

Flexible Insulin Therapy (FIT)

Approach to Managing Diabetes Mellitus



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Glossary

It is recommended that you familiarise yourself with all the terms in this glossary as these terms will be used throughout this guidebook.

Apidra	Insulin glulisine, a rapid-acting insulin for bolus coverage
Basal Insulin	Background insulin coverage to control blood glucose throughout the day and night, even when fasting. This usually refers to intermediate- or long-acting insulin
BG	Blood glucose or blood sugar
Bolus Insulin	Refers to short- or rapid-acting insulin to cover mealtime glucose rise from carbohydrate consumption (meal bolus) and to correct for high BG levels (correction bolus)
Carbohydrate (carb) counting	Carbohydrates which include sugars and starches, are one of the main nutrients found in food and drinks. Carbs affect your BG more than other nutrients and is usually counted in grams (g) or by carb portions
Diabetes Mellitus (DM)	A metabolic disease that is characterised by either decreased insulin sensitivity or the inability of the pancreas to produce insulin.
DKA	Diabetic ketoacidosis: A serious complication of DM that occurs when the body produces high levels of blood acids called ketones. This usually occurs when blood glucose has been too high for too long and is life-threatening

Gestational Diabetes Mellitus (GDM)	A type of diabetes that can occur during pregnancy. It can happen when hormones produced by the placenta prevents the effective utilisation of insulin which results in GDM
HbA1c	Glycated haemoglobin, the average blood glucose level over a 2-3 month period
Hyperglycaemia	High BG
Hypoglycaemia (hypo)	Low BG of less than 4 mmol/L
ICR	Insulin to Carbohydrate Ratio: This estimates the dose of insulin for the amount of carbohydrates (g) consumed. For example, if your ICR is 1:10 g, you will require 1 unit of rapid-acting insulin for every 10 g of carbohydrate
Insulatard	Isophane insulin, an intermediate-acting insulin for basal coverage
ISF	Insulin Sensitivity Factor or Correction Factor: This estimates how much one unit of rapid-acting insulin will lower blood glucose. For example, if your ISF is 1:3 mmol/L, 1 unit of rapid-acting insulin will lower your blood glucose by 3 mmol/L
Lantus®	Insulin glargine, a long-acting insulin for basal coverage
Levemir®	Insulin detemir, a long-acting insulin for basal coverage



CHAPTER 1: WHAT IS DIABETES MELLITUS?



Learning Objectives:



1. Understand the role of glucose and insulin
2. Know the symptoms of high blood glucose (BG)
3. Understand the different types of diabetes mellitus (DM)

DM refers to a set of different diseases where the body is unable to maintain healthy levels of glucose in the blood. Glucose is the main energy source for the body. Glucose mainly comes from foods that contain carbohydrates. When you eat, food is broken down into nutrients such as glucose. These nutrients are absorbed from your stomach and digestive tract into your bloodstream.

Insulin is an essential hormone made by the insulin-producing cells (beta cells) in the pancreas that enables the body to use or store glucose from food. Insulin acts like a key to unlock the door for glucose to enter cells and by doing so, provides energy for the body and lowers the amount of glucose in your bloodstream. Cells in the body then use glucose as an energy fuel to survive. Glucose that is not used for energy immediately after eating is stored in the liver and muscles. This stored glucose, called glycogen, is converted back to glucose and released into the bloodstream when glucose levels are low; for instance, when you have not eaten for a long period of time (such as overnight) or when you require extra energy (such as in exercise). Insulin also helps the body to store extra energy as fat.



The term blood glucose (BG) will be used throughout this handbook.

When BG levels rise too high (hyperglycaemia), symptoms of DM may develop. You may recall some of these symptoms of hyperglycaemia when you were first diagnosed. These include:

- Frequent urination.
- Increased thirst.
- Unexplained and constant tiredness.
- Unintentional loss of weight.
- Blurred vision.
- Slow healing of wounds and cuts.

There are two main types of DM - T1DM and T2DM. A third type of DM, GDM, occurs during some pregnancies.

1.1 Type 1 Diabetes Mellitus

T1DM usually starts in childhood or teenage years, but it can also be diagnosed in adulthood.

In people with T1DM, their pancreas makes little or no insulin. T1DM is an autoimmune disorder, which means that the immune system mistakenly destroys its own beta cells in the pancreas. The cause of this is not known but it is likely due to many different factors (such as genetics, exposure to viruses or other environmental factors). The beta cells are eventually destroyed and treatment with insulin injections is required, often immediately following diagnosis. Sometimes your doctor may order special blood tests to check the beta cell autoimmunity markers.



Once insulin therapy has started, the beta cells of the pancreas may sometimes recover for a period of time (several weeks to months) and this is known as the honeymoon period where smaller amounts or even, no insulin is required. However, this period is usually transient and insulin therapy is then required long term. Without insulin therapy, BG levels rise to high levels and may lead to a serious condition called diabetic ketoacidosis (DKA). (Further information on DKA in Sick Day Management, Chapter 7).

