Technology and Tools in Diabetes

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Disclosures

- Speaker's Bureau: Novo Nordisk, Medtronic
- Advisory Panel: Novo Nordisk, Sanofi
- I have type 1 diabetes and have personally used a number of these products

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Objectives

- Review current diabetes technologies
- Discuss benefits and limitations of diabetes technologies
- Apply knowledge gained to clinical settings in diabetes practice
- Discuss and describe closed loop artificial pancreas and other future technologies

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Many technologies

- Pumps
- CGM
- Smart Meters
- Apps
- Personal devices/trainers

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Question

- Closed Loop Artificial Pancreas Systems are on the market as FDA approved devices
  - A. True
  - B. False

Question

- Closed Loop Artificial Pancreas Systems are on the market as FDA approved devices
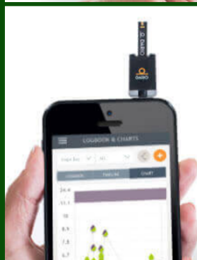 - A. True
  - B. False

  Answer: B. False (but not for long……)

Smart Meters, Apps, Fitness Trackers

Smart Meters

Contour

Dario-clip on to smartphone

All are downloadable, some smartphone interface, track food, exercise, illness

Diabetes and Technology – Glucometers
(FDA, January, 2014)

- For home use meters, 95% of all measured blood glucose meter values must be within 15% of the reference value (a laboratory measurement)

- 99% of meter values must be within 20% of the reference value

FDA
Slide acknowledgement Dr. James Chamberlain

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Interactive Smart Meter


Livongo is Redesigning
Chronic Condition Management

By combining consumer health technology, data insights, and real-time support, we deliver a personalized experience that drives behavior change.

▶ Personalized Insights at the Point of Impact
Unearthing hidden trends and delivering actionable guidance.

▶ On-Call, On-the-Go Coaching
Real-time support 24/7/365 from Certified Diabetes Educators.

▶ Connected Care Community
Creating better experiences for members, their family, friends, and physicians.

▶ Unlimited Strips, On Demand
All the test strips members need, shipped directly to their doors, at no cost.

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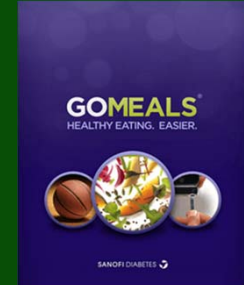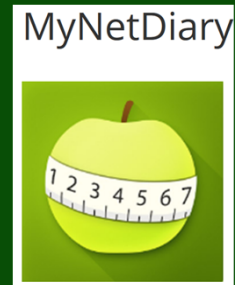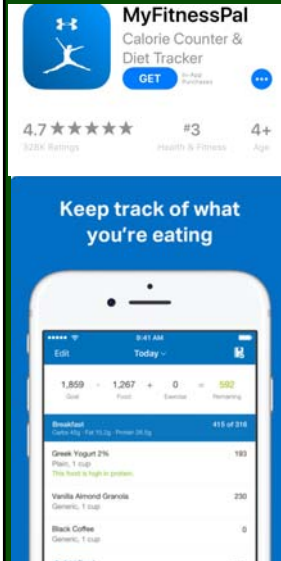
Apps

Food, activity

*Look these up in the app store on your smartphone

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Apps/Meter/Subscription Service

One Drop System

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Apps

Mysugr
Most used diabetes app in the world

"Helping diabetes not suck"

Built/developed by persons with diabetes

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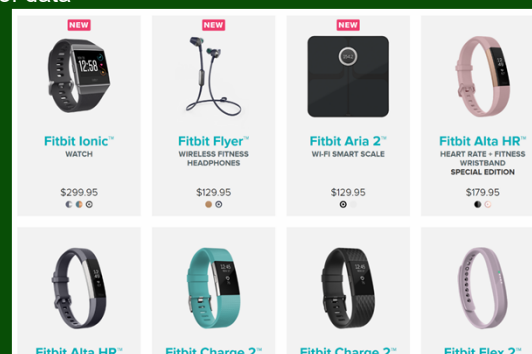
Fitness Trackers

