

Activity 2.1.1: Diagnosing Diabetes

Introduction

At the scene of Anna’s death, the medical examiner noted she was wearing a Medical Alert bracelet labeling her as a diabetic. As you continue to investigate the mysterious death of Anna Garcia, pay attention to all aspects of her medical history and begin to think about how diabetes impacts overall health and wellness. Could this disease have contributed to her death?

According to the National Institute of Health (NIH), diabetes is one of the top three health issues facing Americans in the 21st century. NIH scientists estimate 25.8 million Americans currently have diabetes and another 79 million are thought to be pre-diabetic and at serious risk for developing the disorder in the near future. Scientists at the Centers for Disease Control (CDC) in Atlanta have said one way to evaluate the seriousness of the epidemic is to look at diabetes statistics in a 24-hour period. Currently in the United States, 5082 new cases are diagnosed every day. Every 24 hours complications from diabetes lead to 238 amputations, 120 new diagnoses of serious kidney disease, and 48 cases of vision loss or blindness. In the United States, billions of dollars are spent each year on health care costs related to the treatment of diabetes.

In this activity you will explore how doctors make an initial diagnosis of diabetes as well as characterize the disease. You will complete simulated glucose tolerance testing as well as insulin analysis on three patients and draw conclusions about their disease status based on your findings. By analyzing test results, you will deduce what is happening inside the body when a person has Type 1 or Type 2 diabetes. You will further explore these diseases throughout this unit.

Equipment

* Computer with Internet access and Microsoft Excel (optional)
* PBS Course File
* Activity 2.1.1 Medical History Resource Sheet
* Diagnosing Diabetes - Glucose Tolerance Testing Sheet
* Graphing BasicsResource Sheet
* Glucose Test Paper Color Chart
* Insulin Test Indicator Color Chart
* Graph paper (optional)
* Simulated blood plasma samples
* Glucose test strips
* Insulin indicator
* Droppers or pipets

Procedure

Part I: Patient Histories

1. Use the Internet to help you craft a simple one sentence definition of diabetes. Record your definition in your laboratory journal.
2. Obtain an Activity 2.1.1 Medical History resource sheet from your teacher and review Anna’s initial symptoms at age 14. Highlight any information you believe could be related to her disease. In this activity you will walk through the steps of Anna’s diagnosis as well as the diagnosis of two additional patients.
3. Review the additional patient histories described below. Highlight any information that you believe could be related to diabetes or should be investigated further.
	* **Patient A**

Patient A is an overweight, 27-year-old woman who recently has noted excessive thirst and occasional unexplained mood swings. She works as a computer programmer and sits at a desk for 8-10 hours a day. She gets home late and only has time to exercise 1-2 times a week. When she can exercise, she bikes or runs for 30-45 minutes. Patient A eats a lot of reheated food that is loaded in sodium and indulges in the occasional fast food meal. She does sit down to a healthy dinner each night with her family and claims to eat a good amount of fruits and vegetables each day. Patient A does not think there is anyone in her family who has had diabetes. Routine urinalysis was normal.

* + **Patient B**

Patient B is a 48 year old man who has been experiencing an increase in thirst and urination. Otherwise, he feels fine, so for months, he has avoided going to the doctor. After two fainting spells, his wife convinced him to come in for a checkup. He does take medication for both elevated blood pressure and high cholesterol. He takes occasional walks with his family, but does not participate in any formalized exercise. He describes a very carbohydrate-heavy diet and claims pasta and desserts are his two weaknesses. Patient B thinks his maternal grandmother and an uncle on that side of the family were both diabetics. Routine urinalysis revealed ketones in the urine.

**Part II: Glucose Tolerance Testing**

Your blood always contains trace amounts of glucose, as this simple sugar found in food is used by the body as fuel for everyday activities. Normally the amount of sugar in urine is too low to be detected. If routine testing reveals significant levels of sugar in the urine or a patient complains of excessive thirst or urination, a patient is sent for additional tests to rule out diabetes. An examination of levels of glucose in the blood can provide definitive proof of disease.

*Glucose Tolerance Testing* (GTT) monitors the amount of sugar in the liquid portion of blood called plasma, over a set time period and gives doctors information as to how the body utilizes sugar.

Because of their symptoms and/or urinalysis results, all three patients were sent to the lab to undergo Glucose Tolerance Testing. Each of the three patients was asked not to eat or drink anything for 12 hours. At the beginning of the appointment, the patient had his/her blood drawn to establish a baseline blood glucose level. Each patient was then asked to drink a concentrated sugar solution. More blood was drawn and the level of glucose in the blood was monitored at varying time intervals to show how glucose was broken down by the body. Normally, blood glucose does not rise very much from baseline and returns to normal within two to three hours.

