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Opinion Article

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Exterior Artificial Pancreas Project

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Abstract

Objective: Pump size exterior artificial pancreas that will keep the glucose between 120 – 150mg/dl.

Method: The whole project based on the idea that we should already know one insulin unit how much is able to go down the glucose and one glucagons unit how much is able to increase the glucose. Less than 120 mg/dl it uses glucagons. More than 150 mg/dl it uses insulin. The pump checks the glucose automatically for every 8 minutes. The pump (which is software decision) will choose between insulin or glucagons base in an internal database table with prerequisite glucose values and the insulin or glucagons units requiring for each glucose value (adaptive database table for each diabetic). The pump (the software) is able to choose how many insulin or glucagon units it should use (that is not based on what the diabetic will eat, but base on the current glucose level that received from the sensor which is located in the human body, needle and sensor are one piece). The insulin should have a work duration of 8 minutes and works instantly.

Result: I choose 120 mg/dl as the lowest allowance glucose level as this level is secure for the diabetic (there is a time to prevent big hypoglycemia).

Conclusion: This project offers to diabetics insulin injections freedom, hypoglycemia prevention, run emergency tests, ideally for all ages, endocrinologists will have the software to adapt the internal database table of the pump for each diabetic needs.

Keywords

Artificial Pancreas; Glucagon; Insulin; Diabetes

Artificial Pancreas Presentation and Analysis

The pump size exterior artificial pancreas (**Fig-1**), uses one sensor (the sensor is one material which includes the needle that require to inject to human body both glucagons or insulin, when the sensor is replacing, replace the needle too, is one device with two operations) to collect the current glucose levels from the human body, when the sensor collects the current glucose level, send the data to the artificial pancreas through a cable, then the artificial pancreas read the received glucose value and through table with prerequisites insulin and glucagons units for each received glucose value decide how many insulin units require to decrease the glucose or how many glucagons units require to increase the glucose to prevent hypoglycemia. My logic is below 120 mg/dl to use glucagons and above 150 mg/dl use insulin (I choose 120 as the lower level for safety purposes because the artificial pancreas has the time to increase the glucose in next 8 minutes that will check automatically the glucose and if the glucose goes down will automatically increase it without the diabetic to feel hypoglycemia, I think glucose need some time goes down from 120 mg/dl until feeling hypoglycemia,

I think there is a time to prevent it). The artificial pancreas is remaining standby when the glucose is between 120 – 150 mg/dl. I set the artificial pancreas to make auto glucose tests every 8 minutes, while I added "emergency test" button which the artificial pancreas is able to do current glucose test and chose either glucagons or insulin, this button is useful for hypoglycemia or hyperglycemias cases.

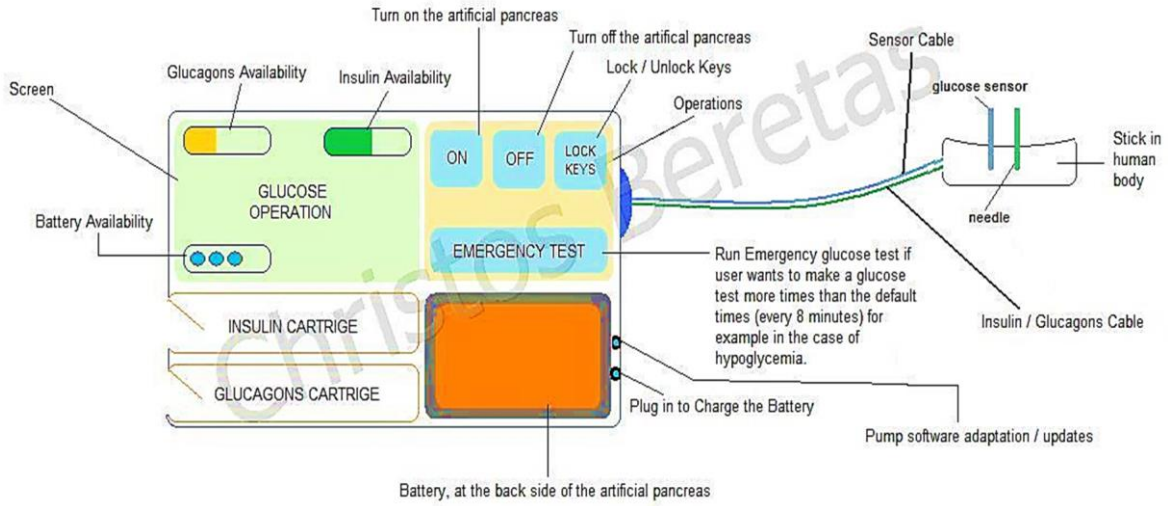

Fig-1: Pump Size Artificial Pancreas Designed by Christos Beretas

Usage

- The goal of the above pump size exterior artificial pancreas is to keep the glucose between 120 – 150 mg/dl.
- Less than 120 mg/dl it uses glucagons.
- More than 150 mg/dl it uses insulin.
- The pump checks the glucose automatically every 8 minutes.
- The pump (which is software decision) will choose between insulin or glucagons base in an internal table.
- The user by pressing the "emergency test" button is able to do a glucose test (extra test) which the pump will decide to use insulin or glucagons (base on the result).
- The pump (the software) is able to choose how many insulin or glucagon units it should use (that is not based on what the diabetic will eat, but base on the current glucose level).
- Automatically the pump notifies the user for low levels of buttery, insulin, and glucagons.
- I chose 120 mg/dl as the lowest allowance glucose level because this glucose level is secure for the diabetic (there is a time to prevent hypoglycemia) generally the diabetic needs more than 8 minutes to feel hypoglycemia, pump run automatically tests every 8 minutes. Thus, the pump will prevent hypoglycemia because have the time to do that.
- Between the glucose results (120 – 150 mg/dl) the artificial pancreas is in standby mode because these glucose levels are normal for the pump. Also, the artificial pancreas remains standby when it is not able to receive any data from the sensor, while notifying the diabetic by continuous sound.
- Endocrinologists will have the software to adapt the internal database table of the pump for each diabetic needs.

Synopsis

There are two important points, the first one is the insulin, the pump automatically run tests every 8 minutes, thus we can't use insulin that has a duration one, three, or six hours, this pump needs insulin that has duration 8 minutes and it should work immediately (we should know both how much one insulin unit decrease the glucose in mg/dl and how much one glucagons unit increase the glucose in mg/dl to make the best table). The second point is the kids with diabetes below of 10 years old require usually fewer insulin units, this artificial pancreas is not able to determine the age of the people, for example, cannot be used on 10 years old diabetic,

because his/her body requires fewer insulin units than a 25 years old or older diabetic. To overcome this limitation, endocrinologists will have the software to adapt the internal database table of the pump for each diabetic needs including the need that is required for example a 10-year-old kid.