Overview of Type 1 Diabetes

- ~ 3 million Americans
- Autoimmune disease
  - Body destroys insulin-producing cells in pancreas
## Overall Problem and Solution

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Patients only get feedback from doctors once every 3-6 months</td>
<td>● Enable direct/instant communication between doctor and device</td>
</tr>
<tr>
<td>● Devices like the PDM or CGM are expensive and clunky</td>
<td>● Expand access to quality care for all patients</td>
</tr>
</tbody>
</table>
Interviewee #1: Cody

- Uses injections as opposed to a pump
- Checks blood sugar 6-8 times/day
Contextual Inquiry
Interviewee #2: Saniya

- Uses insulin pump and continuous blood glucose monitor
- How diet affects her levels
Contextual Inquiry

Hourly Stat Report over last 3 months

Blood Sugar Numbers

Time
Interviewee #3: Austin

- Athlete - Doesn’t like extra units on body
- Self-medicates (insulin dosages)
Task Analysis

1. Who is going to use the system?
   a. People who suffer from chronic disease like Diabetes

2. What tasks do they now perform?
   a. Take insulin
   b. Communicate with doc
   c. Blood sugar measurement

3. **What tasks are desired?**
   a. Not have to think about it (automatically done)

4. How are the tasks learned?
   a. Help from device manufacturer and hospital people and parents

5. Where are the tasks performed?
   a. Mobile, anywhere
Task Analysis

6. What’s the relationship between customer & data?
   a. Want remote access to health history

7. What other tools does the customer have?
   a. Hand written notebook and unit-specific (proprietary) software

8. How do users communicate with each other?
   a. See doc ~once every 3-6 month

9. How often are the tasks performed?
   a. Testing blood sugar (6-8 times a day)
   b. Emergency (rarely)
   c. Insulin shots (4+ times daily)
   d. Counting carbs (every meal and snack)
Task Analysis

10. What are the time constraints on the tasks?
   a. Taking insulin (must take within 30mins after meal)

11. What happens when things go wrong?
   a. Bracelet + dog tag
   b. Educate people around you
   c. Call support phone #
   d. Carry emergency supply (snack + glucagon)
Representative Tasks

1. Personal care (changing dosages)
2. Preparing to cover meals
3. Emergency care
<table>
<thead>
<tr>
<th>Date</th>
<th>Breakfast/Dejeuner</th>
<th>Lunch/Diner</th>
<th>Dinner/Souper</th>
<th>Other/Autre</th>
<th>Comments/Commentaires</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-6</td>
<td>LCH</td>
<td>NPH NR</td>
<td>25</td>
<td>11</td>
<td>6.0</td>
</tr>
<tr>
<td>14.8</td>
<td>LCH</td>
<td>NPH NR</td>
<td>25</td>
<td>16</td>
<td>3.4</td>
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<tr>
<td>15.7</td>
<td>LCH</td>
<td>NPH NR</td>
<td>25</td>
<td>10</td>
<td>3.8</td>
</tr>
<tr>
<td>18.4</td>
<td>LCH</td>
<td>NPH NR</td>
<td>25</td>
<td>16</td>
<td>8.5</td>
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<tr>
<td>16.4</td>
<td>LCH</td>
<td>NPH NR</td>
<td>25</td>
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<tr>
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<tr>
<td>27.4</td>
<td>LCH</td>
<td>NPH NR</td>
<td>20</td>
<td>8.0</td>
<td>13.0</td>
</tr>
</tbody>
</table>

**Personal care**
Preparing to cover meals

Shepherd’s Pie? 30 carbs?

Mac ‘n’ Cheese 40 carbs

Potatoes 25 carbs
Emergency care
## Application Ideas

<table>
<thead>
<tr>
<th>Idea</th>
<th>Significance</th>
<th>Feasibility</th>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color-Coded Band Aid Monitor</td>
<td>High</td>
<td>Med</td>
<td>Med</td>
</tr>
<tr>
<td>Directions for Newbies</td>
<td>Med</td>
<td>High</td>
<td>low-med</td>
</tr>
<tr>
<td>Carb Counting Photo Essay</td>
<td>High</td>
<td>Med-High</td>
<td>Med-High</td>
</tr>
<tr>
<td>Context-Based System</td>
<td>High</td>
<td>med-High</td>
<td>high</td>
</tr>
<tr>
<td>Smart Pump Emergency</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Mobile 2CG Software</td>
<td>High</td>
<td>High</td>
<td>Med-High</td>
</tr>
<tr>
<td>Data for Academics</td>
<td>High</td>
<td>High</td>
<td>Med</td>
</tr>
</tbody>
</table>
Application Ideas

Context-Based System

- collect and use data from location, meals, past experiences, etc. to recommend treatment

Salad: 5 Carbs
Potatoes: 30 Carbs
Emergency Pump Unit

● Deliver Glucagon if patient has lost consciousness due to low blood sugar
● Automatically contact paramedics and caregivers
Application Ideas

Mobile Data Shared with Caregiver

● Collect data on phone glucometer/pump
● Upload to the cloud periodically
● Algorithms tell if care has become anomalous & flag for doctor
● Doc. contacts patient
Sketches
Sketches

Easy & painless health monitor

Apply sticker

Red color: Stains bad

Green color: Stains good
Sketches

Context-based treatment

- Adjust treatment based on user condition (e.g., heart rate),
  environment (e.g., temperature & weather),
  and location.
Summary

1. Enable real time treatment by direct access to patient data.
2. Alleviate user stress by “offloading” emergency and daily care to smart wearable devices.
Questions?