The Artificial Pancreas

Group Members

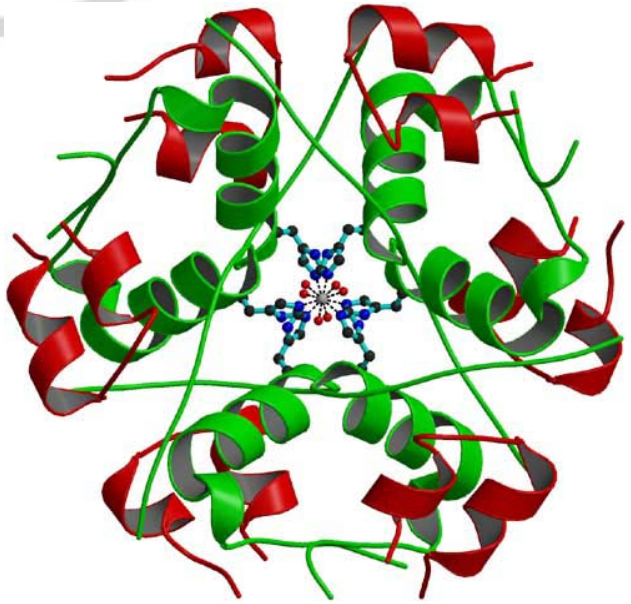
- Elena Davis - MBB
- Jennifer Miller – BIO
- Maje Nazim - MBB
- Sapna Patel - MBB
- Shital Patel - EE
- Yagna Pathak - BME
- Venkata Ravuri - CHEE
- Kirthi Reddy - EE
- Vidya Shivakumar - MBB
- Ryan Tanner - CS
- Aurimas Vinckevicius – MBB

Breakdown of Presentation

- Background
- Project Plan/Strategy
- Accomplishments
- Analysis
- Conclusions

Diabetes

- Body does not make or properly use insulin
- Insulin is a hormone required for the metabolism of sugars
- It is estimated that 20 million Americans have diabetes



Types of Diabetes

Type 1

- "Juvenile"
- The body produces little or no usable insulin

Type 2

- "Adult Onset"
- Insulin resistance causes insulin to be less useful

Adverse Effects of Diabetes

Hyperglycemia

- High blood glucose
- Effects develop slowly
- Include: ocular neuropathy, poor circulation, and heart problems

Hypoglycemia

- Low blood glucose
- Medical emergency called ‘Insulin Shock’
- Results very quickly in slowed breathing, coma and even death

Monitoring and Delivering

- Blood glucose/insulin levels
- Venepuncture
- Painful and patient compliance suffers
- Non-Invasive techniques must be developed

Steve Almburg

Project Design and Goals

Phase 1

- Research
- Prototype Design
- Market Analysis

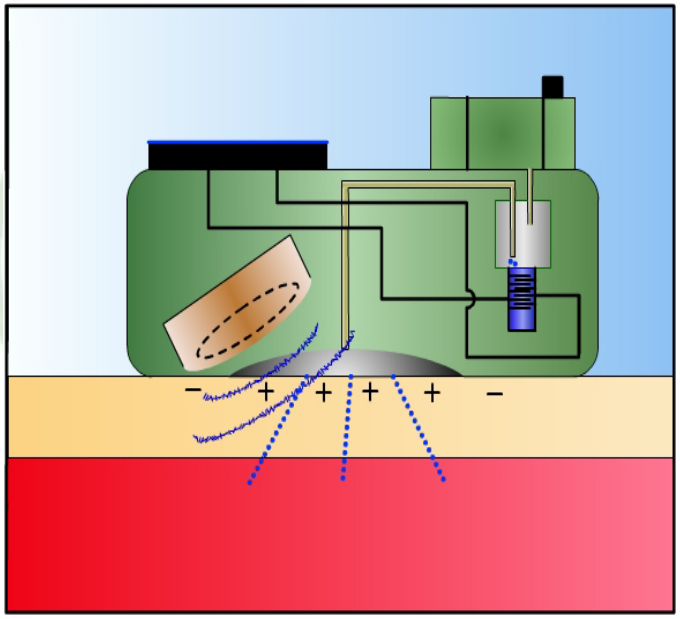
Phase 2

- Aesthetics
- Patents
- Customer Analysis

Previous Work

Spring 2004 - Spring 2005

- Focused primarily on monitoring
- Combined vacuum, ultrasound, and reverse iontophoresis



