

IPRO 331 Non-invasive Blood Glucose Monitoring

Professor Opara

Team Members	Sheetal Bhat	Bhargava Gannavarapu
	Jen Tullman	Amanda Ritter
	Maeran Uhm	Norby Wang
	Priti Patwari	Jayashree Nakkana
	Ronak Lakhia	Michelle Chen
	Adeseye Adekeye	Kristina Chapman

Objective and Background

Approximately 18.2 million people in the United States alone suffer from diabetes.

Diabetes is a disease in which the body does not produce or properly use insulin, a hormone that is needed to convert sugars, such as glucose, into energy needed for daily life. The effect of insulin on the body's tissues is the intake of glucose from the blood so that blood glucose is lowered. Glucagon is a hormone with an effect opposing that of insulin; it releases glucose from the tissues into the blood so that blood glucose is raised.

While the cause for the disease is still under study, current treatments for diabetes involve administration of insulin to help control blood sugar levels in the human body. Constant monitoring of blood glucose is necessary to determine the amount of insulin to be administered. High blood glucose results in complications such as renal failure, blindness, and even amputation of limbs. Insulin administration is necessary to lower high blood glucose. Low blood glucose results in hypoglycemia and can result in a comatose state for a patient. Diabetes patients whose blood glucose is at a normal range should therefore avoid insulin treatments since additional insulin will result in hypoglycemia.

Our IPRO project revolves around the blood glucose monitoring that is associated with the treatment of diabetes. Most of the current techniques for monitoring blood glucose levels in diabetes patients require blood sampling through venepuncture, a procedure that is quite invasive and uncomfortable for patients, especially pediatric patients suffering from juvenile diabetes. Since monitoring of blood glucose is quite frequent throughout the day for patients, obtaining blood samples thus requires constant pricking and puncturing of the skin. To avoid this discomfort for patients, it is the goal of this IPRO project to develop a non-invasive technique, either *in vivo* or *ex vivo*, to measure blood glucose without the need of venepuncture so that patients can measure blood glucose in a more comfortable fashion.

To accomplish our proposed tasks, the IPRO team will be working with physicians and scientists from the University of Chicago Hospitals for development of a device to measure blood glucose non-invasively. Corporations from the health-care industry will also be targeted in the future for marketing of our expected product.

Methodology

I PRO 331 will begin by examining various techniques being developed currently in the market for non-invasive blood glucose monitoring. These are listed below:

1. Light beam through skin and tissues
2. IR from body (NIRS)
3. Radiowaves to fingertips
4. Ultrasound
5. Viscosity of fluids in tissue underneath the skin
6. Glucose levels in saliva and skin
7. Electricity to draw blood up to skin and measure levels of glucose

The team has paired up to research these methods and will present them to the rest of the team making reference to both the pros and cons. The team will then determine which method is the most feasible and likely to succeed. Based on this decision the team will break up into three sub-groups

1. Group 1 – Scientific Design – this group will thoroughly design the basics of the system looking at all of the science aspects
2. Group 2 – Aesthetics/Practicality – this group will evaluate and determine the aesthetic qualities of the tool and make the outer design taking into consideration ease of use, cost, etc.
3. Group 3 – WebPage/Connections/Marketing – This group will investigate the market for such a device and make connections with companies to support our project. In addition, this group will develop a web page for the I PRO.

Expected Results

By the end of this semester, we the members of I PRO-331, hope to have developed a non-invasive or minimally invasive technique to monitor the blood sugar levels in diabetic patients. Most of the current techniques for monitoring blood sugar levels in diabetic patients require blood sampling through venepuncture, a procedure that is invasive and uncomfortable for most pediatric patients. To overcome this problem, we hope to have a concept and design for a device that could make the process of blood sugar measurement less painful for millions of diabetes patients around the globe. Key features we hope to incorporate in this device would be cost effectiveness, ease of use and have a good aesthetic sense.

Schedule

Week #	Tuesday	Thursday
1	1 st day of I PRO	Background Lecture
2	Background Lecture	Brainstorming
3	Method Presentation	Method Presentation
4	Method Debate	Method Debate
5	Method Debate	Method should be chosen
6	Break into 3 Groups	Work in Groups

7	Work in Groups	Work in Groups
8	Work in Groups	Work in Groups
9	S P R I N G	B R E A K !!!!!!!
10	Work in Groups	Work in Groups
11	Work in Groups	Work in Groups
12	Work in Groups	Work in Groups
13	Prep for Presentation	Prep for Presentation
14	Prep for Presentation	Prep for Presentation
15	Prep for Presentation	Final prep for IPRO day
16	Finish Final Report	Finish Final Report

****All dates are tentative****

Assigned Responsibilities

Team Leader- Kristina Chapman

Research Groups for the different techniques

TOPIC	MEMBERS
Light beam through skin and tissues	Bhat
	Nakkana
IR from body (NIRS)	Chapman
	Ritter
Radiowaves to fingertips & Electricity to draw blood up to skin and measure glucose levels	Lakhia
	Patwari
Ultrasound	Chen
	Adekeye
Viscosity of fluids in tissues underneath the skin	Tullman
	Uhm
Glucose levels in saliva and skin	Gannavarapu
	Wang

The 3 groups for design, website/contacts/marketing, and aesthetics/practicality will be decided after the decision of which method will be chosen.