Abstract Section

Having type 1 diabetes can affect your whole life, it can cause loss of limb, eyesight, and even death. If you have type 1 diabetes it's harder to exercise and can cause very bad health issues. Our team wants it to be easier to live a normal life without worrying about having sugar on you. Our vision is a dual chamber pump with insulin and sugar. The pump will have artificial intelligence technology to monitor and manage insulin levels. No batteries or chargers are needed, the pump will be powered by body heat.

Present Technology

Diabetes is a very serious condition that causes your blood sugar to be higher than normal. There are two types of diabetes with Type 1 being the most serious. When you have type 1 diabetes your body can no longer produce insulin, and if left untreated can damage eyes, kidneys, and the heart. It can also lead to a coma or even death. Type 1 diabetes is caused by an autoimmune reaction that destroys the cells in the pancreas that make insulin, but it can also be caused by genetics.

Having type 1 diabetes can affect your hobbies and what you can achieve. If you have type 1 diabetes it's harder to exercise. For example, if you run a marathon and your sugar is low, you would have to stop and eat something with sugar in it. That could cause cramps and make you fall behind. But what if you're in a place where you don't have access to glucose (sugar)? I remember when I was about eight years old, I was in the mall with my mom, who has type 1 diabetes. Her phone notified her that her sugar was very low. But we were in a store with no food or drinks, and it was late so no restaurants were open. She got very dizzy and sweaty and finally the security guard had to call for help. Medics came and gave my mom sugar gel. This shows that even if you're exercising or not, when your sugar is low you have to pause your life, even if you're just shopping. Hundreds of thousands of people have to pause their life because their sugar is low, this should not be such a big problem. Today there is no scientific cure but they have created monitors and more to help face this disease.

Present Technology

Technology for Monitoring

Technology, like glucose meters and insulin pumps, are used to monitor type 1 diabetes.

Technology to Manage Insulin

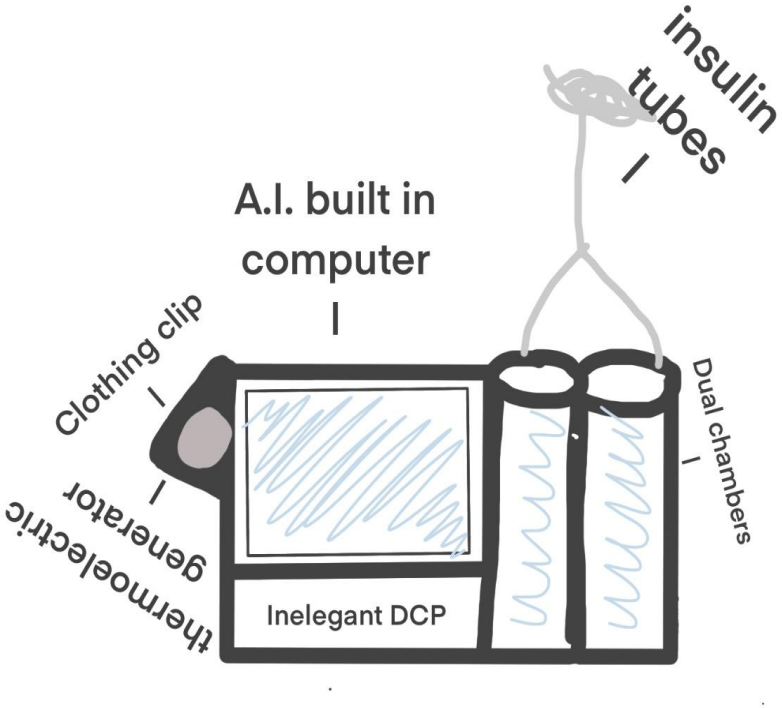
There are insulin pumps and shots to help manage diabetes and there are ways to monitor your blood sugar like using a continuous glucose monitor. The insulin pump is filled with fast acting insulin, then the needle, or cannula, is inserted under your skin and secured with an adhesive patch, but it does not produce insulin automatically.

The current insulin pump has one tube with insulin and a monito. When your insulin is low, you press an app and press ok to start pumping insulin. The limitation of the insulin pump is it has 1 chamber that only has insulin and does not have a sugar chamber as well. People with type 1 diabetes need to have sugar at least 6 times a day and there might not be sugar available. For example, let's say you're on a 15 hour plane ride and there is no sugar then you may be in trouble. This could be a big problem. If I had type 1 diabetes, I would want to carry a candy bar or something with sugar in it, but some people don't want to carry any sort of candy around. Also insulin pumps today are not intelligent, a person needs to understand what they need to eat and how much insulin they need.