Our Work

- "Possibility to Actuality"
- True Artificial Pancreas
  - Monitoring
  - Delivery
  - "The Link"

How it Works

1. Monitor Blood/Glucose Level

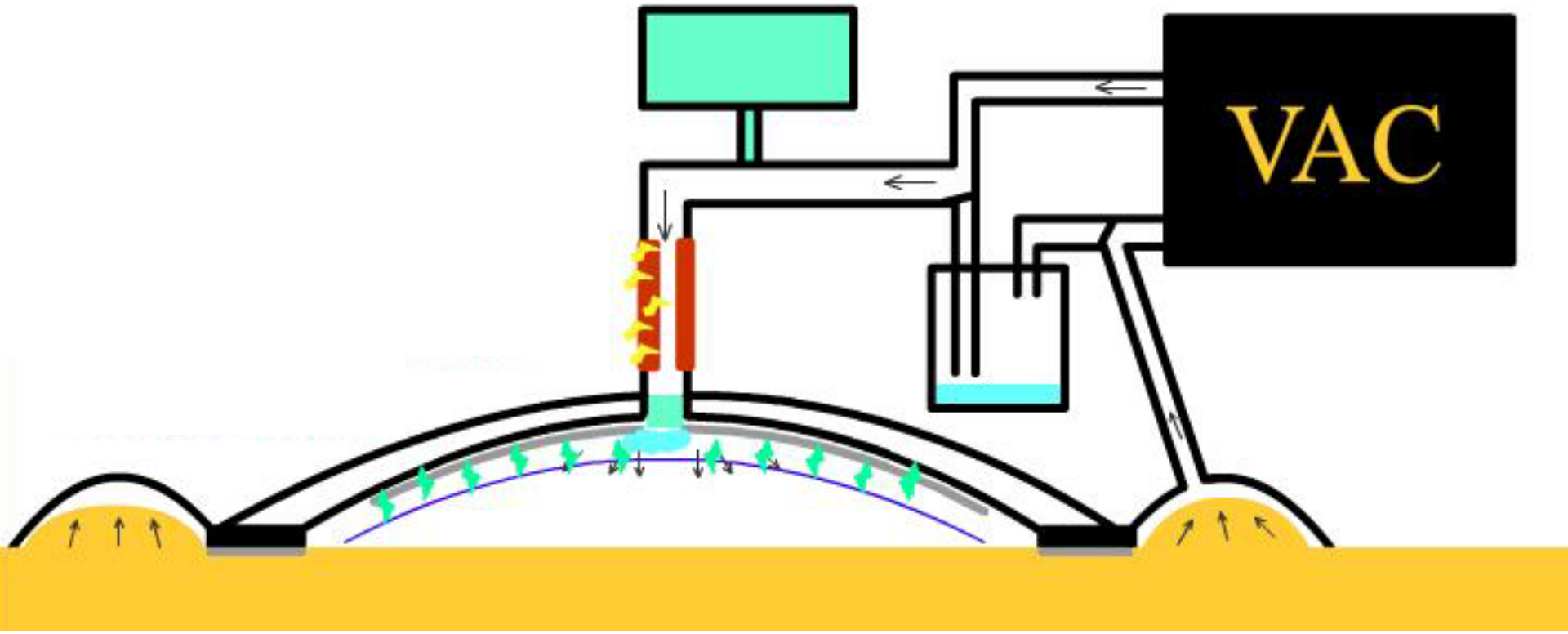
2. Determine Amount of Insulin Needed

3. Deliver Insulin

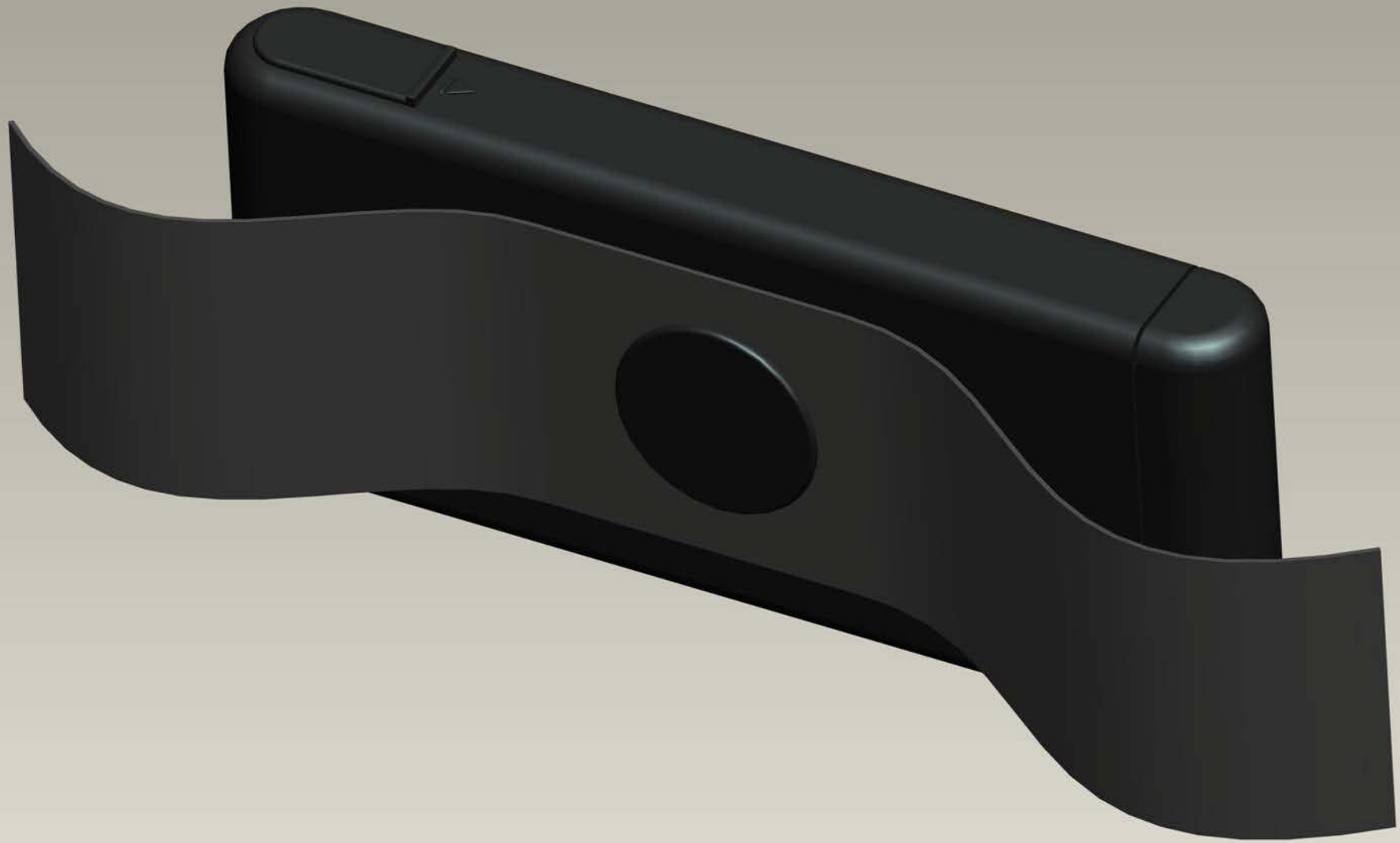
The Artificial Pancreas

Let B be the basal amount given every 10 minutes.
Let x be the glucose points in the blood at a certain time
Let y be the small amount of bolus given (0.05?)
Let z be the amount of points lowered by y [$(X_0 – X_1) = z$]
Let A be the number of points that must be lowered (A = X-100)
Let C be the number of boluses needed to lower the glucose level to normal (A/z = C)

1. **Administer B**
2. **measure X after ten minutes**
3. **store value of X in an array**
    a. **if X is between 100-110,**
        i. **administer y**
        ii. **calculate A**
        iii. **measure X every minute for next ten minutes**
        iv. **store each X in array**
        v. **average or RMS X values for ten minute interval**
        vi. **calculate z**
        vii. **calculate C**
        viii. **administer C units of y**
        ix. **store C + 1 in an array**
    b. **if X is less than 60,**
        i. **administer glucose injection (Jude)**
        ii. **measure X after ten minutes**
        iii. **store X in array**
        iv. **loop**
    c. **If other, start program over at step 1**


