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Assignment title: Case Study 1: Helping patients to understand and manage diabetes

1. Introduction

This report has been prepared from the perspective of a practice nurse in a local GP surgery where a growing number of patients have been diagnosed with diabetes. Many would benefit from understanding their condition better, so that they can engage with their care plans and manage their blood sugar safely. The report therefore explains how the body controls blood glucose and uses it for energy, examines why recording and tracking blood sugar matters, and recommends evidence-based lifestyle changes relating to diet, exercise and smoking.

Diabetes mellitus is a long-term condition in which blood glucose stays too high, either because the pancreas does not produce enough of the hormone insulin or because the body cannot use its insulin effectively (World Health Organization [hereafter WHO], 2024). In type 1 diabetes the pancreas produces little or no insulin, so daily insulin is essential (WHO, 2024). In type 2 diabetes the body does not respond properly to insulin; this form accounts for around 90% of diagnosed cases in the UK (Diabetes UK, no date) and is the focus of this report. The rise seen in the surgery reflects a national trend: almost six million people in the UK are estimated to be living with diabetes, including almost 1.3 million who are undiagnosed (Diabetes UK, no date).

Some risk factors for type 2 diabetes cannot be changed, such as increasing age, family history and ethnicity; people of Asian, Black African and Black Caribbean ethnicity are two to four times more likely to have diabetes than White populations (Diabetes UK, no date). Others are modifiable, including living with overweight or obesity, physical inactivity and smoking (WHO, 2023; WHO, 2024). Risk is also linked to income, housing and access to healthy food (Diabetes UK, no date), so lifestyle is not simply a matter of personal choice. Over time, raised blood glucose (hyperglycaemia) damages nerves and blood vessels and can cause heart attack, stroke, kidney failure, sight loss and lower limb amputation (WHO, 2024), which is why good self-management matters.

2. How Blood Sugar Levels Are Maintained at a Safe and Effective Level

Glucose is the body's main fuel, and the brain depends on a continuous supply. The body therefore keeps blood glucose within a narrow range of about 3.5 to 8 mmol/L (Waugh and Grant, 2022). This is an example of homeostasis achieved through negative feedback: a change in a controlled variable is detected and triggers a response that reverses it (Tortora and Derrickson, 2020).

The organ at the centre of this system is the pancreas, a gland lying behind the stomach. Most of its tissue produces digestive enzymes, but scattered through it are clusters of endocrine cells called the pancreatic islets (islets of Langerhans), in which beta cells secrete insulin and alpha cells secrete glucagon (Waugh and Grant, 2022). Structure suits function here: the islets have a rich capillary supply, so the cells can sense the glucose concentration of passing blood and release hormones straight into the circulation. The islets act as both sensor and control centre, while the liver, skeletal muscle and adipose (fat) tissue are the effectors.

After a meal, carbohydrate is digested to glucose and absorbed into the blood. The rise in blood glucose stimulates beta cells to release insulin. Insulin binds to receptors on muscle and fat cells, causing glucose transporter proteins to move to the cell membrane so that glucose can enter. In the liver and muscle it promotes glycogenesis, the conversion of glucose into the storage molecule glycogen. As blood glucose falls, insulin secretion declines (Tortora and Derrickson, 2020).

Between meals, overnight and during exercise the opposite occurs. Falling blood glucose stimulates alpha cells to release glucagon, which acts mainly on the liver. Glucagon triggers glycogenolysis, the breakdown of glycogen to glucose, and gluconeogenesis, the production of new glucose from substances such as amino acids, and the glucose is released into the blood (Waugh and Grant, 2022). Figure 1 summarises these two opposing pathways.