1. Obtain 3 copies of the Glucose Tolerance Testing Sheet from your teacher. Label one sheet for Anna Garcia, one sheet for Patient A, and one sheet for Patient B. Alternatively, you may be asked to rinse and reuse the sheet between patients.
2. Copy the table below into your laboratory journal.

|  |  |  |  |
| --- | --- | --- | --- |
| **Time of Blood Collection** (minutes after drinking glucose solution) | **Glucose Level in the Blood** (milligrams/deciliter)Anna Garcia | **Glucose Level in the Blood** (milligrams/deciliter) Patient A | **Glucose Level in the Blood** (milligrams/deciliter)Patient B |
| 0 (Baseline Level) |  |  |  |
| 30 |  |  |  |
| 60 |  |  |  |
| 90 |  |  |  |
| 120 |  |  |  |

1. Obtain 5 samples of each patient’s blood plasma, collected at 0, 30, 60, 90, and 120 minutes after ingestion of the glucose solution, along with a dropper or disposable pipette, glucose test strips, and insulin indicator. These items may be at your laboratory station. Note that you will complete the analysis one patient at a time.
2. Place one drop of the appropriate blood plasma sample on the appropriate circles in Column 1 of the Testing Sheet. Note that Column 2 will be used in the next part of the activity.
3. Place a strip of glucose test paper into the plasma sample in each of the circles in Column 1. Use a separate strip for each sample.
4. Immediately compare the color of the strip to the color on the Glucose Test Paper Color Chart. Record glucose levels in the table you created in your laboratory journal in Step 5.
5. Obtain a Graphing Resource Sheet from your teacher. Review how to set up a basic graph. Your teacher may have you complete online tutorials on using Excel to make graphs.
6. Graph your GTT data to clearly demonstrate how glucose levels changed over time. Graph all three patients’ information on the same graph. Use a different color or pattern line for each patient. If you are graphing by hand, complete your work in your laboratory journal. If you are graphing using Excel, print a copy of your final graph and include it in your laboratory journal.
7. Analyze your graph and interpret your findings for each patient. Craft a paragraph under your graph that explains who you believe can be diagnosed as a diabetic and why.
8. Discuss your findings with the class before moving on to Part III.
9. Answer Conclusion question 1.

**Part III: Insulin Level Testing**

There are two major type of diabetes – Type 1 and Type 2. Each type causes high blood sugar levels; however, the reason for this increase is different for each type. The hormone insulin is produced by the body to help cells take in the glucose found in the blood. The glucose is then used as an energy supply for the cell. Without enough insulin, our cells are not able to take in the necessary glucose. The level of insulin in the blood helps doctors further define a diagnosis of diabetes. Type 1 diabetics do not produce insulin. Type 2 diabetics produce insulin, but the body does not permit this hormone to effectively do its job.

Because GTT only determines blood glucose levels, it can indicate whether or not a person has diabetes, but it cannot be used to determine whether they have Type 1 or Type 2. To determine whether a patient has Type 1 or Type 2 diabetes, you need to test the level of insulin in the patient’s blood.

1. Obtain the Glucose Tolerance Testing sheet you used in Part II for all relevant patients (i.e., any patient who you diagnosed as diabetic).
2. Draw a table in your laboratory journal that you can use to gather insulin level data at each time period. Use the table you created in Step 5 as your guide.
3. Place one drop of the appropriate plasma sample to be tested in the appropriate circles in Column 2.
4. Add 1 drop of insulin indicator to the plasma in each circle. After 10 seconds, compare the color of the fluid in each circle with the Insulin Test Indicator Color Chart.
5. Record the results in your data table.
6. Graph your data, making sure to label both axes. Include data for all patients on the same graph. If you are graphing by hand, complete your work in your laboratory journal. If you are graphing using Excel, print a copy of your final graph and tape it into your laboratory journal.
7. Analyze your graph and interpret your findings for each patient. Pay attention to whether or not insulin levels appear to be normal.
8. Return to the Activity 2.1.1 Medical History resource sheet. Under the heading Diagnosis/Follow-up, clearly explain Anna’s diagnosis. Make sure to reference the results of both tests you have completed and how your data relates to your findings. You will discuss treatment for Anna in later activities.
9. File the Activity 2.1.1 Medical History Resource Sheet and the Graphing Resource Sheet in the appropriate tab of your course file. Use the PBS Course File – Table of Contents as a guide.
10. Review the animations at <http://kidshealth.org/kid/videos/indiabetes_vd.html> to review the basic differences in Type 1 and Type 2 diabetes. Use the information to confirm your diagnosis for each patient.
11. Research risk factors for diabetes. Note that risk factors are anything that increases a person’s chances of developing a disease.
12. Using a full page, draw the framework for a Venn diagram in your notes. On one side, you will list facts about Type 1 diabetes. Use the other side to list facts about Type 2 diabetes. Use the intersecting section to list facts that apply to both forms of the disease. Add a clear heading to each section of the Venn diagram.



1. Fill in the Venn diagram with information you know at this point regarding the two diseases. Make sure to add the information you researched about risk factors in Step 25. You will add additional information about symptoms, diagnosis, physiological cause of the disease, short and long-term effects of the disease, preventative measures, as well as treatment options, as you move through the unit.
2. Discuss what you have added to the Venn diagram thus far with your group. Compare entries and discuss any discrepancies.
3. Answer the remaining Conclusion questions.

Conclusion

1. Describe how Glucose Tolerance Testing can be used to diagnose diabetes.
2. Explain why insulin injections are not the course of treatment for all diabetics.
3. Explain how lifestyle choices can impact a person’s risk for developing diabetes.
4. What do you think it means if doctors say that a person is “pre-diabetic”?
5. Using information from this activity, explain the basic relationship between insulin and glucose.