.

It is important to remember that these domains interlink with one another and are not mutually exclusive. 'Skills', on the other hand, do not only apply in a manual context; but we also refer to concepts, such as listening skills, facilitation skills and analytical skills.

The Following Levels Exist In The Cognitive Domain:

- **Knowledge:** The ability to remember or recall previously learned facts.
- **Comprehension:** The ability to understand the facts or principles learned.
- **Application:** The ability to apply knowledge to new situations, i.e., using what has been learned.
- **Analysis:** The ability to breakdown a whole into its component parts, and identifies the relationship between the parts.
- **Synthesis:** The ability to put parts together to form a new whole, e.g. creates, design, plan, and construct.
- **Evaluation:** The ability to judge the value of things according to specific criteria. This is the highest level of the cognitive domain.

Consequently, the ability to remember/recall facts or information is necessary to **understand.** Understanding must exist to be able to apply or use knowledge.
One must be able to **apply** knowledge in order to **analyze,** which in turn is necessary for synthesis. Finally, all prior levels need to be acquired before one can **evaluate.**

5. The Learning Styles

We all learn differently. As people, we use our primary senses of hearing, seeing, touching and of smell, to gather information. Each person has a definite preference about which senses are used to learn and in what combination. It is important to identify what the preferred learning style of each participant is. Select teaching or learning methods that will be most appropriate for the person.

The following learning styles have been identified:

- Visual Learners: learn through looking at things. They need to create visual pictures or images to learn. It would be helpful to draw pictures, create diagrams, etc. in the learning process.
- Tactile Learners: learn through touching and handling materials. They might find it helpful to use highlighters and pencils to underline text or hold material or handouts in their hands, instead of placing them on a table.
- Auditory Learners: learn through listening. It could be helpful for them to read learning

text aloud, and audio tapes could be helpful.
- Kinesthetic Learners: utilize the whole body in the learning process and would be prone to pick up material and walk around and participate physically.
- When teaching, it is important to vary methods of teaching to incorporate all the various learning styles of the participants in a group.

6. Adult learning.

The differences between adult learners tend to be more noticeable because of their differences in previous experiences, concerning work, life experiences, and differences in age, educational background, and personal interests.

The following factors should be considered regarding adult participants:

■ **Physical factors**
- Poor co-ordination and slower reactions might be expected.
- A decline in ability to adapt quickly to environmental changes might occur.
- Decline in muscle strength and stamina might occur.
- A decrease in acuteness of perception, e.g. seeing and hearing might be present.Therefore, ensure that:
- A good physical and social environment is provided for learning.
- Pay attention to physical comfort, e.g. heating and ventilation.
- Visual materials should be large and clear.

■ **Mental factors**
- Some decline in speed of thought processes might occur, requiring increased time to learn.
- Short-term memorizing capacity might be diminished.
- Comprehensive skills and ability to organize material might be enhanced; experience may benefit retention and recall abilities, e.g. through association.
- More difficulty in handling complex and unfamiliar information.
- To achieve the best learning outcomes:
- Ensure that the pace of learning is appropriate.
- Where possible allow participants to progress at their own preferred rate.
- Avoid using techniques that rely heavily on short-term memory.
- Use appropriate learning aids.
- Work towards achieving tangible and realistic goals.

■ **Life/work experiences:**
- Pre-existing ideas, prejudices and beliefs may affect learning.
- External issues and concerns may affect learning, e.g. domestic problems, financial problems, and various other adult concerns.
- Role conflicts may occur, e.g. role of participant vs. role of breadwinner.

It is important to:
- Recognize and use previous experience and knowledge.
- Expect to be challenged.
- Try to identify existing assumptions and beliefs that might interfere with learning.

- **Personality factors:**
  - Adult participants might lack confidence.
  - Might be anxious and fearful of making mistakes.
  - Could be extremely self-conscious and self-critical.

Assist adult participants by:
- Allowing generous practice to reinforce skills.
- Encouraging active participation.
- Providing honest and constructive feedback.
- Being tactful and sensitive when correcting errors.
- Helping to preserve a positive self-image.

1. Motivation
   - Adults can be highly motivated and could set unrealistic high personal targets, which could be counter-productive.

Therefore, it is important to:
- Encourage self-assessment to enable adult participants to recognize achievements.
- Reward success and positive contributions.
- Repeat, summarize, emphasize, and recap, as necessary.

7. Methods of Learning.

People learn by two processes:
a. Learning by observing: offers minimal opportunities for participant involvement and offers low retention rates. Processes, which could be utilized, include lectures, videos, and films, demonstrations of a task, procedure, or equipment.

b. Learning by contributing: involves participants in some kind of activity that leads to learning. If used properly, this process can enhance excitement, stimulation, and active group learning; the learning processes are dependent on interaction among people.

Examples include:
- Brainstorming: helpful to explore attitudes, help with problem solving.
- Discussions: helpful to change attitudes, compare experiences, develop commitment, etc.
- Role-play: the individual practices a face-to-face situation that presents real life; practicing occurs in a safe environment and participants can gain insight into their own and other's behaviours or needs.
- Exercises: participants are asked to perform certain tasks or activities in a small group or individually. This could meet several learning objectives.
- Return demonstration: This involves demonstration of a learnt skill under supervision

8. Different Teaching Methods.
Information and education can be presented in several ways. The following teaching methods are available:

A. Group-based training.
This could be small or large groups. Many people are used to this method of training. Examples are:

- **Formal lectures:**
  - A formal lecture is a presentation given to an audience with little interaction or feedback. This method allows for education of large groups of participants, and a large amount of information is conveyed in a short period.
  - Limitations: could be a lack of participation, a passive form of learning, difficult to assess if learning outcomes are achieved.

- **Group discussions:**
  - Knowledge, ideas, and opinions on a particular subject are freely exchanged between participants and the educator.
  - Useful in most learning programmes and allows for open flexible learning. Can be useful to change attitudes or obtain feedback on participants' level of understanding and ability to apply knowledge.
  - Limitations: discussions may become unfocused, one person may dominate discussions, and interpersonal attitudes may influence the flow of discussions. This form of learning could allow some participants to withdraw and not participate fully, personality clashes could occur.

- **Demonstrations:**

A demonstration is a session where a skill is learned, following a formal procedure, e.g. description/ demonstration of a skill under supervision. This is suitable to teach skills and can be broken down into small stages, e.g. injection techniques, urine or blood glucose testing techniques, foot care, etc.

  - It is important that the demonstration is clearly visible to all participants.
  - Limitations: this does not guarantee that learning will take place, unless consolidated by practice as soon as possible after the demonstration.

- **Brainstorming, discussions, role-play, and exercises:**

  - Allow for group interaction and participation to take place. These sessions need to be well guided.
  - Group-based teaching could be suitable to teach people with diabetes and their families about diabetes, healthy eating habits, foot care, managing a diabetes diary, managing everyday life with diabetes, sick days, exercise, lifestyle changes, etc.

B. One-on-one training.

- **Individual training:**
  - It offers the trainer the opportunity to encourage the participant to acquire new skills and habits in a practical way under the trainer's supervision.
  - One-on-one training facilitates a more personal exchange of opinion and feedback.
  - It allows participants to progress at their own pace.
  - Useful for reviewing progress and discussing specific matters or subjects. Provides an opportunity for individual counseling and guidance.
  - Availability of time might be a limitation.

- This form of teaching is suitable when teaching the person with diabetes on individual eating plans, insulin injection techniques, storing of insulin, etc.

■ **Text-based training.**

- The use of the printed word in the form of handouts, posters, wall charts etc. To stimulate the person with diabetes to acquire knowledge has little value in handing out printed sheets of information in the hope that the educational process will proceed automatically. However, it could be used effectively as an adjunct to other teaching methods.
- When teaching the person with diabetes, handouts, insulin diaries, eating plans and information on foot care, could be text based.
- Charts and pictures could be displayed in the clinic setting. Posters should give an instant clear message. Lettering should be large and clear enough to be read at a distance. Words, illustrations, and diagrams can be used to convey the message.

■ **Technology-based training.**

- Computer-based training: advanced computer technology allows for computerised graphics, animation, and sound, which allows increased participant interaction.
- Interactive video coupled to the computer, with the possibilities of full-motion video, digital sound and photograph quality images, provides exciting new ways of exploring and communicating information, and provides opportunities for participant interaction
- The compact disc (CD) and other data storage devices are an advancing force in computer technology, because of their ability to store vast quantities of data.
- E-learning: Also known as Internet-based training or Web-based training allows learning anywhere and at anytime as long as a properly configured computer is available. This allows participants to learn at their pace and time.

Limitations: a prerequisite for technology-based training is computer literacy, and access to a computer and/or Internet facilities, which could exclude certain participants and patient groups, e.g. those with low literacy levels, low socio-economic status, living in rural areas with poor electricity supply, etc.

10. The Learning Programme:

To ensure effective learning, it is essential to design a learning programme to achieve specific outcomes or competencies.

A learning programme could be defined as "sets of learning activities in which the learner will become involved in working towards the achievement of one or more outcomes". Competency can then be defined as a skill or cluster of skills carried out within an indicated range or context, to specific standards.

Competency therefore requires the integration of knowledge, skills, and attitude (values) that an individual can demonstrate to a defined standard in a specific context.

What should be taken into consideration when designing a learning programme?

a. Identify the need of the participant:

To eliminate unnecessary training or learning that is not related to the need of the participant.

Use the following formula to identify the participant's needs: **DESIRED KNOWLEDGE - EXISTING KNOWLEDGE = LEARNING NEED**. This can also be applied to skills and attitudes:

DESIRED	- EXISTING	=	LEARNING NEED
Knowledge	- Knowledge	=	Learning gap
Skills	- Skills	=	Skills gap
Attitude	- Attitude	=	Attitude gap

b. Identify learning prerequisites,
This is necessary to cope with the learning process, e.g.:

- Physical requirements: good eyesight is required for the person with diabetes to be able to inject insulin with a standard insulin syringe and needle.
- Previously learned skills: the ability to read, write and calculate if the person with diabetes is to manage his/her diabetes at home with a multiple-injection insulin regimen.
- Previously learned knowledge: most persons with diabetes will have no or little biology background. To enable the understanding of diabetes, some knowledge of basic functioning of the body and its systems might be required. Basic knowledge of a specific language might be required.
- Previously learned attitudes: for example, the value of patience, courtesy, self discipline, motivation to learn, ability to accept being corrected and given advice, ability to learn in a group, etc.

c. Identify the specific tasks that have to be learned or learning objectives that have to be met.

- For example, the person with diabetes needs to learn specific skills, such as eating for a healthy lifestyle, self-monitoring that includes urine tests or blood glucose testing, recording of the test results, foot care, eye care, treatment with oral medication or injections with insulin, etc.

d. Decide in which order or sequence the learning objectives will be facilitated;
This will help to ensure maximum learning in the shortest time. Before the participant can achieve competence in the complex skills, the enabling skills must be mastered. For example, the person newly diagnosed with diabetes cannot be expected to learn everything about diabetes in the first education session. It might be vital to learn how to inject insulin, and how to recognize and treat the symptoms of hypoglycaemia in the first education session.

The learning process should be a step-by-step process.

Considering the above concepts, there are three ways to approach the learning process:

- From general to specific
  The participant is first given a broad overview of the topic before the specific parts to learn are introduced.
- From specific to general
  The participant is led through specific learning experiences towards the general end-result.
- From the known to the unknown
- The sequence starts with material or concepts that are familiar to the participant, and then moves on to the new or unknown.

e. Assemble, field test and revise the learning programme:
After completion of the learning programme, it could be of value to test the learning material on participants for their comments on appropriateness and time taken to complete the programme. The necessary changes should be made before embarking on the formal learning programme.

f. Develop an appropriate assessment instrument for each learning outcome: to decide if the participant is competent in the acquired skill or learning outcome.
For example, the educator can ask the person with diabetes to demonstrate how he/she measures the insulin dose, injects the insulin, stores the insulin, tests urine, or blood for glucose, etc.

Simple questionnaires or tick lists can be utilized to assess knowledge on foot care, suitable eating plans, self-care principles, etc.

g. Implement an evaluation system to monitor the effectiveness and success of the learning programme continuously.

h. Ensure that the programme is culturally sensitive:

- It is important to apply equal opportunity practices in the learning process to ensure non-discriminatory practices and a suitable climate for learning.
- Take cultural differences, such as language, backgrounds, experiences, and religious beliefs into consideration.
- Avoid using language that discriminates against groups or individuals on the ground of race, gender or other characteristics.
- Ensure a non-threatening environment, which enhances the learning process.
- Encourage participation of all members in the group.

i. Avoid stereotyping people.
Avoid sexist practices, e.g. always referring to individuals in general as masculine.

j. Demonstrate Active Listening Skills:

- Effective communication allows for two-way communication. An effective educator/ teacher should always listen to what participants are telling them:
- This requires concentrating on the other person talking, followed by a suitable response.
- You need to listen and understand to what the speaker is really telling you, without interrupting.
- You might only need to LISTEN sympathetically – being a good listener enables you to judge whether the speaker wants you to respond verbally.

The following gestures would enhance effective listening:

- Provide/support an environment where the speaker feels comfortable.
- Make supportive eye contact.
- Use encouraging body language.
- Repeat key words and the other person's views to clarify uncertainties.
- Show interest.
- Ask open-ended questions.
- Notice non-verbal or unintentional messages.
- Allow everyone who wants to speak a chance to do so.

k. Demonstrate The Use Of Open-Ended Questions:
A good way to ensure effective two-way communication is to ask questions. By asking questions, the educator/teacher could determine how much background participants have, and how much learning is taking place. In this way, participants feel involved in the learning process.

Closed questions often requires a "yes" or "no" response. They could be useful as a revision aid or assessing promptly what a participant knows; often used before an open-ended question. Closed questions alone do not provide much stimulus or involvement of participants on their own.

Open questions, on the other hand, are used to gain explanations and information from the participant, and usually start with "why, what, how, where or when". Correct questioning techniques are of great value in helping the participant to develop and gain confidence in learning.

The following techniques could be of value:

- Pausing: giving time to participants to assemble their response.
- Prompting: giving a hint at the kind of answer you are looking for by asking a supplementary question, e.g. "Have you thought about…"
- Refocus: if the answer leads away from the point of discussion, lead the group back to the point of origin, e.g. "That is very interesting. Now what about…"
- Seek clarification: should the answer be unclear, ask more guiding questions on what the participant thinks and why, e.g."Are you saying…"; "Do you mean that…"
- Accept: always treat every response with value and without rejection, seek further for the correct answer.

l. Demonstrate Positive Feedback:
It is important to be able to give constructive and positive feedback in the learning process, to ensure a favorable environment for learning to continue. The following steps should be considered when giving positive and constructive feedback:

- Analyze the current situation:
- Be clear in your mind on good performance, as well as problems that need addressing.
- Make a decision on the desired outcomes and objectives:
- Construct an action plan for the feedback session around the desired outcomes objectives – be specific.
- Focus on what needs to be achieved, not on what is wrong.
- Decide what you could do to assist the participant.
- Make sure that your relationship with the participant is not harmed by your feedback.
- Consider receptiveness of participant: Remember that people differ in their ability to accept and absorb feedback. This ability might change daily, depending on how people feel: Some people are ready and able to receive feedback, and desire to know about their progress. Others might feel insecure and doubt their own abilities to improve; they should be approached carefully and at a slower pace.
- Pay close attention to the participants' reactions and listen carefully to their response during the feedback session – adjust the pace and content accordingly.

m. Create the right environment:

- Establish a positive and supportive climate of trust, openness, and mutual respect for giving and receiving feedback. Ensure there are no interruptions during the process.

n. Communicate effectively:
Use effective communication skills, and maintain awareness of the three ways that a message is conveyed:

- What words say (7%).
- How these are said, e.g. tone of voice (38%).
- Body language (55%).

o. Discuss the actions or behaviour that needs changing:

- Concentrate on behaviour and performance that needs changing, and avoid comments on personality.
- Stay with the facts.
- Beware of putting the participant down or using language or behaviour that causes an emotional reaction and defensiveness.
- Clearly describe the desired behaviour or outcomes that need to be achieved.
- Make suggestions and seek a solution together.
- Focus on successful outcomes
- Alternate positive and negative messages by using the Feedback Sandwich Model:

POSITIVE
NEGATIVE
POSITIVE

A good message opens the participant to effective communication.
The negative message is then conveyed to influence improvement of the behaviour.
End with a final good message to leave the participant in a positive frame of mind.

p. Get agreement: the participant cannot be forced to make changes, but instead should be supported and motivated to change the current behaviour to achieve the desired goals/outcomes.

q. Manage Group Dynamics:
To achieve learning outcomes, it is important that educators/ understand how groups and individuals operate and how they should apply their practical skills and knowledge.
The responsibility of the educator/ is to facilitate the following processes:

- Keeping the group/participant focused.
- Defuse conflict.
- Remain neutral and objective.
- Acting in the best interests of the group/participant.
- Help discover the real issues and hidden conflicts.
- Help establish objectives and criteria for measuring progress and success.
- Handle difficult people and redirect energies in a constructive manner.
- Assist with problem identification and problem solving.
- Help establish ground rules and agreements.
- Treat all people with respect.
- Identify and improve one's own weaknesses as an educator

Therefore, it is vital to pay attention to any warning signs of amounting tension, personality clashes, or potential problems. Occasionally, participants can withdraw their co-operation and loose interest

resulting in a breakdown of relationships.
The following behaviour could result in dissatisfaction within the group:

- Participants who show minimal interest and lack of effort to participate in group activities.
- Participants who constantly challenge others to prove that their knowledge are superior.
- Aggressive and argumentative participants.
- Participants who prefer to talk about irrelevant topics.
- Participants who constantly disrupt group activities by having their own conversations during sessions.
- Participants who demand attention all the time.

Some hints on handling difficult participants/people:

- **The quarrelsome type:** do not become involved in arguments, stay neutral, and refer questions to the rest of the group.
- **The shy type:** ask questions and involve in activities to increase confidence.
- **The hijacker (someone who takes over the training session):** interrupt tactfully and limit speaking time.
- **The "know-it-all":** do not criticize or argue; rather use the, "Yes, but…"-technique.
- **The persistent questioner:** pass questions back to the group.
- **The un-cooperative rebel:** give recognition to his/her knowledge and play on his/her ambitions.
- **The grump:** involve in conversations and ask his/her opinion.

The effectiveness of teaching and learning in a group context depends largely on the ability of the educator/ to manage group dynamics. Without harmony and order, effective learning cannot occur.

An effective teaching and learning process aims at changing behaviour, and motives the person with diabetes towards living a full, normal life. The complexity of changing behaviour requires the educator to understand the psychosocial and behavioural approaches in diabetes.

MODULE 1.4: THE PS YCH OSOCIAL ASPECTS OF DIABETES: THE IMPACT ON THE PATIENT AND FAMILY

Overview:

Diabetes mellitus is a chronic condition that has a major impact on the lives of people with diabetes and their families and may complicate family functioning. People with diabetes are faced with the challenges to self-regulate their diabetes, live a full and normal life, while facing the other responsibilities and stresses of life, which is psychologically complex and burdensome. Diabetes is a life-long condition, and as such, affects many aspects of a person and family's life. Some of these are: The need for a regular schedule, Change in eating habits, Daily medication and monitoring, possible changes in occupation and recreational pursuits and possible changes in relationships with people

It is important for the person to identify/acknowledge himself/herself as someone with diabetes. A decision has to be made on who else should know and why, e.g. family, school, employer, responsible adult, etc. The person with diabetes is often concerned how others will react on knowing about their condition.

Feelings and emotions: everyone has feelings about having diabetes, which might differ from day to day:

- Fear and worry about long-term effects of diabetes.
- It is normal to go through the grieving process: denial, anger, depression, and adaptation.
- Feelings and increased stress levels affect the person's blood glucose levels, which in turn could have a negative effect on moods and ability to cope with stress.
- Thoughts influence feelings, which influence motivation and behaviour. For example, people who think of diabetes as a disaster or burden might be less motivated to cope or change behaviour. Consequently, it is important to evaluate the influence of thoughts on behaviour.
- It is important to recognize the person and family's need for support.

Objectives:

1. Describe the psychosocial effects of diabetes on the person with diabetes and family members.
2. Discuss Strategies to Support the Psychosocial Needs of People with Diabetes and their families.

1. Psychosocial Effects of Diabetes and Its Treatment on the Person with Diabetes and Their Family Members

i) Reaction to Diagnosis

The reaction to the diagnosis of diabetes varies with individuals. The Psychosocial adjustment needed by people with diabetes to live well with this condition is a long-term and an up-hill task. Because of the biological changes that have already taken place many changes are required. The members of the team, especially the diabetes educator, have to be prepared for just about any response.

- Some individuals/families have even more adjustments to make within their particular cultural settings.
- They have to combat superstition and other cultural beliefs.
- Their cultural diets and other practices could offer even more challenges to living well with diabetes.

Each person's ability to live with and adjust to diabetes depends on his/her beliefs and attitudes

concerning the disease and health in general. Time must be taken to explore these in detail and correct any misconceptions
The expectations of a newly diagnosed person should firstly be considered:

- Most people believe that the responsibility for their treatment lies with the health-care team. This belief is counterproductive as it is essential for persons with diabetes to undertake their own management.
- Life-long education in diabetes is necessary; regular follow-up sessions will help to maintain the original standards and to introduce new objectives.
- Long-term reinforcement is essential if motivation is to be maintained.
- Not only newly diagnosed persons with diabetes need to attend education sessions, but particularly those with some years of diabetes who usually think they "know it all", are in great need for re-education seeing that knowledge about diabetes is constantly advancing.

It is difficult to explain why some people with diabetes are able to accept and comply with the major adjustments in lifestyle demanded by diabetes, whereas others are not.
Factors that influence acceptance of diabetes and adjustments:

- Attitudes and beliefs about the disease,
- Lack of accepting responsibility for self care
- Lack of comprehension or appreciation of the need to change their behaviour,
- Reluctance to self-monitor
- Fear of hypoglycaemia

Motivation might be poor in those who do not perceive themselves as threatened by diabetes or its complications. Denial is particularly frequent among teenagers

ii) Diabetes and depression

People with diabetes are more likely to develop depression than those without the condition. Depression in people with diabetes is associated with a higher mortality rate, with more than 50% likely to die over a ten-year period compared to people without diabetes. Depression affects a person's ability to manage his/her condition and follow the appropriate diabetes care.

Identifying signs and symptoms of depression in the person with diabetes

- Loss of interest: no longer taking interest in doing things one used to enjoy.
- Change in sleeping patterns: having trouble falling asleep, waking often during the night, or wanting to sleep more than usual, including during the day.
- Early to rise: waking up earlier than usual and not being able to get back to sleep.
- Change in appetite: eating more or less than one used to, resulting in a quick weight gain or weight loss.
- Trouble concentrating: not being able to watch a TV programme or read an article because other thoughts or feelings get in the way.
- Loss of energy: feeling tired all the time.
- Nervousness: always feeling so anxious and not being able to sit still.
- Guilt: feeling one "never does anything right" and worried about being a burden to others.
- Morning sadness: feeling worse in the morning than the rest of the day.
- Suicidal thoughts: feeling like dying or thinking about ways to hurt one-self.

The presence of any of these symptoms is enough reason to seek medical help.

iii) Fear of hypoglycemia/hyperglycaemia

Fear of hypoglycaemia and long-term complications is a common cause of diabetes related stress. Hypoglycaemia is an important cause of people with diabetes losing confidence in their ability to control their condition. This is particularly true for nocturnal hypoglycaemia, since they may be less able to deal with a developing episode themselves, and because third party assistance may be less reliable or available. Many of these people are afraid of dying during an episode of hypoglycaemia. Lack of warning symptoms can be particularly devastating and can shatter the individual's confidence. The increased risk of hypoglycaemia with intensified treatment is a major obstacle towards achieving normal blood glucose levels.

Furthermore, the attainment of blood glucose control within the target levels comes with some cost, not only in terms of hypoglycaemia, but also to personal lifestyle. As a result, some people with diabetes feel that the price of commitment is too high.

Many patients fall victim to "learned hopelessness" feeling that all their lifestyle adjustments will have no or little effect on the outcome of the disease. Long-term complications and their treatment place an enormous burden on patients, their families, and health-care resources.

2. Strategies to Support the Psychosocial Needs of People with Diabetes.

i) Stress management

Different cognitive and behavioural change strategies can be used to cope with the demands of diabetes and treatment related to stress. Most problems can be solved by paying attention to the attitudes and beliefs of the person with diabetes, not only at diagnosis but also throughout this person's life.

Beliefs and behaviour can be changed for the good, if opportunities are provided that can be expressed and explored.

The following are some ways to manage stress:

- Exercise: elevates the mood and helps relax tense muscles.
- Writing: just getting it out on paper can make one's problems seem more bearable (do not worry about spelling or grammar -- this is just for oneself).
- Relaxation exercises: things like yoga, deep breathing, or tensing and relaxing one muscle at a time.
- Distraction: having an evening out, renting a video or getting lost in a good book.
- Massage: this is a great way to relax.
- Meditation or prayer: taking care of one's spiritual side.
- Visualization: is another technique that could be helpful. The person with diabetes visualizes him/herself as successful at meeting goals. This is done by closing one's eyes and picturing oneself in the future when these goals have been met. Visualize how you would look, physically feel, and how your family, and friends would feel about you, and how you feel about yourself. This action could be repeated with regular intervals, especially when feeling discouraged.

ii) Psychosocial Support services available to people with diabetes and their families

- Support groups
- Religious groups
- Peer clubs
- Psychological counseling
- Social services

MODULE 1.5: MODELS FOR FACILITATING BEHAVIOUR CHANGE

Overview:

Because of the complexity of changing behaviour, educators need not only teaching skills but also skills in approaches to behavioural change and motivational interviewing. To be successful, diabetes self-management training must be focused on the promotion of positive behaviour change. In years past, education programmes typically targeted an increase in diabetes knowledge as the critical outcome variable. Through countless studies, however, we have learned that knowledge alone does not have a potent impact on clinical outcomes such as glycaemic control.

Clinical improvement is likely only when knowledge prompts a positive change in self-care behaviour. Without doubt, behaviour change is the major mediating variable linking diabetes self-management training and positive clinical outcomes. Helping people change behaviour involves establishing clear, specific, and reasonable goals that are focused on concrete actions rather than outcomes. Such goal setting requires honesty and a respectful two-way collaboration between the clinician and people with diabetes. It is critical that clinicians be sensitive to the personal obstacles to behaviour change of these people, and addresses these before setting goals.

Objectives

1. Discuss goal setting in behavior change
2. Describe elements of behaviour change.
3. Discuss readiness to behaviour change

1. Goal setting.

Making a list of short and long-term goals related to diabetes, as well as set objectives/ actions towards achieving these goals is a constructive way towards changing behaviour patterns and making a commitment towards change. The educator could assist the person with the setting of realistic timeframes for each objective, considering the costs and benefits of any action or change.

In contrast, setting a goal for weight loss or a reduction in blood pressure is targeting a clinical outcome, a hoped-for result of positive self-care action (or actions), not a direct behaviour as such. This distinction is critically important, especially if motivation is to be respected and encouraged regarding people with diabetes. Consider that a person with diabetes may succeed in enacting new self-care actions (e.g., reducing portion sizes), but still be unable to reach expected outcomes (e.g., 4.5 kg weight loss) because of biological or medical constraints (e.g., high daily doses of insulin). In this situation, if the clinician and individual have focused on a "behavioural" goal of weight loss, both parties are likely to become discouraged. If the targeted goal was actual behaviour change, the person with diabetes can be congratulated on his/her success and, consequently, plans for additional behaviour change are more likely to be enacted and supported.

Behavioural goals should be clear and specific (rather than vague) and reasonable (rather than unrealistic or unachievable).

An example of a clear and specific goal is; "Over the next week, I will go for a 1 mile walk 3 times. I will plan on going right after breakfast on Monday, Thursday, and Saturday." In comparison, a vague goal is "I am definitely going to start exercising." Specific goals target concrete actions to take, not obscure changes in attitude (e.g., "I need more willpower").

Goals tied to clear and specific actions are more likely to be undertaken because the person with diabetes can imagine more easily how to initiate those goals. As a consequence of their specificity, such goals are easily measurable and time-limited. These qualities allow the person with diabetes and

clinician to more accurately determine whether or not the goal has been reached.

An example of a reasonable goal might be, "I will check my blood glucose levels 3 times a week over the next month." Of course, whether or not this is reasonable depends on the unique perspective of the individual, including their previous history of blood glucose monitoring. If this person with diabetes typically monitors twice a day, an additional blood test each day might be quite realistic. However, if this is someone who quit monitoring several years ago and is no longer sure how to use a blood glucometer, then the goal – given his/her current circumstances – may be unreasonable and unachievable at this time.

In some cases, the most effective approach is to develop a realistic goal that targets actions that seem minimal in scope (e.g., the chronically sedentary person who agrees to walk to the end of their driveway and back several days a week). When this person with diabetes reaches the goal, he/she will feel more confident about taking positive actions and will be more enthused about committing to new, more challenging behaviour changes. In contrast, when the clinician pushes for more formidable goals that are unrealistic for the individual at the time, discouragement and feelings of failure are the result.

2. Elements of behaviour change

The idea of behaviour change seems straightforward, yet clinicians make common conceptual mistakes when attempting to promote positive changes in diabetes self-care actions. When setting goals for people with diabetes, for example, a focus on self-care behaviour should not be confused with expecting changes in self-care outcomes.

Successful behaviour change means that the individual is doing the following steps must be applied:

- Awareness of the problem and the need to change
- Motivation to make a change
- Prepare for the change
- Adoption of the new activity or behavior
- Maintenance of the new activity and integration into the lifestyle

■ **Rewarding:**

This is a proven way of changing habits – the person with diabetes should reward him/herself when achieving objectives towards a set goal. This reward could be as simple as taking time to do something enjoyable, such as reading or spending time on a hobby.

■ **Readiness to change behaviour.**

It is important to assess the person's readiness to change behaviour, before embarking on the education process. When barriers to change behavior and learning still exist, these barriers need to be addressed. Appropriate teaching strategies need to be developed, considering these barriers to ensure that effective change can take place. For example, if the person with diabetes is still in anger or denial, initial education sessions should be focused on need-to-know and survival strategies, and possible psychotherapy, rather than embarking on lengthy discussions on management strategies.

