Activity 6: Diagnosing Diabetes

Background Information:

Diabetes is a common condition in Australia that can contribute to illness, disability and early death. It has been estimated that nearly one million Australians have diabetes and about half of those are not aware that they have the condition.

There are three main types of diabetes:

- **Type 1 diabetes** is characterised by total lack of insulin and accounts for approximately 10-15% of all people with diabetes in Australia. Insulin injections are required for survival.
- **Type 2 diabetes** accounts for more than 85-90% of people with diabetes in Australia, and is characterised by reduced levels of insulin, or the body's inability to use insulin.
- **Gestational diabetes** occurs during pregnancy and disappears after delivery, in about 3-8% of women not previously diagnosed with diabetes.

Diabetes is caused by a deficiency of the hormone insulin, which is produced by the beta cells of the Islets of Langerhans in the pancreas. Insulin controls the uptake of glucose by body cells. Cell membranes have receptor sites for insulin. Insulin changes the permeability of the cell membrane to glucose.

Although there may be many signs and symptoms in an undiagnosed person with diabetes, they tend to present to a doctor with tiredness, constant thirst and excessive urination. These symptoms are related to high circulating levels of blood glucose that the body has difficulty excreting.

Purposes:

- to investigate the characteristics of diabetes.
- to predict changes in blood glucose levels.
- to analyse graphical information in relation to blood glucose and hormone levels.

Part A: Oral Glucose Tolerance Test (OGTT)

Many people have the OGTT. It is usually ordered by their doctor in response to symptoms shown or described by the patient. In preparation for an OGTT, a person fasts overnight or for at least 8 hours but not more than 16 hours. An initial blood glucose reading is taken via a blood sample. After this, the person is given 75 g of glucose, usually in the form of a sweet drink. Blood samples are taken at intervals over a period of 3 hours.

NOTE: In Australia, Blood glucose is usually measured in mmol/L (millimoles per litre)
US information uses mg/dL.

Normal Blood Glucose Levels.