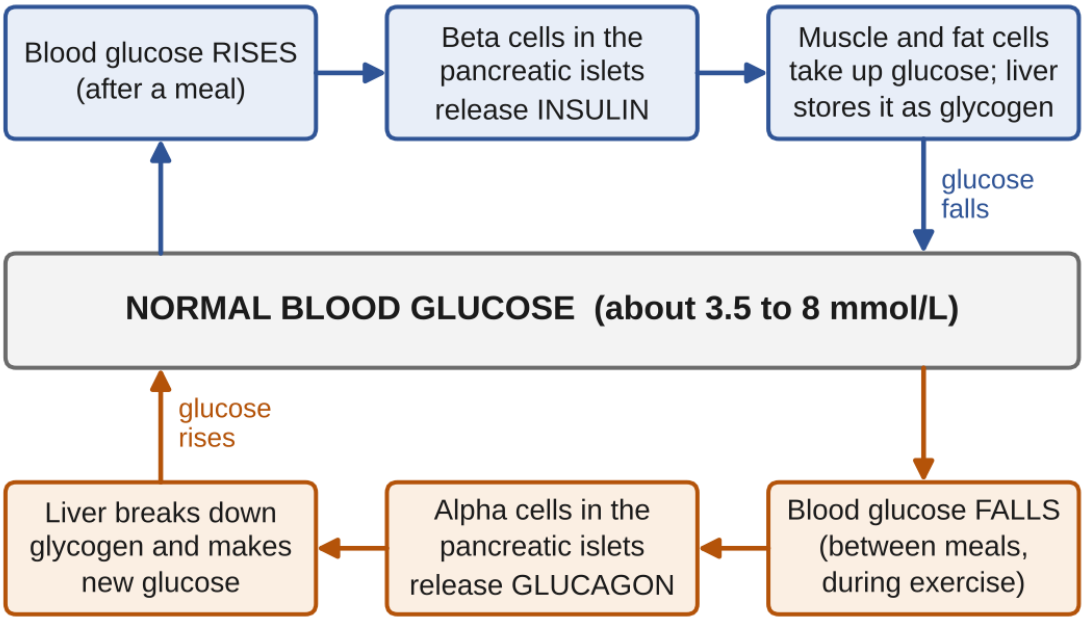

Figure 1: Negative feedback control of blood glucose by insulin and glucagon (own image, based on Waugh and Grant, 2022)

In type 2 diabetes this feedback loop is disrupted. Muscle, fat and liver cells become resistant to insulin, and although the beta cells initially compensate by secreting more, they eventually cannot keep pace, so glucose accumulates in the blood (Waugh and Grant, 2022). When the concentration exceeds what the kidneys can reabsorb, glucose is lost in the urine and draws water with it, which explains why patients often present with frequent urination and thirst (Waugh and Grant, 2022; WHO, 2024).

3. How Oxygen and Glucose Are Used to Produce Energy

Every cell needs energy in the form of adenosine triphosphate (ATP) to power processes such as muscle contraction and active transport. Most ATP is produced by aerobic cellular respiration, in which glucose is broken down using oxygen: glucose + oxygen → carbon dioxide + water + energy (ATP and heat). As Figure 2 shows, this takes place in four linked stages (Tortora and Derrickson, 2020).

First, glycolysis in the cytosol splits one six-carbon glucose molecule into two molecules of pyruvate, with a net gain of two ATP; this stage does not need oxygen. Second, pyruvate enters the mitochondria and is converted to acetyl coenzyme A,

releasing carbon dioxide. Third, the Krebs (citric acid) cycle in the mitochondrial matrix completes the breakdown, releasing more carbon dioxide, a little ATP and hydrogen, which is picked up by the carrier molecules NADH and $FADH_2$. Finally, in the electron transport chain on the inner mitochondrial membrane, electrons from these carriers pass along a series of proteins and the energy released is used to make ATP. Oxygen is the final electron acceptor, combining with hydrogen to form water (Tortora and Derrickson, 2020).