History

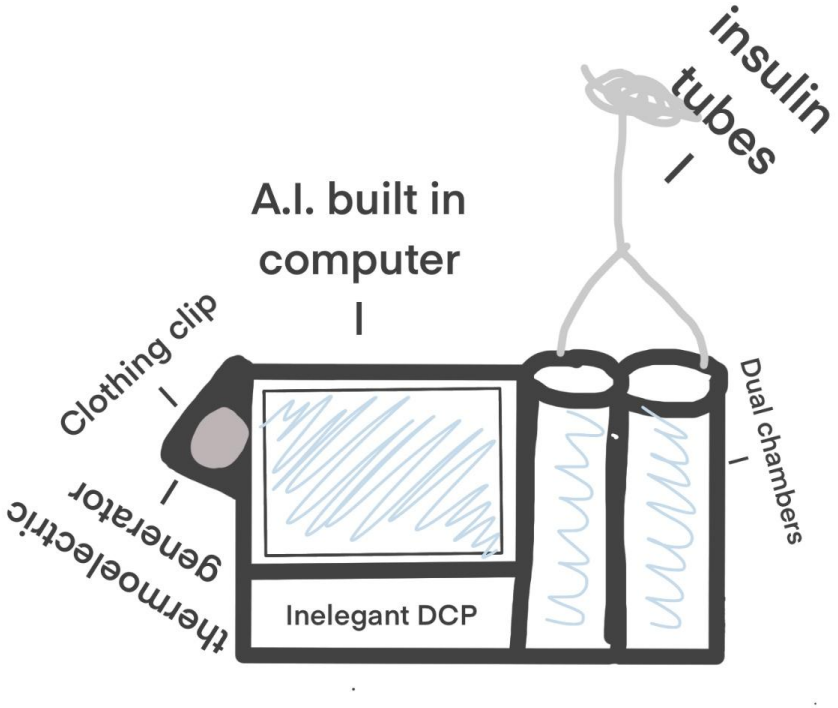
The first ever insulin pump was invented in 1974 and was called a biostater. The Biostater was the size of a microwave so it could only be used to treat cases of Diabetic ketoacidosis, this is a condition where your body does not have enough insulin and is triggered usually by an illness or infection. It was used to dispense insulin and measure glucose levels very frequently. Now insulin pumps are small boxes that are 2-4 inches and pump insulin under the skin.

Future Technology – Slide 1



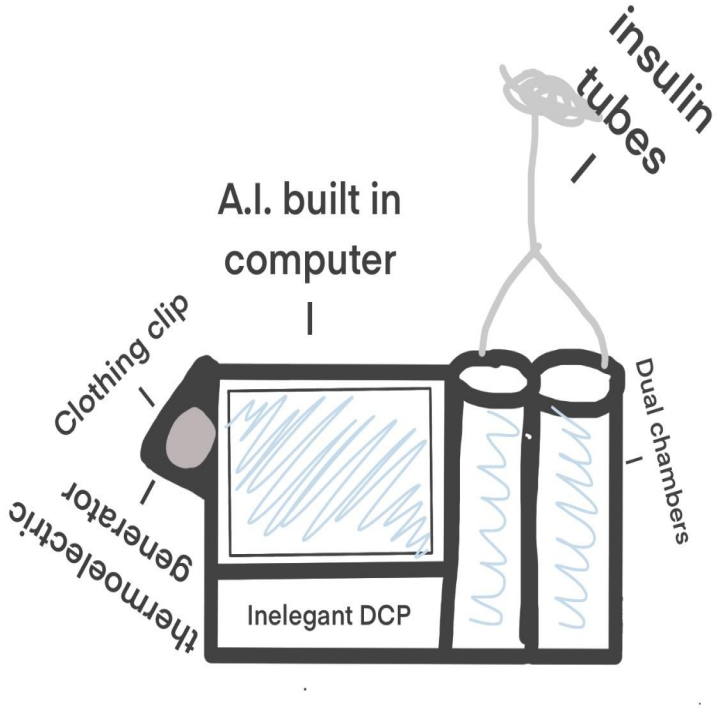
The current insulin pump is a one chamber pump; our idea is a dual chamber pump that uses Artificial Intelligence to manage insulin. In chamber one would be where the insulin is. In the second chamber would be the glucose for emergencies. No batteries or chargers are needed, the pump will be powered by body heat. Your body's heat is around 96-98, with that temperature your pump will be running successfully.