1.2 Type 2 diabetes mellitus

T2DM is much more common than T1DM. It often develops in adulthood, but with increasing rates of childhood obesity, there is an increasing number of children and teenagers diagnosed with T2DM. The symptoms of T2DM develop gradually and the condition often goes undiagnosed for a long period of time. It may be detected when symptoms finally appear, or perhaps, even during a routine blood test or examination.

People with T2DM still make insulin in their pancreas, but the cells in the body are resistant to the action of insulin, making the insulin ineffective. T2DM is caused by a combination of genetic and environmental factors. It tends to run in families and being overweight is a major risk factor for developing T2DM.

As such, healthy eating and exercise are very important in managing T2DM. Oral medications (tablets) are also often used to control high BG levels, and help insulin to be more effective. Eventually, the insulin-producing beta cells of the pancreas may become exhausted, and many people with T2DM will go on to require insulin treatment.

1.3 Gestational Diabetes Mellitus

GDM is a form of diabetes mellitus that develops during pregnancy in women with no known previous history of T1DM or T2DM. It is diagnosed through blood tests at the antenatal clinic, usually during the 24-28th week of pregnancy.

High BG levels may affect the developing baby and treatment usually consists of modifying dietary intake of carbohydrates, regular BG testing, and insulin injection treatment if dietary measures alone fail to control BG levels sufficiently.

GDM usually goes away after pregnancy, but women with previous GDM are at higher risk of developing T2DM in the future and will need regular check-ups to detect the onset of T2DM.



CHAPTER 2: WHAT ARE MY GOALS IN MANAGING DIABETES MELLITUS?



Learning Objectives



1. Identify individual goals in managing DM
2. Write down your short-term and long-term goals in managing your DM

The Flexible Insulin Therapy guideline has several objectives. The main objectives include teaching you to:

- Understand and improve your BG control
- Reduce your risk of hypoglycaemia and severe hypoglycaemic emergencies
- Enable flexibility in your diet and lifestyle

Think about your goals in managing your diabetes to keep you on track. If you are not sure what your goals are, it may be helpful to think about them as short-term or long-term goals. Long-term goals are what you hope to achieve over the next few months or even years. Short-term goals are the steps you can take now to achieve your long-term goals.

List some of your objectives here.

1.
2.
3.
4.
5.

People will have different goals at different stages of life. Goals may also change as circumstances change. It is important for you to know what your goals are in managing your DM. For example,



Patricia, aged 25, is newly married. She has had T1DM since she was 12 years old. Her DM control has worsen up and down over the years. She and her husband are now keen to start a family as soon as possible. Her present goal is her DM care is for her DM to be well controlled to ensure a safe and successful pregnancy.

Patricia's long-term goal is to achieve a safe and successful pregnancy. Her short-term goal is to check her BG levels before and after meals to ensure that her BG levels stay within the safe target in pregnancy.



Mr Lee, aged 65, newly retired has had T1DM for 35 years. He has been diagnosed with heart disease, high cholesterol and has some of kidney disease. He has a goal to continue being healthy to enjoy his retirement, travel the world and play with his grandchildren.



Roseett, aged 35, is a cycling enthusiast and self-proclaimed foodie. He was diagnosed with T1DM last year. His goal is to manage his diabetes and adjust his meals so that he can continue to enjoy his food and his cycling passion without experiencing hypoglycaemia.

List some of your long and short term goals here.

Long term goals

1.

2.

3.

Short term goals

1.

2.

3.

To achieve your goals, you will need to work on the following:

- Understanding what your BG means.
- Checking your BG levels at the right time.
- Recording your BG readings in a diary.
- Understanding how your food intake affects BG.
- Counting carbohydrates in your food and drink.
- Taking your insulin as prescribed and working out the insulin dose that is required for each meal/ snack.
- Reflecting on your BG patterns in your diary.
- Adjusting your insulin based on these patterns.

Name

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CHAPTER 3: GETTING TO KNOW MY BLOOD GLUCOSE LEVELS AND HbA1c



Learning Objectives:

1. Understand the difference between blood glucose (BG) and HbA1c
2. Familiarise with BG targets in order to attain HbA1c goal
3. Understand the importance of checking BG and know when to check BG
4. Understand the importance of keeping a diary



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3.1 What is Blood Glucose?

Blood glucose (BG) is the amount of glucose in your blood. This is measured at a single point in time. It is called the blood glucose (BG) testing.

3.2 What is HbA1c?

HbA1c indicates your DM control based on your average BG level over the previous 2-3 months. The more glucose you have in your blood, the higher your HbA1c will be. The higher the HbA1c, the greater the risk of developing DM-related complications. Your HbA1c and BG targets are individualised according to your goals and health condition.