MODULE 1.6: COMMUNITY AWARENESS, PROMOTION AND PREVENTION OF DIABETES

Overview:

The need to increase community understanding of the special needs of people with Diabetes is essential. Diabetes health professionals should also promote strategies for the primary prevention of Type 2 diabetes. Many of the strategies used to meet these goals are designed not only to bring about positive change in an individual's behaviour, but also to increase the understanding of the community and to dispel myths surrounding diabetes. Change occurs most readily and permanently when people's environment, home, work and recreation enable them to reinforce change.

Objectives

1. To provide participants with an understanding of the community's knowledge and attitudes towards diabetes including community's perceptions and beliefs about diabetes, and clarification of myths and misconceptions about the disease.
2. To provide participants with an understanding that community strategies need to reflect the differences between Type 1 and Type 2 diabetes.
3. To provide participants with strategies for health promotion and primary prevention of type 2 diabetes

1. Understanding of Diabetes in the local community

The culture of a specific community influences its perception of diabetes. Understanding and evaluating the socio-cultural aspects of diabetes within the community are vital when trying to increase awareness in the community.

Culture determines beliefs and judgment about what is good, what is desirable and has an influence on health-seeking behavior and attitudes. For example, in some communities in Kenya, being plump is considered as a sign of good health and prosperity. This may influence eating patterns, promoting overweight and obesity and hence increase the risk of diabetes. This may create some difficulties when educating and creating awareness on diabetes.

Other beliefs, Myths, and misconceptions influence the acceptance and adherence to self-care skills. The following are some of the misconceptions and myths regarding diabetes in Kenya; these should be considered and addressed:

- Diabetes is a disease of the rich
- Diabetes is the result of eating too much sugar
- Diabetes gets cured after a while
- If you look fat/obese you are healthy despite having diabetes
- Diabetes is the result of a curse
- Diabetes is the result of witchcraft
- Diabetes is cured through prayers since it is brought on by evil spirits
- Traditional healers can cure diabetes
- Alternative therapy preferred over scientific therapy
- Ozone therapy is a cure for diabetes
- Nutritional and herbal supplements can cure diabetes
- Drink and eat bitter leaves to neutralize the blood sugar

2. Approaches to Health promotion and awareness

The community should be made aware of diabetes by using simple and effective methods of education. Appropriate information materials such as brochures and posters in local languages would be useful. Awareness could also be created in plays and drama in road shows, schools and churches.

The following are approaches to health promotion:

a. Medical and behavioural change

Diabetes often causes severe complications that can include heart disease and stroke, blindness, lower extremity amputations, kidney failure, dental disease, and increased susceptibility to infections. Diabetes may affect anyone, however, persons with risk factors, i.e. obese persons, persons with sedentary lifestyle, those with a family history of diabetes, or women with a history of giving birth to children above 4 kg must be advised to have regular screening and undertake lifestyle changes. The components of lifestyle modification and their aims should include, but not be limited to the following list:

- Weight loss of 5% - 10%.
- Reduction in fat intake < 30% of calories.
- Reduction in saturated fat intake < 10% of calories.
- Increase in fibre intake > 15 g/1000 kcal (traditional African diets are high fibre).
- Increase in physical activity levels. This type of exercise (e.g. brisk walking) should last for at least 30 minutes and should be undertaken at least three times a week.
- Formal assessment of sedentary adults for underlying physical conditions that may limit the degree and duration of exercise that will require a structured prescription.
- Reduction in high levels of alcohol intake to less than one drink/day of any type of alcohol.
- Stopping smoking.

b. Patient/local organisation-centred programme

Develop a diabetes-screening programme with the help of local diabetes organizations or medical facilities.

Screening may be planned during routinely at local medical centre or special outreach screening programmes during special days, such as World Diabetes Day, or other special community occasions may be planned. During these screening programmes, persons with diabetes may participate to promote awareness and dispel misconceptions about the disease.

Develop a diabetes health-care team with an interdisciplinary approach.

c. Education

- Training of diabetes educators. Persons trained could offer advice and promote awareness among the community and offer specialized advice to persons with diabetes.
- Develop a Public Awareness Campaign on diabetes and its complications. The campaign may use various tools, such as posters, plays, and talks at church or other gatherings.
- The campaign should include, clear, accurate and consistent messages and information about the risk factors and complications of diabetes and encourage those at risk to be screened and to change their lifestyle.

d. Societal and public policy change

Diabetes affects everybody in some way, and therefore everyone (e.g. individuals; communities; all government sectors including health, agriculture, transport, education, sport, tourism; small business, industry and other corporations) should be responsible to address the determinants of diabetes and related chronic diseases and conditions. There is need for political and administrative goodwill which encourages government ministries/departments and local area decision makers to ensure diabetes becomes a health priority and to support preventative measures.

e. Media

The media serve as important partners in promoting diabetes prevention messages. The following are ways that the media can be involved in awareness and health promotion on diabetes:

- Promote public awareness about the importance of diabetes prevention and the benefits of maintaining a healthy weight with regular physical activity and a healthy diet.
- Disseminate credible and accurate messages that encourage healthy habits and discourage risky behaviours.
- Collaborate with medical professionals, local governments, and private-sector community entities to help the public understand the importance of preventing diabetes.

MODULE 1.7: RESEARCH AND EVALUATION

Overview:

The purpose of this module is to introduce research as a core component of the role diabetes educator. The module should be designed to cater to participants with little or no research training. It should emphasize the role of research in diabetes education and management and as an agent for change, and encourage participants to reflect on their practice and develop skills in critical thinking.

The module is included with the knowledge that the majority of participants will not be formally involved in conducting research, but that they will need research skills to be assess research papers and use the information in their practice. The role of research for individual study should be discussed with respect to:

- Professional development
- Increasing knowledge
- Developing project management skills
- Developing critical appraisal and reflective practice skills
- Improving practice
- Making presentations and/or publishing

Objectives

After completing the module, the participant will be able to:

1. Discuss the three major research methods: qualitative, quantitative, and quality management/audit.
2. Identify the major steps in the research process, including reviewing the literature.
3. Critique research literature, including assessment of bias.
4. Discuss questionnaire development.
5. Describe ethical issues in research, including informed consent.
6. Interpret basic statistical results.
7. Write basic research reports and communicate results.

1. Major research methods

There are 2 major research methods:

i. Qualitative research
ii. Quantitative research

i) Qualitative research

This is non-numerical research which investigates the why and how of decision making, not just what, where, when. Hence, smaller but focused samples are more often needed, rather than large samples. Qualitative research involves analysis of data such as words (e.g., from interviews), pictures (e.g., video), or objects (e.g., an artifact).

ii) Quantitative research

Quantitative research involves analysis of numerical data. The aim is to classify features, count them, and construct statistical models in an attempt to explain what is observed.

2. Types of studies currently used in diabetes research

The two categories of studies that are most frequently reported are experimental and observational (also known as descriptive studies). In experimental studies, the interventions and conditions are strictly defined and controlled. Observational studies describe outcomes in relation to variables of interest, but without intervention on the part of the investigator.

The following is a listing of the most common types of studies:

Experimental studies

The two types of experimental studies are randomized controlled trials and crossover trials:

- ***Randomized controlled trials:*** these are the gold standard of scientific enquiry. A group of subjects with similar characteristics is identified and then randomly assigned to intervention or control groups. In this way, the biases of observational studies are avoided because participants have an equal and unbiased chance of being assigned to each treatment under the study. Depending on the intervention, both participants and investigators may be blinded (i.e., double blinded) as to which treatment a participant is receiving, usually with placebo medications. Blinding assists with controlling for potential placebo effects and the effects of a participant's expectation to the benefit. These trials assess the efficacy of the treatment in a controlled setting, which may not reflect its actual effectiveness in a real-world clinical practice setting. Often, these trials use a highly defined patient population, so it may not be correct to extrapolate the results to other patient populations.

- ***Crossover trials:*** allow subjects to serve as their own controls. Participants are randomly assigned to one treatment arm and later switched to the other treatment arm.

Observational studies

These include longitudinal cohort studies, case-control studies, case reports, and case series:

- Longitudinal cohort studies: begin with a defined group of subjects (e.g. individuals of a particular age, or people who work in a particular industry) called the cohort. This cohort is then followed over time for a variety of outcomes. Commonly, data are collected in a similar manner on all participating subjects at the beginning of the study (i.e. baseline data) and at set intervals during the follow-up. Cohort studies are usually prospective or retrospective, but the evidence from prospective cohort studies is considered stronger because data on exposures are collected before outcomes occur.

- Case-control studies commonly commence with an outcome of interest, and then compare the characteristics of individuals with the outcome (cases) and those without the outcome (controls). Case report and case series are descriptions of the experience of a single patient or series of patients. These reports are useful in bringing new diseases or phenomena to the attention of the clinical and scientific community and for generating new hypotheses. However, without further study, case reports can only be considered suggestive.

Meta-analysis

This is an analytical technique used to pool the results from many smaller studies, which has the effect of increasing the sample size to gain statistical power. Specific criteria are established to determine which studies will be included in the analysis. It must be remembered that any biases present in the contributing studies will be present in the meta-analysis.

All research is selective: there is no one way a researcher can capture the literal truth of events. Research

involves collecting particular sorts of evidence by various methods each with its pro and cons: thus, descriptive studies using qualitative approaches will assist in applying evidence of effectiveness in practice. Combining assessment of literature from a range of methods helps one take a more holistic approach to decision making.

Quality management audit
Audit involves an examination of the diabetes clinic or practice records to determine whether they are meeting the minimum standards of care. Data may be collected to assess the frequency of blood pressure measurement in people with diabetes, their levels of blood pressure control, lipid monitoring, or the percentage of people with diabetes with abnormal HbA1c levels. The results are analyzed and presented to various stakeholders and fed back to individual clinics or practices and can be used to formulate working standards. The aim of the audit is to reinforce good practices and to promote positive changes in practice. Audit should be repeated at regular intervals to maintain a high profile of diabetes and to maintain quality of care.

The choice of method depends on the nature of the problem, the objective for collecting data, available resources, time, capacity, and experience. Some studies require the use of multiple methods as each method can look at different aspects of a problem.

3. Steps in designing a research project

As with all scientific research, there are guiding principles that researchers should adhere to for maintaining high ethical standards. The starting point is a review of the literature on a selected topic of diabetes. The literature review leads to formulation or testing of a new hypothesis. A method of testing the hypothesis or study design is carefully selected. The study is carried out, the results analyzed, and a conclusion is drawn.

The following steps can be used as a guide to carry out research:

a. Observation of a phenomenon.
b. Postulation of a theory to account for the observation.
c. Prediction of a result based on the theory.
d. Experiment/study designed to test the prediction.
e. Analysis of experimental results.

The process of research is aimed to:

Generate new knowledge.
Provide results that can be generalized (applicable to similar patients or situations).
Challenge the current situation or practice.
Inform policy makers and service delivery practitioners.

4. Critical literature appraisal

This is a systematic way of considering the truthfulness of a piece of research, and the results to determine how relevant or applicable they are. One must be open to new ideas and ready to challenge previously held beliefs to eliminate bias: bear in mind that no research is perfect, so there will be flaws in the papers one reads. One needs to consider whether these flaws are important enough to make them question the conclusion from the research.

The assessment should be balanced and constructive; lessons can always be learnt and research improved upon.

Critical research appraisal can be developed through professional education and problem-based learning (use of case studies resembling those in clinical practice).

5. Questionnaires

These are useful for data collection on simple and well-defined issues. Their design should be carefully planned to ensure they provide:

- The required data.
- Data can be analyzed and used.
- An unbiased response.

6. Ethical considerations including informed consent

Before carrying out the study, a research proposal should be submitted for approval by the appropriate ethics committees of the Ministry of Health and the Medical Research Council or equivalent.

Where the research involves human subjects, informed consent should be obtained. The researcher is responsible to explain the nature of the research in detail to the subject, and to design a consent form. The signed consent form is kept with the rest of the records pertaining to the research.

7. Interpreting and presenting basic statistical results statistics are vital for:

- Aiding data description to provide general observations referred to as descriptive statistics.

- Allowing conclusions or comparisons to be made from the population or sample referred to as inferential statistics.

Descriptive statistics

One of the simplest forms is use of percentages (%). Other common measures used are:
Mean (or average): add all values; divide by the number of measurements, a drawback is that the mean is affected by all the outliers (any extreme values) included in the data. Therefore, the mean will not be reflective of the point where most values lie.
Median: is the midpoint of a set or ordered data (central value).
Mode: used in categorized data, e.g. social class, to describe the most frequent category.
Range: indicates the difference between the highest and lowest values.
The standard deviation summarizes the average distance of all scores from the mean set of data. The larger the standard deviation, the larger the spread of numbers observed.
Tables, graphs, pie charts are ways of presenting data to enable one to get an overview of the results.

Presentation of a research report

Components of the written paper

- Introduction
- Research design and methods
- Statistical analysis
- Results
- Conclusion.

Oral presentation techniques: Key factors

- timing
- attention span
- personal approach
- practice
- evaluation
- consider the audience makeup
- theme should be short and direct

Keep the slides simple and legible, minimize words and list key points.

MODULE 1.8: MONITORING AND EVALUATING DIABETES

EDUCATION CARE

Introduction

Surveillance, monitoring, and evaluation serve different functions in diabetes programmes but they do overlap. However, they all play a role in providing information to help determine the links between programme endeavors and resources allocated/available, and the goals of the programme.

The issues involved include inputs vs. outputs, and then consequently, effects or outcomes of the diabetes care programme being implemented. The short-term outcomes lead to the long-term impact of the programme.

Defining terms

Monitoring: Is a routine tracking of priority information about a programme and its intended outcomes. This includes monitoring inputs and outputs through record keeping and regular reporting systems, health facility observation, personnel performance and client surveys. The most important aspect of monitoring is linkage in data interpretation from different sources, especially looking at several indicators.

Surveillance: Is the routine tracking of disease (or risk factors) using the same data collection system over time. Surveillance helps describe trends and contributes to predicting future trends and targeting needed priority interventions.

Evaluation: Is a collection of activities designed to determine the value or worth of the diabetes care programme or intervention. This involves three levels/phases of evaluation:

Process evaluation – for content, extent and validity,

Outcome evaluation – for successes (failures) of the programme in achieving the intended objectives through the specific intervention, and

Impact evaluation – for long-term value of care or an intervention programme.

Diabetes Education: Relevance of monitoring and evaluation

Several levels of diabetes education require monitoring, (surveillance) and evaluation. Diabetes education is given to health-care providers in diabetes care as well as to people with diabetes. The health-care providers are given accurate knowledge to enable them to provide good care to people with diabetes, as well as enable them to pass on the knowledge of diabetes and skills for self-care practices to these people. The health-care providers and people with diabetes alike can be monitored during the training to maintain relevance, content, and viability of methods of training to the target groups. The health-care providers have different levels of knowledge of diabetes and therefore they will be taught to varying depths, even with varying methods.

The target groups can be evaluated, at the short-term on their levels of knowledge of diabetes and even skills of diabetes self-care. Checklist of specified skills, e.g. insulin injection, foot examination, etc., can be used during the evaluation process, or more so, demonstration of such skills.

Questionnaires are useful tools for the evaluation process, but must be validated for construct, and contents to ensure that it is able to measure what is intended. Validated questionnaires also are reproducible and can be adapted.

Therefore, monitoring and evaluation will/should be done on:

- Inputs: Money, staff time etc.
- Outputs: Facilities, information materials, trained staff levels of knowledge.
- Outcomes: Quality of self-care numbers of staff achieving targets of training, number of dedicated staff.
- Impact: Such as reduced acute complication rates, e.g.: Hospitalizations for diabetes ketoacidosis (DKA)
- Microvascular complication rates
- Macrovascular complication rates
- Mortality attributable to diabetes
- Acceptability of care etc.

Monitoring and evaluation is even more imperative in resource poor settings where cost-benefit analysis of interventions is needed most.

It is suggested that monitoring and evaluation of diabetes education be done at all levels/stages of training that include:

i. Initial diagnosis, with clinical and laboratory investigation, e.g. by whom, where, what time, risk factors. Symptoms, access, etc.
ii. Stage of definitive management by whom, access, acceptability, affordability, availability, of oral hypoglycemic agents (OHAs), insulin, laboratory, etc.
iii. Periodic follow-up and review by whom, tests done, targets achieved, complications, etc.

The methods of training can be evaluated for their viability, validity, and effectiveness. The participants can give their opinions in a structured manner. Alternatively, the teaching/training programmes can be evaluated through peer review and/or experts. The impact of diabetes education is to ultimately improve long-tem outcomes in the patients and improve proficiency in diabetes care among the dedicated staff. The evaluation process should be acceptable and friendly, devised to improve people and programmes rather than antagonize them.

The indicators for monitoring and evaluating diabetes education need to be relevant to the programmes, easy to collect, interpret, and for tracking changes, and preferably universal for comparability within health institutions or provinces.

MODULE 2

MODULE 2.1: PATHOPHYSIOLOGY OF DIABETES

Introduction

Diabetes is a chronic condition characterized by hyperglyceamia. This is caused by deficient insulin production, resistance to insulin action, or a combination of both. Knowledge on the functioning of the ß-cell, the relationship between glucose, insulin and counter regulatory hormones and glucose homeostasis is important in understanding these defects and the resulting abnormal glucose and fat metabolism.

Chronic untreated hyperglyceamia results in multiple complications which affect the whole body. This module will give a brief overview on relevant organs and structures to enhance the understanding of the complications of diabetes. The goal of this module is to provide participants with an understanding of normal pathophysiology and the defects that lead to abnormal glucose metabolism

Objectives

After completing this module the participant will be able to:

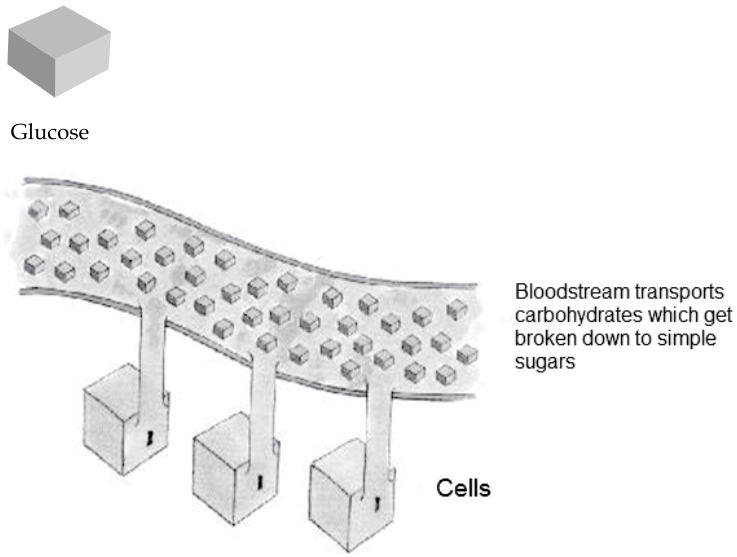
1. Describe the relationship between blood glucose and insulin in healthy people, including gluconeogenesis, glycogenolysis, lipolysis and ketogenesis.
2. Describe normal insulin synthesis and secretion.
3. Understand the hormonal, metabolic and neural control of insulin production and secretion.
4. Discuss insulin action and the effects of insulin and counter-regulatory hormones on fuel homeostasis.
5. Describe the results of insulin deficiency, its effects on lipid and protein metabolism as well as carbohydrate metabolism.
6. Describe the pathophysiology involved in type 1 and type 2 diabetes.
7. Understand the natural history of type 2 diabetes.

■ **Normal Glucose Metabolism**

The body derives energy from food sources such as Carbohydrates, Proteins and Fats. After eating, food is chemically broken down by enzymes into smaller units in the intestines:

- Carbohydrates {Glucose;
- Proteins {Amino Acids;
- Fats {Fatty Acids and Glycerol.

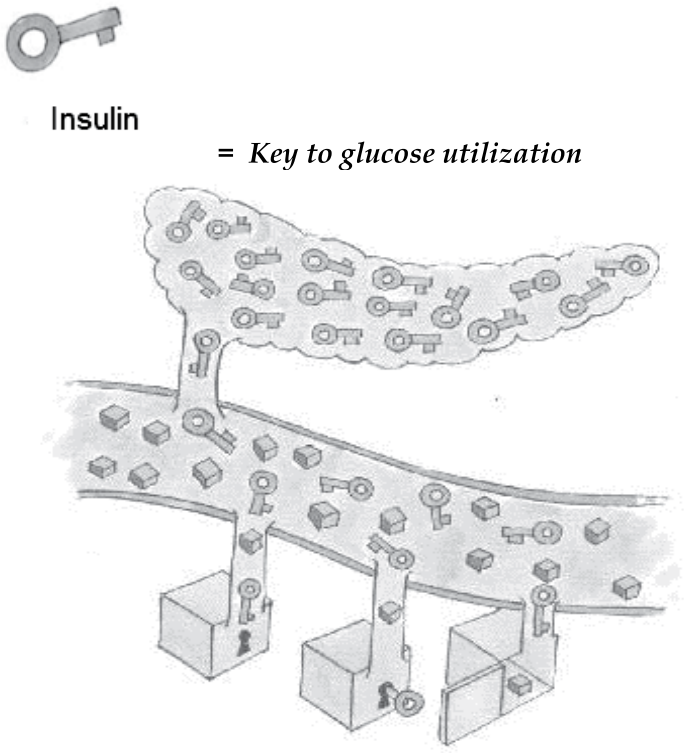
▪ The glucose, amino acids, fatty acids, and glycerol are then absorbed through the intestinal wall and transferred to the bloodstream.



The rise in plasma glucose levels stimulates the release of insulin from the pancreas. Insulin is a hormone that acts to lower blood glucose

■ What Are Hormones?

- A hormone is a substance secreted by a cell, which acts as a chemical messenger that affects the function of another cell or cells.
- The actions of hormones are restricted to their target cells and operate by binding themselves to specific parts of the cells called receptors.
- Because hormones are very potent substances, their release by endocrine cells must be regulated precisely for the amounts released to balance with the amounts used in the body.



Pancreas-secreting insulin, Insulin acts as a key to promote glucose uptake by cells

■ Actions of Insulin

a. Insulin is secreted in response to high blood glucose levels, Insulin stimulates the liver to:
   - Convert and store glucose as glycogen, an inactive form of glucose.
   - Inhibit the conversion of non-carbohydrates into glucose (gluconeogenesis).

b. Insulin promotes facilitated diffusion of glucose through the membranes of cells that possess insulin receptors, e.g. skeletal muscles, cardiac muscles, adipose tissues.

c. Protein metabolism: Promotes the transfer of amino acids into cells, thereby enhancing the synthesis of proteins especially in muscle tissue.

d. Lipid metabolism: Stimulates the adipose cells to synthesize and store fat and reduces the release of fatty acids from adipose tissue.

Through its actions insulin lowers blood glucose concentration

■ The Role Of Insulin Antagonists

A number of hormones are secreted in response to low blood glucose. These activate glycogen conversion to glucose (glycogenolysis) and conversion of fats and amino acids into glucose (gluconeogenesis), thus increasing blood glucose concentrations.

These hormones, which tend to counter the effects of insulin, are:

1. Glucagon
It is produced by alpha cells in the pancreas to:
- Convert glycogen to glucose.
- Convert non-carbohydrates, e.g. amino acids into glucose.
- Stimulate the breakdown of fats into fatty acids and glycerol (lipolysis).

Glucagon will act to increase blood glucose levels through glycogenolysis and gluconeogenesis

As insulin levels fall between meals or during normal overnight fasting, the secretion of glucagon is activated. As blood glucose levels rise, glucagon is no longer secreted.

2. Growth hormone (GH):
- This hormone is secreted by the anterior pituitary gland in rhythmic pulses, especially during sleep. Growth hormone enhances uptake of amino acids into cells and increases the rate at which cells convert these molecules into proteins.
- GH increases blood glucose levels through increases in the rate of fat breakdown in cells.
- More GH is released during periods of protein deficiency and abnormally low blood glucose concentrations; conversely, when blood protein and glucose concentrations increase, GH secretion decreases.
- Secretion of GH increases with stress, to mobilize energy sources, and increase blood glucose levels through gluconeogenesis (fatty acids and glycerol) and to stimulate uptake of amino acids in cells to facilitate the repair of injured tissue.

3. Cortisol:
This hormone is secreted by the adrenal cortex, especially during stressful conditions.

- It increases blood glucose levels through gluconeogenesis
- It stimulates liver cells to form glucose from non-carbohydrates, such as circulating amino acids and glycerol, thus promoting an increase in blood glucose concentration.
- Physical and psychological stress factors could increase the secretion of cortisol.
- Cortisol also acts to block the effects of the inflammatory process in the body.

4. Adrenalin, "the fight or flight hormone":

- Adrenalin is released under conditions of stress, and in the face of a physical emergency.
- Adrenalin raises the blood glucose levels by promoting the conversion of glycogen into glucose, thereby increasing the blood glucose levels, to assist the body in the "fight" or "flight" mode.
- Adrenalin intensifies all the responses of the sympathetic nervous system.

■ The Consequences Of A Lack Of Insulin

Blood glucose levels rise because:

- Glucose is not converted to glycogen, to be stored for energy purposes.
- Uptake of glucose into muscle and adipose tissue is reduced.
- The absence of glucose in cells for energy purposes results in breakdown of amino acids and lipids as alternative sources of energy.
- This results in ketogenesis, and because ketones and hydrogen accumulate in the cells, ketoacidosis occurs, which could be life threatening.

■ Release Of Insulin And Glucose

- **An increase in plasma glucose:** this is the most important stimulus for insulin release.
- **Chemical stimulation:** amino acids, sulphonylureas, and other drugs stimulate the release of insulin from ß-cells.
- **Neuronal stimulation:** sympathetic nervous stimulation can decrease glucose release into the bloodstream, whereas parasympathetic stimulation increases glucose release into the bloodstream.
- **Hormonal stimulation:** gastro-intestinal hormones, glucagon, and GH can increase glucose release into the bloodstream.
- **ß-cell functioning:** Insulin release in response to glucose stimulation is biphasic:
    - The rapid first phase lasts 5-10 minutes.
    - Then a prolonged second phase will last for the duration of the stimulus.
    - The half-life of insulin is 4-5 minutes in the bloodstream, when bound to the receptors, the effect lasts longer.
    - The ß-cells respond to blood glucose concentrations from 5 mmol/l up to approximately 9 mmol/l.
    - Above 9 mmol/l, the hyperglyceamia exerts a toxic effect on the ß-cells.

■ Pathogenesis Of Diabetes Mellitus

1. Type 1 Diabetes
Can be classified as:

a. Autoimmune type 1 diabetes; The ß-cells are destroyed by a deranged immune system, producing auto-antibodies:

- In genetically predisposed people, a triggering factor sets off the production of islet cell antibodies.
- The islet cell antibodies destroy the ß-cells. Insulin production decreases as the ß-cells are destroyed.
- When insulin production falls to a critical level, the development of diabetes occurs.
- Markers of immune destruction include islet cell antibodies, found in newly diagnosed persons with diabetes: Studies have shown an association of type 1 diabetes with HLA genes DR3 and DR4, located on chromosome 6.
- Other markers include auto antibodies to insulin or Glutamic acid decarboxylase, also known as GAD65, present in 85-90% of persons with type 1 diabetes who present with fasting hyperglyceamia.
- These patients may often present with other autoimmune diseases e.g. Addison's disease, Hashimoto's disease or Graves disease.

Triggering responses have been identified as follows:

- **Viruses, as** well as other environmental agents have been implicated as being trigger factors in the autoimmune process.
- The viruses may damage the ß-cells by direct invasion or by triggering an autoimmune response.
- Implicated viruses are: mumps, intrauterine rubella, coxsackie b virus, echo virus, cytomegalovirus virus, and herpes virus.
- Certain **chemical substances** have been shown to induce diabetes in animals, and these include alloxan, streptozotosin and dietary nitrosamides present in some smoked meats.

b. Idiopathic type 1 diabetes; This form of type 1 diabetes has no known aetiology.

- Persons with this diabetes have permanent insulinopaenia and are prone to ketoacidosis.
- This form is frequently inherited, lacks immunological evidence for ß-cell autoimmunity, and is not HLA-associated.
- This form of diabetes is more common among African and Asian individuals.
- Another form of idiopathic diabetes is found in Africans, where the absolute requirement for insulin replacement therapy may come and go, and these persons may periodically develop ketoacidosis.

Type 1 diabetes mellitus is regarded as less common among black Africans in Sub-Saharan Africa than among other peoples living in the same region.

The peak age of onset of type 1 diabetes among black African subjects is 23 years, which is almost a decade later than that reported for the other groups.

It is thought that prolonged breast-feeding may protect people against the development of type 1 diabetes, since early exposure to cow's milk may predispose them to the development of type 1 diabetes.

The prevalence of GAD antibodies and IA-2 antibodies was found to be significantly lower in black adolescents, which might suggest that more of these persons could have a non-autoimmune form of type 1 diabetes.

2. Type 2 Diabetes

The exact cause or causes of type 2 diabetes still need to be identified, but several predisposing factors have been identified.

- A striking feature common to type 2 diabetes seems to be its genetic component, which is much greater than in type 1 diabetes. However, specific genetic defects have not been identified for type 2 diabetes.
- Environmental factors are also important: changes in the composition of the diet, particularly higher levels of fat and refined carbohydrate intake, and lower physical activity levels, frequently observed in urbanized societies.
- These risk factors greatly favour the development of type 2 diabetes in people with genetic susceptibility which predisposes them to obesity (especially "central" or apple-shaped obesity) and the development of insulin resistance.
- Type 2 diabetes is thought to occur because of a combination of impaired insulin secretion from the ß-cells and insensitivity of target tissues (cells with insulin receptors) to insulin, known as insulin resistance:
- The first phase release of insulin is noted to be deficient in some persons with type 2 diabetes. This leads to elevated postprandial (after meals) blood glucose levels.

Other abnormalities that could impair insulin secretion from the ß-cells include:

- Abnormal amounts of inactive insulin being secreted (pro-insulin ratio disturbed).
- Congestion of the ß-cells with amyloidal deposits, a waste product from insulin production which impairs ß-cell functioning.
- Slow, but progressive destruction of the ß-cells.
- Insulin resistance on peripheral cell level; Dysfunction of the insulin receptors and their activities could occur in the peripheral cells, which could include insensitivity to the actions of the insulin molecule, or abnormalities within the cell. These abnormalities cause an uptake of glucose into these cells that is reduced and sluggish, resulting in elevated circulating blood glucose levels.