Between 4-6 mmol/L
Less than 10 mmol/L two hours after meals

Hyperglycemic state

Greater than 22 mmol/L

Hypoglycemic state

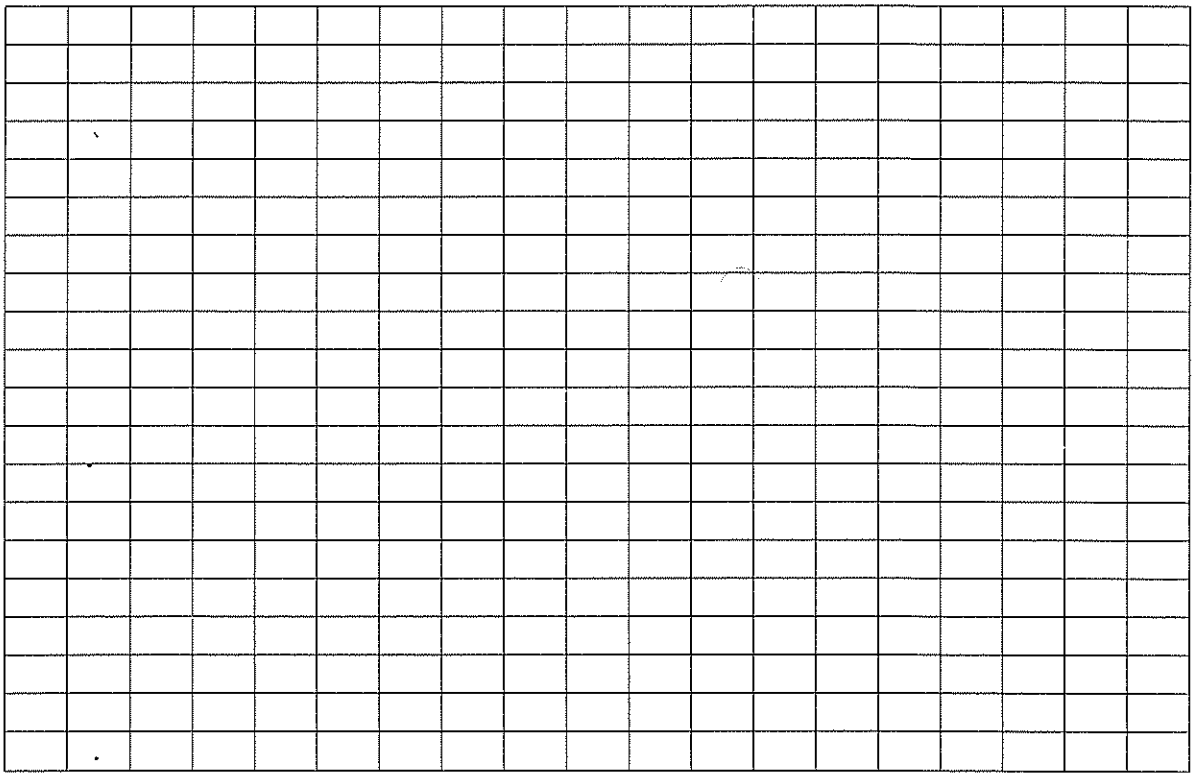
Less than 4 mmol/L

The following table shows the results of OGTTs from three people.

	Blood Glucose Levels (bgl) mmol/L		
Time	**Person A (male)**	**Person B (female)**	**Person C (female**
0	8.3	6.9	5.3
30	19.4	9.7	8.9
60	17.8	11.1	7.8
120	11.1	9.7	6.1
180	9.7	9.7	5.5

Procedure:

a. Graph the data on the grid provided below.



1. What do the results of the OGTT indicate about each patient?

2. What other information would you like to know about the patients before making a diagnosis?

3. What factors could influence the results of the OGTT?

Part B: Graphical analysis of Blood Glucose Levels (bgl)