- Many devices
- Many applications
- Some have data sharing
- Challenge is integration of data meaningfully with EHR

Fitbit

Apple-use with Apple Watch

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Smart Meters, Apps, Fitness Trackers

- Generally, only worthwhile if:
  - Willing to enter data
  - Share data with provider
  - Follow the recommendations generated

Insulin Dosing Apps

- Diabnext Clipsulin Insulin Dosing and BG App
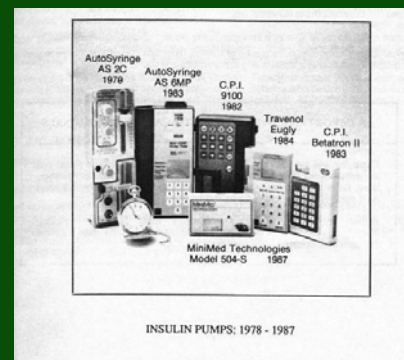
- Eli Lilly Go Dose® Insulin Pen Dosing Calculator App

Insulin Pumps and Sensors

A Pictoral History of Insulin Pumps

Continuous Glucose Monitoring (Sensors)

- Technology developed over the last decade, clinic use first, now also home use
- Record glucose 24/7, usually displayed every 5 minutes
- Record interstitial fluid glucose, not serum or capillary, generally ~15 min 'lag'
- Getting into 9-10% variability, most meters are ~15%

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Pumps and Sensors

- Interfaced devices developed last decade
- Close to "closed loop" artificial pancreas that is consumer ready- hybrid system is pretty close
- Currently, patient gets info, has to act on it (my blood sugar is x, I'm eating y amount of carbohydrate)
- High/low alarms, trends alarm (more rapid rise or decline)

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Basic Setup Pump/Sensor

<Sensor site

<Insulin infusion set

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Medtronic 670g

- Hybrid closed loop insulin delivery system ("artificial pancreas")
- New sensor system (Guardian 3)
- Predictive algorithms
- Dependent on user for carb input and fingerstick glucose

Accurate carb counting seems
to help a lot with overall performance

Uses a Contour meter exclusive
To this device

SmartGuard™ features:

AUTO MODE‡
- Automatically adjusts your basal (background) insulin every five minutes based on your CGM readings.
- Helps keep your sugar levels in your target range for fewer lows and highs — day and night.
- See how Auto Mode works

SUSPEND BEFORE LOW§
- Stops insulin up to 30 minutes before reaching your preset low limits.
- Automatically restarts insulin when your levels recover without bothersome alerts.
- Helps you avoid lows and rebound highs.
- See how Suspend Before Low works

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Omnipod

Tubeless
Operates with remote

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Tandem Tslim

Touch screen

Downloadable

Interface with Dexcom
CGM

CGM Enabled
t:slim X2™ Insulin Pump

Largest Capacity
t:flex Insulin Pump

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V-Go

The "anti-technology pump"

Insulin delivery for type 2 diabetes that's worn like a patch

Simplify with V-Go®

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CGM (Sensor) Freestanding Systems*

*Can be used with injections or pump

DEXCOM
-also interfaces with Tslim pump and soon will with Omnipod.
-**sharable data**

Slide courtesy Dr. James Chamberlain

Freestyle Libre-doesn't need routine fingerstick glucose
Works up to 14 days
No alarms- scanner or smartphone

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CGM Professional

- Can also use CGM by health professional to assess 7-10 days of blood glucose data
- We often do this for patients with control problems or those considering a pump +/- CGM