What Are The Implications Of Insulin Resistance?

Insensitivity of insulin receptors in muscles and liver to insulin tends to cause blood glucose levels to rise, and this will stimulate the pancreatic ß-cells to secrete more insulin. As a result, hyperinsulinaemia occurs; in many insulin resistant states there is decreased insulin clearance, and numbers of insulin receptors on the cell surfaces are often reduced (down regulation).
In people with severe insulin resistance, marked degrees of hyperinsulinaemia are required to maintain normo-glycaemia, fasting and stimulated insulin concentrations of > 50 IU/ml and 300 IU/ml respectively may be found.

In time, a decline in ß-cell function occurs because the ß-cells lose their ability to secrete enough insulin to overcome increasing target tissue resistance – this is the prelude to worsening hyperglycaemia and the appearance of clinical diabetes.

MODULE 2.2: DIAGNOSIS, CLASSIFICATION AND PRESENTATION OF DIABETES

Introduction

In the past, diabetes was considered a single condition. However, it has become clear that diabetes is a heterogeneous metabolic condition caused by a variety of mechanisms. The classification of diabetes is now based on differences in cause, natural history, and clinical characteristics.

Goals:

To provide participants with sound knowledge of the different metabolic disorders of glucose metabolism, pathogenesis, clinical characteristics, and their diagnostic criteria

Objectives

After completing this module, the participant will be able to:

5. Define diabetes mellitus.
6. Understand the WHO diagnostic criteria for different disorders of glycaemia.
7. Identify the laboratory investigations used in the diagnosis of diabetes and their appropriate use (e.g. fasting blood glucose, postprandial blood glucose, oral glucose tolerance test).
8. Discuss the incidence and prevalence of diabetes globally and locally.
9. Understand the difference between type 1 and type 2 diabetes in relation to the clinical presentation, patient characteristics, and pathogenesis.
10. Describe the role of various factors in the development of type 1 and type 2 diabetes.
11. Describe the emerging trend of type 2 diabetes in young people.
12. Describe the signs and symptoms of type 1 and type 2 diabetes.

■ Definition: What is diabetes mellitus?

The most characteristic feature of diabetes mellitus is persistently high levels of glucose in the blood, referred to as "hyperglycaemia".
When glucose cannot enter the cells to be metabolized, it remains in the bloodstream. As the glucose level rises significantly, some of the glucose is excreted in the urine.
This leads to a commonly known phenomenon called sugary urine or glucosuria. Hence the name "diabetes", which means, "to run through" and "mellitus", which means sweet, or with a taste of honey.

Why does this happen?

- Insulin is required for the entry of glucose into the cells for its metabolism.
- In persons with diabetes mellitus, insulin is lacking or present in insufficient amounts.
- The sensitivity of cell receptors towards insulin could be decreased in varying degrees.
- These disturbances lead to abnormally high glucose levels.

Diabetes mellitus can thus be defined as a metabolic disorder of multiple aetiologies characterized by:

- Chronic hyperglycaemia.
- Disturbances of carbohydrate, fat, and protein metabolism, which result from defects in insulin secretion or in insulin activity or both.

- The effects of diabetes mellitus include long-term damage to various organs, including the eyes, nerves, heart, kidneys, and blood vessels. Furthermore, untreated diabetes could result in ketoacidosis or a non-ketotic hyperosmolar state, which may finally lead to the development of stupor, coma, and death.

■ The World Health Organization (WHO) classification of diabetes mellitus

The classification of diabetes is based on the pathogenesis of the disease, and not on the insulin therapy needed or its dependence. For this reason, the WHO working group has eliminated the terms 'insulin dependent diabetes mellitus (IDDM)' and 'non-insulin dependent diabetes (NIDDM)', as these terms were confusing and frequently resulted in patients being classified on treatment rather than pathogenesis.

Diabetes is classified as follows:

1. Type 1 diabetes mellitus
   - Autoimmune induced
   - Idiopathic

2. Type 2 diabetes mellitus
   - Obese person with diabetes
   - Non-obese persons with diabetes

3. Gestational diabetes mellitus (GDM)

4. Other types of diabetes associated with certain conditions and syndromes.

The three most common types of diabetes are type 1, type 2, and gestational diabetes.

■ What are the differences between these types of diabetes?

1. Type 1 diabetes

- This condition develops primarily due to destruction of the ß-cells in the pancreas. This class includes all cases attributable to an autoimmune process, including destruction of the ß-cells but also patients prone to ketoacidosis where no pathology or etiology is known, idiopathic.
- No other forms of ß-cell destruction or failure because of specific causes are included in this classification.
- This can develop at any age, but tends to develop in younger age groups.
- Most of these persons are diagnosed before the age of 35 years, i.e. typically the younger population.
- The rate at which destruction of the ß-cells takes place varies – it could be rapid in some individuals or slow in others. Therefore, the onset of the disease is often acute or sub-acute.
- The slower progressive form usually occurs in adults, and is referred to as latent autoimmune diabetes in adults (LADA).
- Persons with type 1 diabetes are usually of normal weight, or underweight.
- Undiagnosed persons, particularly children and adolescents, may present with diabetic ketoacidosis and/or coma.

- People with type 1 diabetes are dependent on insulin for survival, to prevent rapid and severe dehydration, catabolism, ketoacidosis and death.
- Type 1 diabetes usually presents acutely.
- Ketones are usually found, and can lead to the symptoms of abdominal pain, nausea, and vomiting.
- Other symptoms, such as blurred vision and repeated infections may occur if the onset is not acute.
- Moderate fasting hyperglycaemia can develop rapidly into severe hyperglycaemia and ketoacidosis in the presence of infections and stress.
- During the diagnosis of type 1 diabetes, there are usually no chronic complications present. In most countries, mortality is high as many people with type 1 diabetes die before being diagnosed.

Clinical features

Typical symptoms of hyperglyceamia could include

- Polydipsia
- Weight loss
- Polyphagia
- Malaise
- Blurred vision
- Tiredness
- Repeated infections
- Tingling of hands and feet

■ Incidence and prevalence of type 1 diabetes

- The incidence of type 1 diabetes peaks at about 11-14 years of age.
- Although it develops mainly in children and young adults, it may be seen in all age groups; however, most persons with type 1 diabetes present at a youthful age, with only about 10% being older than 65 years.
- Type 1 diabetes has been seen to occur on all continents, but with considerable variations with regard to geographical and ethnic groups.
- The peak age of onset of type 1 diabetes among black African persons is 23 years, which is almost a decade later than that reported for Europeans.
- It is thought that prolonged breast-feeding may protect people against the development of type 1 diabetes, since early exposure to cow's milk may predispose to the development of type 1 diabetes.
- The prevalence of GAD antibodies and IA-2 antibodies was found to be significantly lower in black adolescents, which might suggest that more of these persons could have a non autoimmune form of type 1 diabetes.

■ **Risk of diabetes in children of persons with type 1 diabetes**

A higher risk of inheritance is seen in families, indicating a genetic susceptibility:

General population with diabetes:	0.5%
Siblings and children of parents with diabetes:	5 -10%
Father with diabetes:	9%
Mother with diabetes:	3%
Both parents with diabetes:	30%

It is significant that adult males seem to carry a considerably higher risk than females.

2. Type 2 diabetes

- Type 2 diabetes usually develops in people older than 40 years – but is now also being seen more commonly in younger people. Type 2 diabetes in children and adults is acknowledged as a very important and growing problem.
- In contrast to type 1, these persons do not necessarily depend on insulin for survival. Although impaired, the ß-cells still produce insulin, but they may also have insulin resistance.
- Traditionally, they are treated with diet, exercise, and tablets known as oral hypoglycemic agents (OHAs). In many people, this type of treatment fails after several years. In this situation, known as secondary failure, insulin is needed to obtain good metabolic control.

According to the WHO classification, people with type 2 diabetes can be divided into two groups:

- obese and
- The non-obese.

The proportions of these groups vary between races and countries:

- Among Europeans and Americans, obese type 2 diabetes constitutes up to 80% of these persons.
- In Asia, the proportion of obese to non-obese type 2 persons is about equal.
- In a South African survey, prevalence of overweight and obesity was 19.4% and 9.1% respectively for men, and 25.5% and 29.4% respectively for women.
- Type 2 diabetes mellitus is frequently undiagnosed for many years because hyperglycemia develops gradually and in the earlier stages is often not severe enough for the person to be aware of any classic symptoms of diabetes.
- Type 2 diabetes is the most common type of diabetes worldwide, accounting for 85-95% of cases.
- An epidemic of type 2 diabetes has emerged in developing countries. It is predicted that there will be a dramatic increase in the incidence of type 2 diabetes in Africa, but this may be modified by factors relating to the current HIV/AIDS pandemic.

■ Clinical features in type 2 diabetes:

Only approximately 53% of patients present with classic diabetes symptoms. Many patients do not complain about obvious symptoms of diabetes, and the disease is detected:

- Accidentally (e.g. screening or at medical examinations, in about 30% of cases);
- Because of the presence of infections (e.g. intercurrent genital or urinary tract candidiasis infections); or diabetic complications, such as foot problems, gangrene, myocardial infarction, peripheral vascular disease or microvascular disease, e.g. Retinopathy.
- Obesity is a major predisposing factor and is often present at the time of diagnosis.
- Significant hyperglycaemia may be present on average for about 5-7 years before diagnosis.
- Ketoacidosis is rarely seen in persons with type 2 diabetes.
- A hyperosmolar non-ketotic state could be the first manifestation of type 2 diabetes, and those affected may rarely present with a stroke or peripheral neuropathy.

■ Incidence and prevalence of type 2 diabetes

Type 2 diabetes is predominantly, although not exclusively, a disease of the middle-aged and elderly population; in Europe and the USA, most persons are older than 55 years, with the average age of diagnosis about 60 years.
The prevalence of type 2 diabetes increases with age in all population groups; in Europe and the USA, it affects approximately 10% or more of the population over the age of 70 years, with an overall higher incidence of 3:2 occurring in Males vs. Females.

■ Risk of diabetes in children of parents with type 2 diabetes

There is a very strong possibility for inheriting type 2 diabetes:

- One parent: 1 in 2 (some say 1 in 4)
- Both parents: 3 in 4
- Brother or sister: 1 in 2.

Risk of type 2 diabetes in children:

- Type 2 diabetes mellitus is not such a rare disease in children and adolescence as in previous years, and now has become an emerging problem worldwide.
- The age of onset for type 2 diabetes is becoming increasingly younger: Japanese, African American, and Asian American persons are presenting as high-risk groups.
- It is thought that genetic and environmental factors are involved with the increasing prevalence of obesity, which is a major factor, in childhood.
- Monogenic diabetes; previously referred to as MODY, is an unusual subgroup of maturity onset diabetes in young people, and is characterized by an early onset and dominant inheritance.
- Often children with type 2 diabetes may present with clinical features indistinguishable from those of type 1 diabetes
- Children with type 1 diabetes may be obese.
- Approximately33% of children with type 2 diabetes may have ketosis and 5-20% may have ketoacidosis.
- Features suggestive of childhood type 2 diabetes are obesity, acanthosis nigricans, slow onset, and belonging to a high-risk ethnic group.

■ **Differences in clinical features between type 1 and type 2 diabetes**

Characteristic	Type 1	Type 2
Onset	Sudden, acute or sub-acute	Slow, insidious onset, progressive disease. Patient could be undiagnosed for years.
Age	Usually < 30-35 years; exception of LADA.	Older patients, > 40-45 years; exception of MODY
Typical symptoms	Moderate to severe symptoms of diabetes present.	Person often asymptomatic because of slow onset of the disease; asymptomatic glucosuria present.
Weight	Lean, often rapid weight loss before	Normal to overweight diagnosis
Insulin secretion survival	Insulin deficient, needs insulin for	Deficient ß-cells insulin secretion patterns and or insulin receptor abnormalities
Chronic	Less frequent	Frequent because of later diagnosis, complications present at diagnosis
Insulin resistance	absent	present
Ketosis	Yes often diagnosed in Ketoacidosis	Not as common as in type 1
Immune markers	Autoimmune disease: anti-GAD, ICA, 1A-2.	Absence of auto-immune markers
Genetic	Genetically linked	Stronger genetic link and higher involvement inheritance risk
Metabolic syndrome	absent	present; a cluster of cardiovascular disease risk factors often present, e.g. hypertension, dyslipidaemia, abdominal obesity, insulin resistance, microalbuminuria, and hypercoagulability.
Treatment	Insulin therapy	Initially: lifestyle changes +/- oral options hypoglycaemic agents. As ß-cells failure progresses, insulin therapy will be required.
Complications of Diabetes	More prone to microvascular complications	High risk for macrovascular diabetes: complications; also develops microvascular complications as disease progresses.

3. Gestational diabetes

WHO definition: Carbohydrate intolerance resulting in hyperglyceamia of variable severity with onset or first recognition during pregnancy. This definition applies irrespective of whether or not insulin is used for treatment, or if the condition persists after pregnancy.

Gestational diabetes can develop at any time during pregnancy, but most commonly this appears after the middle of the second trimester or into the third trimester.

Typically, the prevalence of GDM is estimated to be 1-3% of all pregnancies. (USA 12.3%).
When persons with pre-existing diabetes become pregnant, they are not classified as GDM, but pregnant women with diabetes.

GDM is associated with increased perinatal complications; foetal size and mortality in women who have been discovered to have mild diabetes during pregnancy are still greater than usual.
Furthermore, the mothers have increased risk of developing diabetes within 5-10 years after delivery. Maternal GDM may also have surprisingly long-term consequences for the offspring: foetuses exposed to GDM are at increased risk of developing diabetes in adult life. Early detection and vigorous treatment of GDM is vital to prevent the complications.

■ **Which persons are at risk?**

- Persons with a family history of diabetes
- Previous pregnancy complicated by gestational diabetes
- Persons who have given birth to a previous large baby
- Obesity
- Age over 35 years
- Certain ethnic groups, e.g. the Asian population groups.

4. Other Types Of Diabetes Mellitus

■ **Diabetes as a result of pancreatic diseases**

Any process that diffusely injures the pancreas can cause diabetes.

In conditions, such as pancreatitis (inflammation of the pancreas), trauma, chronic alcoholism, infection, cancer of the pancreas and pancreatectomy (surgical removal of the pancreas), secretion of insulin may be impaired or non-existent, hence leading to the clinical signs of diabetes.

Chronic or recurrent pancreatitis, cystic fibrosis, and haemochromatosis will also damage ß cells and cause impaired insulin secretion.

■ **Diabetes because of endocrine diseases**

Some diseases cause abnormally high concentrations of hormones that antagonise the effects of insulin on blood glucose levels, e.g. growth hormone, cortisol, glucagon, and adrenalin. The following diseases may therefore induce diabetes:

- In Cushing's syndrome, there are high levels of corticosteroids;
- In phaeochromocytoma, there is an excessive amount of adrenalin
- In acromegaly, there is excessive secretion of growth hormone.
- Other hormonal diseases may also be associated with diabetes.
- Hyperaldosteronism
- Thyrotoxicosis
- Glucagonoma
- Polyglandular autoimmune syndrome
- Tumours of endocrine, pancreas, or gut.

■ **Diabetes as a result of drugs, chemicals and toxins**

Many drugs can impair insulin secretion. These drugs may not cause diabetes by themselves, but they may precipitate diabetes in persons with insulin resistance. Certain drugs, such as corticosteroids, can

cause glucose intolerance and trigger diabetes in susceptible persons. This condition will persist even after the drug or toxin has been eliminated from the person. Certain toxins, such as rat poison and Pentamidine can permanently destroy the ß-cell function.

Other drugs that influence insulin secretion include:

- Glucocorticoids and adrenocorticotropic hormone (ACTH) Diazoxides
- Diuretics (thiazides)
- Phenytoin
- Protease inhibitors
- Pentamidine
- Pyriminil (rodenticide).

■ **Diabetes as a result of abnormalities of insulin action or its receptors**

- There are some unusual causes of diabetes that result from genetically determined abnormalities of insulin action, resulting in mutations of the insulin receptor. Resulting effects may range from hyperinsulinaemia to symptomatic diabetes.
- Some of the individuals with these mutations have acanthosis nigricans, which appears as hyper-pigmented, velvety skin areas in apposed and flexural locations; the palms and soles are usually not affected. The severity of acanthosis nigricans correlates with the degree of insulin resistance.
- Women may present with virilisation and have enlarged, cystic ovaries.
- Insulinopathies.
- Receptor defects.
- Circulating anti-receptor antibodies.

■ **Genetic defects of ß-cell function**

- Monogenic diabetes (Maturity onset of diabetes in the young). This is an unusual sub-group of several forms of a diabetic state and is characterized by an early onset of mild hyperglyceamia at a young age, generally before 25 years. These forms of diabetes (i.e. MODY) are characterized by impaired insulin secretion with minimal or no effect on insulin action. Abnormalities at four genetic loci on different chromosomes have now been identified. Genetic abnormalities include the inability to convert pro-insulin to insulin; mutations of the glucokinase gene have been identified as the cause of ß-cell dysfunction and hyperglyceamia in some cases. These forms of diabetes are usually inherited in an autosomal dominant pattern.

The proposed criteria for defining this condition are as follows:

- Early diagnosis of diabetes – before age 25 years in at least two family members.
- Non-insulin dependent, which is demonstrated by the absence of insulin treatment 5 years after diagnosis, or alternatively by significant circulating C-peptide concentrations.
- Autosomal dominant inheritance through vertical transmission of diabetes by at least three generations, ideally, with the same phenotype in cousins or second cousins.

When applying these criteria, the prevalence of MODY is estimated at about 0.5% to 1% of persons with type 2 diabetes. Persons with glucokinase MODY have an early onset of impaired glucose tolerance. This gradually deteriorates with age to become diabetes at mid-life according to WHO criteria.

Mild hyperglycaemia rarely needs treatment other than diet until old age, when oral agents are usually adequate.

During pregnancy, persons with diabetes may need insulin to obtain strict control of glycaemia. It is often difficult, but essential to differentiate between type 1 diabetes mellitus and MODY.

- **Late onset of diabetes in adults (LADA)**
  - LADA is a form of autoimmune diabetes mellitus, where ß-cell destruction is slow and progressive, and generally occurs in adults. Here adults may retain residual ß-cell function, sufficient to prevent ketoacidosis for many years. Individuals with this form of type 1 diabetes eventually become dependent on insulin for survival and are at risk for developing ketoacidosis. At this stage, there is little or no insulin secretion as determined by low or undetectable levels of plasma C-peptide.

  - Islet cell antibodies and/or autoantibodies of insulin and GAD65 antibodies are present at diagnosis. Other autoimmune disorders may also be present (Grave's disease, Hashimoto's thyroiditis, and Addison's disease).

- **Diagnosis Of Diabetes**

There are several ways of determining diabetes, such as:

1. **Signs and symptoms of diabetes**: Most people are suspected to be suffering from diabetes at first when they show signs and symptoms of the disease

Clinical signs/symptoms: In most instances, diabetes is diagnosed by clinical signs and/ or symptoms such as:

- Polyuria
- Polydipsia
- Polyphagia
- Weight loss
- Malaise
- Tiredness
- Blurred vision
- Poor wound healing
- The above symptoms accompanied by persistent hyperglycaemia
- Severe hyperglyceamia: When severe hyperglyceamia is detected under conditions of acute infective, traumatic, circulatory, or other stress factors, this may be of a transient nature and, therefore, should not be regarded as diagnostic of diabetes. It is advisable to treat the hyperglyceamia appropriately and review the person's glucose tolerance status only after full recovery. However, a significant proportion of persons with diabetes mellitus may present with acute illness as ketoacidosis or non-ketotic hyperosmolar state for the first time; under these circumstances the diagnosis of diabetes is not difficult.

2. Blood glucose determination: The biochemical diagnosis of diabetes mellitus and other categories of hyperglycaemia can be made as follows:

- Using a random venous plasma glucose sample
- Using a fasting venous plasma glucose
- Using a 2-hour venous plasma glucose sample or the 2-hour OGTT after 75 g glucose load

Oral glucose tolerance tests (OGTT); is usually confirmed with a blood glucose determination. If the symptoms and blood glucose are at borderline, an OGTT will be performed.

- The major indication for an OGTT is to exclude or diagnose diabetes in cases not clarified, and where clinical signs and fasting or random blood glucose measurements are inconclusive.
- This test can be performed after three days with an unrestricted diet and physical activity.
- The test requires the patient to fast overnight for 8 to 14 hours (water may be taken) After collection of a fasting blood sample, the person then takes an oral glucose load of 75 g (adults). In children, 1.75 g/kg body weight is used.
- 2 hours after the oral glucose load, blood glucose is tested.

Impaired glucose tolerance (IGT) and impaired fasting glucose (IFG)

IGT and IFG refer to a metabolic stage intermediate between normal glucose homeostasis and diabetes mellitus. The WHO has reclassified "impaired glucose tolerance" as a stage of impaired glucose regulation, since it can be observed in any hyperglycaemia disorder, and is not diabetes as such. Many individuals with IGT have normo-glycaemia during their daily lives. IGF and IGT, in the absence of pregnancy, are not clinical entities in their own right, but rather risk factors for future diabetes and cardiovascular disease. Although IGT is often associated with the metabolic syndrome, it may also occur as an intermediate stage in the pathogenesis of the various forms of diabetes. If an OGGT is performed, some individuals with IFG will have IGT and some may have diabetes.

Insulin resistance

Insensitivity of insulin receptors to insulin in muscles and liver will tend to cause blood glucose levels to rise, which will stimulate the pancreatic ß-cells to secrete more insulin, resulting in hyperinsulinaemia. In many insulin resistant states, there is decreased insulin clearance and often, reduced numbers of insulin receptors on the cell surface (down regulation). In people with severe insulin resistance, marked degrees of hyperinsulinaemia are required to maintain normoglycaemia, and fasting and stimulated insulin concentrations > 50 Mu/l and 300 Mu/l, respectively, may be found.

In time, a decline in ß-cell function occurs because the ß-cells lose their ability to secrete enough insulin to overcome increasing target tissue resistance – this is the prelude to the deterioration of hyperglycaemia and the appearance of clinical diabetes.

Blood glucose level

- When diabetes has fully evolved, the fasting plasma glucose level will be equivalent to or exceeding 7.0 mmol/l (126 mg/dl)
- The random plasma glucose level will be equivalent to or exceeding 11.1 mmol/l. (200 mg/dl)
- In some instances where diabetes is asymptomatic and the blood glucose level is inconclusive, an OGTT is necessary
- The diagnosis of diabetes in an asymptomatic person should never be made based on a single abnormal blood glucose level, but only after the plasma glucose concentration within the range of diabetes has been found at a second different time. This second sample may be obtained either in the fasting state, or randomly, or by an OGTT. Should these samples fail to confirm the diagnosis of diabetes mellitus, it is advisable to continue with periodic re-testing until the diagnosis becomes clear.
- Glycated haemoglobin (HbA1C) which reflects the average blood glucose over a period of weeks is not recommended as a diagnostic test for diabetes mellitus, as this procedure is currently not adequately standardized.

3. Urine tests for glucose are not recommended for diagnosing diabetes. This test should never be utilized for diagnosis of diabetes if there is any possible alternative. If a urine test is positive, refer for further glucose testing if not available at your centre.

■ **WHO diagnostic criteria for diabetes:**

The diagnostic criteria in children are the same as for adults.

	Venous plasma (mmol/L)	Venous whole blood (mmol/L)	Capillary whole blood (mmol/L)
DIABETES			
Fasting	>7	>6.1	>6.1
Or 2h post 75g glucose load	>11.1	>10.0	>11.1
IMPARIED GLUCOSE TOLERANCE			
Fasting	5.6 <7.0	5.6 <6.1	5.6 <6.1
And 2h post 75g glucose load	>7.8 and <11.1	>6.7 and <10.1	>7.8 and <11.1
IMPAIRED FASTING GLYCAEMIA			
Fasting	>5.6 and <7.0	>5.6 and <6.1	>5.6 and <6.1
GESTATIONAL DIABETES			
Fasting	>7		>6.1
2h post 75g glucose load	>7.8		5.6 to 6.1

Capillary whole blood =finger prick blood glucose

■ **The metabolic syndrome**

This is a cluster of cardiovascular risk factors:

- Abdominal obesity
- Atherogenic dyslipidaemia
- Raised blood pressure
- Insulin resistance and/ or glucose intolerance
- Pro-inflammatory state
- Prothrombotic state.

WHO diagnostic criteria for metabolic syndrome include any 3 or more of the following:

- Type 2 diabetes or impaired fasting glycaemia,
- Hypertension,
- Dyslipidaemia,
- Central obesity.

MODULE 3

MODULE 3.1: SELF-MANAGEMENT

Overview

Self-management is the cornerstone of overall diabetes management. Persons with diabetes will achieve optimal outcomes only if they are willing to and capable of managing their condition adequately on a daily basis.

Self-care imposes various social, emotional, and economic challenges to the person, especially in view of the increase in self-care technology.

Access to high quality services, and care information from health care professionals is a fundamental right. People with diabetes should be well educated and motivated effectively to take responsibility of their care. Follow-up is thus important on a regular basis, and access to advice whenever necessary.

The transition from paediatric to adult care is crucial and must be handled effectively by the health-care personnel, the family, and the young person.

Good self-management reduces costs of care by reducing morbidity. The diabetes educator must aim at being an advocate for children and adults with diabetes to reduce discrimination against them at school, the workplace and in society.

The primary goal is to improve the quality of life in persons with diabetes. This will assist in understanding: The burden of diabetes (personal, economic, and psychosocial costs), the needs of effective self-management skills, ways to facilitate access to services and transition of care from childhood to adulthood.

Objectives

After completing this module, the participant will be able to:

1. Discuss the impact of living with diabetes (refer to module 1-3).
2. Recognize barriers to self-care.
3. Promote self-care as integral to effective management.
4. Assist the person with diabetes in becoming competent with self-care management appropriate to their needs, e.g. Self urine and blood glucose monitoring and the need for regular complication assessment.
5. Inform the person with diabetes of their personal targets for treatment, e.g. blood glucose, lipid values, blood pressure, HbA1C, albumin secretion status, meal-planning activity.
6. Recognize and assess barriers to self-care (refer to module 1-3, psychosocial behavioural approaches).
7. Adopt a flexible approach to the education and management of individuals (refer to module 1-3).
8. Recognize that individuals manage their diabetes in different ways (refer to module 1-3).
9. Prepare the young person for transition from the paediatric setting to the adult environment (refer to module 4-1).
10. Teach people the importance of regular contact with both the medical practitioner and

members of the health-care team.

11. Realize the need for regular education updates (refer to module 1-3).
12. Establish a link of mutual confidence.
13. Give the person the self-confidence to advocate for their rights when dealing with health professionals.

The impact of living with diabetes:

Diabetes mellitus is a chronic condition that has a major impact on the lives of people with diabetes and their families, which could complicate family functioning. People with diabetes are faced with the challenges to self-regulate their diabetes, live a full and normal life, while facing the other responsibilities and stresses of life, which is psychologically complex and burdensome. Refer to Module 1-3 for a discussion on the impact of living with diabetes.

Barriers to self-care

- The educator must be able to recognize and assess barriers to care, and make appropriate referrals if needed. These could include:
- Peer pressure, e.g. adolescents and teenagers
- Lack of familial support
- Beliefs/ taboos
- Economic factors
- Geographical factors
- Depression and anxiety
- Old age
- Poor health, poor eyesight
- Poor motivation
- Mental factors: inability to comprehend the impact of diabetes on quality of life
- Distorted/incorrect information.

Self-care is integral to effective management

Diabetes is a lifelong condition, which requires lifelong commitment to self-care. Patient education is vital to empower and motivate the patient to:

- Understand diabetes
- Cope with the disease
- Take control of their disease
- Develop survival skills.

It is important to keep discussions at the understanding level of people with diabetes, therefore, principles taught should be simple and in the language of people with diabetes.

The diabetes educator should assist the person with diabetes to become competent with self-care behaviours.

Living with diabetes requires lifestyle and behavioural changes, and the need for a regular schedule to achieve good blood glucose control. (Refer to module 1-3).

To take control of their disease management, education and support, the person with diabetes should apply the following principles of self-care:

a. A change in eating habits; A healthy eating plan, which incorporates regular and evenly

sized meals, is required for the person with diabetes. This should be individualized (refer to Module 3-5 for principles in nutrition).

b. A regular exercise programme is vital to ensure good glucose control, and improve fitness and circulation (refer to Module 3-4 for guidelines on exercise in diabetes).

c. Examine the feet regularly.

d. Daily medication will be required (refer to Modules 3-2 & 3-3).

Self-monitoring and use of results:
Various methods could be used to monitor control

- Regular self-monitoring of urine or blood glucose is essential to determine whether blood glucose targets are met.
- Blood testing is a direct method that tells the person exactly what the blood glucose level is at the specific time of testing, and has largely replaced urine glucose testing. Urine testing is an indirect test for blood glucose.
- Testing urine is a poor means of assessing blood glucose control. However, in certain clinics, this may be the only available tool, in which case the second urine specimen of the day should be tested.
- Testing for ketones in the urine is essential for monitoring blood glucose control, especially in difficult cases.

Monitoring diabetes gives the person with diabetes information about the effects of the meal pattern and food intake, medication, physical activity and stress on blood glucose. Keeping a record of these results helps the person with diabetes and the health care team to keep track of progress towards achieving optimum control of the blood glucose levels.

The diabetes educator should be able to teach the person with diabetes how to test and record the results, using the most suitable, available method for each individual.

The person with diabetes should be taught when to monitor blood or urine glucose levels. This should be individualized according to need and insulin regimen. There are many options when and how frequently to test. These include:

- One fasting test plus one more test at different hours of the day, which could be either before a meal or 2 hours after a meal, before bedtime or 2-3 am in the morning.
- Once a day, but at different times each day.
- More frequent testing may be required if blood glucose is too high or too low, poorly controlled diabetes, during illness or severe stress, in children and adolescents, during pregnancy, brittle diabetes or if on multiple injection regimens.

The educator should discuss with the person an individualized and realistic schedule for monitoring, taking into account availability of strips and financial means.

Ketone Testing
The diabetes educator should teach the patient on the relevance of ketone testing:

- Ketones appear in the urine when the body cells have insufficient glucose for energy purposes.

- Ketones indicate insufficient insulin activity caused by an inadequate dosage or because of illness.
- If neglected, ketoacidosis can occur.