Future Technology – Slide 2 (optional)



The Intelligent DCP would use Artificial Intelligence (Ai) to monitor and manage the insulin that you need. Using Ai you would know if you need insulin, glucose, or if you need to eat or drink something. A computer and Ai program would be built into the pump. The Ai would understand when to deliver the insulin by understanding your physical activities and what you are eating.

Future Technology – Slide 3 (optional)



Our pump would be powered by a thermoelectric device that turns body heat into energy. The thin material would be placed on the back side of the clip that is used to keep the pump in place. When the air around us is at a different temperature than our body we can use the differences in the temperatures along with a conductive material to generate electricity. This is known as the "Seebeck Effect". The clip would be able to be placed on any type of clothing as long as the thermoelectric device is placed on the skin.

Breakthroughs – Slide 1

Artificial Intelligence (AI) is a new emerging technology that still needs advancements. We would want to include it in our design. Using AI, the pump would learn to manage and monitor by adjusting your insulin and glucose if needed.

To make this design a reality, we would need to test it by having a sample of people of all ages who have type 1 diabetes. We would test over a span of 2-4 months, to collect data and see what their opinions are, if they like the design and find it helpful to use. This device would be named the Intelligent DCP (Dual Chamber Pump).

Breakthroughs – Slide 2

N/A

Breakthroughs – Slide 3

N/A

Design Process – Slide 1

We thought that a dual chambered insulin pump would be better because it may help you when you are on the go and you need glucose, you won't need to stop and eat something. You would just have glucose entering your body through an insulin pump, that way you could continue your day without stopping. Also, in this new design there will only be one pump that would be connected to each chamber so that insulin and glucose can be pumped when needed. This device would have technology to manage your insulin so you don't need to have glucose but the chamber will always be there in case you do need glucose.

Design Process – Slide 2 (optional)

Originally we thought of a text message that would tell you when you need insulin or glucose, but then eliminated that idea because there are already a few apps that already do that and you might not have a device to receive the text. Instead we thought of the idea of having an intelligent app using artificial intelligence to understand your physical activities along with what you are eating. It can assist you in what you need to eat, such as glucose, carbs, or calories, and then also give you examples of foods to help get what you need. Using Ai, the pump would learn to help manage the insulin so the glucose pump would just be used in the case of an emergency.

Design Process – Slide 3 (optional)

The new pump would be powered by a thermoelectric device and that device would be on a clip where you can clip it on your clothing. The main reason why we changed the pump to be powered by heat instead of batteries is because batteries made the pump bigger and very bulky. You also would have to change the batteries and they are bad for the environment.

We researched if we could turn stem cells into insulin. Although it is a very good topic we learned that sometimes when you are using stem cells to produce insulin it can sometimes be difficult to control. Stem cells are not assigned a roll so scientists are figuring out ways to assign the cells into different cells like to produce insulin. Instead of using stem cells we decided to want a person to be able to make their own insulin or buy insulin. The pros of this idea is that making one's own insulin is more affordable and would be difficult to include the technology in the device to differentiate cells.

Consequences

There are many positive features to the dual pump, overpowering the negatives. Some positives are that you will not have to stop what you are doing to get your sugar or manage your insulin. Also if you take two types of insulin, you can put your second type in the second chamber so you do not have to give yourself a shot with a different insulin. This allows you can continue doing your loved hobbies. Also because our design is powered by body heat it should make the pump lighter and smaller thanks to not having to use a battery. With our AI it's also easier to maintain your health and know what and when you need to eat. The negative is that it’s managing diabetes but not curing the disease. Our next goal is to cure diabetes.

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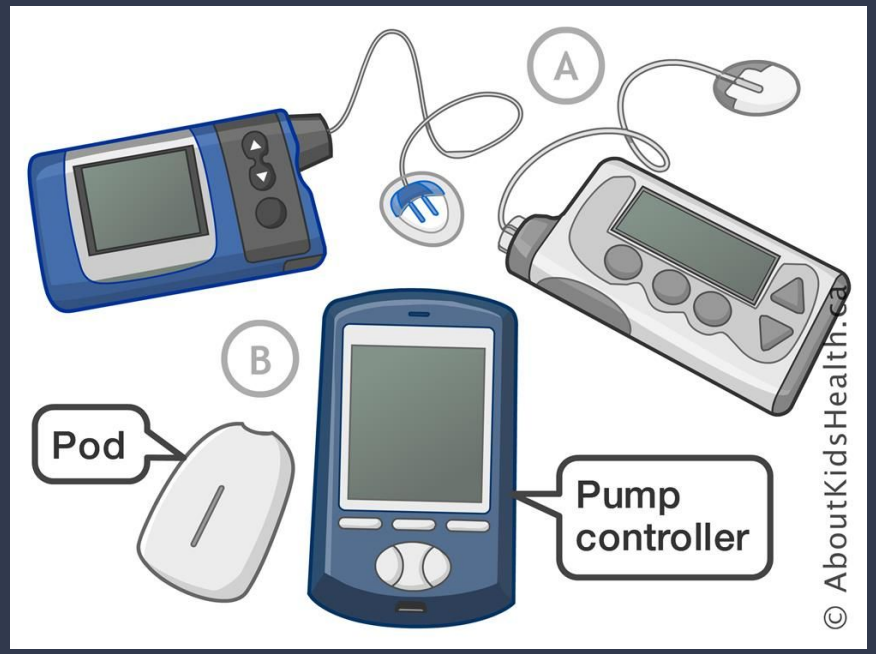
Intelligent DCP