VAC


FULL
EMPTY
START




EMPTY

The Artificial Pancreas

- Better Control
- Flexibility
- More Freedom
- Outward signs of Diabetes

Other Insulin Delivery Method

- Insulin pens

- Inhaled delivery

- Jet injectors

Ideal Pump Candidates

- Have realistic expectations
- Ability to problem solve
- Accepting of the disease
- Self motivated
- Mature

Comparison of Insulin Pumps

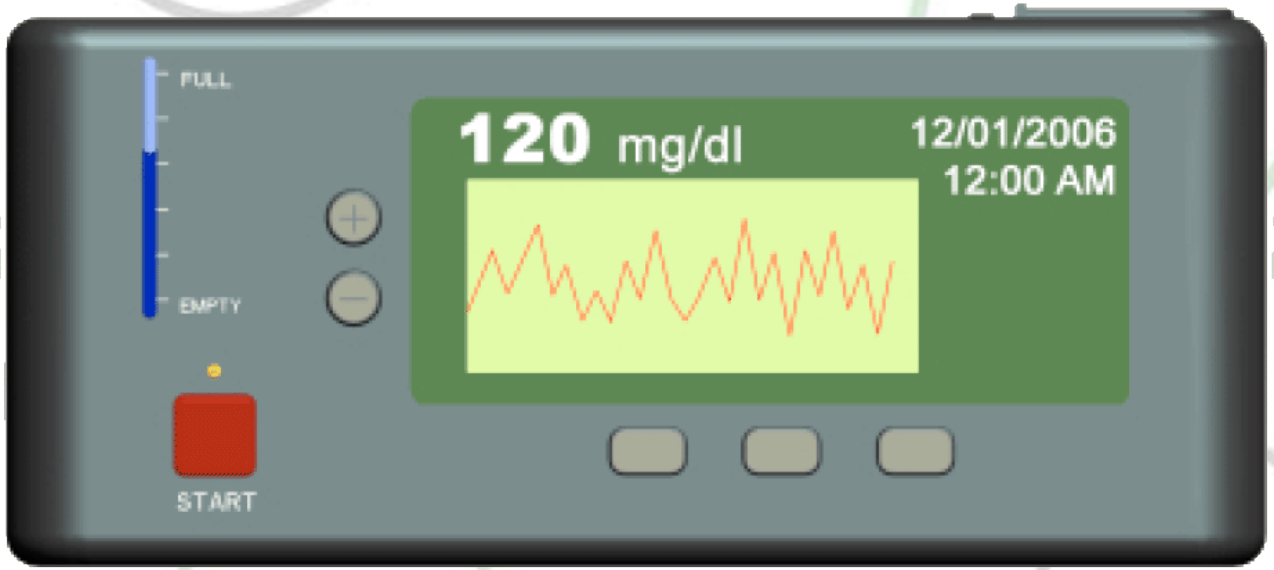
	Deltec	MiniMed	**IPRO 308 - Artificial Pancreas**
Non-Invasive	No	No	**Yes**
Glucose Monitoring System and Insulin Pump together	Can be attached to the pump	Yes	**Yes**
Waterproof	Yes	No	**Yes**
Can be used on airplanes	Yes	No	**Yes**

Comparison of Insulin Pumps

	MiniMed's Paradigm	MiniMed's Guardian	Dexcom STS	**IPRO 308 Artificial Pancreas**
Batteries for monitor	No separate monitor	2 AAA batteries	Chargeable batteries that need recharging every 5 days	**Lithium ion rechargeable**
Communicate With the insulin pump	Yes, with Paradigm 522 & 722	No	No	**Yes**

MiniMed - Paradigm

Cozmore - Deltec



IPRO 308 - The Artificial Pancreas

The Past, The Present, The Future

Past

- Non - Invasive Glucose Monitoring

Present

- Non-Invasive Glucose Monitoring and Insulin Delivery

Future

- Aesthetics, Features, Patents and Grant Proposals, BME Competition

Steve Almburg

Acknowledgments

We would sincerely like to thank:

- **Dr. Emmanuel Opara**
- **Mr. Ray Deboth**
- **Mr. Steve Almburg**
- **Dr. Lou Philipson**
- **Dr. Ganash Raman**
- **Dr. Myron Gottlieb**
- **Mr. Jude Kieltyka**