Ketone testing is essential when:

- Blood glucose is uncontrolled,
- Insulin dose has been missed, or
- Feeling bad, ill, or under stress.

Recording and use of test results

All test results should be recorded in a diary and be available at visits to the doctor and health-care team for evaluation. The person with diabetes should understand the benefits of regular monitoring. Monitoring alone will not control blood glucose, but the results could be useful to adjust the eating plan, medicine and exercise programmes, to achieve targets for control.

Long-term optimal blood glucose control is important to help prevent or delay long-term complications.

Of importance is the annual assessment of:

- Eyes – Proliferative diabetic retinopathy is often asymptomatic and difficult to detect by non-specialists. Patients should have an ophthalmologic examination at least once a year, or more frequently, where indicated.
- Nerve function - Clinical assessment of nerve function annually or more frequently, as asymptomatic patients may have considerable functional impairment.
- Heart – Electrocardiogram assessment at least annually to detect any abnormalities in heart function.
- Kidneys – urinalysis for Proteinuria and urine microalbumin for patients whose urine is negative for proteinuria, urea and creatinine clearance annually or as needed to detect kidney abnormalities and impairment, should be done in patients with type 2 diabetes. For children with type 1 diabetes, these should be done 5 years after diagnosis then annually or as needed thereafter. .
- Feet examination: should be done at diagnosis and at every subsequent visit.

Inform the person with diabetes of their personal targets for treatment, e.g. blood glucose, lipid values, blood pressure, HbA1C, albumin secretion status. The person with diabetes should be empowered towards efficient self-care practices, and must therefore be informed on which targets to achieve. Targets for control should be individualized.

Table 3.1: Optimal targets for glycaemic, lipid and blood pressure control

Parameters	Measurements	Targets
Blood values	Capillary blood glucose values (finger-prick) Fasting (mmol/) 2-hour postprandial (mmol/ Glycated haemoglobin (HbA1C	4-6 4-8 < 6.5
Weight	Body mass index (BMI in kg/m	18.5 – 24.9
Blood pressure (mmHg)	Systolic Diastolic If persistent, dipstick for proteinuria Systolic Diastolic	< 130 < 80 < 125 < 75
Lipids (mmol/	Total cholesterol Low-density lipoprotein (LDL) cholesterol High-density lipoprotein (HDL) cholesterol Triglycerides	< 5.0 < 3.0 > 1.2 < 1.5

Adopt a flexible approach to the education and management of individuals, as Individuals manage their diabetes differently (refer to Module 1-3).

Prepare the young person for transition from the paediatric setting to the adult environment
Young children require a lot of supervision and emotional support in diabetes care, yet the freedom to be a child is of paramount importance. As they grow up, and depending on their individual cognitive maturity, they will be able to take up self-care skills with waning supervision. However, through these stages, continuous education, care and support from the diabetes care team and their family is vital for a successful transition to adult life. **(Refer to Module 4-1).**

Teach people the importance of regular contact with their medical practitioner and members of the diabetes health-care team:
Self management and monitoring is an essential component of living with diabetes, However, regular follow-up visits to the medical practitioner and contact with the health-care team is critical to evaluate and ensure effective long-term control and treatment of diabetes. Apart from healthy eating habits, regular exercise and frequent self-monitoring, and other important metabolic targets need to be evaluated on a regular basis.

Monthly assessments of the following parameters are important:

- Weight
- Blood pressure
- Blood glucose
- Feet pulses
- Urine tests for ketones.

Alternatively, 3-6-monthly assessments of the following parameters may be deemed necessary:

- HbA1c – to determine average long-term blood glucose control
- Proteinuria
- Eye evaluation
- Lipids.

Once people with diabetes have been empowered with knowledge they will then be able to advocate for their own rights to obtain the best possible care. This will provide them with self management skills and the necessary steps that the health-care team should take to assist in the prevention, detection, and management of long-term complications of their diabetes.

Please note that exposure of insulin vials to methylated spirits over extended periods of time will affect the integrity of the cover of vials.

Diabetes mellitus and traveling:
For persons with diabetes, traveling requires prior preparation and planning. In Africa, various factors, such as mode of transport and infrastructure, access to medical care and food, make travel even more difficult for a person with diabetes. Hence, preparation prior to long distance travel is vital. Travel should be made safe, and as far as possible not restrictive for these persons.

Planning tips before travelling
a) Food
Extra food/ fruits should be carried with patient in case of transport delays/ breakdowns. Sugar/ sweets should be carried especially for patients on Insulin. Drinks – fresh boiled water/ bottled water should be carried.

b) Insulin/ and syringes
An extra supply of tablets and insulin should be taken. Details of medical services/ facilities available enroute and at the destinations should be known. Persons with hypoglycaemic unawareness on insulin should preferably travel accompanied by others who are aware about their condition.

c) Appropriate foot wear
When travel involves prolonged walking or prolonged sitting in one position appropriate footwear should be worn (refer to section on the Diabetic foot).

d) Other tips
A doctor's letter for customs and or security reasons would be useful when travelling across borders. People with diabetes who have glucometers should carry these and ensure they have adequate strips and batteries. An identification card bracelet should be worn by the diabetic person to make people traveling with them aware of their condition.

Important points while traveling:
a) Insulin storage

i. Traveling by road:
Insulin should be carried by the person with diabetes, kept in a cooler bag away from sunlight and not in the dashboard or boot. When using a cooler bag, ensure that insulin vials are not placed directly in contact with ice packs, to prevent freezing of insulin. Ice cubes or packs should be wrapped in paper or cloth before putting insulin into the cooler bag.

Where cooler bags are not available, the insulin vial may be carried in a small improvised container with cotton wool soaked with methylated spirit surrounding the vial. The container should have a cover to ensure the spirit does not evaporate.

ii. Travelling by air:
Insulin and tablets should be carried in the hand luggage and not in the checked in baggage because of sub-zero temperatures. Ensure insulin is at hand in case of delays/ luggage losses. The person with diabetes should carry a script from a doctor for extra insulin in the event of any mishaps and replacement of insulin. A letter from the doctor, stating that the person suffers from diabetes should be carried, to authorize possession of needles for injecting purposes; otherwise these items may be confiscated from the person at the airport security points.

iii. At destination
Preferably store insulin in a refrigerator if available, if a refrigerator is not available, insulin can be stored in the coolest part of the room or covered with a wet flannel cloth, or in water tight container, submerged in water in a clay pot.
Persons with diabetes should acquaint themselves with the medical services available at their destination in case they do require medical supplies or services. Patients should continue using their normal treatment doses, and should follow nutrition advice that they have been given.

b) Illness while traveling:
If diarrhoea develops the person with diabetes should be advised to continue taking insulin/ medication, carbohydrates and fluids. When possible, self-monitoring of blood glucose would be useful. Prompt medical attention should be sought if symptoms persist.

c) Treatment adjustments while traveling:
When travelling by plane involves crossing over time zones, persons on insulin may require treatment adjustments. Conversion to bolus soluble insulin injections prior to meals during the travelling period under advice from the doctor would be useful.

d) Food and nutrition
During travelling, the person with diabetes must ensure adequate intake of food and fluids to avoid dehydration and hypoglycaemia.

e) Exercise
When travelling involves sitting in one position for prolonged periods, people with diabetes should be advised to stretch their limbs periodically during travel stops.

MODULE 3.2: SICK DAY MANAGEMENT

Introduction

An inter-current illness can destabilize the metabolic state of a child or adult with diabetes (especially type 1), leading to a hyperglycaemic crisis, e.g. Diabetic ketoacidosis. These can be prevented by certain simple steps highlighted as "Sick Day Management". The aim of the sick day management is prevention of diabetic ketoacidosis.

Metabolic Disturbance As A Result Of Inter-current Illness

An inter-current illness, e.g. an upper respiratory tract infection, can destabilize the metabolic state leading to a hyperglycaemic crisis. The stress factors, e.g. infection, inflammatory disease, injury, surgery, and severe emotional disturbances, results in the secretion of stress or counter-regulatory hormones: glucagon, growth hormone, epinephrine, and cortisol. Acting in synergy, these hormones create a state of insulin resistance, causing increased hepatic glucose production and reduced peripheral glucose utilization. Though calorie intake is low in illness, blood glucose levels increase and ketonaemia and ketonuria may occur.

Unchecked, these metabolic disturbances may progress to full-blown diabetic ketoacidosis. Sick day management thus serves to prevent ketoacidosis.

Principles of treatment

- Never omit insulin injections.
- Treat underlying illness.
- Prevent dehydration.
- Monitor blood glucose and urine ketones every 4 hours.
- Administer supplemental insulin.
- Watch out for symptoms that require hospital care (admission).
- Never omit insulin injection
- The schedule of insulin should not be changed.
- If blood glucose is low, the dose of insulin is reduced. However, supplemental injections of regular insulin are often required, as blood glucose is usually high and ketonuria frequently present.
- Treat underlying disease: Seek medical attention sooner rather than later
- Any underlying illness should be treated on its merit e.g. for an infection give antibiotics.
- Prevent dehydration. High fluid intake is important to prevent dehydration (see Table 3.2). Fluids chosen should contain sodium and potassium to replace loss of these electrolytes as occurs in uncontrolled Diabetes: if one is not able to follow meal plan, use fluids with sugar to provide carbohydrate. Fluids can be oral rehydration salts, broth, (meat soup), fruit juice, regular soda.

Table 3.2: Minimum amounts of fluid

Volume per hour			
Age in years	**Weight in kg**	**ml**	**oz**
5 yrs old	20	45 -90	1.5 - 3
10	30	75 - 120	2.5 - 4
15	55	120 - 240	4 - 8
16+	56 +	240 - 300	8 - 10
Adapted from Challenges in diabetes management, Lifescan 1998.			

Monitoring every 4 hours (by person with diabetes or relative)

- Weight loss is a reliable sign of dehydration so a child or adult can be weighed several times in a day (3 - 4 times).
- Self-monitoring of blood glucose levels done every 3 - 4 hours around the clock.
- Urine ketones: checked every 3 - 4 hour around the clock.
- One should be advised to rest and avoid strenuous exercise/activity.

Give supplemental insulin (by person with diabetes or relative)

- Depending on results of blood glucose monitoring and urine tests for ketones, it may be necessary to administer additional (supplemental).
- Regular insulin every 3 - 4 hours until blood glucose < 13 mmol/l (< 240 mg/dl) (see Table 3.3)
- Generally an additional 10% - 20% of usual daily dose may be safely given.

Table 3.3: Guidelines for supplemental regular insulin

Blood glucose levels (mmol/l)	Urine ketones more than trace	Amount of supplemental insulin
Below 4 mmol/ (80 mg/dl)	Yes or No	Omit regular insulin, decrease NPH, Mixtard, Lente by 20% test again in 3-4 hours
4-13 mmol / (80 – 240 mg/ dl)	No	No extra insulin test again in 3-4 hours
4-13 mmol/ (80 – 240 mg/ dl)	Yes	No extra insulin, carbohydrates ingestion will correct starvation ketosis. Test again in 3-4 hours
13-22 mmol/ (240 - 400 mg/ dl)	No	Give 10% supplement, test again in 3-4 hours and repeat dose if no improvement
13-22 mmol/ (240 – 400 mg/ dl)	Yes	Give 20% supplement, test again in 3-4 hours and repeat dose if no improvement
> 22 mmol/ Above (400 mg/ dl)	Yes or no	Give 20% supplement, test again in 3-4 hours and repeat dose if no improvement

Adapted from challenges in Diabetes management Lifescan 1988

Signs and symptoms that need hospital care (admission)
If any of the following circumstances pertain, the affected must be admitted:

- The child/adult exhibits any signs of dehydration, e.g. especially in children: dry mouth cracked lips, sunken eyes, weight loss.
- The child/adult is unable to consume the recommended amount of the fluid or if vomiting persists for more than an hour or two.
- The child or adult develops symptoms of diabetes ketoacidosis, e.g. Nausea, abdominal pain, vomiting, hyperventilation, drowsiness.
- High blood glucose ≥ 13 mmol/l (≥ 240 mg/dl) and or ketonuria persist for more than 12 hours.

Sick day management is vital in minimizing the impact of intercurrent illness. In many cases this prevents hospital admission and the accompanying costs, reducing not only the economic burden of diabetes; but also reducing the days lost because of illness. However, this is limited to those who are able to afford blood glucose machines and urine test strips, as well as to those patients who are highly motivated. With good education and motivation, most sick day episodes can thus be successfully managed at home or in a primary care setting such as a health clinic.

MODULE 3.3: GLUCOSE-LOWERING MEDICATION

Introduction

In type 2 diabetes mellitus there are variable degrees of defective insulin secretion and/or utilization by the peripheral tissue. Type 2 diabetes ranges from a predominantly insulin resistance with defective insulin secretion to predominantly defective insulin secretion with insulin resistance.

Diet and physical activity are the first-line therapy in all persons with diabetes. Where diet and physical activity alone fail to achieve glycaemic control, oral agents should be commenced. Current evidence suggests that treatment with oral agents early in the course of the disease prevents progression of diabetes and its complications.

Goals:
To provide the participant with an understanding of the different oral agents used to treat type 2 diabetes, and why particular agents are chosen in preference to others.

Objectives
After completing the module, the participant will be able to:

5. Discuss the role of these medications in the management of type 2 diabetes.
6. Identify appropriate treatment aims when using glucose-lowering agents.
7. Describe the different oral medications available, their mechanism of action and maximum dosage of secretagogues, biguanides, thiazolidinediones and alpha-glucosidase inhibitors.
8. Describe the potential for hypoglycaemia when using secretagogues.
9. Describe the need for caution when using long-acting sulphonylureas in the elderly.
10. Describe the side-effects and potential problems associated with the use of secretagogues, biguanides, thiazolidinediones and alpha-glucosidase inhibitors.

The role of oral glucose-lowering agents in the treatment of diabetes
Oral pharmacotherapy is indicated when individualized glycaemic targets are not met by lifestyle modifications, such as dietary adjustments and a regular exercise programme. In many parts of Kenya, refusal or failure to prescribe oral therapy soon enough, may cause loss of faith in the system and a resort to parallel therapies.
Oral therapy may be used as monotherapy or in combination therapy to target different aspects in the pathogenesis of hyperglycaemia in type 2 diabetes mellitus. The choice of oral therapy should depend on the characteristics, lifestyle, degree of glycaemic control, access to drugs, economic status of the person with diabetes, and mutual agreement between the doctor and the patient.
Monotherapy should be the initial choice. The stepped-care approach is recommended, as monotherapy is seldom sufficient, because of the progressive nature of the disease. Currently, sulphonylureas and biguanides (metformin) are the agents most widely available.

Choice of oral glucose-lowering agents in the treatment of diabetes

- If overweight (BMI > 25 kg/m2) biguanides (metformin) should be the first choice; if metformin is contra-indicated, thiazolidinediones may be used.
- Long-acting sulphonylureas should be avoided in elderly patients, because of the risk of hypoglycaemia; short-acting sulphonylureas or glitazones should be used.
- Metformin should be used with care in the elderly (> 75 years old); it is also contra-indicated in people with elevated serum creatinine (kidney impairment), liver disease, and severe respiratory-, cardiac- and peripheral vascular disease; as it may cause lactic acidosis.

- Combination therapy using oral glucose-lowering agents with different mechanisms of action is indicated if monotherapy with one of the agents has failed. Two drugs from the same class should not be used concurrently.
- The rapid-acting insulin secretagogues (glitinides) and the alpha glucosidase inhibitors allow for flexibility in the management of glycaemia, but could be relatively expensive.
- When oral combination therapy fails, insulin should be added to the regimen, or, alternatively, replace treatment with oral glucose-lowering agents.

Drugs that stimulate insulin release from the ß-cells

1. Sulphonylureas

a. Mechanism of action

Sulphonylureas stimulate basal as well as glucose-mediated insulin secretion, thus resulting in continuous stimulation of the ß-Cell to release insulin. The action of sulphonylureas requires the presence of functional ß-cells. With progressive ß-cell failure over time, sulphonylureas may become ineffective and additional oral agents or insulin may be required for glycaemic control. Measurement of C-peptide levels gives an indication of residual ß-cell function. Early use of combination agents has been shown to reduce glucose toxicity and preserve ß-cell mass.

b. Pharmacokinetics

Sulphonylureas are well absorbed orally. Most reach peak plasma concentration within 2-4 hours. They circulate by binding to plasma proteins and can potentially interact with other drugs, such as salicylates and sulphonamides that bind to plasma albumin. As elimination is mostly through the kidneys, the half-life can be significantly prolonged in the elderly and those with renal disease. Sulphonylureas cross the placenta and can stimulate foetal ß-cells to secrete insulin.

c. Clinical use

Sulphonylureas are indicated for type 2 diabetes where diet alone is insufficient to achieve glycaemic control. Treatment should be commenced at low doses and titrated every 4-7days as needed. They can be used alone or in combination with other oral anti-diabetic agents or with insulin. To preserve ß-cell function it is recommended that drugs from other classes of oral anti- diabetic agents be added before a maximum daily dose is reached. Lower-starting and maximum doses should be used in the elderly and those with impaired renal function to minimize the risk of hypoglycaemia.

d. Side-effects of sulphonylureas

Hypoglycaemia is the most serious complication and often results from inadequate caloric intake. The risk of hypoglycaemia is increased in the elderly and patients with impaired hepatic or renal function. Long-acting sulphonylureas should be avoided in these groups of patients. The incidence of hypoglycaemia is related to the potency and duration of action of the sulphonylureas. The highest incidence occurs with chlorpropamide and glibenclamide. Sulphonylurea drugs stimulate appetite and weight gain. Rare side-effects include gastrointestinal upsets, allergic skin rashes and very rarely, bone marrow damage.

e. Contra-indications

- Type 1 diabetes
- Pregnancy
- Hepatic or renal insufficiency
- Major surgery

- Severe infections
- Sensitivity to sulphur
- Drug interactions with sulphonylureas.

The following drugs increase plasma levels of sulphonylureas and increase the risk of hypoglycaemia:

- Aspirin, fibrates, trimethoprim displace sulphonamides from albumin.
- Alcohol, H2 receptor blockers and anticoagulants reduce metabolism of sulphonylurea.
- Concomitant use of potential hypoglycaemic agents such as alcohol and aspirin.
- Antagonism of counter regulatory hormones, e.g. ß-blockers, and sympatholytic drugs

The following drugs reduce the anti-glycaemic effects of sulphonylureas:

- Drugs such as barbiturates and rifampicin increase the metabolism of sulphonylureas.
- Diuretics, e.g. thiazide and loop diuretics reduce insulin secretion and or its action.

2. Meglitinides

Repaglinide is a benzoic acid derivative and nateglinide an amino acid derivative which are both insulin secretagogues.

a. Pharmacokinetics

These drugs are only taken should the person eat a meal; if a meal should be skipped, the tablet is not taken. It is given directly before meals and is useful for controlling postprandial hyperglyceamia, thus mimicking physiological insulin secretion. Repaglinide is primarily metabolized into inactive metabolites that are secreted through bile. It is the only oral hypoglycaemic agent registered in Europe and America for use in renal insufficiency, and renal failure, to the point of dialysis – only 8% of the drug is excreted via the urine.

The starting dose is 0.5 mg per meal and can be titrated on a weekly interval to a maximum dose of 4 mg per meal or 16 mg per day.

b. Side-effects

Repaglinide may cause hypoglycaemia.

c. Interactions

The metabolism of repaglinide is increased by drugs that induce hepatic enzymes, e.g. barbiturates, and thiolidizinediones. Drugs, such as ketoconazole, miconazole, and erythromycin inhibit repaglinide metabolism. Repaglinide has no significant interactions with commonly used drugs such as digoxin, warfarin, cimetidine or theophyllin.

Nateglinide is taken with meals at a dose of 120 mg per meal. The use of nateglinide as monotherapy is not recommended, as the efficacy for lowering blood glucose is less efficient. Nateglinides are only used early on in type 2 diabetes.

Drugs that increase insulin sensitivity

1. Biguanides - **Metformin;**

Metformin is a biguanide that is used as adjunctive therapy in type 2 diabetes where diet and exercise alone have failed to achieve the desired glycaemic control. Metformin is particularly useful in the obese person with type 2 diabetes.

Mechanism of action

Metformin does not stimulate insulin release. It is not a hypoglycaemic agent but an antihyperglycaemic drug. Metformin acts by:

- Reducing hepatic production of glucose (gluconeogenesis).
- Increasing insulin-induced glucose uptake in muscle i.e. increased muscle sensitivity to insulin.
- Reduction in intestinal glucose absorption.
- Reducing lipolysis.

Other beneficial effects of Metformin include:

- Weight reduction by suppressing appetite.
- Improved lipid profile i.e. increased HDL cholesterol and decreased triglycerides and LDL cholesterol.

Uses of Metformin

Metformin is useful in obese persons with type 2 diabetes where lifestyle changes alone are inadequate for control. It is often used alone or in combination with a sulphonylurea. Use of Metformin has been shown to delay the progression to type 2 diabetes in persons with impaired fasting glucose and in those with impaired glucose tolerance. It is also indicated in persons with polycystic ovarian syndrome and in patients with gestational diabetes.

Pharmacokinetics

Metformin has a half-life of 3 hours and is entirely excreted through the kidneys. It is given in 2-3 doses per day. The usual dose is 500 mg every 8 hours up to a maximum of 3 gm per day.

Side-effects

- Gastrointestinal: diarrhoea, abdominal discomfort, nausea, anorexia, metallic taste.
- Lactic acidosis is rare (0.1 per 1000 patient years) but potentially fatal. The risk is increased in the elderly and in conditions that lead to increased lactate production such as chronic hypoxic lung disease, congestive cardiac failure, renal insufficiency, hepatic dysfunction.
- Impaired absorption of vitamin B12 with long-term use.
- Renal function should be monitored in patients on Metformin therapy.

Contra-indications

- Kidney impairment and kidney failure
- Conditions that could lead to lactic acidosis
- Tissue hypoxia
- Past history of lactic acidosis
- Major surgery
- Type 1 diabetes
- Septicaemia
- Myocardial infarction.
- Elderly

2. Thiazolidinediones: Pioglitazone, Rosiglitazone

The Thiazolidinediones (TZDs) are a relatively new class of drugs used to treat type 2 diabetes.

Mechanism of action

- Decrease insulin resistance and increase insulin action on glucose and lipid metabolism.
- Decrease hepatic gluconeogenesis.
- Increase glycogen synthesis in muscle.

- Increase lipogenesis.

Side-effects

- Weight gain because of an insulin-like effect.
- Fluid retention.
- Stimulates ovulation in peri- menopausal women with **diabetes.**
- Hepatotoxicity can be fatal. The first TZD, troglitazone was withdrawn from the market because of hepatic toxicity.

Contra-indications

- Cardiac failure
- Impaired hepatic function
- Ketoacidosis
- Drug interaction
- Not recommended to be used in combination with oral contraceptives.

Drugs that delay glucose absorption

1. Alpha-glucosidase inhibitors: Acarbose, miglitol, voglibose

Acarbose and related drugs inhibit the enzyme alpha-glucosidase which is responsible for the breakdown of carbohydrates into monosacharides in the intestinal brush border. It delays absorption of carbohydrates and limits postprandial hyperglycaemia.

Acarbose is used in type 2 diabetes where diet with or without other antidiabetic drugs have failed to adequately control blood sugar. It is given at meal times in doses of 50-100 mg per meal.

Side-effects

- Gastrointestinal upsets; flatulence, loose stools or diarrhoea, abdominal pain, bloating.
- Tolerability can be improved by slowly titrating the dose over several days.

Table 3.4 Algorithm on the management of type 2 diabetes

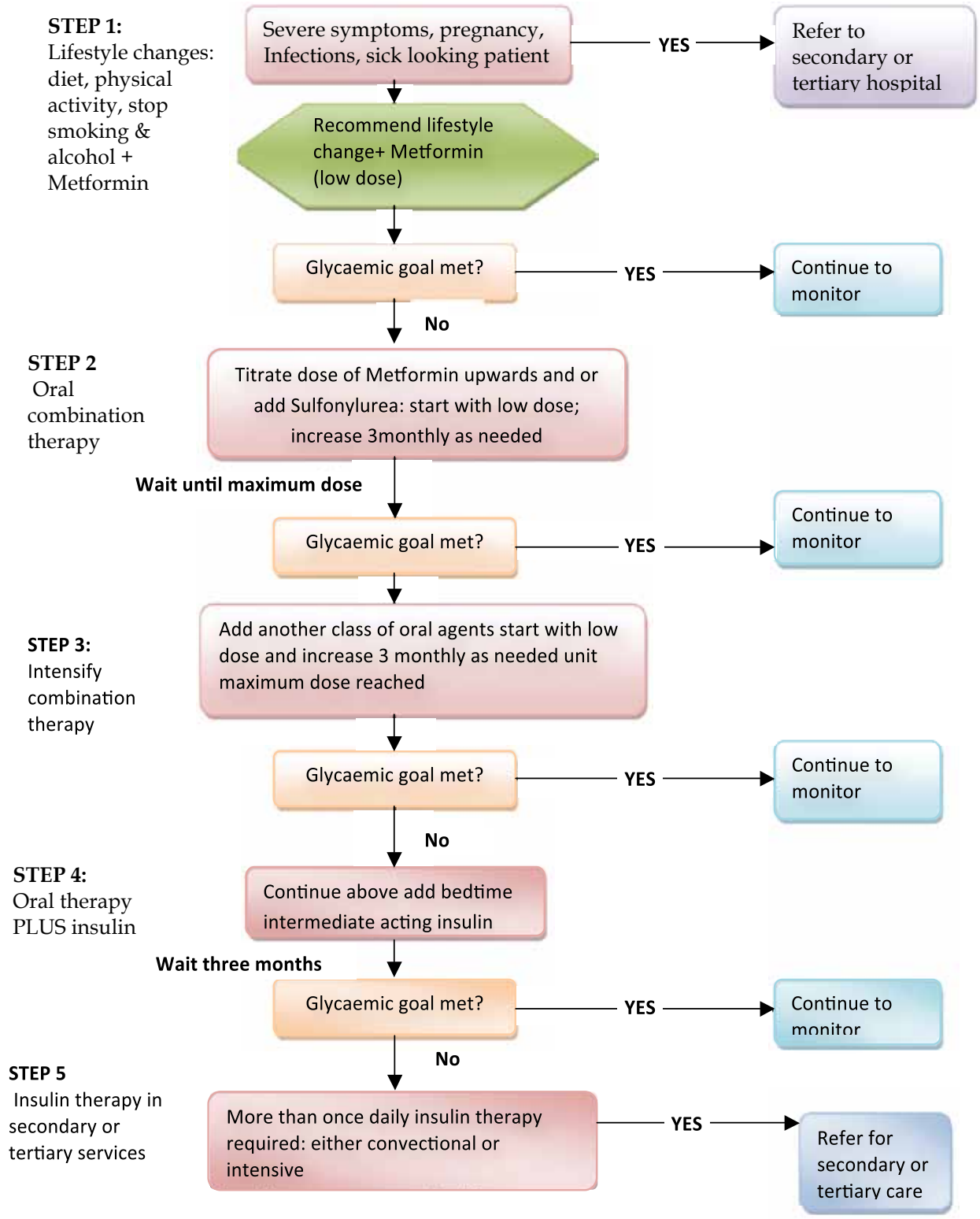


Table 3.5 Summary of glucose-lowering agents

NAME OF DRUG	Starting dose	Maximum dose	MAJOR SIDE-EFFECTS	CONTRAINDICATIONS
SULPHONYLUREAS				
Glibenclamide	2.5 mg	20 mg	Hypoglycaemia, weight gain, skin rashes	Pregnancy, use with caution in liver and renal disease
Gliclazide	40 mg	320 mg	Hypoglycaemia, weight gain, skin rashes	Pregnancy, use with caution in liver and renal disease
Glimepiride	1 mg	8 mg	Hypoglycaemia, weight gain, skin rashes	Pregnancy, use with caution in liver and renal disease
Glipizide	5 mg	40 mg	Hypoglycaemia, weight gain, skin rashes	Pregnancy, use with caution in liver and renal disease
BIGUANIDES				
Metformin	500 mg	3000 mg	Abdominal pain, nausea, loose bowel motions, lactic acidosis	Renal, heart and liver failure; pregnancy
THIAZOLIDINE DIONES				
Rosiglitazone	4 mg	8 mg	Liver impairment, fluid retention, weight gain, dilutional anaemia	Renal, heart and liver failure; pregnancy
Pioglitazone	15 mg	45 mg	Liver impairment, fluid retention, weight gain, dilutional anaemia	Renal, heart and liver failure; pregnancy
MEGLITINIDES				
Nateglinide	180 mg	360 mg	Hypoglycaemia, weight gain, dyspepsia	Heart and liver failure, pregnancy
Repaglinide	1.5 mg	16 mg	Hypoglycaemia, weight gain, dyspepsia	
ALPHA-GLUCOSIDASE INHIBITORS				
Acarbose	25 mg	300 mg	Dyspepsia, loose bowel motions	None
Meglitol	25 mg	300 mg	Dyspepsia, loose bowel motions	None

MODULE 3.4: INSULIN THERAPY

Introduction

Insulin is the core treatment for people with type 1 diabetes and many persons with type 2 diabetes mellitus. Persons with type 1 diabetes lack functional ß-cells and require insulin for survival.

a. Insulin secretion:

A healthy thin person without diabetes produces from 18-40 units of insulin per day or 0.2-0.5 units/kg body weight per hour. About half of this is produced as basal insulin secretion (between meals and during the night) and another half in response to meals, known as prandial or bolus insulin secretion. This occurs in two phases:

- The 1st-phase insulin secretion is a rapid phase lasting 5-10 minutes; this phase is often absent or deficient in persons with type 2 diabetes.

- The 2nd-phase insulin secretion is a longer phase where insulin secretion continues as long as glucose is released into the bloodstream, e.g. during a meal. In persons with type 2 diabetes, this phase is delayed and insufficient.

b.General Information on Insulin:

Insulin is currently available mainly as an injection. It is also produced for inhalational use in some parts of the world:

Since insulin is a protein, it cannot be taken orally as it will be digested by enzymes in the gastro intestinal tract (GIT).

The insulin available on the Kenyan market is biosynthetic human genetically engineered insulin (HM). The most recent insulin molecules on the local market are known as analogues, which are classified as synthetic insulin.

The insulin strengths available on the local market are, 100 IU/ml.