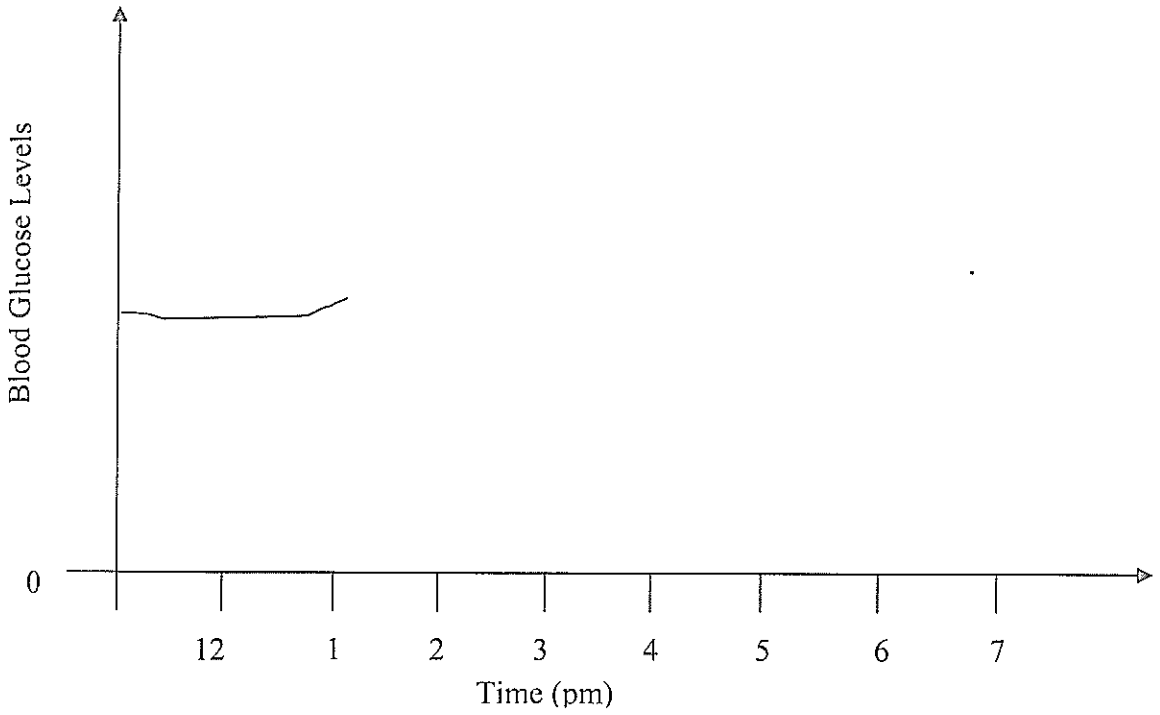


Figure 1: Graph showing changes in blood glucose levels during Big Race Day.

4. Complete the above graph to show the bgl changes using the information from the following diary entry.

"Big Race Day today. I was quite nervous for about half an hour before the race started at 1.30 pm. I tried to calm my nerves by having a high energy bar just before the race. The race started and I ran hard for the first 20 minutes to get clear of the pack. There was a drinks station halfway through the race where I collected and drank my special recipe energy drink. I finished the race in a personal best time of 1 hour and 30 minutes. I was very tired after the race, but drank only water.
The presentation of awards was at 4 pm when I had a beer and a hotdog. By 6 pm I was worn out. I went home had a light dinner and fell asleep in front of the TV at about 8 pm."

5. Use different colours to indicate the levels of insulin and glucagon for this person during the time shown.

6. Compare your lines with others and justify your graph lines for insulin and glucagon. What were the main differences between your graph lines and others?

7. How would adrenalin affect the blood glucose levels at the beginning of the race?

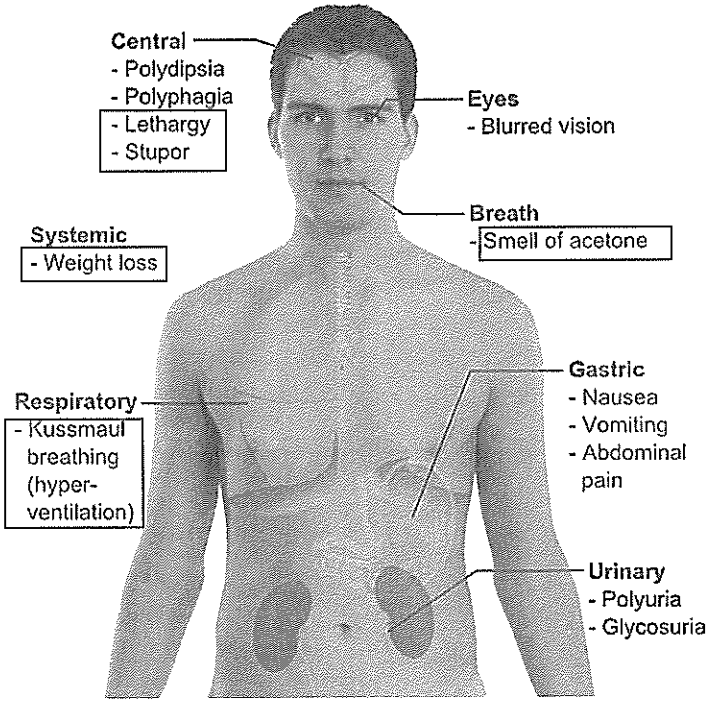


Figure 2: Main symptoms of diabetes
(The symptoms in the boxes are more common in Type 1 diabetes.)

8. Explain why the symptoms shown in Figure 2 are caused by the lack of insulin.

Insulin is a protein and as such can't be taken orally because it would be digested before it was absorbed from the digestive system. Insulin needs to be given by injection.

9. What problems are involved with using injections to control diabetes?

10. Explain the latest clinical and technological developments in controlling diabetes.