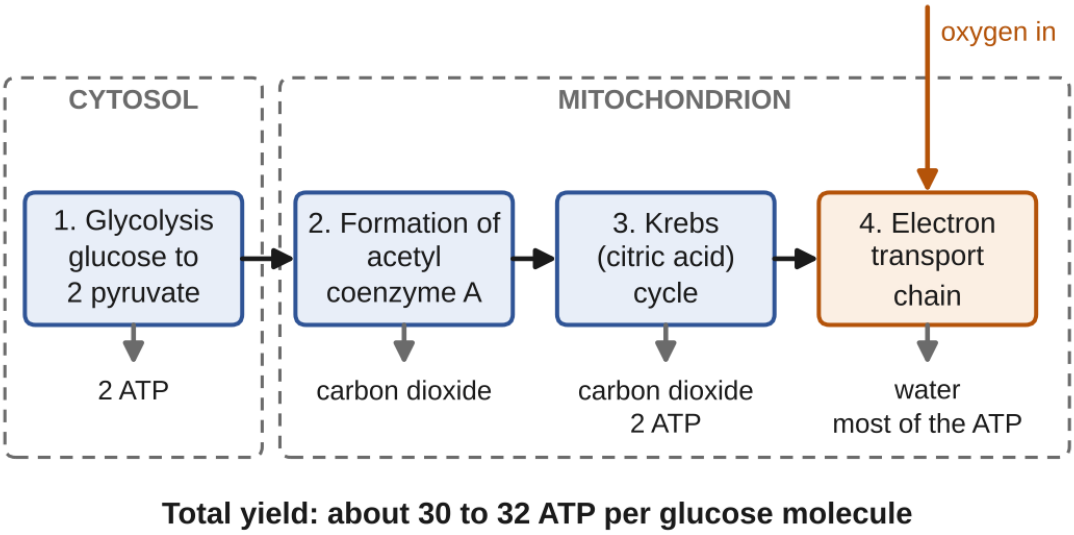

Figure 2: The four stages of aerobic cellular respiration (own image, based on Tortora and Derrickson, 2020)

The complete oxidation of one glucose molecule yields around 30 to 32 ATP, most of it from the final, oxygen-dependent stage (Tortora and Derrickson, 2020). Structure and function are again closely linked: the inner mitochondrial membrane is folded into cristae, increasing the surface area for the electron transport chain, and cells with high energy demands, such as muscle cells, contain many mitochondria (Waugh and Grant, 2022). Without enough oxygen only glycolysis can proceed, yielding just two ATP per glucose molecule and producing lactic acid. Efficient energy production therefore depends on the lungs and circulation delivering oxygen and on insulin allowing glucose into cells.

This explains several features of diabetes. Glucose can only be used once it is inside the cell, so when cells are resistant to insulin they are short of fuel even though the blood contains plenty, which contributes to the tiredness that patients commonly

report (WHO, 2024). Cells then rely more on fatty acids, and when insulin is severely lacking the liver converts these to ketone bodies, which can build up and cause ketoacidosis (Tortora and Derrickson, 2020). It also explains why exercise helps: working muscle needs more ATP and so draws more glucose out of the blood (Kanaley et al., 2022).

4. Recording and Tracking Blood Sugar Levels

Two kinds of glucose data help patients with type 2 diabetes and the practice team to manage the condition. The first is the HbA1c blood test, which reflects average blood glucose over the previous three months (Diabetes UK, 2026). The National Institute for Health and Care Excellence [hereafter NICE] (2026) recommends measuring HbA1c every three to six months until it is stable and every six months thereafter. Targets are agreed individually: 48 mmol/mol (6.5%) for adults managed by lifestyle or by medication not associated with hypoglycaemia, and 53 mmol/mol (7.0%) for those taking medication that can cause it. Because each result is recorded, the trend can be tracked over time rather than relying on a single reading, and this drives decisions: a rise to 58 mmol/mol (7.5%) or above is the point at which NICE (2026) advises reinforcing lifestyle advice and intensifying medication.

The second is self-monitoring, either by finger-prick testing, which gives a snapshot at one moment, or by a continuous glucose monitor worn on the skin (Diabetes UK, 2026). Recording readings in a diary or app allows the patient and nurse to spot patterns, such as the effect of particular meals, activity, illness or a change of medication. It also promotes safety, because readings identify hypoglycaemia, usually defined as below 4 mmol/L, which needs immediate treatment (Diabetes UK, 2026). This is vital for people taking insulin or sulfonylureas.

However, the evidence does not support every patient with type 2 diabetes testing at home. In a randomised trial of 450 people in primary care who were not treated with insulin, Young et al. (2017) found no significant difference in HbA1c or quality of life after one year between those who self-monitored daily and those who did not. A limitation is that clinicians were not required to act on the readings, which suggests that data is only useful when it leads to action. Finger-prick testing can also be stressful (Diabetes UK, 2026). NICE (2026) therefore advises against routine self-monitoring unless the person is on insulin, has had hypoglycaemic episodes, takes

oral medication that increases the risk of hypoglycaemia while driving or operating machinery, or is pregnant or planning pregnancy. Patients in the surgery should therefore understand HbA1c tracking as essential for everyone, and self-monitoring as a targeted tool whose purpose is agreed with the healthcare team.