Persons with diabetes can be changed from insulin preparations of 40 IU/ml to 100 IU/ml without any problem, provided that they are supplied with the correct syringes. No dosage adjustment is necessary. However, an explanation should reassure the person with diabetes that although the volume of insulin being injected is different, the number of units is the same. Insulin that is supplied as a sterile preparation contains a preservative. Multi-dose vials will remain sterile throughout their use because of the action of the preservative. Different preservatives are used in the different types of insulin and this has to do with the stability of the product.

Insulin preparations can be classified according to duration of action or according to source of origin. There are three different types of human insulin:

- Soluble human insulin
- Isophane insulin
- Premixed insulin

Regular insulin molecules are attracted to each other, and exist as dimers and hexamers in solution. For the insulin to be absorbed from the injection site, it has to be broken down from a hexamer into six monomers. This process can take as long as 30 minutes.
An insulin analogue is created by making a small change in the structure of regular human insulin, i.e. changing the amino acid positions. Because of this amino acid sequence change, the onset of action and duration of action can be altered.

c. The limitations of soluble human insulin:

- Hexamer formation and slow dissociation into dimers and monomers extend the onset of action in subcutaneous- administered soluble human insulin.
- This means that soluble human insulin is recommended to be injected approx. 30 minutes before a meal, allowing insulin monomers to reach the circulation before glucose levels rise.
- This restriction is inconvenient for people with diabetes, and actually, many people with diabetes do not comply with the recommended 30-minute interval for insulin injection before meals, but often administer their insulin shortly before mealtimes.

As a result, this:

It exposes individuals to excessive postprandial glucose peaks, as insulin concentrations rise slowly after subcutaneous injection;
May also increase the risk of hypoglycaemia, as insulin levels may increase after injection before glucose levels rise, or remain high after postprandial hyperglycaemia has passed;
Does not mimic endogenous insulin profiles; diurnal (daytime) plasma insulin profiles are therefore frequently inappropriate, with a resulting failure to normalize glycaemic control.

Hence, there is a need for new advances in therapeutics and understanding of diabetes to facilitate achievement of good control in people with diabetes.
Insulin analogues
Insulin analogue is a synthetic form of insulin, as there is not a natural example of such a molecule in the body

d. Advantages of analogues

- Improved compliance – "inject and eat", since no 30-minute interval is required (rapid acting).
- Can be injected 15 minutes from starting a meal – convenient for children (rapid acting).
- Mimics the physiological insulin profile more closely, allowing:
- improved postprandial and 24-hour blood glucose control;
- improved HbA1C;
- lower risk for hypoglycaemia – major and nocturnal;
- Allows person more flexibility of lifestyle.

Analogues currently available in the market

1. Short-acting analogues or bolus analogues:
   - Aspart
   - Lispro–

2. Long-acting or basal analogues:
   - Glargine

3. Premixed analogues soluble and intermediate acting; :

   - 25: 75
   - 30:70
   - 50:50–

e. Choosing an insulin regimen

A regimen is chosen according to the person's lifestyle:

- If the person requires extreme flexibility in their normal day-to-day activities, the regimen of choice is basal long acting insulin and boluses of short acting insulin injection (4 injections daily). This allows the person to adapt the insulin injection to suit their lifestyle.
- If the person leads a well-organized unvaried lifestyle, a twice-a-day injection of premixed insulin is reasonable regimen. A person on this regimen will find that when the morning injection has been given, the insulin release is dictated for the day ahead. This dose will therefore determine the size and time of breakfast, the size and time of the morning snack, size and time of lunch, and the size and time of the afternoon snack.
- A person should not mix their insulin if they have a physical incapability or if their eyesight is poor.
- A person's need for tight control must be assessed before a regimen is chosen
- If the person is elderly, very stringent control of glycaemia may not always be a priority, and therefore, a twice-a-day injection of intermediate-acting insulin may suffice.
- If the person has hypoglycemic unawareness, the regimen chosen should account for this (i.e. control must be relaxed).

Table 3.6: Summary of available insulin profiles

Trade name	Composition	Type of insulin	Onset of action: time after injection	Peaking action: hours after injection	End of action: hours after injection	Use in practice	When to inject
Actrapid	Soluble insulin	Short-acting	30 min	1-3	8	IV, sliding scale in DKA, as bolus component in multiple injection regimen	½ hr before meals
Humulin R	Soluble insulin	Short-acting	30 min	1-3	5-7	IV, sliding scale in DKA, as bolus component in multiple injection regimen	½ hr before meals
Protophane/	Isophane	Intermediate-acting	1.5 hrs	4-12	24	Basal insulin In combination with bolus insulin in multiple injection regimen Not for IV use	Once a day , e.g. 22:00
Humulin N	Isophane	Intermediate-acting	1 hr	2-8	18-20	Basal insulin In combination with bolus insulin in multiple injection regimen Not for IV use	Once a day , e.g. 22:00
Actraphane/ Mixtard 30	30% soluble insulin 70% isophane	Premixed	30 min	2-8	24	Monotherapy in twice a day regimen. Not for IV use	½ hr before breakfast ½ hr before supper
Humulin 30/70	30% soluble insulin 70% isophane	Premixed	30 min	1-8	14-16	Monotherapy in twice a day regimen. Not for IV use	½ hr before breakfast ½ hr before supper
NovoRapid	Insulin aspart	Short-acting analogue	10-20 min	1-3	3-5	Bolus insulin in combination with basal in multiple injection regimen	Directly before/after each meal
Humalog	Insulin lispro	Short-acting analogue	5-15 min	1	1-3	Bolus insulin in combination with basal in multiple injection regimen	Directly before/after each meal
NovoMix 30	30% insulin aspart 70% protamined insulin aspart	Premixed analogue	10-20 min	1-4	24	Monotherapy in twice a day regimen Not for IV use	Directly before/after breakfast and supper
Humalog Mix 25	25% insulin lispro 75% protamined insulin lispro.	Premixed analogue	5-15 min	1-8	14-16	Monotherapy in twice a day regimen Not for IV use	Directly before/after breakfast and supper
Lantus	Insulin glargine	Basal analogue	variable	4-24	24	Basal insulin	Once a day , e.g. 22:00

Table 3.7: Some variations and problems that may influence the choice of insulin regimen in persons with diabetes

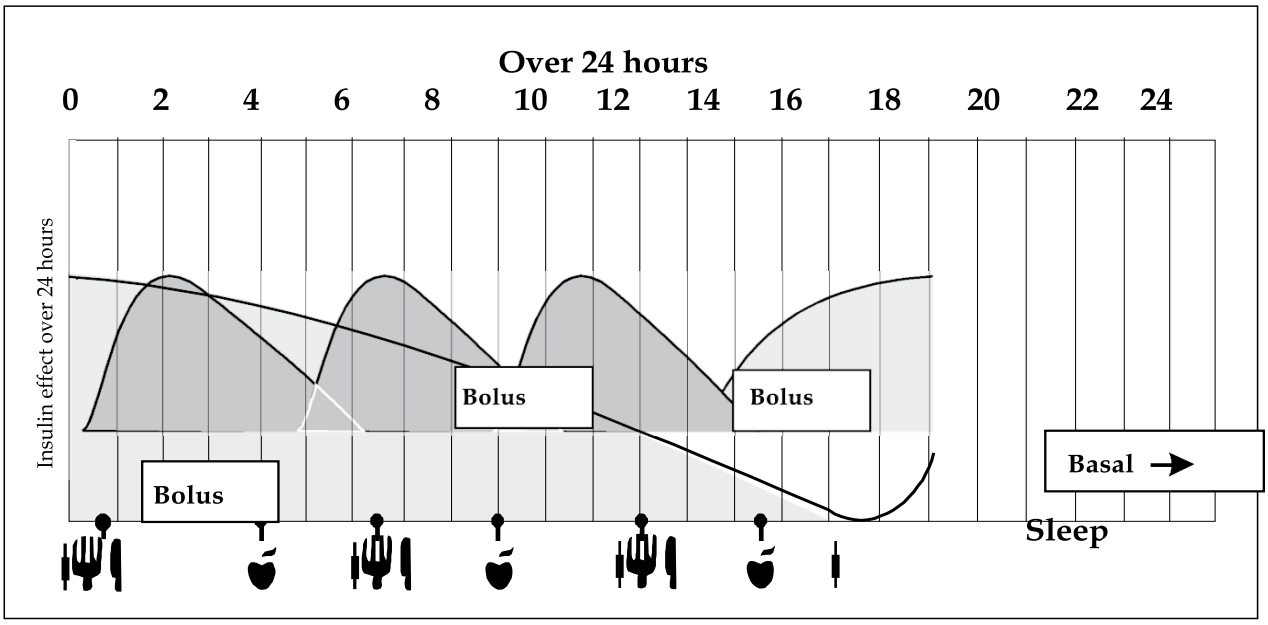
Employment	Shift-workers
	Long working day (early breakfast, late evening meal)
	Missed midday meal or frequent business lunches
	International travel
Eating	National variations (e.g. Traditional large breakfast or main meal at midday in some communities, dietary composition form community to community, etc.)
	Individual variations (fads, availability, affordability, preferences, eating out at restaurants).
Travel	Long-haul air travel
	Travelling to work, e.g. long walking distance
Exercise	Sportsmen and women
	Sedentary office workers
	Labourers
Leisure	Strenuous hobbies, e.g. gardening, sports, etc.
Age and disability	Elderly
	Children
	Handicapped person (visual impairment, arthritis, etc.)
Diabetic complications	Nephropathy (hypoglycaemia prone)
	Retinopathy (inability to perform BGSM)
	Autonomic neuropathy (hypoglycaemia prone)
Intercurrent illness and events	Other chronic illnesses
	Pregnancy
Injection preferences	Dislike of multiple injections
Insulin absorption	Individual variations in absorption and its predictability
	"Brittle diabetes" and 'subcutaneous insulin resistance syndrome'
Stability of diabetes	Long duration of diabetes (no endogenous insulin)
	Multiple hospital admissions for ketoacidosis and/or hypoglycaemia
Psychological state of person with diabetes	Poor compliance
Intelligence and education	Poor education about diabetes
Medical facilities	Poorly trained staff
	Lack of diabetes education facilities

Initiating insulin therapy

- Ideally, the insulin regimen should be individualized, based on the lifestyle of each person. Insulin replacement should mimic physiological insulin secretion characterized by a slow basal secretion that suppresses hepatic glucose output, and an increased secretion in response to meals.
- The quicker absorbed rapid-acting insulin analogues given before meals take care of mealtime glucose excursions and prevent post prandial hyperglycaemia.
- Basal insulin levels can be maintained by injections of intermediate-acting insulin at bedtime with or without a smaller morning dose. Long-acting insulin given once a day can achieve the same effect. A number of regimens can be adapted to suit an individual person

INSULIN REGIMENS:

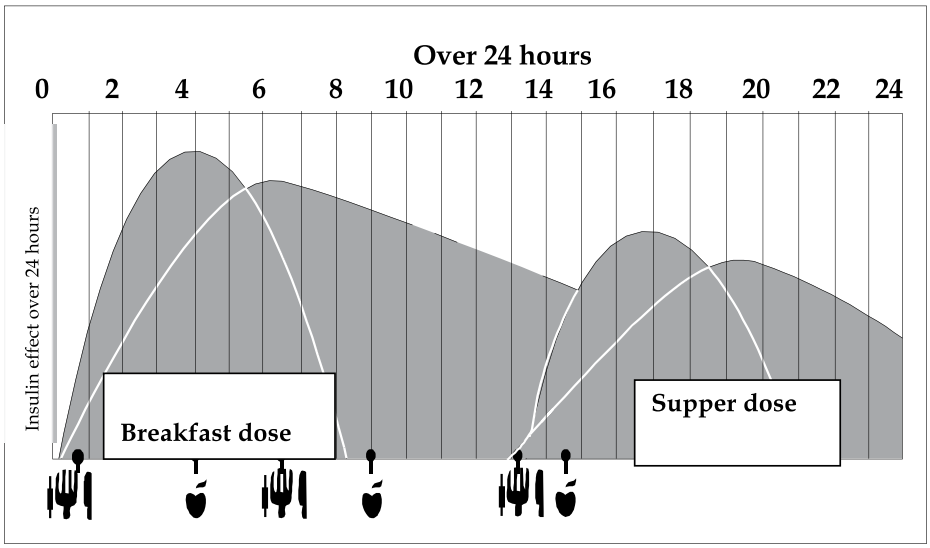
Figure 3.2: Basal bolus regimen



Basal bolus regimen: to achieve flexibility and tight control

Basal (Long acting) bolus regimen: to achieve flexibility and tight control
Starting dose:
Type 1 diabetes: 0.6 IU/kg x body weight = total daily dose (TDD) Type 2 diabetes: 0.2 IU/kg x body weight = TDD
Sixty percent of the TDD should be injected as short-acting (bolus) insulin before meals, e.g. if person has three equally sized meals per day:

- Before breakfast 20%, before lunch 20%, and before supper 20%.
- he remaining 40% of the TDD should be injected as basal insulin, e.g. before bedtime (22:00).



Twice-a-day regimen: simple regimen to suit a well-organized lifestyle:

Premixed insulin;
Starting dose:

- Type 1 diabetes: 0.6 IU/kg x body weight = TDD Type 2 diabetes: 0.2 IU/kg x body weight = TDD.
  - 2/3 of TDD to be administered before breakfast.
  - 1/3of TDD to be administered before supper.

Initiating insulin in the person with type 2 diabetes:

- The following two regimens are suitable for the person with type 2 diabetes:

Supplement therapy
Basal (long acting) insulin and oral antidiabetic agent (OAA) combination: Continue to lower dose of oral agent and start once daily insulin regimen

Starting dose (Type 2):

- 0.2 iu / Kg / day
- To be administered at 10pm

Replacement of oral Antidiabetic

- *Stop oral agent and start twice daily insulin regimen*

Analogues and oral combination in type 2 diabetes:

- Persons with type 2 diabetes can be initiated on a premixed analogue (0.2 IU/kg/day) introduced before supper, and Metformin given at breakfast and lunch.
- When the TDD exceeds 30 IU, the additional units of insulin above 30 are administered as rapidly acting analogue 50% of which is given before breakfast and 50% before lunch and Metformin continued.
- This regimen provides the person with type 2 diabetes with much needed postprandial control, as well as basal insulin for 24 hours.

Adjusting insulin doses:

GREAT CAUTION SHOULD BE EXERCISED WHEN INCREASING OR DECREASING INSULIN DOSAGES:

- Obtain a pattern of pre-prandial blood glucose levels over a period of at least 3-4 days of 4 time's daily profiles.
- Increase/decrease one insulin dose only at a time, not more than twice a week.
- Do not adjust insulin doses by more than 2-4 units (adults) at a time.
- In the presence of ketones adjustment can be made more rapidly.

Other options:

Continuous subcutaneous infusion pumps

- Most pumps provide a basal infusion of insulin with an option to adjust the release rate during the day and at night.
- Pump therapy should be prescribed and implemented by a skilled professional team.
- The person with diabetes should demonstrate a high level of understanding for using the pump, and should be highly motivated to control their blood glucose.
- Rapid-acting insulin analogues are recommended for use in insulin pumps.

Important Practicalities on Insulin Therapy

i) Rebound hyperglyceamia

- A hypoglycaemic episode, whether it causes symptoms or not, stimulates secretion of insulin antagonistic hormones.
- In a person without diabetes, increased pancreatic insulin secretion will neutralize the hyperglycaemic effect of these hormones.
- In the insulin-deficient person with diabetes, these hormones act unopposed to cause hyperglyceamia. This is known as the Somogyi effect.
- As a result, the person with diabetes may wake up with an early morning elevated blood glucose level.

ii) Dawn phenomenon

- In a person without diabetes, the early morning levels of insulin at about 03:00 hrs are very low.
- These levels gradually increase until 09:00 hrs – this increase is essential to cope with the increase in the blood glucose that is seen in response to the increased GH and cortisol levels (overnight).
- In the person with insulin dependent diabetes, it is desirable that the levels of insulin follow the same pattern – low in the early evening and peaking at about 06:00hrs.
- This increase in insulin requirement in the morning is called the Dawn phenomenon (note this is not the same as the Somogyi effect). For this reason, it is desirable that the person with diabetes who is on basal insulin administer it as late as possible in the evening, i.e. 22:00 instead of 06:00. The later the injection is given, the later the peak action of insulin occurs

Then Consider The Following:

IF THE BLOOD GLUCOSE IS TOO LOW: PERSON EXPERIENCES EARLY MORNING HYPO, FOLLOWED BY A REBOUND HYPERGLYCAEMIA RESPONSE

CORRECTION:

Lower insulin dose at night time

- Add a snack at 22:00

IF THE BLOOD GLUCOSE IS NORMAL TO HIGH: PERSON MAY BE EXPERIENCING THE DAWN PHENOMENOM

CORRECTION:

Inject basal insulin at 22:00
OR
Choose basal insulin with a longer

How Would You Determine Whether The Patient Is Suffering From Rebound Hyperglyceamia Or From Dawn Phenomenon; As In Both Cases The Patient Might Wake Up With Early Morning Hyperglyceamia?

- *Ask the person with diabetes to set an alarm clock for about 02:00-03:00 in the morning.*
- *Monitor and record the blood glucose.*
- *Repeat this action for a couple of mornings*

iii) Lipohypertrophy

- The repeated and prolonged injection of insulin into one particular site can cause hypertrophy of the fatty tissue.
- This reaction is characterized by the appearance of large, elevated, spongy masses of fatty fibrous tissue (lumps) at the injection site.
- Easily accessible sites, such as the thighs, are most commonly affected.
- Injections into the fatty masses are relatively painless, which may lead to multiple injections on one affected site. This gives the lesion the appearance of a pin cushion.
- Of importance is that the absorption from these areas is poor, so the effects of insulin are unpredictable.
- Simply changing to a different injection site prevents lipohypertrophy.
- Skin necrosis can occur when insulin is injected into the skin intra-dermally, rather than subcutaneously.

Storing insulin

Insulin not in use:

- Keep insulin in the fridge at 4-8 °C. Human insulin is stable for 30 months from the manufacturing date at these temperatures, compared to 24 months for analogues
- Store the insulin in a separate container, at the bottom of the fridge and away from the freezer compartment.
- Do not store insulin in the fridge door, as this will cause exposure to fluctuating temperatures.
- Insulin must not be frozen. This may appear to be perfectly acceptable once it has defrosted, but changes in the crystalline structure cause it's action profile to be unpredictable.
- The expiry date is printed on each insulin vial, penfill or penset

Insulin in use:

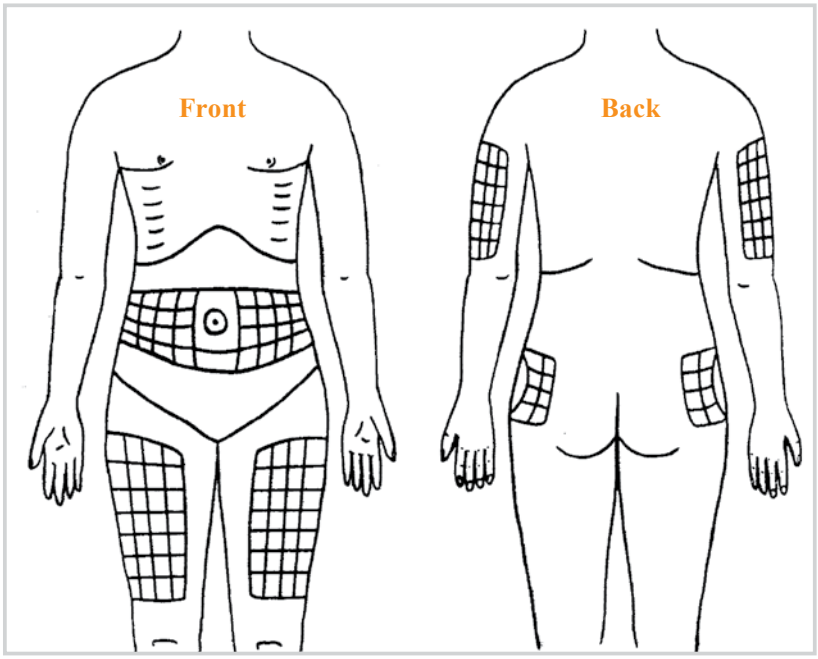
- Insulin currently in use by the person with diabetes does not need to be stored in the fridge.
- An injection of cold insulin will hurt.
- Human insulin is stable at 25 °C for 6 weeks and at 37 °C for 4 weeks.
- The insulin, however, must be kept away from direct sunlight. .
- Analogues will maintain stability for 4 weeks at temperatures of 30 °C and lower.

Re-suspend insulin by rolling the vial gently between the two hands; avoid vigorous shaking, as this will destroy the insulin molecules.

Transporting insulin

- Persons with diabetes travelling abroad should be advised to check on the availability of the insulin at their port of arrival.
- If the insulin is not available, they should take adequate supplies of insulin with them.
- Please advise persons with diabetes to carry their insulin in their hand luggage as cargo luggage is often sent to incorrect destinations, temperatures in the hold are not guaranteed, and freezing can occur.
- All persons with diabetes should carry a valid prescription for insulin with them.
- Insulin should not be kept cool in direct contact with ice packs, as this could cause the insulin to freeze.

Figure 2: Injection Sites for Insulin



- The injection sites most commonly used are the abdomen, the thigh, and the buttock.
- The upper arm is an acceptable injection site, but is not popular because of difficulty to access.
- The rate of absorption is fastest on the abdomen and slowest on the unexercised thigh.
- The thigh should be avoided as an injection site when exercise is going to be done, as this will increase the rate of absorption of the insulin.
- One area should be used for an injection at a particular time of day, e.g. the abdomen is the site for the morning injection, and the thigh is the site for the evening injection.
- Within these areas, the injection site is to be rotated.
- It is desirable that the person use the same area for the same time of day as absorption rates can differ and this can lead to changes in control.
- The rotation within an area is essential to avoid lipohypertrophy occurring to the subcutaneous fat.
- If there is hypertrophy to an area (seen as a lump), this area should be avoided for future injections, as the absorption rate from hypertrophied tissue is not predictable.
- Soluble insulin is best given into the abdomen and NPH is best given into the thigh. The reasons are that soluble insulin should be absorbed as quickly as possible and the NPH insulin to be absorbed more slowly.

Injection technique

- The skin should not be cleaned with spirit or alcohol as this hardens the skin. This is especially so if one has taken a bath with soap and water in the preceding 24 hour period and has not exerted them so as to have a soiled or greasy skin.
- If the person feels more comfortable with cleaning the area prior to injection, then this can be done with water.
- A skin fold should be supported and the needle slid into the loose tissue.
- The injection should be done at a 90-degree angle with the skin if the needle is short, i.e. 12 mm or less.
- If the person is very thin, very wasted or the needle is long, then a 45-degree angle for entry is suggested.

- The needle should be held in place for 10 seconds after injection before withdrawal.
- The injection site may bleed slightly if there are many surface capillaries.
- Do not use any cloudy insulin intravenously.

• **Rate of absorption**

Increasing the rate of absorption of an injection should be avoided, such as:

- Exercise.
- A hot bath or a sauna.
- Rubbing the area.
- Giving the injection intramuscularly instead of subcutaneously may be indicated in case of an emergency

Decreasing the absorption rate should also be avoided, such as in the following cases:

- Inactivity,
- Extreme cold.
- Giving an injection into a hypertrophied area.

• **Checklist before changing insulin dosages:**

- Correct storage of insulin – check compliance with storage temperature and storing conditions.
- Expiry date of insulin in use.
- Whether or not the person is injecting the required insulin as prescribed by the doctor, e.g. basal at 22:00 and bolus insulin before meals?
- Check injection timing – does this comply with the stipulated requirements, e.g. soluble insulin and premixed human insulin ½ an hour before a meal, rapid analogues and rapid mixed analogues immediately before a meal?
- Check injection techniques, e.g. proper re-suspension of a premix, priming the pen before injection, correct dosage drawn up and injected, correct mixing procedure followed.
- Check injection sites for lipodystrophy.
- Check compliance of the person with diabetes regarding eating plan, exercise, blood glucose monitoring, etc.
- Check what other conditions may be present to interfere with blood glucose control, e.g. stress, underlying infection, myocardial ischemia, intake of sugar-based cough mixtures, energizers, vitamin syrups, etc.
- It is important to correct and or treat any compliance or other probable causes for poor control, before adjusting insulin dosages. Should insulin dosages be adjusted, the person needs to monitor blood glucose control more frequently, until the desired effect is achieved.

• How to adjust insulin dosages:

- Insulin dosages could be adjusted once a week, but not more than twice a week, as the body needs time to adjust to the change in dosage.
- Children: not more than a ½ to 1 unit per dosage adjusted.
- Adults: Human insulin adjustment should not be more than 2-4 IU according to the TDD, and analogues not more than 4-8 IU according to the TDD.
- When a single dose is adjusted, e.g. a specific dose during the day or night, titration should be done slowly to avoid hypoglycaemia – human insulin at 1-2 IU/dose, analogues at 2-4 IU/dose. This is followed by frequent blood glucose monitoring.
- Check whether food is available, and if not, be careful

MODULE 3.5: DIABETES AND PHYSICAL ACTIVITIES

Introduction

Physical activity (exercise) is an important component of diabetes management with physiological and psychological benefits. Regular physical activity is beneficial in the management of type 1 and 2 diabetes.

Objectives

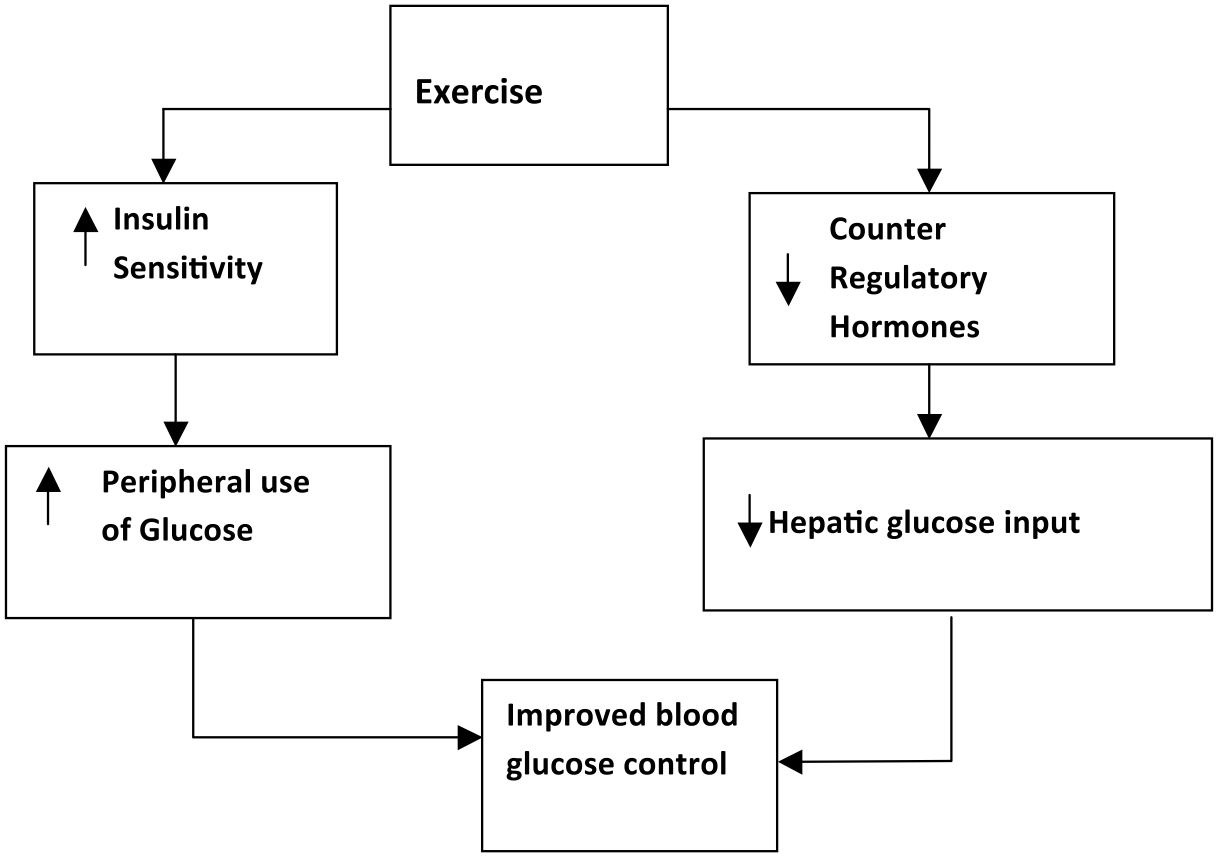
After completing the module, the participant will be able to:

11. Describe the benefits of exercising.
12. Describe the different types of exercise.
13. Identify the risks of exercise for people with diabetes.
14. Give recommendations for exercising.
15. Know how to assess the person with diabetes before the exercise session.
16. Monitor the person with diabetes during the exercise session.
17. Recognize that individuals have barriers to exercise.
18. Give recommendations for particular cases.

The benefits of exercise

- Improves cardiovascular fitness in type 1 and 2 diabetes.
- Reduces cardiovascular risk factors, such as hypertension and hyperlipidaemia in type 1 and 2 diabetes.
- Contributes to the flexibility, endurance, and muscle strength.
- Improves glucose control in type 2 diabetes.
- Increases peripheral use of glucose.
- Decreases glucose hepatic output.
- Increases insulin sensitivity.
- Decreases counter regulatory hormones.
- Helps maintaining weight in addition to meal planning among people with type 2 diabetes whose weight is normal, and helps to reduce weight in obese people.
- Gives a sense of well being and a better quality of life in people with types 1 and 2 diabetes.

Figure 3.4: Metabolic effects of physical activity in type 2 diabetes



The different types of exercise:

i. Aerobic exercises

- Aerobic exercises are rhythmical, can be sustained over a prolonged period, and are recommended in most cases.
- These exercises usually engage large muscle groups, and increase the body's demand for oxygen. These exercises are effective in managing weight.
- Examples of these are walking, running, swimming and cycling.

ii. Anaerobic exercises

- Exercise without using oxygen, with the principal fuel as glucose (usually short bursts of energy as in the 100-m dash, shot put, or javelin).
- These are less adapted to the needs of most people with diabetes.
- Resistance training (strength or weight training) such as lifting of weight or resistance machines is also utilized.