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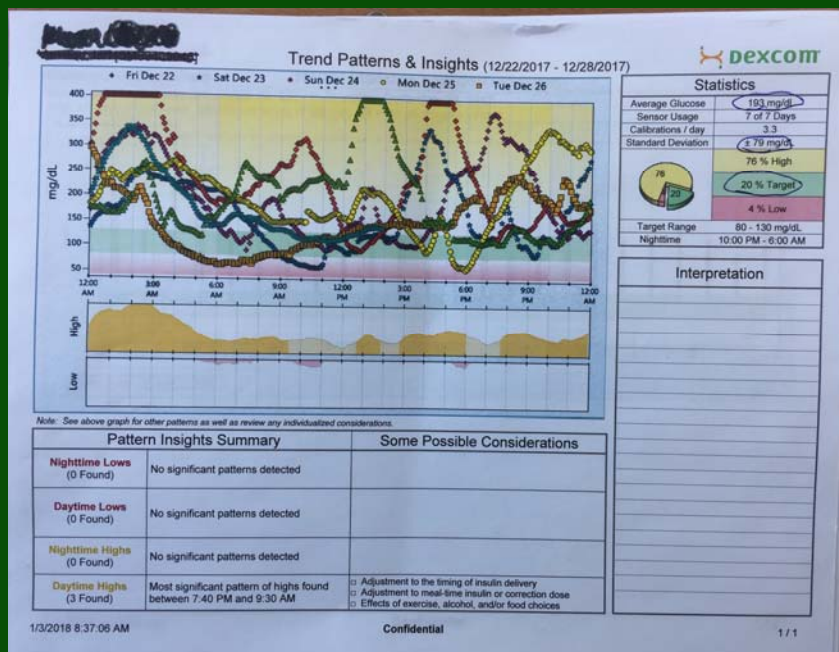
Case #1

Problems:
- high average, some variability
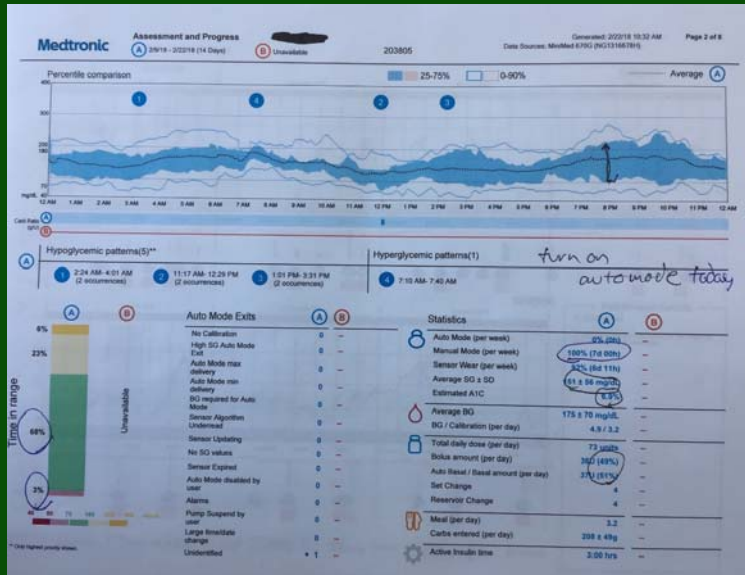- Clear high overnight pattern

Solutions:
- consider higher overnight basal or see if uncovered snack at bedtime-
- see if everything else settles down with these changes

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Case #2

Problems:
- Very minor post meal elevation after evening meal
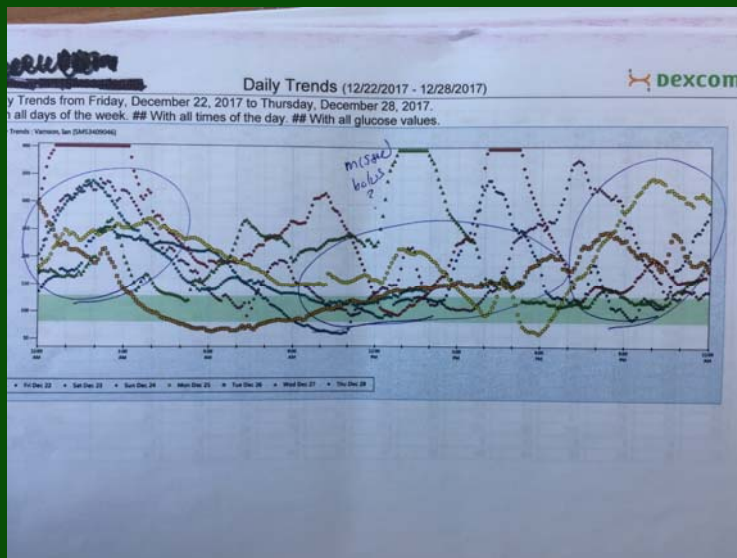- Doing all on his own-lots of work