5. Evidence-Based Lifestyle Recommendations

Lifestyle changes work because they act on the physiology described above: they reduce the glucose entering the blood, improve the response of cells to insulin, or protect the blood vessels that hyperglycaemia damages. The evidence for each change a practice nurse can recommend is discussed below and summarised in Table 1.

Diet and weight. NICE (2026) recommends that adults with type 2 diabetes follow the same healthy eating advice as the general population, including high-fibre, low-glycaemic-index carbohydrates such as wholegrains and pulses, given in a way that is sensitive to the person's culture and beliefs. Dyson et al. (2018) likewise emphasise a flexible, individualised approach based on foods rather than nutrients, so there is no single 'diabetic diet'. Weight loss has the most striking effect. In the UK DiRECT trial in primary care, a structured weight management programme put 36% of participants into remission at two years; however, only 26% of those remained in remission at five years (Lean et al., 2024). Remission is therefore achievable but hard to sustain, so patients need long-term support rather than a short-term diet.

Exercise. The UK Chief Medical Officers advise adults to accumulate at least 150 minutes of moderate-intensity activity each week, to do muscle-strengthening activities on at least two days and to break up long periods of sitting, while stressing that any activity is better than none (Department of Health and Social Care [hereafter DHSC], 2026). Kanaley et al. (2022) conclude that such guidelines also apply to people with type 2 diabetes. They report that contracting muscle takes up glucose through pathways that do not depend on insulin, and that activity after meals lowers glucose whatever its type or intensity. Patients who take insulin or sulfonylureas may need extra carbohydrate or a dose adjustment to avoid hypoglycaemia (Kanaley et al., 2022), which links exercise advice back to the monitoring discussed in section 4.

Smoking. Smoking impairs the body's ability to regulate blood glucose, increases the risk of complications such as cardiovascular disease, kidney failure and blindness, and delays wound healing (WHO, 2023). Quitting lowers the risk of developing type 2 diabetes by 30 to 40% and improves the management of existing diabetes (WHO, 2023), so every patient who smokes should be offered stop smoking support.

Lifestyle factor	Recommendation	How it helps	Source
Diet	Choose high-fibre, low-glycaemic-index carbohydrates (fruit, vegetables, wholegrains, pulses), oily fish and less saturated fat	Follows the healthy eating advice given to the general population, adapted to the person's needs and culture	NICE (2026)
Weight	Aim for sustained weight loss, with structured support, if living with overweight or obesity	Sustained weight loss is the main driver of remission	Lean et al. (2024)
Exercise	Build up to 150 minutes of moderate activity a week, strengthen muscles on two days and break up long periods of sitting	Working muscle takes up glucose without needing insulin	DHSC (2026); Kanaley et al. (2022)
Smoking	Stop smoking, using stop smoking support	Improves blood glucose regulation and lowers the risk of complications	WHO (2023)

Table 1: Summary of lifestyle recommendations for patients with type 2 diabetes (own table, based on the sources shown)

These changes work best together. International consensus now places weight management and physical activity within a holistic, person-centred approach that takes account of the social determinants of health (Davies et al., 2022). This matters because lifestyle advice assumes that people have the money, time and environment to act on it. Goals should therefore be realistic, agreed with each patient and reviewed regularly.

6. Conclusion

Blood glucose is normally held within a narrow range by the opposing actions of insulin and glucagon from the pancreatic islets, and glucose that enters cells is combined with oxygen in the mitochondria to release the ATP on which every tissue depends. In type 2 diabetes, insulin resistance disrupts both processes, leaving glucose in the blood where it gradually damages nerves and blood vessels.

Recording and tracking blood sugar is central to managing this safely: regular HbA1c results guide treatment for everyone, while self-monitoring is valuable mainly for those at risk of hypoglycaemia and only when the results are acted upon. Healthy eating, weight loss, regular exercise and stopping smoking each address the underlying physiology, and substantial weight loss can even lead to remission, although maintaining change is difficult. For the patients attending this surgery, the key message is that understanding how the body handles glucose makes the reasons for monitoring and lifestyle change clear, and that realistic, individually agreed goals with ongoing support give the best chance of living well with diabetes.

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