Risks of exercise for people with diabetes

- Developing hypoglycaemia during or after exercise, especially in a person on insulin.
- Increased hyperglycaemia in poorly controlled persons and under-insulinised persons with pre-exercise blood glucose levels of 250-300 mg/dl (14-17 mmol/l).
- Myocardial infarction or arrhythmia in persons with diabetes who also have atherosclerotic disease, if exercise is not properly paced.
- Possible worsening of Microvascular diabetes complications especially retinopathy.
- Damage to soft tissue or joints in the presence of peripheral neuropathy.
- Damage to the feet, when not wearing the proper shoes.

Recommendations for exercising

- Adequate fluid intake during exercise.
- Use of proper footwear.
- Wearing an identification bracelet.
- Avoidance of exercise in extreme temperatures (heat or cold).
- Inspection of feet after exercise.
- If possible, exercise with a friend.
- For type 1 diabetes no uniform recommendation can be made for hypoglycaemia prevention and improving metabolic control. However, self-monitoring of blood glucose needs to be integrated into the exercise programme and the information to be used to adjust the insulin dosage and food intake (see general guidelines below).

In type 2 diabetes, the following are general recommendations:

- Adapt the type of exercise to person's general physical condition, preferences, and lifestyle to enhance adherence, reduce risks.
- Frequency: at least 3 days per week.
- Duration: according to the individual.
- Intensity: 50-70% of person's maximal heart rate (maximum heart rate = 200-age)
- People using hypoglycaemic agents or insulin should self-monitor their blood glucose to determine glycaemic response to exercise. They should adhere to the recommended different phases of exercise as follows:
- Warm-up: 10 - 15 minutes
- Actual exercise: 30 - 45 minutes
- Cool down: 5 - 10 minutes.

Assessment of the person with diabetes before exercise

It is important that persons with diabetes be assessed to ascertain their fitness in readiness for exercise. These are geared toward detecting diseases of the heart, blood vessels, eyes, kidneys, and nervous systems. Persons with diabetes especially at risk must have a more detailed medical examination. This includes people:

- aged > 35 years
- With type 2 diabetes.
- With type 1 diabetes for longer than 5 years
- With any additional risk factors for coronary heart disease.
- With microvascular disease (proliferative retinopathy, nephropathy).
- With peripheral vascular disease, autonomic neuropathy.
- Always examine feet and footwear.

Basic tests: These can be done depending on the individual situation

- Cardiovascular system: ECG, 2 D Echocardiogram, exercise ECG.
- Peripheral arterial disease: toe pressure, ankle Doppler
- Retina: retina screening (fundoscopy)
- Kidneys: urine microprotein
- Peripheral neuropathy: 10 g monofilament test.

Monitoring During Exercise

• Metabolic control before physical activity

- Avoid exercise if fasting level is > 250 mg/dl (14 mmol/l) and urine ketones present, or if > 16.6 mmol/l irrespective of whether ketosis is present or not.

- Increase intake of carbohydrates if glucose levels are < 100 mg/dl (6 mmol/l).
- Blood glucose monitoring before and after physical activity
- Identify when changes in insulin or food intake are necessary.
- Gain knowledge of the glycaemic response to different physical activity conditions.

• Food intake
- Consume additional carbohydrates as needed to avoid hypoglycaemia.
- Carbohydrate based food should be readily available during and after exercise, e.g. Fresh juice, commercially available high-energy drinks.

• Insulin administration
- Avoid exercise during peak insulin action.
- Reduce insulin dose if exercise is anticipated.
- Administer insulin away from the working limbs.
- It is notable that the effect of exercise especially in type 1 diabetes may last several hours later. The lag effect (as result of muscular uptake of glucose to restore glycogen) causes hypoglycaemia up to 24 hours following exercise, so it may be advisable to eat a snack or carry a carbohydrate supply in case of hypoglycaemia.

Targets of Exercise
i. Metabolic targets.
- Glycosylated haemoglobin below 7% and glucose level in acceptable range adapted to the situation or
- Total cholesterol below 5 mmol/l.

ii. Cardiovascular fitness:
- The cardiovascular system's ability to take up, transfer and utilize oxygen for energy.

iii. Achievement of ideal body weight.

Barriers to Exercise
These are hindrances to exercise which need to be identified and addressed. They may even require psychological help.
Barriers may be real, e.g. lack of motivation, presence of debilitating illness, physical disability, e.g. polio, blindness, lack of available space, time, and security. Real barriers often relate to foot problems, neuropathy, or arthrosis.
There may also be perceived barriers, such as having to the gym, exercising being expensive and a waste of time, child play, not liking it or being tired.

How to Help People to Overcome Barriers
An effective approach to barriers enhances the possibility of successful adherence to an exercise programme thus;
- Encourage group exercising.
- Allow the person with diabetes to choose what they like and can afford to do.
- Discuss with the person and agree about a specific target, such as walking 30 minutes every day, and so on.
- Explain that simple, regular exercise is possible in most cases, such as walking, climbing stairs, going uphill, and even the usual daily chores that can be organized.
- Show a few exercises that the elderly people can perform regularly every day.

- In young people, playing football or basketball, doing gym in a group, or jogging are suitable suggestions.

Recommendations in Particular Cases

i. Exercises for people with retinopathy
- Not recommended: excessive jogging, high-impact aerobics, weight lifting, and boxing.
- Recommended: mild exercises, such as walking, low-impact aerobics, and endurance exercising.

ii. Exercises for people with nephropathy
- Moderate exercise is allowed (working at 65% of heart rate).
- In overt nephropathy: exercise is self-limiting.

iii. Exercise for people with current or previous foot disease, Charcot's arthropathy:
- No weight-bearing exercises.
- Avoid repetitive exercises, e.g. prolonged walking, jogging, step exercises.
- Recommended: swimming, bicycling, rowing, chair exercises, and arm exercises.
- Amputees can do exercise in a wheel chair, with arms and body. They need strength in their arms to keep their balance when walking with crutches and prosthesis.
- In case of arthritis or arthrosis: mild exercising, e.g. walking, relaxed gym.

iv. Exercise in children
- Encourage them to do regular physical activity, such as sport, outdoor play, football, gym.
- Pay attention to the need of balancing glycaemic control with normal playing.
- To achieve control, parents, teachers, and caregivers have to work together.
- Hormonal changes in adolescents may complicate control.

v. Exercise in the elderly
- Advancing age and obesity may hinder aerobic exercising.
- Encourage mild exercise, e.g. walking regularly.

The response to exercise is so variable and multi-factorial that adjustments in medication and food should be based on individual responses to exercise.
The use of blood glucose monitoring is important for understanding exercise response patterns.

MODULE 3.6: NUTRITION THERAPY

Introduction

Medical nutrition therapy is an integral component of diabetes management. It has both short and long term benefits for diabetes outcomes. Dietary modification is one of the cornerstones of diabetes management, and is based on the principle of health eating in the context of social, cultural and psychological influences of food choices. Dietary modification and increasing levels of physical activity should be the first step in the management of diabetes mellitus and have to be maintained.

Diabetes nutrition therapy aims to enable people with diabetes to make appropriate changes to their lifestyle to reduce the risks of both micro- and macro vascular complications. This involves recommending change and facilitating it through behavioural interventions, such as identifying barriers to change, motivational interviewing and goal-setting. Nutritional therapy should however be individualized to accommodate preferences, age, needs, religion, culture, lifestyle, complications and readiness to change

Aims of the Nutrition Therapy

- Diet therapy aims at tailoring the care plan in accordance with the prevailing clinical situation. It is understood that this therapy will be implemented alongside appropriate changes in lifestyle to improve diabetes outcomes. Diet therapy is not only concerned with the prevention of micro and macro vascular complications but also chronic complications of diabetes.
- Its aims are set out to:
- Attain and maintain blood glucose levels as close to normal as possible using appropriate diet management
- Prevent hypo- and hyperglycaemia through diet and treatment, prevent swings in blood sugar and minimize the risk of developing diabetes complications
- Attain optimum blood lipids and blood pressure control and so reduce the risk of macro vascular disease
- Assess energy intake to achieve optimum body weight (this can mean taking action to either increase or decrease body weight).
- To promote physical, social and psychological well being. The diet should be modified to prevent and treat chronic complications of diabetes by:
- Encouraging healthy food choices and physical activity
- Preparing individual diet plans that suit the person's lifestyle as well as respecting his/her wishes and desire to change.

Assessment of the Nutritional Status for a Person with Diabetes

- Nutritional assessment is a pre-requisite for conducting dietary counseling; this enables the diabetes educator to provide optimal nutrition therapy that is individualized to the needs of each person with diabetes.
- The nutrition information gathered during nutrition assessment should be used in managing the patients' nutritional needs.
- The Nutritionist/dietitian, diabetes educator and the person living with diabetes can suggest changes to the current food choices and meal patterns.
- Always try to involve the person who prepares the food.

Information required:

i. Personal information:

- Age,
- Gender,
- Socio-economic circumstances,
- Ethnicity,
- Occupation,
- Literacy and numeracy.
- Ability and willingness to change nutritional habits and practices.
- Emotional state, especially if newly diagnosed.

ii. Behavioral Information

- Alcohol Intake
- Smoking
- Physical activity

iii. Nutritional Assessment

- Anthropometric (Weight, Height, BMI, Waist Circumference, Hip Circumference)
- Biochemical (Blood Glucose, HBA1C, Lipid Profile, RFTs, LFTs,)
- Clinical (Blood Pressure, Symptoms of Hyper/hypoglycemia)
- Dietary information (Diet History, Food security, Food Preferences/Choices, Taboos, beliefs and misconceptions, Allergies)

iv. Medical Information

- Type of Diabetes
- Treatment modality, insulin, oral hypoglycaemic drugs or diet
- Blood pressure
- Other medical conditions e.g. visual handicap, nephropathy and celiac disease

Basic Guidelines to Nutrition Education and Counseling

- Nutrition education and counseling is an ongoing interactive process between person with diabetes and Nutritionist/dietician and/or the diabetes educator, and not a standard package delivered in a single session.
- After diagnosis: explain types of dietary changes needed and explore how these may be met. Written information highlighting key messages can be given to the person to refer to later on.
- The education should cover the following;
- Regular follow-up sessions are advisable to evaluate the effectiveness of change, continue the learning process, and correct nutrition and health misinformation and deception
- Various educational strategies can be used, e.g. in-group or individual setting – through verbal, written, or audiovisual information media.
- Match the type and level of information to individual needs and abilities.
- The nutritionist and dietician should work closely with diabetes team members to ensure consistent dietary messages

Components of a healthy diet for the diabetic person

A 'diabetic diet' is not a special 'diet'. It is rather a healthy eating plan. It is important that the plan is practical, realistic, and avoids setting perfection as a goal. Periodic review of the plan is essential because it will need to evolve as the person goes through different life stages and their circumstances change.

When planning a meal for the diabetic person there is need to consider the following basic principles of a healthy eating plan which are;

- To balance energy intake to energy expenditure
- To provide adequate quality and quantity of macro and micronutrients to meet nutritional requirements
- To integrate a healthy meal plan in accordance with culture, beliefs, taboos, values and socio economic status (It is important to eat a variety of all foods.)
- Make starchy foods the basis of all meals.
- Limit intake of fatty foods and simple sugars.
- Include 2 to 4 fresh fruit per day. When drinking fruit juice, choose the juice that has no sugar added but dilute the juice (half glass of water and half glass of juice) before drinking it
- The overall effect of a meal on blood glucose levels will depend on the different types of foods comprising the meal. High carbohydrate foods have the greatest effect on blood glucose levels because, after digestion, they are mostly converted to glucose, which is absorbed from the intestine straight into the bloodstream. However, proteins and fats in the diet do affect blood glucose levels, too.
- The following food groups needs to be included in the diet;

a) Starchy foods (Carbohydrates)

- Starchy foods Provide energy and are required by the body for daily functioning. They are key component of a healthy diet and should be included in the meal plan. It is recommended that 55-60% of energy should come from carbohydrates
- **Common sources are;** cereals, grains e.g. maize, rice, ugali, arrow roots (Nduma), sweet potatoes, wheat, and wheat products, cassava etc
- The amount of carbohydrate a person eats can make a big difference in their blood glucose levels. When a diabetic person eats more carbohydrate than usual at a meal, their blood glucose level is likely to be higher than usual several hours afterward.
- Whole grain starches are recommended because they are digested at a slower rate than simple sugars, they in turn, either reduce the demand on beta cells in the pancreas to produce insulin or reduce the need to inject large amounts of insulin. Complex carbohydrates also have more vitamins, minerals, and fibre. Examples of complex carbohydrates include brown bread, rice, cereals, sweet potatoes, arrowroots, pasta etc.

Some healthy ways to include starches in your meals

- Buy whole grain breads and cereals.
- Eat fewer fried and high-fat starches such as regular potato chips/French fries, pastries, or biscuits. Try baked potatoes, boiled bananas, sweet potatoes and arrowroots.
- Use low-fat or fat-free plain yogurt
- Use mustard instead of mayonnaise on a sandwich.
- Use low-fat or fat-free substitutes such as light margarine on bread, rolls, or toast.
- Eat cereal with fat-free (skim) or low-fat (1%) milk

Tips

- Individual receiving Bolus insulin therapy should adjust their doses based on CHO content of meals
- Individuals receiving fixed daily insulin doses should be consistent with the amount of day to day CHO intake

b) Proteins

- Proteins are body building foods and are for the maintenance and repair of the body tissues.
- Protein in the diet can help to stabilize blood sugar as it is not broken down as quickly to glucose like carbohydrates and it therefore decreases the demand for insulin on your pancreas. However, it's still important not to consume protein in excess, because it is converted to glucose by the liver.
- It is recommended that 12-15% calories/energy should come from protein (approximately 0.8g protein/kg body weight)
- Sources of protein can be classified into two categories; animal and plant sources.
- Animal sources; meat and meat products, milk and milk products, fish, poultry (chicken, turkey, ducks) and eggs,
- Plant sources; Dry legumes e.g. beans, peas, soya, lentils, nuts etc. Plant-based protein sources provide quality protein. Most of the fat in these products are unsaturated and their foods contain fiber so they are good for your heart as well, especially if you substitute them for other meats or poultry in your diet.
- Foods in this group include: dried beans such as black, kidney, pinto and bean products, Lentils such as brown, green or yellow, dried peas such as black-eyed or split peas, soya Soya-based "meat" products, Soy nuts, Nuts and spreads such as almond butter, cashew, butter, peanut butter, and soy nut butter.
- Diet high in protein and low in carbohydrates is not advised because it is generally high in saturated fats

Some healthy ways to eat meat and meat substitutes

- Buy cuts of beef, pork, ham, and lamb that have only a little fat on them. Trim off the extra fat.
- Eat chicken or turkey without the skin.
- Cook meat and meat substitutes in low-fat ways e.g. broil, grill, stir-fry, roast, steam or microwave
- To add more flavors, use vinegars, lemon juice, soy sauce, salsa, ketchup, barbecue sauce, herbs, and spices.
- Cook eggs using cooking spray or a non-stick pan.
- Limit the amount of nuts, peanut butter, and fried foods you eat. They are high in fat.
- Check food labels. Choose low-fat or fat-free products.

c) Fruits

Fruits provide carbohydrate, vitamins, minerals, and fiber. It is recommended that one uses the fruits in season

Examples of fruits include;

Apples	Peaches
Strawberries	Mango
Grapefruit	Guava
Bananas	Papaya
Raisins	Berries
Oranges	Tangerine
Watermelon	Canned fruit

Some healthy ways to eat fruits

- Eat fruits raw or cooked, or juice with no sugar added,
- Canned fruits in their own juice, or dried fruits.
- Buy smaller pieces of fruit or choose pieces of fruit more often than fruit juice.
- Whole fruit is more filling and has more fiber.
- Save high-sugar and high-fat fruit desserts such as fruit pie for special occasions.

d) Vegetables

- Vegetables provide vitamins, minerals, and fiber.
- They are low in carbohydrate.
- Include both the Green leafy and Yellow or orange Vegetables in your diet

Examples of vegetables are;

Lettuce	Tomatoes
Broccoli	Celery
Spinach	Chilies
Peppers	Kales
Carrots	Cabbage
Green beans	Traditional vegetables such as amarath (terere) managu, mrenda, saget, etc

Some healthy ways to eat vegetables

- Eat raw and cooked vegetables with little or no fat, sauces, or dressings.
- Try low-fat or fat-free salad dressing on raw vegetables or salads.
- Steam vegetables using water or low-fat broth.
- Mix in some chopped onion or garlic.
- Use a little vinegar or some lemon or lime juice.
- Add a small piece of lean meat instead of fat to vegetables when cooking.
- Sprinkle with herbs and spices.
- If you do use a small amount of fat, use canola oil, olive oil, or soft margarines (liquid or tub types) instead of fat from meat, butter, or shortening.

e) Dietary Fat/Oils

- These are high energy giving foods.
- It is recommended that fat intake should not exceed 30% of total calorie intake per day.
- The total fats depend on many factors. However the type of fat an individual eats is more important than total fat.

- All Fats provide more energy per gram than other foods (9 cal/g) but only differ in their action on the cholesterol metabolism. Therefore it is important to watch portion sizes as well.

Sources of fats include;

Salad dressing	Mayonnaise
Oil	Avocado
Cream cheese	Olives
Butter	Bacon
Margarine	

Fats are classified as;

i) Saturated Fat

- They are mainly found in food of animal origin, however, coconut and palm oils belong to this category.
- They are solid at room temperature with the exception of coconut and palm oils.
- They adversely affect serum cholesterol levels.
- One of the important diabetes nutrition guidelines is to eat less than 7% of calories from saturated fat.

Foods containing saturated fat include:

High-fat dairy products such as full-fat cheese, cream, ice cream, whole milk, 2% milk and sour cream.
High-fat meats like regular ground beef, hot dogs, sausage, bacon and spareribs
Lard
Butter
Fatback and salt pork
Cream sauces
Gravy made with meat drippings
Chocolate
Palm oil and palm kernel oil
Coconut and coconut oil
Poultry (chicken and turkey) skin **Unsaturated Fats**
These are divided into;

ii) Trans-unsaturated Fats

Like Saturated fat, Trans-fat tends to increase blood cholesterol levels. Trans-fats are produced when liquid oil is made into a solid fat through the process called hydrogenation.

Sources are

Processed foods like snacks (crackers and chips)
Baked goods (muffins, cookies and cakes) with hydrogenated oil or partially hydrogenated oil
Stick margarines
Shortening
Some fast food items such as French fries

iii) Monounsaturated Fats

- Monounsaturated fats are called "good or healthy" fats because they can lower the Low Density

Lipoproteins (LDL). To include more monounsaturated fats, try to substitute peanut butter instead of butter, margarine or shortening when cooking. Sprinkling a few nuts or sesame seeds on a salad is an easy way to eat more monounsaturated fats. Nuts and oils are high in calories, like all fats. If trying to lose or maintain your weight, eat small portions of these foods.

Sources of monounsaturated fat include:

- Avocado
- Canola oil
- Nuts like almonds, cashews, pecans, and peanuts
- Olive oil and olives
- Peanut butter and peanut oil
- Sesame seeds

iv) Polyunsaturated Fats (PUFA)

- Polyunsaturated fats are also "healthy" fats. It is recommended that you include these in your diet as well as monounsaturated fats.

Sources of polyunsaturated fats are:

- Corn oil
- Cottonseed oil
- Safflower oil
- Soybean oil
- Salad dressings
- Sunflower oil
- Walnuts
- Pumpkin or sunflower seeds
- Soft (tub) margarine
- Mayonnaise

Some healthy ways to include fat in your diet

- Liquid skim milk may be used or powdered skim milk can be made up according to instructions on the packet.
- Prepare most foods without fat e.g. meats, chicken etc. Trim all the visible fat from meat before cooking. Remove skin from chicken before cooking. Grilling, boiling, steaming, and baking are the best cooking methods. Use polyunsaturated and monounsaturated cooking oils only. Avoid deep fried foods.
- Grill fish with lemon juice and a little margarine. Bake in a hot oven with skim milk, tomato and onion, or in foil with vegetables.
- Boil or steam vegetables but add a little oil for availability of fat soluble vitamins (ADEK), no butter, sugar sauce or fat should be added. Use onion, garlic and other spices. Chopped parsley or cinnamon added to carrots adds a different flavour. Potatoes should be baked in jackets, boiled or steamed. Lemon juice or vinegar can be used as a dressing
- Use milk dessert and custard made with skim milk. Use fat free yoghurt as a topping instead of cream or ice cream. Fresh fruit salad with fat free yoghurt is also allowed. Avoid commercial baked products with pastry.

f) Fibre (Both Soluble and Insoluble)

- Dietary fiber (fibre), sometimes called roughage, is the indigestible portion of plant foods that pushes food through the digestive system, absorbing water and easing defecation. Dietary fiber comes from the thick cell wall of plants.
- Dietary fiber can be soluble (able to dissolve in water) or insoluble (not able to dissolve in water). Soluble fiber, like all fiber, cannot be digested. But it does change as it passes through the digestive tract, being transformed (fermented) by bacteria there. Soluble fiber also absorbs water to become a gelatinous substance that passes through the body. Insoluble fiber, however, passes through the body largely unchanged.
- Potential advantages of consuming fiber are the production of health-promoting compounds during the fermentation of soluble fiber, and insoluble fiber's ability (via its passive water-attracting properties) to increase bulk, soften stool and shorten transit time through the intestinal tract.

Sources

- Food sources of dietary fiber are often divided according to whether they provide (predominantly) soluble or insoluble fiber. To be precise, both types of fiber are present in all plant foods, with varying degrees of each according to a plant's characteristics.
- Whole grains are the best source of insoluble fiber.
- Oats, barley, beans, fruit (but not fruit juice), and some vegetables contain significant amounts of both forms of fiber and are the best sources of soluble fiber.

Some helpful hints about fiber

- **Increase slowly:** The best way to begin is to figure out how much fiber you are currently eating each day. Once you know your number, you can begin to slowly increase how much you are eating until you reach your recommended amount. Increasing too quickly can lead to gas, bloating, and/or diarrhea.
- **Add the fluids:** If you do not have enough fluids (preferably water) with your high-fiber diet, you may end with the problem that you are trying to avoid: constipation. Get into the habit of drinking a minimum of 2 cups of a calorie-free beverage between each meal and you will avoid any unwanted problems.
- **Don't go overboard:** More is not always better, so try not to eat more fiber than your body can comfortably handle. There is no Tolerable Upper Intake Level (UL) set for fiber, which means that there is no limit on how high you can go before it causes any damage. Pay attention to how your bowel movements are responding to your fiber intake, and speak with your dietitian or physician if you have any questions.

g) Water

- 8 glasses per day is the recommended.
- But consider other factors like environment, your weight,

Commercially 'Diabetic' foods

There are many commercially prepared diabetic food substances in the market. This are not recommended because:

- These foods are expensive.
- They are high in trans-fatty acids.
- They contain sugars other than glucose/sucrose.
- They are as high in energy as other regular products.
- These foods do not have a role in a healthy eating plan.

- Before using these foods, one must consult with a dietician

Educational Methods for Teaching Dietary/Meal Planning

- An individual plan enhances dietetic outcomes and consequently influences diabetes complications.
- It is important that the plan is practical, realistic, and avoids setting perfection as a goal.
- Periodic review of the plan is essential because it will need to evolve as the person goes through different life stages and their circumstances change.

Factors to consider in Meal Planning

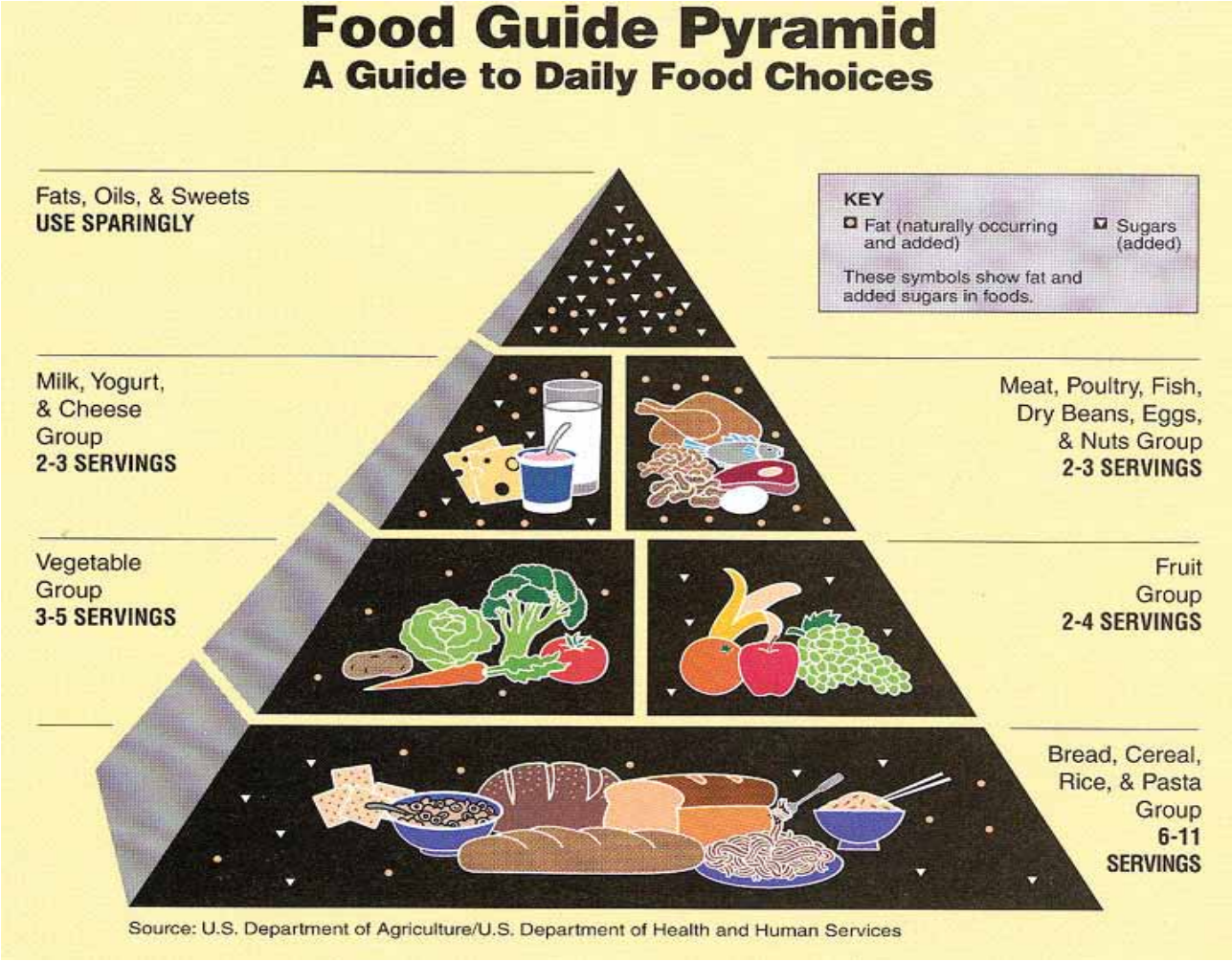
- Specific needs of the individual
- Locally available foods
- Personal and cultural preferences
- Beliefs and lifestyle
- Wishes and willingness to change

Tools for Dietary/meals planning

- Food Pyramid
- Plate Model
- Food Exchange System
- Carbohydrate Counting
- Glycaemic Index

Food Pyramid

- The food pyramid gives average food serving per food group sufficient to keep one healthy.
- The diabetes food pyramid can help one make healthy food choices.
- The Food Pyramid divides food into six groups.
- These groups or sections on the pyramid vary in size. The largest group – grains, beans, and starchy vegetables – is on the bottom. This means that one should eat more servings of grains, beans, and starchy vegetables than of any of the other foods. The smallest group – fats, sweets, and alcohol – is at the top of the pyramid thus one should limit food in this group.



• **Explain what a serving is**

A serving is one exchange of foods within one exchange group. E.g. bread, ugali, rice belong to one exchange group. 1 slice of bread can be exchanged with ½ cup of ugali or cooked rice.

The Diabetes Pyramid gives a range of servings. The exact number of servings you need depends on your diabetes goals, calorie and nutrition needs, your lifestyle, and the foods you like to eat. One should divide the number of servings they eats among the meals and snacks each day.

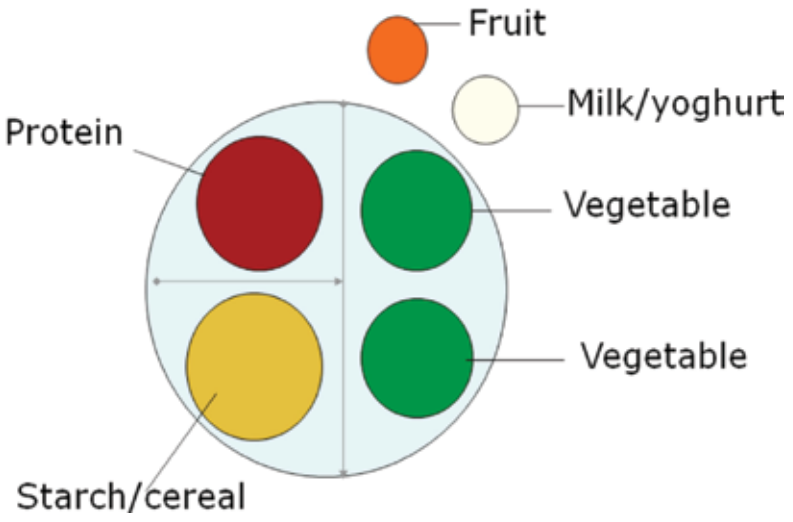
Food pyramid: Food guide[2]

Food group	Number of servings	What is a serving?
Starches and breads	6-11	1 Slice bread ½ cup cooked rice, cereal ¼ cup dry cereal, ½ cup pasta 3 biscuits (eat whole-grain, fortified or enriched starches, bread, and cereals)
Vegetables	3-5	½ cup vegetables cooked 1 cup vegetables raw
Fruits	2-4	1 cup fruit juice (fresh, frozen or canned without sugar) 1 medium piece fresh fruit
Milk and milk products	2-3	1 cup skim / low fat milk / ¾ cup plain or artificially sweetened yogurt
Meat and meat substitutes	2-3	57-85 g cooked lean meat fish or poultry 28.5 g meat is equivalent to: -1 egg 28.5 g cheese ¼ cup fish (Omena, tuna, salmon or cottage cheese
Fat	Use sparingly	1 teaspoon margarine 1 teaspoon salad dressing 1 teaspoon oil or mayonnaise 1 tablespoon peanut-butter

Adopted from: Food Guide Pyramid: A guide to dairy food choices. Bulletin 259, Washington DC: US government printing

The plate model

This is used to plan meals without measuring (a qualitative diet approach).
You fill your plate (20 cm diameter) to match the amount of vegetables, starches, and meat in the sample picture, and then add a piece of fruit and/or a glass of milk. Divide your plate in portions.



