Mobile applications for diabetes
Opportunities and Barriers

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President, Israeli endocrine society
Diabetes is the prevailing epidemic of the century.
Obsolete Diabetes Care Model

Lack of diabetes experts
Limited time per patient

Communication Failure 80% VS 20%

Patients actually understand the treatment guidance

Poor disease Management

1) www.diabetes.co.uk
2) Communication Between Healthcare Professionals and Patients on Basal Insulin Titration: Results of a Quantitative Survey, Lori Brad
No one is served right

Patient

Alone 99% of the time

Clinic

Extreme shortage of Health care resources

Health System

Increasing cost
Deteriorating health
How Mobile App Can Make a Difference?

Convenience - "meet" people where they are

Data and reminders can be provided "just in time"

Collaborate with peers, coaches and care providers

Data Collection and Management

Seamless tracking and analysis

Personalization

User tailored display and guidance

Behavior modification tools

Customized rewards and incentives
Mobile applications can improve DM care

- Provide enhanced access to timely information for patients, health care professionals, and payers.
- Facilitate remote monitoring of patients.
- Provide decision support to assist patients in selecting treatment.
- Deliver timely recommendations for treatment to increase adherence to prescribed therapy.
Mobile application – center of chain
Recent Digital Diabetes Market Investments and Acquisitions

- **Jun'15**: Raises $22M
- **Mar'16**: Raises $8.5M
- **Apr'16**: Raises $44.5M
- **Dec'16**: Acquired for $7M by BioTelemetry
- **Jan'17**: Raises $5.1M
- **Mar'17**: Raises $52.5M
- **May'17**: Acquired for $110M by Roche
- **Jul'17**: Raises $6.1M
- **Dec'15**: Raises $8M
- **May'17**: Raises $6.1M
- **Sep'16**: JV of Sanofi and Verily, $500M
- **Jun'17**: Raises $35M
- **Jul'17**: Raises $50M
Empowering Digital Diabetes Care
Service architecture patient/clinic

“Moving from Data to Intelligence!”

1. Data Management
   - What data do we have?

2. Data Analysis
   - What does the data show?

3. Data Interpretation
   - What does the data mean?

4. Assessment/Diagnosis
   - Why does this happen?

5. Clinical Management
   - How to treat the patient?

- Glucose and estimated HbA1c
- Glucose trends and HbA1c comparisons
- Deterioration of glycemic control
- Increase in morning post prandial glucose increasing HbA1c
- Increase insulin dosage before breakfast
- Treatment Recommendation
- Event Detection
- Computation and Presentation
Mobile Application

Provides set of monitoring and management tools

- Raw data acquisition (Including external sensors)
- Personal dashboard
- Diabetes care treatment plan
Display of diabetes management on smartphone screen
Glucose displays on smartphone screen

Daily average glucose distribution

Average glucose levels

Daily average glucose levels in the selected period
### Suggested treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Recommendation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lantus evening</td>
<td>Add insulin or reduce carbs, Possible somogyi, add night measurements</td>
<td>33 → 36</td>
</tr>
<tr>
<td>Apidra morning</td>
<td>Keep the same</td>
<td>24 → 24</td>
</tr>
<tr>
<td>Apidra noon</td>
<td>Keep the same</td>
<td>22 → 22</td>
</tr>
<tr>
<td>Apidra evening</td>
<td>Keep the same, Measure more</td>
<td>22 → 22</td>
</tr>
</tbody>
</table>

[Send to patient]
Digital Diabetes Clinic / Control tower

Provides information to healthcare provider:

• Raw data
• Analytics data (summary)
• Treatment recommendation
• Population Management
• Artificial intelligence (Big Data / Machine learning)

GlucoMe™
Control tower tools

- Manages the patient, clinic and population under one roof
- Enables change in the care model
- Collects and analyzes data
- Includes personalized real-time alerts Proposes actions based on decision support algorithms
- Enables intervention
### Control tower events

<table>
<thead>
<tr>
<th>Name</th>
<th>In queue since</th>
<th>#Severe</th>
<th>#Moderate</th>
<th>#Mild</th>
<th>Compliance</th>
<th>HbA1C</th>
<th>Last activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kim Hargis</td>
<td>Wed Jun 28 2017 16:23:31 GMT+0300</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>50%</td>
<td>6.6</td>
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<td>Doretha Horrocks</td>
<td>Wed Jun 28 2017 16:23:30 GMT+0300</td>
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<td>Mark Radford</td>
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<tr>
<td>Jackson Peterson</td>
<td>Wed Jun 28 2017 16:23:31 GMT+0300</td>
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<td>0</td>
<td>1</td>
<td>50%</td>
<td>6.5</td>
<td></td>
</tr>
</tbody>
</table>

Showing 1 to 4 of 4 entries

Page 1 of 1
Changing Management Paradigm

1. Digital Monitoring Control
   - Some
     - New patient
     - 2 Week interval
     - Protocol Flagging
     - Urgent

2. DDC Filter
   - Diabetes Nurse / GP
     - All
     - Some
       - Complex New Patient
       - 6-12 Months interval
       - Protocol Flagging
       - Urgent

3. Diabetes Specialist
   - Few
     - Complex New Patient
     - 6-12 Months interval
     - Protocol Flagging
     - Complex Urgent
     - Nurse’s call
Tools for the payer
Value Proposition