Why is it important to pay special attention to your BG levels? There are many reasons why having good glucose control is important and these include:

- Avoiding BG levels that are too low (Hypoglycaemia) or too high (Hyperglycaemia).
- Feeling well, living a healthy lifestyle and being actively involved in school, work and social activities.
- Preventing or delaying the long-term complications of DM, such as damage to the kidneys, eyes, nerves, heart and blood vessels (Figure 3.1 and Figure 3.2).

DIABETES COMPLICATIONS Microvascular

The DM complications that affect the small blood vessels are called microvascular complications. These include:



Figure 3.1 Diabetes Microvascular Complications



STROKE

DM can damage blood vessels in the brain, which may lead to stroke.

What to do:

• Talk to your doctor immediately.



HEART ATTACK

DM can cause damage and blockages in the blood vessels of the heart, which may lead to a heart attack.

What to do:

• Talk to your doctor. Type 1 and 2 diabetes.



REDUCED BLOOD CIRCULATION

DM can cause a blood vessel that is your leg, which might lead to gangrene. Gangrene may require a limb amputation.

What to do:

• Talk to your doctor immediately. Type 1 diabetes. Type 2 diabetes. Open to the leg through or the walking foot is affected with loss of sensation, pain.



DIABETES COMPLICATIONS Macrovascular

Poor DM control might lead to complications in the heart and large blood vessels of the body. There are some possible causes and signs/symptoms and what to do if you have them.

Figure 3.2 Diabetes Macrovascular Complications

There is a correlation between BG range and HbA1c results. This correlation helps you to know whether your BG level is keeping to your target HbA1c.

BG range	HbA1c result
Under 7 mmol/L	Less than 6%
Mostly under 10 mmol/L	6-7%
Mostly between 10 to 12 mmol/L	8-12%
Mostly over 15 mmol/L	More than 12%

Table 3.1 BG correlation with HbA1c



Do you know your BG targets? BG targets may differ for different people and you should discuss with your doctor and healthcare team what your BG targets are. BG targets can also be different at different times of the day.

Write your BG and HbA1c targets here.

	Good	Sub-optimal	Poor	My Targets
Fasting/ waking up glucose (mmol/L)	5-7	7.1-10	>10	
Pre-meal glucose (mmol/L)	4-7	7.1-10	>10	
Post-meal glucose (mmol/L)	<10	10.1-12	>12	
Pre-bed glucose (mmol/L)	<10	7.1-8	>8	

Keep a Diary

It is important to record your BG results in a diary along with your carbohydrate intake and insulin dose given. Keeping a record allows you to recognise and reflect on patterns in BG levels, and improve your DM control in the long term. For example, if your readings are consistently high at a certain time of day, ask yourself why? Is it because you are consuming too much carbohydrate for a particular meal and not going enough insulin? Or is it due to having a large meal without giving a dose of insulin? Discuss the possible reasons to the patterns that you see and the action required with your doctor. You may need to change your dietary habits or your medication plan.

If you are avoiding monitoring your BG, ask yourself why. Are you facing some problems that limit BG testing? Discuss this with your doctor to find some solutions. Don't give up on monitoring!



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3.3 When should I check my BG?

You should check your BG levels whenever you need to make a decision in your day-to-day DM management. It is inaccurate to guess the actual BG levels based on symptoms. Hence the correct way is through self-monitoring of BG using the glucometer. Self-monitoring of your BG is important to:

- Find out your current BG level.
- Recognise and avoid hypoglycaemia and hyperglycaemia.
- Work out your dosage of bolus insulin before meals and before exercise.

With these reasons in mind, it is recommended to test your BG each day:

- When you wake up and before going to bed.
- Before main meals to help you plan and adjust your insulin and decide your bolus insulin dose.

It is also useful to check your BG at the following times:

- 2 hours after meals to see how well your insulin works and if your food is good for you.
- Other times of the day when necessary (e.g. before driving, before and after exercise, when you feel unwell, to confirm hypoglycaemia, or in the middle of the night).

To achieve good DM control, it is usually necessary to test your BG at least 3-5 times a day, especially before meals and at bedtime, particularly looking for patterns that may influence your decision on insulin dosing.

How do I improve my BG levels?

Many factors affect BG levels. These include:

- Food
- Insulin
- Exercise
- Stress and illness.

These will be covered in greater detail in the following chapters.

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FOOD	PORTION	CARBOHYDRATES (g)
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BEVERAGES		
Bandong	1 glass	32
Barley water	1 glass	14
Coffee (regular) coffee shop	1 cup	15
Coffee (less sweet) coffee shop	1 cup	10
Coffee, 3-in-1, powder	1 sachet	17
Milo® 3-in-1	1 sachet	18



FAST FOODS		
McDonald's, burger, Big Mac	1 whole	46
McDonald's, burger, Fillet-o-Fish	1 whole	38
McDonald's, burger, McChicken	1 whole	44
McDonald's, chicken nuggets	6 pieces	18
McDonald's, apple pie	1 piece	26
McDonald's, potato fries	1 medium portion	42
McDonald's, ice cream with cone	1 portion	27
Subway, 6 inch sandwich	1 whole	45-55

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