Alcohol

The metabolic effects of the alcohol are complex and are influenced by many variables:

- The type and quantity of alcohol consumed.
- The rate of ingestion.
- Age and gender.
- Individual variations.
- Time of consumption in relation to meals and exercise.
- Nutritional status.
- Ill health and medication.

The major issues in relation to alcohol intake:

- Alcohol has the potential to worsen hypoglycaemic episodes.
- Alcohol has the ability to create an unawareness hypoglycaemia.
- Sustained effects of heavy drinking on glycaemic control.
- The possibility of aggravating microvascular complication

People with diabetes can be safely consuming Alcohol, if they adhere to the following precautions:

- Maximum units per week: 14 units for women and 21 units for men. Explain with practical beverages
- Units must be spread over the week not taken all at once.
- Observe 1-2 alcohol free days per week.

Alcohol should be avoided in the following instances:

- During pregnancy.
- Persons who experience gastritis, pancreatitis and severe liver disease.
- Persons who have previously been addicted.
- Persons who use chlorpropamide.
- Alcohol provides 7 kcal/kg, and can cause or aggravate hypertriglyceridaemia.

In type 2 diabetes: it can also cause reactive hypoglycaemia because of enhanced early insulin response to sucrose. Hence, advise to use low carbohydrate mixers and cordials and limit consumption of sweet drinks (especially sweet wines and sherries).

In type 1 diabetes: increased risk of severe hypoglycaemia with large alcohol quantities especially if food is omitted or if alcohol is substituted for some or all carbohydrates of the meal.
Delayed hypoglycaemia can occur up to 16 hours post drinking, hypoglycaemia awareness is reduced at blood alcohol concentration of 20 - 25 mmol/l; recovery from hypoglycaemia is also delayed.
It is not advisable to consume alcohol on an empty stomach. Heavy alcohol consumption causes severe but reversible hypoglycaemia in persons with type 2 diabetes, in persons with type 1 diabetes it causes recurrent episodes of hypoglycaemia.

Benefits of alcohol

Moderate alcohol consumption has the same cardio-protective functions in persons with and without diabetes, and may be protective in peripheral vascular disease.

Guidelines for use of alcohol drinks

1 standard alcoholic drink per day (7 units per week) for women
2 standard alcoholic drinks (14 units per week) for men
Ensure Alcohol free days

NUTRITION THERAPY IN SPECIAL GROUPS

Children and adolescents

Ideally, children and adolescents should be seen by a specialist paediatric dietician periodically. However, this is not always feasible. Changes in eating habits are more easily achieved, when involving the family, school and carers in making decisions on healthy food choices. Information on appropriate snacks as well as treatment of hypoglycaemia must be made available to all carers.

Nutritional or energy requirements change throughout childhood and adolescence, e.g.:

- < 5 years – need a relatively energy-dense diet.
- 6-12 years – energy intake doubles, protein intake per kg body weight decreases.

Recommendations

- Regular dietetic review every 3-4 months during growth and puberty.
- Monitor height and weight.
- Review changes in lifestyle and physical activity.

- Provide advice on safe alcohol use (older children) (better to avoid).
- Be on the lookout for eating disorders.

In extreme adolescent rebellion: it's more important to maintain contact with the person than risk alienation by labouring principles of healthy eating. Motivated adolescents benefit from a more flexible approach to diet and insulin.
Use and intensive management approach in order to permit variability inherent in normal teen lifestyles or eating habits. Dietary advice must be individualized. Make sure that the person with diabetes understands the link between the time of injecting insulin and the time of the meals.
Nutrient requirements for children and adolescents with type 1 or 2 diabetes are similar to other children/adults of similar age.

As the incidence of type 2 diabetes in childhood rises, dietary advice must take the requirement for calorie restriction into account. However, linear growth should not be compromised. Persons should also be screened for any associated dyslipidaemia or hypertension. Physical activity must be encouraged.

Eating disorders
Eating disorders, such as anorexia and bulimia, are very common in adolescent females. This is because of their concern about body weight/shape since they (type 1 females) tend to be heavier than their non-diabetic peers. It may involve omission of insulin, reduced food consumption, or outright starvation.
Success rates for treating eating disorders are lower in persons with diabetes than in those without diabetes.
The following events should arouse suspicion regarding possible eating disorders:

- A high HbA1c.
- Recurrent or unexplained episodes of diabetic ketoacidosis.
- Recurrent severe hypoglycaemia.
- Early onset of microvascular complications.

Early intervention may enhance success rates as the condition may persist into adulthood.
The emotional distress associated with adult type 2 diabetes is often greater than in adolescents with type 1 diabetes, especially as these women become trapped in the vicious circle of low self-esteem, increased restraint eating or binge eating.

Pregnancy

Pregnancy in pre-gestational diabetes
Good control of diabetes before/during pregnancy is vital to reduce risks to the mother and the child. Optimal control preconception reduces the incidence of congenital malformation.
A dietary review is essential to keep up with changes in insulin regimen. Folate supplementation (5 mg daily) should be taken to prevent neural tube defects in the baby. Vitamin/mineral supplements should be given if deemed necessary.
Women whose body weight exceeds 120% of the ideal should be advised to lose weight before pregnancy.

During pregnancy
Regular dietary follow up is necessary to maintain near-normal glycaemia and provide nutritional demands for pregnancy. A stable meal pattern that is composed of smaller frequent meals is vital. Food choices should focus on the need for micronutrient-rich foods (fruits, vegetables, low fat dairy products, lean meat, fish or alternatives) rather than energy-dense fat rich foods.

Greater consumption of low glycaemic index foods is advisable.

- Alcohol should be avoided.
- Tight glycaemic control increases hypoglycaemic risk and people with diabetes need to be advised on symptoms and measures to take.
- Measures to cope with nausea and vomiting should be given.
- Weight gain must be monitored. For a pre-pregnancy BMI of 20-26 kg/m2, recommended total gain is 11.5-16 kg.

If weight is gained too rapidly, try to replace energy-dense food with nutrient-rich, lower energy alternatives. The aim is to stabilize weight/reduce the rate of weight gain. Active weight reduction is not advisable as it may compromise nutritional intake/foetal development.
Energy consumption should be sufficient to prevent ketonaemia.

Lactation
Breast feeding should be encouraged unless the infant requires specialist care in a neonatal unit.
The high energy costs of lactation means the mother may require an additional 40-50 g of carbohydrates/ day compared with her pregnancy state.
Extra carbohydrates may be required before going to bed while the infant is still having nocturnal feeds.

Gestational diabetes
The benefits of dietary intervention and optimal dietary prescription remain uncertain.
Provide advice on healthy food choices.

- Emphasize low glycaemic index foods and carbohydrate distribution throughout the day.
- Modest dietary restriction 24-30 kcal/kg in obese women may be advised.

Postpartum advice on healthy eating and weight management is vital as these women are prone to type 2 diabetes.

The elderly person
General principles of dietary management of diabetes apply, but as appetite is often diminished, the use of nutrient-dense foods needs to be encouraged.
Overweight persons: weight reduction is beneficial as long as micronutrient intake is not compromised.
Zinc deficiency is more common in elderly, hence, a need for supplements or zinc-rich diet.
Calcium intake: at least 1200 mg; multivitamin supplementation is advisable especially if low appetite.

Dietary guidelines:

- Meals should be balanced to meet clinical needs of diabetes without diminishing older person's ability to enjoy meals.
- Avoid hypoglycaemia (relax targets): to reduce falls with associated fractures. Physical activity/exercise is beneficial and should be encouraged.

Institutional care
In Kenya, this is an emerging concept, i.e. homes for the elderly. However, we have children in boarding schools, residential homes, and juveniles or adults in prison. Residents have no control over the time of their meals and medications, or type and amount of food provided; as well as no access to facilities for food preparation and storage.

Under nutrition is common in elderly people in residential care. It is recommended that such elderly residents be given regular meals, with less restrictive diets for better nutritional status and quality

of life. In prisons, problems include inappropriate foods and or meal times, and limited opportunities to exercise. Diabetes management must thus be provided by a multidisciplinary team, who are fully aware of the realities of prison life.

Ethnic considerations

Kenya has great ethnic and religious diversity. Type 2 diabetes, obesity and hypertension are major challenges. The dietician must be familiar with customs, food habits and cooking practices of various ethnic groups, while also aware of the enormous diversity within a particular ethnic group or in a family – no assumptions can be made. Language barriers are also obstacles, but a translator or a relative may help. The intricacies of fasting, depending on particular religions, are to be addressed in dietary plans and medication regimens.

Other aspects of dietary advice

Insulin treatment

Tailor dietary and insulin regimen to individual's lifestyle. If on flexible regime (intensive), the dietician should be knowledgeable regarding the time action profiles of different insulin types and insulin analogues. Insulin is an anabolic hormone; hence weight gain in type 2 diabetes should be anticipated. This should be explained to these persons and dietary measures should be instituted. Combination of insulin and Metformin (type 2 diabetes) can reduce insulin resistance (less insulin used) and lessen weight gain by its anorexic effect.

Oral hypoglycaemic drugs

In overweight type 2 diabetes: drug of choice is metformin as opposed to sulphonylureas, thiazolidinediones or insulin. The meglitinides (repaglinide) are probably weight neutral.

All those treated with oral agents to be advised on causes, recognition and management of hypoglycaemia. Acarbose rarely causes hypoglycaemia as sole therapy, if hypoglycaemia occurs with it being used with another agent: glucose not sucrose should be used, as acarbose is an alpha glucosidase inhibitor and prevents hydrolysis of disaccharides.

Hypoglycaemia

Glucose (10-20 g) is the treatment of choice, as this requires no digestion or metabolism. Toffees and snack bars are inappropriate, as they contain fat and slow down carbohydrate absorption, though gastric emptying during hypoglycaemia is as rapid for solids as it is for fluids.

After recovering from hypoglycaemia a further 10-20 g of slower-acting carbohydrates should be given, unless the next meal or snack is due which should then be taken.

Exercise

Regular exercise should be encouraged in all people with diabetes. Advice on prevention of hypoglycaemia is vital, especially during and after exercise. Blood glucose concentration may increase during the early phase of intense exercise a metabolic decompensation can occur if pre-exercise blood glucose concentration is too high. Thus, exercise should be avoided if glucose > 15 mmol/l, or if there is ketonuria.

If unplanned exercise: increase carbohydrate intake before and during exercise or if planned: reduce insulin or sulphonylurea dosage to prevent hypoglycaemia. If possible, monitor blood glucose before and after exercise to determine the magnitude of adjustments in food and insulin that are to be made.

While exercising – ensure easy access to rapidly absorbed carbohydrates. Beware of the 'lag effect', as muscles replenish glycogen stores, with increased insulin sensitivity: hypoglycaemia can occur soon

or long after exercises (hours later). So reduce insulin, and increase food especially after intensive exercise. A bedtime snack may also be advisable or reduce evening dosage of intermediate insulin. The potential for nocturnal hypoglycaemia is greater if alcohol is consumed after exercise.

Special situations

Intercurrent illness

During acute intercurrent illness, advise on adequate hydration/nutrition especially easily assimilatable foods/drinks, e.g. soup, yoghurt, jelly, fruit juice (Sick day management). Increase fluids especially if there is fever, vomiting, or diarrhoea. Commercial oral rehydration salts can be used or even tomato juice or broth. Continue medication when ill.

Hospital care

As far as possible, allow persons with diabetes to make their own food choices. Hospital dieticians should ensure menus have appropriate or healthy food choices. All wards should have food and drink for oral treatment of hypoglycaemia.

Catabolic illness

The energy needs of most hospitalized persons can be met by providing 25-35 kcal/kg body weight. In catabolic illness, at least 1.0 g/kg body weight up to 1.5 g/kg body weight in more stressed persons. Avoid overfeeding to prevent hyperglycaemia, hypertriglyceridaemia and hypertonic dehydration. Correct mineral/vitamin deficiencies before enteral or parenteral feeding is begun when indicated.

Palliative/terminal care

The aim of nutritional advice in this case is no longer that of risk reduction for micro/macrovascular disease, but avoidance of symptoms because of hyper- or hypoglycaemia. Avoid non-intrusive dietary/management regimens, especially in cases of long-term palliative care. Appetite changes, use of glucocorticoids may require substantial alterations to insulin dose/regimen or to oral hypoglycaemias. Persons with poor appetites on sulphonylureas may revert to megitinides as and when they feel able to eat.

Nephropathy

The role of dietary protein restriction in the management of diabetic nephropathy is still uncertain. Many people in Kenya are still following a diet poor in proteins, against their wishes, out of poverty.
A pragmatic approach:

- Reduce protein to 0.8-1 g/kg/day in individuals with microalbuminuria.
- Reduce protein to 0.8 g/kg/day in individuals with overt nephropathy as this may slow the progression of nephropathy.

Hypertension

- Advise overweight persons to lose weight. There is approximately 1 mm Hg decrease in mean arterial pressure for each 1 kg body weight lost.
- Reduce salt consumption to less than 6 g daily.
- Replace processed foods, which are mostly high in salt, with fruits and vegetables, which are rich in potassium and aid in reducing blood pressure.
- Avoid sustained excessive alcohol consumption, as it has a deleterious effect on blood pressure.
- Regular exercise (30-45 minutes) on 4-5 days/week is beneficial.

Dyslipidaemia
This is often present at diagnosis or in those with poor control. Re-assess regularly and after control of hyperglycaemia. In many persons with type 2, and overweight persons with type 1 diabetes, dyslipidaemia is associated with insulin resistance. This is characterized by raised triglycerides and small dense LDL cholesterol. Plant sterols and stanols have been shown to lower LDL cholesterol: Sterols and stanols are being incorporated into spreads and other fat-derived products, e.g. yoghurt; semi-skimmed milk, cereal bars, soft cheese, and marketed as adjuncts to other dietary methods for reducing LDL cholesterol. They are very expensive and out-of-limit for many people. An intake of 2 g/day – LDL reduction of 10-15%. Hypertriglyceridaemia is also associated with alcohol consumption.

The use of pharmacological doses of fish oils > 3 g daily to treat hypertriglyceridaemia is not recommended because of its potential deleterious effects on LDL cholesterol and glycaemic control.

Coeliac disease
This is especially prevalent in type 1 diabetes. Poses a dietary burden on the person and expert advice is required. If not treated there is high risk of hypoglycaemia. Use of gluten free foods raises insulin requirement. Beans and legumes can be used to increase fibre content of the diet Calcium supplements to be given to reduce risk of osteoporosis if dietary intake is < 1500mg/day.
Gluten-free foods from wheat or maize starch have similar glycaemic indices as those of gluten-containing products, and these are indicated.

Cystic fibrosis
Patients with Cystic fibrosis and diabetes may be underweight. Hence, high-energy diet with extra calories from fat and no restriction on carbohydrate is required. Adjust insulin regimens when supplementary overnight enteral tube feeding is used and during periods of acute infection.
Good metabolic control is a challenge but can be reached with a basal bolus regimen and is associated with weight gain.

Conclusion
Dietary modification is one of the cornerstones of diabetes management. Diabetes nutrition therapy aims to enable people with diabetes to make appropriate changes to their lifestyle to reduce the risks of both micro- and macro vascular complications. Positive outcomes of the therapy are improved metabolic control, decreased risk of micro- and macro vascular complications and quality of life and life expectancy similar to that of the general population

MODULE 3-5 (b): DIABETES AND OBESITY

Introduction

Increasing numbers of the people with type 2 diabetes are either overweight or obese. Being overweight or obese significantly increases the risk of morbidity and mortality from type 2 diabetes and its co-morbidities. Successful reduction has a positive impact on these outcomes. Obesity is a major component of the metabolic syndrome.

Objectives

1. To be able to define, classify and assess for the presence of obesity.
2. Describe the risks of obesity.
3. Describe life style interventions for prevention and management of obesity.

1. Definition and classification of obesity

Various anthropometric measures are used to describe people with diabetes mellitus and may be related to risk of developing the disease. The most common measures in adults are weight, height, body mass index, waist circumference, waist-hip ratio, and sagittal diameter. These are defined and measured as follows.

- Weight in kg is recorded to the nearest 0.1 kg wearing light indoor clothing without shoes. Use a leveled platform scale with beam and movable weights. Alternative methods may be necessary in the elderly and infants (see WHO report).
- Height in cm is recorded to the nearest 0.1 cm without shoes. A vertical board with attached metric scale and vertical rule and horizontal headboard should be used or a stadiometers. The person being measured should stand with heels together and with the buttocks, back and head in contact with the vertical board. The head is positioned so that the external auditory meatus and the lower orbit are level. The movable headboard is brought onto the top of the head with the subject inhaling deeply.
- Body mass index is a derived index and the main measure used to assess relative weight in adults. It is calculated as weight (kg) / height (m2) following the measurement guidelines above. The WHO guidelines to express relative weight are given in the table below.

BMI	Description
18.5-24.9	Normal
< 16	Grade 3 thinness
16.0-16.9	Grade 2 thinness
17.0-18.4	Grade 1 thinness
25.0-29.9	Grade 1 overweight
30.0-39.9	Grade 2 overweight
> 40.0	Grade 3 overweight

- Waist circumference is measured in the standing position with the feet 25 cm to 30 cm apart. This measurement is taken with a flexible but inelastic tape measure. The waist measurement is measured midway between the inferior margin of the lower rib and the iliac crest in the horizontal plane with the subject exhaling gently. The circumference is measured to the nearest 0.1 cm.
- Hip circumference is measured in the standing position in underwear. The tape measure is placed around the maximum extension of the buttocks in the horizontal plane and the

circumference measured to the nearest 0.1 cm.

- Waist/hip ratio is calculated to two decimal places. No internationally agreed criteria are available. The Suggested working definitions for a normal ratio is less than 0.9 for men and 0.95 for women.

2. Obesity is a risk factor to the following conditions:

- Type 2 diabetes.
- Impaired glucose tolerance (IGT).
- Hypertension and other cardiovascular diseases.
- Kidney disease.
- Some forms of cancers (breast, colon, uterus, kidneys, etc.).
- Arthrosis.
- Osteoporosis
- Others, including sleep apnoea

General Principles for the Management of Obesity:

- Assess dietary intake, level of physical activity, BMI, and waist circumference (on presentation and monitor regularly.
- Dietary changes and increased level of physical activity are the most economical means to lose weight. The socio-economic situation will affect ability to comply with dietary advice [refer to Module 3-4 on exercise and Module 3-5(a) on diet].
- Integrate weight control measures into the overall management of diabetes mellitus and co morbidities if BMI > 25 kg/m2 and/or waist circumference > 102 cm and 88 cm in men and women, respectively.
- Weight loss is difficult to achieve and maintain.
- Educate people with diabetes, as well as their families.
- Set realistic goals.
- Use a multi-disciplinary approach to weight control.
- Psychosocial factors need to be addressed.
- Attention should be given to the development of community facilities and a safe environment to facilitate physical activity.

4. Benefits of weight loss

Two potential benefits of even a 10% reduction in weight on a BMI that is classified as overweight/ obese include improved insulin sensitivity and increased HDL levels.

At the same time, a 10% weight loss leads to a reduction in the risk of developing type 2 diabetes (by up to 50%) and a fall in:

- Insulin requirements
- Blood pressure
- Fasting glucose
- Total cholesterol
- LDL cholesterol
- HbA1c
- Triglycerides.

Challenges of weight loss

- Weight loss requires strict discipline
- It depends on the degree of obesity
- Depending on individual capacity to perform physical activity

MODULE 3-5 (c): FASTING AND DIABETES

Introduction

Most commonly fasting occurs because of religious or cultural reasons. However, in Africa, people with diabetes may be forced to fast because of poverty or because natural/man made disasters causing crop failures hence reducing the family access to food. Religion and culture are an important aspect of life. Culture defines the norms for values, beliefs, and judgments about what is good, what is desirable, and how individuals should behave. An appreciation of one's cultural or religious context is critical in understanding the behaviors and environments that govern an individual's daily life. Many people with diabetes wish to follow their religious convictions and may end up fasting without their doctor's advice and knowledge. Caregivers must be aware of this and should be able give appropriate advice on diet and treatment adjustments to persons who are fasting.

FASTING FOR RELIGIOUS PURPOSES

All the major religions recommend or command one form or other for fasting. In Kenya, most of religious fasting is associated with Christianity, Islam and traditional religions.
Fasting for religious purposes is possible in certain circumstances in people with diabetes.

General principles

- The health provider should be consulted to seek advice whether fasting can be embarked upon on medical grounds.
- Advice from the religious leader should also be sought as to whether (s) he can be exempted.
- Check the level of glycaemic control using HbA1c or fasting blood glucose. Those who are very poorly controlled should be discouraged from embarking upon fasting. Drug dosage adjustment is required for patients with fasting blood glucose < 80 mg/dl (< 4 mmol/l).
- If the person is on insulin or insulin secretagogues, drugs, dosages and timing will require adjustment during the period of food denial to meet calorie intake.
- A total fast is not recommended for anyone with diabetes. Adequate hydration is important even during the period of fasting.
- Self-monitoring of blood glucose is mandatory for people with diabetes who elect to fast.
- Once-a-day monitoring is adequate for persons on diet only, or on a diet along with metformin. In persons on insulin secretagogues, blood glucose should be done at least three times a day. The doctor and persons with diabetes should agree on how to handle abnormal results before starting to fast. If hyperglycaemia is marked, retesting should be done more frequent and the urine tested for ketones.
- Vigorous activity should be avoided during the fasting period.
- People who fast should have ready access to their health-care providers during the period of fast.
- Clear guidelines should be set as to when to terminate the fast, e.g. frequent hypoglycaemia, intercurrent infection.
- Compensatory eating should be avoided when one opens their fasts. Diets should remain the same during fasting periods.
- In persons with underlying complications, such as cardiac failure, nephropathy and hypoglycaemic unawareness, fasting should be discouraged.

RAMADHAN

People treated with oral hypoglycaemic agents and dietary modification:

- In this situation fasting is possible.
- Usual dietary advice should be followed at this time. Compensatory eating should be avoided when breaking fasts.
- Patients on metformin, alpha-glucosidase inhibitors and thiazolidinediones can continue taking the usual doses at the usual times.
- Persons on sulphonylureas:
  - If on chlorpropamide, this should be stopped and substituted with a shorter-acting agent.
  - If on a second or third generation sulphonylureas (glibenclamide, gliclazide, glipizide, glimepiride), this should be taken before breaking the fast and not before dawn.
  - If on tolbutamide, both morning and evening doses can be taken, but the smaller dose should be taken before dawn.

- Persons with type 2 diabetes on insulin:
  - If on once-daily insulin before bedtime: This can be given as usual.
  - If on twice-daily short- and intermediate-acting insulin: Before the dawn meal, give the usual evening dose of short-acting insulin without any intermediate-acting insulin.
  - Before the evening meal, give the usual morning dose of short-acting and intermediate acting insulin.
  - If on basal bolus regimen: Usual doses of the short-acting insulin can be given before the dawn and evening meals, and usual doses of the intermediate-acting insulin can still be given at 22:00Hrs.

- Regular SBGM is essential to ensure prevention of hypoglycaemia, and titration of doses should occur according to SBGM results. Neither the insulin injection nor the breaking of the skin for SBGM will break the fast.

FASTING IN OTHER RELIGIOUS TRADITIONS

If a person with diabetes intends to fast, consider the following:

1. If the type of diabetes or treatment precludes any of the traditional types of fasting, then another form of fasting, e.g. pleasure fast, can be chosen.

2. If medically eligible to fast, the fast that best suits the person's type of diabetes should be selected in consultation with the health-care provider.

3. If the person is on insulin, a partial fast is preferred to absolute or normal forms of fasting.

Table 3.7 Summary of advice to those fasting for religious purposes in people with type 2 diabetes

Treatment regimen	Fasting regimen	When to take antidiabetic agents
Diet only	Total, normal or partial fast	Not applicable
Metformin/thiazolidinediones	Normal or partial fast	With meals
Insulin secretagogues sulphonylureas	Partial fast	Before meals
Daily intermediate- or long-acting insulin	Partial fast	Before first meal
Glinides	Normal or partial fast	With meals
Multiple doses using short- and intermediate-acting insulin	Avoid fasting or partake in pleasure fasting	Not applicable
Long-acting plus bolus fast acting	Avoid fast or partial fast	Lantus a.m. and analogue with meals
Complex medications	Pleasure fasting	No change indicated

Starvation

Sadly, because of various reasons such as poverty, famine or wars, people with diabetes may find themselves in situations where food is scanty and they are forced to fast. The body turns to itself to provide energy. First to go are fat deposits and large quantities of water. Thereafter, the body begins to break down protein in other organs, such as the liver, spleen, and muscle tissue. The heart and brain proportionately show little loss. Intake of less than 150-200 g carbohydrates daily may result in starvation ketosis. Starvation may also increase the risk of hypoglycaemia, especially in people with type 1 diabetes.

Adjustments in treatment regimens will have to be undertaken to avoid the above:

- Reduction in the insulin dosage to provide only basal insulin requirements.
- Basal insulin will also be required to decrease ketone body formation associated with severe starvation (starvation ketosis).
- Dietary restriction to be removed and persons are advised to eat foods that are available.
- When meals are available small boluses of short-acting insulin should be used.
- Adequate hydration is important during these periods.

Fasting prior to specialized investigations

Various diagnostic and radiological investigations may require fasting which lasts up to 12 hours. Where possible these investigations should be carried out early in the morning and may require to be managed with intravenous infusion of glucose, insulin and potassium, as would be in a surgical case (refer to Module 4-5).

MODULE 4-1: DIABETES IN CHILDREN AND ADOLESCENTS

Introduction

Particular people have particular needs "(IDF Bulletin 1998) children and adolescents with diabetes have special, changing needs as they develop and grow. These needs must be recognized and addressed: they arise from the stages of growth through which they pass. All young people have a right to diabetes education and management: children cannot fight for their rights so it is important that society accord them all the necessary support.

Individualized assessment of the child's maturity level, developmental stage, family and social support, eating habits, and school and sports schedule is critical. This must take into consideration cultural, socio-economic, and environmental determinants in developing a realistic comprehensive individualized management plan that is offered in stages as the child develops.

Use a simple approach and a language they can understand. Be very practical in your teaching.

Objectives

1. To help the young person with diabetes in:

- Managing diabetes with self-control.
- Attaining normal growth and development.
- Avoiding acute complications, e.g. ketoacidosis, hypoglycaemia.
- Preventing long-range complications.
- Closer monitoring, especially in adolescence.
- Enjoying a smooth transition to adult life.

2. Practically, this includes teaching the young person in skills such as:

- blood glucose monitoring;
- urine ketone monitoring;
- nutrition advice;
- exercise;
- Regular use of medication.

Administration of insulin

It takes time and patience to teach someone how to inject insulin. Make sure that everything is understood and that the practical aspects are followed. Experience proves that errors are very common, and supervision is needed for a long time. Demonstrate as you explain, and then ask the individual to do it. Later on at a follow-up visit, ask for a control demonstration. Measuring small amounts of insulin in children is sometimes difficult. You have to use small syringes (if possible 0.3 or 0.5 ml) of very good quality. Check the prescribed amount of insulin and explain in details to the child and parents. Most paediatric patients will require insulin therapy except cases of type 2 diabetes and monogenic diabetes (MODY), who will require oral agents. There is no established formula determining a child's insulin requirements. Body weight, age, and pubertal status usually determine the dosage. However there are guidelines.

Children with newly diagnosed diabetes may need from 0.5 IU to 1 IU/kg/day. Usually, after a few weeks or days of sustained treatment, the needs for insulin diminish, and sometimes stop. This is called the so called "honeymoon period". The educator must be watchful for the signs of and adapt the insulin to the real needs of the young person with diabetes.

As a general reminder:

- Pre-puberty dosage: 0.5-0.8 IU/kg/day Puberty dosage: 0.8 -1.5 IU/kg/day Adult dosage: 0.6-1.5 IU/kg/day Insulin may be administered as follows:
- Conventional therapy (2 times daily).
- Intensive therapy (3 or more times daily) enhancing flexibility with meals and activity.

The latter is recommended for older children, with special precaution to avoid severe hypoglycaemia. Insulin is adjusted depending on the results of blood glucose monitoring and in relation to various activities or lifestyle of the child.

Insulin refusal or omission poses a great challenge to care. Consider the use of micro-fine gauge 29 or 30 siliconised insulin needles, which cause less pain, and the hope that repeated injections will enhance acceptance. Most children with diabetes do not complain about the pain. Monitoring
Clinical signs are important. Teaching to recognize the signs of hypoglycaemia and ketoacidosis must be done early. Parents, teachers, and caregivers should suspect hypoglycaemia if the child is irritable, displays abnormal behaviour, complains of hunger, etc. Children need to be trained too, and with time, to carry some form of glucose at all times in case of need.

Urine testing (especially for ketones) is easy to perform and must still be used in young patients as often as possible. Ketones in urine are a sign of emergency. This can be checked at home.
Blood glucose measurement should be performed at home if affordable and as often as possible.
Skills to adapt behaviour to the results of the test are essential, certainly for hypoglycaemia. Education should also include control parameters for blood glucose. In an ideal situation these should be:

- Fasting blood glucose – 5-6 mmol/l
- Postprandial blood glucose – below 8 mmol/l
- Glycosylated haemoglobin (HbA1C): for children younger than 5 years old, 7-9% is acceptable and older children 7-8%.

One has to accept that this is not always possible, and it can even be dangerous if close monitoring is impossible or if food is not always available. Growth (weight and height) monitoring, is essential in all children and adolescents, and if any abnormalities are detected, early intervention or referral is recommended.

Education
Talking to children and teenagers is a special task. You must use simple words, short sentences and make sure at each step that the individual understands. Ask them to repeat what you have told them. The first step is to listen to the family and the person with diabetes. They have a lot to explain and many questions to ask. Integration of the family and school is vital in the education process. Try to understand their problems and find a way to adapt the treatment to the possibilities of the young person with diabetes and their family. The level of education of the person with diabetes and the family may differ vastly. Make the necessary adaptations. Using a stepwise approach, first teach the "survival kit", and add knowledge at each visit. Teach them very simple things at first.