**Patient**
- Actionable instructions
- 24/7 care

**Doctor**
- Data driven medicine
- Seeing the right patients at the right time

**Health System**
- Reduced short and long term cost
- Improve disease management
Assessment of consumer health care app functionality

<table>
<thead>
<tr>
<th>Individual functionality</th>
<th>Number of apps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inform</td>
<td>10,840</td>
</tr>
<tr>
<td>Instruct</td>
<td>5,823</td>
</tr>
<tr>
<td>Record</td>
<td>5,095</td>
</tr>
<tr>
<td>Display</td>
<td>2,302</td>
</tr>
<tr>
<td>Guide</td>
<td>1,434</td>
</tr>
<tr>
<td>Remind/alert</td>
<td>1,357</td>
</tr>
<tr>
<td>Communicate</td>
<td>395</td>
</tr>
</tbody>
</table>

Source: IMS Institute for Healthcare Informatics
Digital tools addressing multiple aspects

<table>
<thead>
<tr>
<th>EDUCATIONAL CONTENT</th>
<th>PERSONAL INFORMATION TRACKING</th>
<th>SOCIAL</th>
<th>COACHING &amp; CLINICIANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personalized Newsfeed</td>
<td>Diet</td>
<td>Friends/Family</td>
<td>Coachings/Virtual Provider</td>
</tr>
<tr>
<td>Learning Module</td>
<td>Weight</td>
<td>Group</td>
<td>Existing Provider</td>
</tr>
<tr>
<td>General Information</td>
<td>Activity</td>
<td>Social Network</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blood Sugar</td>
<td>Competitions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blood Pressure</td>
<td>Live</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mood/Emotion</td>
<td>Algorithm/Virtual Coach</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meds</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Goal Setting and Tracking</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Fooducate
- Health2Sync
- Calorie Counter
- BG Monitor
- Glooko
- Glucosio
- mySugr
- Diabetes in Check
What Are the Benefits of Using Digital Health Applications?

- Change in A1C level
- Self-efficacy - following a healthy eating plan
- Confidence in ability to control DM
- Change in self-monitoring frequency
- Change in QOL
- Cost of care
- Major hypoglycemic episodes.
- Fear of hypoglycemia.
Barriers to proving benefits

- Need for clinically relevant outcome data to drive adoption
- Short life span of digital software – long clinical trial process
- Need for clear economic rewards and improved care
- Need for clear pathways to regulatory approval

21st Century Cures Act
FDA limited oversight to apps that qualify as medical devices

<table>
<thead>
<tr>
<th>Device Name</th>
<th>Manufacturer</th>
<th>Approved or Cleared</th>
<th>Year</th>
<th>Platform</th>
<th>Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Dexcom Share</td>
<td>Dexcom Inc.</td>
<td>Approved</td>
<td>2015</td>
<td>iOS</td>
<td>Share data from a continuous glucose monitor (CGM) with other people in real-time</td>
</tr>
<tr>
<td>Accu-Chek Connect</td>
<td>Roche Diabetes Care</td>
<td>Approved</td>
<td>2013</td>
<td>iOS, Android</td>
<td>Give specific insulin bolus recommendations</td>
</tr>
<tr>
<td>WellDoc Diabetes Manager System</td>
<td>WellDoc</td>
<td>Cleared</td>
<td>2010</td>
<td>iOS, Android</td>
<td>Medication adherence program and secure capture, storage, and real-time transmission of blood glucose data</td>
</tr>
<tr>
<td>BlueStar</td>
<td>WellDoc</td>
<td>Cleared</td>
<td>2014</td>
<td>iOS, Android</td>
<td>Rx app, suggesting, in real time, when to test blood sugar and how to control it by varying medication, food, and exercise. May be reimbursed by insurance</td>
</tr>
<tr>
<td>Glooko Device System</td>
<td>Glooko Inc</td>
<td>Cleared</td>
<td>2012</td>
<td>iOS, Android</td>
<td>Monitoring and management via connection to FDA cleared meters</td>
</tr>
<tr>
<td>MiniMed Connect</td>
<td>Medtronic</td>
<td>Cleared</td>
<td>2015</td>
<td>iOS</td>
<td>Management. View insulin pump and continuous glucose monitor (CGM) data on a smartphone and provides remote monitoring and text message notifications. Gives healthcare teams more convenient access to more comprehensive patient data so they can adjust patients’ care plans</td>
</tr>
</tbody>
</table>
• May 01, 2017 08:00 ET
• Amalgam Rx Unveils iSage Rx, the First FDA-Cleared Application for Titration of all Brands of Basal Insulin
• Advanced Digital Therapy Supports Patients with Type 2 Diabetes Optimize Fasting Glucose Levels
Barriers to adoption of

- Different users have different needs
  - *Insulin users, DM2, CGMS users etc.*
- Personalized solutions for patient with multiple disease.
- Language and culture barriers
- Data Streams From multiple Sensors—Volume, Velocity, Veracity, Variability, and Variety
More challenges

• Aging population
• Cybersecurity and privacy
• Integration Into the electronic medical record
• No obvious business model – Who will pay?
• Different health ecosystems
• Scaling and sustainability
**Big advantage - Data Driven Medicine**

- **Future directions - Data is highly valuable**
  - impact of medicine, variety of health care systems, geographical break down, physician’s feedback, etc.
- **Data is being used to improve the machine learning algorithms.**