Our vision is a dual chamber pump with insulin and sugar. The pump will have artificial intelligence technology to monitor and manage insulin levels. No batteries or chargers are needed, the pump will be powered by body heat.

Click here for DCP video

PRESENT TECHNOLOGY

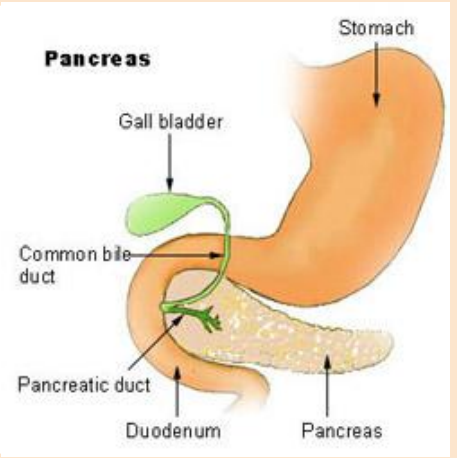


Today's technology is very helpful to people who have type 1 diabetes, such as single chamber pumps, and high tech glucose monitors.

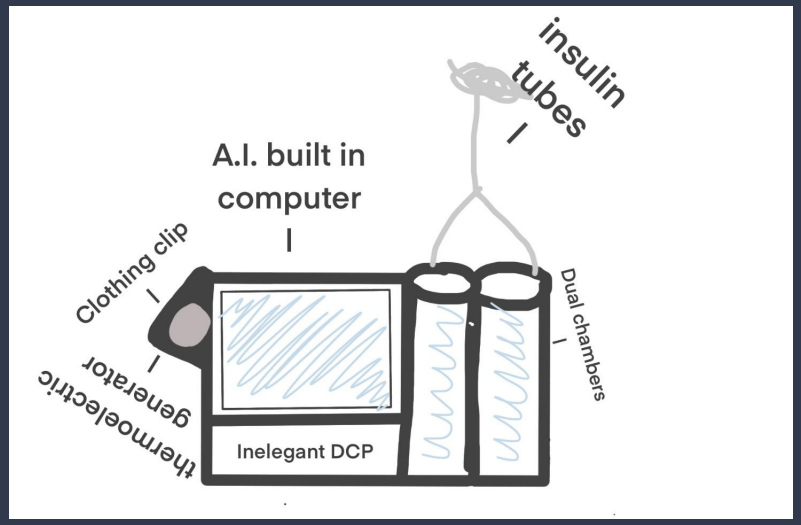
Click here to learn more about the current insulin pumps

Click here for a real life story

Click on the pancreas to learn more about what causes type one diabetes



FUTURE TECHNOLOGY



The current technology for the chamber pump is a simple one chamber insulin pump our idea is for a dual chamber pump. On the sides of the built in A.I computer will be buttons for control. The pump would be managed by artificial intelligence. The pump is amazing for putting in your bag, pocket, ect. The pump is charged by body heat and will take your body heat by a clip that is attached to your clothing and then touches your skin.

Click to learn about each of the technologies in our pump.

Dual Chamber

Artificial Intelligence

Thermoelectric Device

BREAKTHROUGH

Artificial Intelligence is a new emerging technology that we would want to include in our design to help adjust the insulin and glucose. Artificial intelligence still needs advancements and we would need to do testing to ensure the accuracy.

Click here to learn about artificial intelligence

Click here to learn about how we are going to test our device

CONSEQUENCS

PROS

- The pump will still fit in the standard pocket
- You won't have to stop to adjust your insulin or glucose
- If you take two types of insulin you can put one type in the second chamber

CONS

- It's managing diabetes but not curing the disease. Our next goal is to find a cure.