You may encounter a problem with language barriers, as they may speak a language not understood by you or your team. Diabetes education is a vital component of care, providing knowledge of diabetes and its short and long term complications, and ways to curb these. Education empowers them to take control of their disease and play an active role in the management of diabetes. There is no generalized teaching programme, and the content will depend on individual targets.

Compile a record sheet in the file, to record what has been mentioned each time. Education is an ongoing process, and survival skills need to be provided at diagnosis. Family and children need ongoing education and support as the child grows and takes on more elements of self- care.
Frequent contact between the caregiver and the person with diabetes decreases the number of admissions and increase the quality of control. When available, a contact per telephone is very useful. Knowledge and skills should be evaluated regularly.

Exercise
Keep the young person with diabetes active, playing, and following sport sessions. Regular exercise is an important component of management and needs to be encouraged. These children and adolescents should be involved in all school activities and sports. This is especially so, since these activities not only enhance discipline, but also reduce discrimination and feelings of inadequacy. Physical activity is also a crucial component of their management.

These children must be well educated to understand the impact of extracurricular activities on blood sugar, thereby knowing when to reduce insulin, to eat snacks before exercise, and to carry some forms of hypoglycaemia treatment. Importantly, insulin should not be given in an exercising limb, and preferably at least one hour before exercise. Before and sometimes during exercise food intake might be necessary.

Nutrition
For young people with diabetes food should not be very different from the healthy diet of a normal teenager without diabetes. They need the same amount of energy. A balanced diet provides the necessary amount of energy with proteins, starches, fats, water, salt, and vitamins. With the use of drawings or representations of foods, explain those which contain fat, proteins, sugar, carbohydrates, salt, and vitamins. Encourage food intake, which is high in fibre, as well as vegetables and fruits. Water is essential, especially in a hot climate and during exercise. Find out whether or not the person with diabetes knows s how to take enough to drink during a school day or working day.
Explain how to organize meals according to the insulin schedule and to food availability. Inform why food and insulin must be adapted to each child's lifestyle; special precaution being paid to regular meal distribution (4-6 meals/day), to avoid hypoglycaemia. Repeat until well understood.

Use a stepped approach, beginning with survival information and progressing to more advanced topics, e.g. using food exchanges, carbohydrate counting. Try to know the child's food preference and the possibilities of the family. Food plays an important role in family dynamics; it brings a family together, especially if everyone is eating a similar meal. If a family adopts healthy eating habits, it is not necessary to prepare separate meals.

Children differ from each other according to age, parameters, problems, likes, and dislikes, therefore, management goals will differ from one child to another, as will nutritional advice.
Explain that the body needs more energy during exercise, and therefore some food intake is necessary before or during the session. Make sure that the individual knows how to avoid hypoglycaemia, and what kind of food should be taken.

Some special concerns

- **In toddlers:** food refusal, irregular eating.
- **In teenagers:** the influence of peer pressure, such as eating and drinking fast foods, soft drinks, sweets, alcohol, smoking etc.

- The influence or restrictions of culture and religion must be considered and if detrimental, appropriate suggestions offered.
- Eating during a school day is not always easy or possible; find ways to organize a few snacks from time to time.
- In young female teens, self-image is a big issue, therefore, omitting insulin to keep slim poses a challenge to adequate nutrition, and help must be offered.

General support, psychosocial aspects

Young children require a lot of supervision and emotional support in diabetes care, yet the freedom to be a child is of paramount importance. As they grow up, and depending on their individual cognitive maturity, they will be able to take up self-care skills with waning supervision. However, through these stages, continuous education, care and support from the diabetes care team and their family is vital for a successful transition to adult life.

Networking with other children with diabetes can help to deal with the challenges of diabetes care, e.g. participating in diabetic camps, hikes, etc. Recommend small changes and implement them at a rate the child can tolerate. Reward achievement by positive remarks, such as praise, gestures, or small gifts as appropriate.

The diagnosis of diabetes in a child presents the family with challenges they must face. It is important to recognize the emotional trauma this poses. Allow the family and child to go through the various psychological stages of shock, denial, bargaining etc, until they accept their condition, and are ready to take control, then pace education as the family wishes.

The care team should identify problems in family functioning, health beliefs and quality of life. Thereafter they should address issues or offer appropriate referrals and support for the solutions. To enhance adherence to life-long changes in behaviour involving daily repeated tests and activities, the health care teams must discuss these behaviours with parents and families. Educators with experience should be aware that many young people have either no parents, or parents who are absent or unable to help their children. These children with diabetes are in need of a very special support. Always record a family history and try to find out how best the person with diabetes can enjoy support and by whom. Address the child's goals and win his/her trust by being willing to compromise. Encourage parents to play an active role even in adolescents' care (without being over bearing). Share the 'burden of care' with the family, especially when goals are not being achieved. Determine the degree of parental involvement through the success of self-management achieved by the child or adolescent.

In the overall management of diabetes, the fear of hypoglycaemia must be addressed, and parents, caregivers, and children be taught to take appropriate action.

Adolescents

Adolescents with diabetes are in a transitory period and are exposed to many other challenges, which must not be ignored.

Eating disorders: these are especially common in young females, who have an obsession to be slim and may vary from anorexia nervosa to bulimia. Some are life-threatening disorders, which should be identified early and managed. Sudden weight loss, deterioration, or instability in control can be pointers to an eating disorder, or binge eating (especially of restricted foods), and these may be appropriately constituted into meal plans as a solution. Peer pressure pushes children towards eating fast foods or soft drinks.

The use of alcohol, drugs, and cigarettes poses danger to control and may enhance diabetic complications.

Sexual abstinence: needs to be encouraged in adolescents with diabetes, if not able to abstain contraceptive advice needs to be given. Unprotected sex poses danger of unplanned pregnancy and more importantly, the HIV/AIDS risk is great.
These challenges must be addressed long before adolescence: 'forewarned is fore armed'! The integration of family, teachers, religious and community leaders, and sports heroes helps bring out the message louder and appeals to a wider audience.

Persistent denial or other severe emotional disorders: depression or anxiety may require psychological help.

It is imperative for parents, caregivers, and peers to be in support of adolescents with diabetes: at a certain point, they will need someone to turn to and this had better be the right person. Parent support groups should be encouraged.

Transition to adult life
For many young people it is a difficult situation, more so for those affected by a chronic condition, such as diabetes. The most difficult topics are related to the emotional life, sexual desires, and desire to marry, and found a family. Educators cannot do everything, but can listen to the adolescents and their problems, and find a solution along with them. Often, one has to talk to a future husband or wife about their diabetes condition. Some counseling in the choice of a career is essential.

Complications
The educator should approach the person with diabetes cautiously to avoid instilling undue fear. Emphasis should be on weight control of the child being a family issue, which should be approached in a way to avoid alienation.
Education in a positive way should highlight the risks of developing complications; but emphasize the role of overall good diabetes care today as a means of preventing complications.

Conclusions
Diabetes management in children, and especially adolescents, is an arduous task. It is a challenge from which one should not shrink, since any sustained reduction in blood glucose level means fewer incidences of complications, particularly because this special group has a longer way to go.
Above all, children have rights they cannot advocate for, so adults must fight for these children's rights.

MODULE 4-2: GESTATIONAL DIABETES AND DIABETES IN PREGNANCY

Introduction:

Through the entire peri-natal period, women with pre-existing diabetes and gestational diabetes have special needs and concerns. These are best attended to by using the multidisciplinary team approach. Members of the team include an obstetrician, a dialectologist, a nurse educator, a clinical officer, a nutritionist, a midwife, a social worker/psychologist, a lay diabetes educator, and the client.
The multidisciplinary team works together to provide integrated care within these areas:

- Pre-conception counseling.
- Medical management/nursing intervention.
- Nutrition.
- Psychosocial.
- Exercise.
- Newborn care.
- Postpartum.
- Breastfeeding.
- Contraception.

The team's goal is to co-ordinate care and education for the pre-pregnant and pregnant women with pre-existing and gestational diabetes. Throughout the peri-natal period, the woman with diabetes meets with various team members for medical care and/or diabetes self-management education. Each team member reinforces and evaluates the woman's application of the self- management skills she has received from the entire team.

Objectives

1. Define diabetes in pregnancy; pre-existing and gestational diabetes mellitus (GDM).
2. Asses the status of pregnant women with diabetes.
3. Screen women for GDM.
4. Identify the risks for the mother and the baby.
5. Describe pre- and post-conceptual care for women with diabetes.

Pre-existing diabetes, type 1 or 2

Women with pre-existing diabetes can become pregnant. Just like non-diabetic women, they have special needs because of the effect of diabetes on pregnancy and vice versa. They need counseling on the importance of planned pregnancy. The diabetes educator should discuss the following topics:

- Contraception.
- Optimal timing of conception.
- GDM is a condition of abnormal increase in blood sugar that occurs during pregnancy and may return to normal after delivery.

Assessment of mothers with diabetes

1. General medical history, history of diabetes management, history of previous pregnancies, approximation of previous control since diagnosis.
2. Blood pressure, goal 130/80. This goal should be medically managed. ACE Inhibitors should not be used.
3. Fundoscopy should be done by an ophthalmologist early in pregnancy or prior to planned conception. A complete fundal examination should be repeated several weeks prior to delivery. If retinopathy is present, a caesarean section is indicated as vaginal delivery may rupture the retinal vessels.

4. Neurological evaluation. Is there impaired autonomic response to hypoglycaemia? Peripheral neuropathy, gastrointestinal functional impairment?
5. Current diabetes management. What is the nutritional plan, drug therapy? If a woman with type 2 diabetes has been on oral agents, change to pre-conception insulin treatment as soon as she presents for care. If the woman is using insulin, advise her that the first trimester may make her more susceptible to hypoglycaemia. During the second and third trimester, the insulin dosage will increase because of the hormones, which cause insulin resistance during pregnancy. This calls for a rise in the dosage on a frequent basis.
6. General health pre-pregnancy screening, Laboratory assessments.
7. Diabetes-related assessments: HbA1C, creatinine clearance (if elevated, do a 24-hour urine protein test), thyroid profile, lipid profile, ECG if history of cardiovascular disease or elevated lipid profile.
8. What is the mother's knowledge/skill for self-management? What is her attitude to self-care, value of this pregnancy, and motivation for self-care?

Screening for GDM
Screening for GDM should be performed for women at high risk.

High risk
- Age above 35 years.
- History of large (above 4 kg) babies.
- Family history of diabetes.
- Previous GDM.
- History of problematic pregnancies
- BMI above 25
- The standard 75 g OGGT should be used with the same cut-off values, although a 2-hour blood glucose level > 7.8 mmol/l (140.4 mg/dl) (IGT).
- Fasting or any other elevated level is positive for GDM.

Risks to the mother with diabetes
If blood glucose levels are not maintained throughout the pregnancy, the mother is at risk for:
- Spontaneous premature delivery.
- Polyhydramnios.
- Hypertension,
- Eclampsia
- Foetal death.
- Stillbirth.
- Rapidly advancing renal, retinal damage.
- Vaginal lacerations.
- Infections: vaginal, urinary tract.

Risks for infants of women with diabetes:
- Macrosomia.
- Hypoglycaemia first 72 hours/life.
- Hyperbilirubenemia.
- Polycythemia.
- Hypocalcaemia/hypomagnesaemia.
- Respiratory distress syndrome.
- Birth trauma.

- Intra-uterine foetal death caused by maternal diabetic ketoacidosis (DKA).
- Low birth weight.
- Small-for-gestational age.
- Congenital anomalies.
- Prematurity.

Discussion

It is presently believed that the hormones produced by the placenta cause an exacerbation of micro vascular growth in the eyes and kidneys of the mother with long-standing, poorly controlled diabetes. The increased risk of intra-uterine death of the foetus close to the due date is believed to be caused by hyperglycemias causing the placenta to become post-mature. If blood sugar is not controlled, phagocytosis is impaired, leaving the woman vulnerable to opportunistic infections. If the baby is macrosomic, the chances of vaginal tears are increased.

Implications of hyperglycaemia in relation to pregnancy

In the absence of diabetes, metabolism of pregnancy is as follows:

- the foetus depends on the mother for fuel via the placenta;
- The mother is the regulator of the fuel provision.
- The glucose and ketones passively diffuse across the placenta.
- Insulin DOES NOT cross the placental barrier.

In the fasting state, the free fatty acids (FFA) and ketones are expected to be higher than in the non-pregnant state. Glucose and amino acid levels drop more quickly; gastric contents empty more rapidly during pregnancy, thus, there is an earlier peak of glucose in the blood, as well as faster entry of amino and fatty acids into the blood stream from the small intestine.

In the non-fasting state, the postprandial blood glucose goes higher and stays elevated longer during pregnancy. As pregnancy progresses the aforementioned changes are more pronounced.
In the pregnant state (without diabetes) there are dramatic increases in basal and postprandial insulin levels (3times). The insulin needs are usually lower in the first trimester but as the pregnancy progresses and the hormones of pregnancy cause significant insulin resistance, the demand rises appreciatively.

In the poorly controlled women with diabetes, the foetus receives excess glucose, probably less amino acids and more fatty acids. With this altered metabolic state, the different systems (cardiac, neurological, etc). The foetus is at risk of developing abnormally, thus the increased risk of congenital abnormalities if poor control exists during the first 10 weeks of pregnancy. Poor control during the second trimester puts the baby at risk of central nervous system abnormalities and behavioural problems in childhood. Poor control during the last trimester puts the baby at risk of intra-uterine death, lung immaturity, and hypoglycaemia at birth.

The macrosomia is a result of the maternal hyperglycaemia. The mother's glucose crosses the placenta but her insulin does not. At ten weeks' gestation the foetal pancreas starts working, producing insulin when the blood glucose stimulates the glucose receptor of the foetal pancreas. If the mother is hyperglycaemic, excess sugar reaches the foetus and provides excess stimulus to the glucose receptor, developing fat and not muscle, on the foetus causing the macrosomia. The babies of poorly controlled diabetic mothers actually have a higher fat to muscle ratio compared to the babies of other mothers. This has implications for a tendency of obesity in the child, putting them at lifelong risk of easy weight gain. Being in an environment of altered protein, fat, and carbohydrate metabolism in utero predisposes the child to type 2 diabetes often occurring in adolescence or young adulthood.

Hypoglycaemia soon after birth occurs if the diabetes was not well controlled for several days prior to delivery. Maintenance of good control (3.5 to 7.8 mmol/l) is to prevent over stimulation of the foetal beta cells. Once they are hyper-stimulated, they remain hyper-productive for several days thereafter, even if the glucose stimulus has been reduced. The foetus has received glucose via the placenta for the duration of the pregnancy; once the umbilicus is cut the baby loses this source and if the beta cells were hyper-stimulated they will continue to make insulin, lowering the baby's blood glucose severely if not fed with glucose water or put to the breast soon after delivery.

Respiratory distress syndrome occurs because the production of surfactant, the substance that maintains alveolar patency, is defective when there is excess insulin in the foetal circulation. This can be minimized by getting good control for two weeks prior to an induction or planned caesarean section at 38 weeks gestation. Prednisone can be given to the mother several days prior to delivery to speed lung maturation. Birth trauma, i.e. fractured clavicle, can be caused by shoulder dystocia. The mother should be evaluated prior to delivery to estimate the risk; if the baby is too large, plan a caesarean section.
Regarding blood idiosyncrasies do a haemogram and test for electrolytes soon after delivery. Blood glucose monitoring should be done hourly for the first several hours, then two-hourly for the next 24 hours. Regarding birth anomalies, the baby should be evaluated after birth.

Management
Goals for management

- Fasting Blood Sugar 3.3 to 5.0 mmol/l (59.4 - 90.0 mg/dl)
- Before meals 3.3 to 5.8 mmol/l (59.4 - 104.0 mg/dl)
- 1-hour postprandial 6.1 to 7.8 mmol/l (109.8 - 140.4 mg/dl)
- 2-hour postprandial 5.0 to 6.7 mmol/l (90.0 - 120.6 mg/dl)
- Bedtime 5.0 to 6.7 mmol/l (90.0 - 120.6 mg/dl)
- 2:00 - 6:00 am 3.3 to 6.7 mmol/l (59.4 - 120.6 mg/dl)

Blood sugars above 7.8mmol (140.4 mg/dl) carry an increasing risk for maternal and foetal complications. First urine sample testing for ketones is necessary as insufficient caloric intake or wrong distribution of meals may drive the mother into fat metabolism: presence of ketones has been known to have adverse effects on the foetal brain development. If ketones are present, a thorough reassessment of the mother's nutritional intake is needed. A bedtime snack of protein and carbohydrates will prevent hypoglycaemia and ketosis. No more than 10 hours without food should pass.

Hypoglycaemia
Women with pre-existing diabetes usually experience hypoglycaemic symptoms at a lower level of 3.3 mmol/l (59.4 mg/dl) than in the non-pregnant state; 3.9 mmol/l (70.5 mg/dl). The possibility of hypoglycaemic unawareness increases as the duration of diabetes increases. Test blood sugar before driving or operating dangerous equipment. Carry treatment for low blood sugar at all times. See previous Module on hypoglycaemia.

It is important to note that the stomach may be in spasm when the sugar is low so the woman should not trust ingested food to get into the small intestine rapidly. Thrust glucose, sugar, and sweets in the mouth to raise the blood sugar quickly and reliably. If there is sudden, unexplained hypoglycaemia, there may be sudden foetal demise. If the foetus dies in utero there will be a sudden drop in blood glucose 24 hours before spontaneous labour starts.

Hyperglycaemia
Ante partum: Blood glucose is persistently above 7.8 mmol/l (140.4 mg/dl). Target should be 3.3 to 7.8 mmol/l (59.4 to 140.4 mg/dl).

Identify the cause of the hyperglycaemia:

- Is there an infection?
- Review the dietary intake.
- Is insulin dosage adequate?
- Is insulin dosage correctly drawn-up and administered? Abdominal site is the best throughout pregnancy.
- Exercise regularly.

Medication
The woman with type 2 diabetes should be put onto insulin if the diet is not effective in achieving good control. For a woman with type 2 diabetes using insulin for the first time, the dose should be calculated approximately 0.5 IU/kg/24 hours, with 2/3 of the total dose in the morning before breakfast, 1/3 in the evening before supper. The easiest regime is to use mixed insulin, like Mixtard or 70/30, or if this is not available then use the total morning dose of 30% short-acting and 70% intermediate-acting insulin in separate syringes. The same applies for the evening dose: 30% short-acting and 70% intermediate-acting insulin. Secure the syringe to the bottle with a rubber band so that the insulins are not mixed and the short-acting insulin "contaminated" with long acting form The most appropriate injection site is the abdomen as absorption is fastest there. As the pregnancy advances, avoid leg sites since circulation in legs is affected by uterine pressure.

Insulin dosage

- 5th month gestation 0.5 I.U /kg/24 hr
- 6th month gestation 0.6 I.U /kg/24 hr
- 7th month 0.7 I.U /kg/24 hr
- 8th month 0.8 I.U /kg/24 hr
- 9th month 0.9 I.U /kg/24 hr]

If the woman has type 1 diabetes and is monitoring her blood glucose, the dosage should be adjusted to meet the blood glucose targets.

For most women without long-range complications, walking is the best and least expensive exercise. They should take their exercise 5 out of 7 days per week to get the ongoing effects (reduction in insulin resistance) of the exercise.

For nutrition requirements see Module 3-5(a) on nutrition.

Preparation for delivery
If the baby is a reasonable size, induction should be planned at 38 weeks' gestation. The woman should bring her own glucometer and monitor her blood glucose hourly during induction. For the mother with type 1 diabetes, there should be an insulin/glucose intravenous drip regulating her blood glucose level. For women with type 2 diabetes, the insulin dose should be discontinued once induction is started. An intravenous glucose drip should be initiated and regulated according to the blood glucose levels.
After delivery, there is a sharp drop in the need for insulin in both diabetes types. Discontinue insulin for type 2 and be guided by the blood sugar levels. For type 1, cut dosage to pre-pregnant dose and observe blood sugar. Lactation may further reduce insulin requirements.

Gestational diabetes

Most women with GDM can be managed with diet and exercise. If blood sugar does not reach the target levels, start with insulin treatment. The Dawn phenomenon is common in GDM so fasting blood sugar will indicate when insulin should be initiated. Often an evening dose before supper, starting at 10 IU to 12 IU insulin can control the fasting blood sugar for a while and adhering to the diet with a well-controlled fasting blood sugar level may see her through for a while before pre-breakfast insulin needs to be added.

There is no risk of a genuine GDM having congenital abnormalities in the baby, as the blood glucose had not been elevated during the formative period. The woman needs to be counseled about the risks to the foetus if diabetes is not controlled. She also needs to know of her chances of a high-risk delivery and possible neonatal distress after delivery.

Educational Process Monitoring

Mothers should be taught to monitor blood glucose if they can afford to do so. Most important times for testing are during fasting and 1-hour postprandial. Blood glucose monitoring is definitely an advantage if economically possible. It can give excellent feedback on food intake and appropriate amounts. It will indicate when and if insulin is necessary.

As the woman is newly diagnosed with diabetes, she should complete her diabetes self-management education and be given psychological assistance to handle the additional stress of this pregnancy.

The Educational Process

- Client assessment: personal data.
- Learning needs – do not take anything for granted.
- Pregnancy-related learning barriers:
    - Low blood sugar
    - Fatigue
    - Hunger
    - Nausea
    - Discomfort when sitting
    - Urinary frequency
    - Other children present
    - Time constraints Health beliefs
- Predicting success

This depends on the degree to which the client believes she can perform diabetes self-care behaviour. Performing this behaviour will positively influence blood glucose control. Good blood glucose control will positively affect the outcome of pregnancy.

Documentation of what was taught, and what was learned, is very important. As legal documentation is part of the care process. This communication of progress is applicable to all health professionals involved with the client. Frequent communication with all health care providers reduces any problems that might arise.

Frequent follow-up (every 2 weeks) is necessary to assess the diabetes control for adjustments to be made in the treatment regimen. If the client has a blood glucose meter and telephone, she can report results by phone. Psychological support should be given to maintain motivation for continued self-management.

Labour and delivery

Gestational diabetes:

- Blood glucose may drop with onset of labour.
- Stop cutaneous insulin.
- Monitor blood glucose hourly.
- Intravenous fluids (5 % to 10%dextrose, 80ml/hour). Ringers lactate for fluid backup or use dextrose insulin potassium fluid if required.
- Prevent hypoglycaemia.

Postpartum follow-up

- Pregnancy outcomes: birth weight, complications, maternal blood glucose follow-up.
- OGTT at 6 weeks follow-up visit.
- Annual check ups
- Advise early evaluation regarding next pregnancy.
- 50% develop overt type 2 diabetes within 15 years.
- This can be averted or delayed by weight optimization and maintenance, physical activity.
- Choice of contraception.

Effects of lactation

Pre-existing diabetes:

- Lower incidence of type 1 in breastfed infants of mothers with diabetes.
- Lower maternal blood glucose postpartum.
- If type 2, do not use oral agents as these may be absorbed by the milk, causing hypoglycaemia in baby.

Gestational diabetes

- Promotes weight loss.
- Appears to prevent hypoglycaemia in neonate if started early.
- No contra-indications.
- No oral agents if diabetes persists.

Postpartum considerations

Pre-existing diabetes:

- May need little insulin for the first 24-72 hours after delivery.
- Return mother to pre-pregnancy insulin dosage.
- Need for frequent blood glucose monitoring after delivery.
- Insulin needs and blood glucose may be unpredictable.
- Let down reflex often produces maternal hypoglycaemia.
- Reduce caloric intake if not breast-feeding.

Gestational diabetes:

- There is rarely a need for insulin after placental delivery.
- There is a 95%-chance that the diabetes will disappear.
- With each successive pregnancy, the risk of developing type 2 diabetes increases.
- For each successive pregnancy, the diabetes often occurs earlier.

Contraception:
Many women with pre-existing diabetes are unaware that diabetes increases the risk of both maternal and foetal complications in pregnancy. Often there is inaccurate information or no counseling regarding the importance of the use of contraception.

At present, there are no restrictions on any method of contraception and there is no evidence as to which contraception method is the best for women with diabetes. Available contraception methods include:

- Barrier methods.
- Hormones.

Use of the intra-uterine contraceptive device in a female with poor control, increases the risk of vaginal infections. Hormones are associated with hypertension and weight gain especially the pill high in oestrogen. Because of the relationship between poor metabolic control and congenital anomalies during early pregnancy, it is crucial that women with pre-existing diabetes postpone conception until good control (4.0 mmol/l; 72.0 mg/dl) fasting, and less than 7.8 mmol/l (140 mg/dl) postprandial) has been achieved and maintained for three months.

Attaining and maintaining good control reduces the incidence of congenital anomalies and the risk of spontaneous abortion in these women. The women should be educated concerning the risks of hyperglyceamia to the foetus at the time of conception, which should be done prior to conception.

MODULE 4-3: DIABETES AND THE OLDER PATIENT

Introduction

As people age, their ability to cope with living, learn new information and remain independent, vary greatly. Older people are not a homogeneous group and, therefore, it is important to treat them as individuals and address their individual needs.

Some older persons with diabetes are in good health and teaching may be done as for younger ones. We are concerned with those who present with a problem limiting their access to educational programmes. Before starting the education of a person with diabetes, try to recognize and evaluate their disabilities and to adapt the teaching programme accordingly.

Objectives

1. Define factors that may affect diabetes care in this group.
2. Describe how to address these limiting factors to diabetes care.
3. Identify the community resources available to enable planning for safe and appropriate diabetes care.

Factors that may affect diabetes care in the aged

Older people with diabetes may have one or more of the following problems:

1. Hearing defect.
2. Impaired vision.
3. Impaired mobility.
4. Impaired memory.
5. Other illnesses such as high blood pressure, heart or renal impairment.
6. Multiple medications.
7. Lack of social or family support.
8. Depression.
9. Dental problems.
10. Poor nutrition.

How to cope with these factors that limit diabetes care

- Hearing impairment: a hearing aid is helpful if available, if not, talk loudly and clearly, or use sign language.
- Impaired vision: annual check-ups and appropriate prescriptions are needed and a caregiver may have to help administer medication.
- Impaired mobility: use appropriate footwear and supporting aids including crutches, walking frames, and artificial limbs.
- Impaired memory: Additional caregiver support will be critical.
- Other conditions, such as high blood pressure, heart, or renal impairment: Medical follow-up and co-ordination of all therapies should be strictly followed.
- Multiple medications: pill charts and pill containers may be useful.
- Dental problems: Meals need to be adapted to the person's ability to chew.
- Lack of social and family support: Physical and emotional support affect the well-being of the person with diabetes. Work with social services where available to address any deficiencies in support.
- Depression: Identify and refer for appropriate management.

Community resources available for appropriate diabetes care.

- Local Diabetes Associations.
- Department of Social Services.
- Local community health services.
- Associations, Non-governmental organizations, various clubs for the elderly.
- Diabetes clinics: both private and non-governmental.

MODULE 4..4: DIABETES AND PRE-OPERATIVE AND PERI-OPERATIVE MANAGEMENT

Introduction

People with diabetes may have to undergo surgical or medical procedures that can disrupt their usual management. The diabetes educator must be able to assist people with diabetes in making appropriate adjustments to alter their meals and medication, glucose-lowering agents or insulin, and to allow them to maintain target blood glucose levels. Successful management for surgery in people with diabetes also requires simple, safe protocols that are understood by all staff.

Objectives

1. Describe the metabolic changes that may take place peri-operatively.
2. Describe specific diabetes complications and hazards that may occur.
3. Understand the different approaches to diabetes management for major and minor procedures and for type 1 and type 2 diabetes.

Metabolic changes during surgery:

Surgical stress stimulates counter-regulatory hormone secretion. This results in reduced insulin sensitivity and inhibits insulin release. These changes favour catabolism that can rapidly cause hyperglycaemia and even ketosis.

In general: major operations cause greater metabolic disruption and insulin resistance.

Specific diabetes complications and hazards that may occur during surgery

People with diabetes may encounter problems over and above those usually associated with surgery.

- **Hypoglycaemia:** Peri-operative fasting is likely to cause hypoglycaemia in the presence of usual oral sulphonylurea and or insulin therapy. Hypoglycaemia needs to be avoided particularly as anaesthetized or sedated patients either may be unaware of hypoglycaemia, or may be unable to communicate.
- Iatrogenic problems of diabetic control caused by lack of appropriate management protocol, inadequate glucose monitoring, and failure to correct obvious abnormalities.
- Increased risk of post-operative complications, including wound infections and myocardial infarction.
- Deterioration of the renal function, particularly if diabetic nephropathy is already present.
- Autonomic neuropathy can cause severe hypotension during the induction of anaesthesia.

Management of Type 2 Diabetes during Surgery

No major operative surgery should be undertaken in a person with diabetes at a primary level clinic.

Management

Pre-operatively:

Delay surgery if possible if glycaemic control is poor:

- HbAlc > 9%;
- FBG > 10 mmol/L
- RBG> 13 mmol/L

Optimise glyeaemic control if surgery is elective. Screen for complications that may affect surgical risk:

- Nephropathy,
- Cardiac disease,
- Proliferative retinopathy,

- Neuropathy.
- Inform surgical team of the complications.

If on diet and or oral agent therapy and well controlled and surgery is minor:

- Omit therapy on morning of surgery.
- Resume therapy when eating normally.

If on insulin therapy or poor glycaemic control or major surgery:

- Use continuous IV insulin (GIK) infusion,
- Start at 8 am and stop when eating normally.
- Monitor blood glucose before, during and after surgery using quality assured method.
- Aim for blood glucose levels of 6 - 10 mmol/1.

Glucose-insulin-potassium regimen

- Add 16 U short-acting insulin and 10 mmol/L potassium chloride to 500 ml 10% dextrose.
- Infuse IV at 80 ml/h. using a volumetric pump.
- If obese or initial blood glucose is high consider higher dose (20 U).
- If very thin or usual insulin dose is low consider lower dose (12 U).
- If blood glucose is low or falling reduce dose by 4 U.
- If blood glucose high or rising increase dose by 4 U.
- Continue the infusion until 60 min. after the first meal.
- Resume usual therapy just after first meal,
- Check daily for dilutional hyponatreamia.

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