Solution:
- switch to automode to lower his burden

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Case #3

Problems:
- Another obvious high overnight
- Flatline highs- missed bolus?
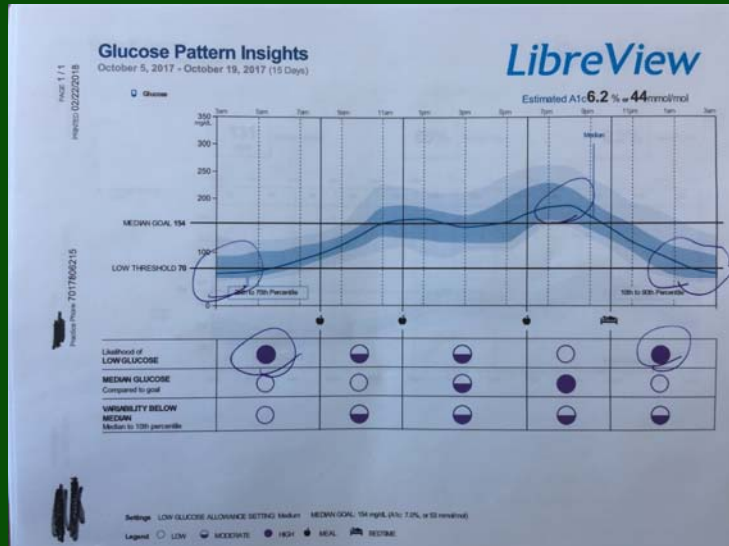- Some postmeal highs, mostly evening

Solutions:
- Revisit overnight basal, see if
- Uncovered snack at bedtime,
- Review factors for accurate and consistent mealtime bolusing

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Case #4

Problem
- a little low overnight, a little high all day with very good A1C

Solutions
- Review overnight basal/daytime basal
- Any stacking from late frequent correction boluses
- Review daytime activity- if very low, try three 3-5 minute activity breaks

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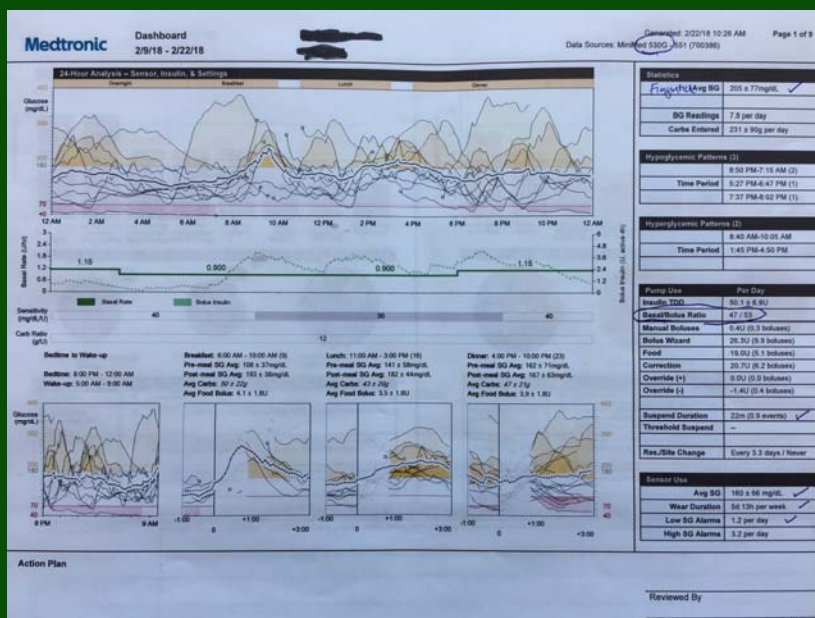
Case #5

Problems:
- High average, some variability
- Taking 10 boluses a day
- Lows following highs (overcorrect)

Solutions:
- Has about 50/50 bolus/basal
- Timely set changes
- Rethink bolus settings- many hyper events followed food bolus
- maybe move some of the correction dosing to increased basal

Hyperglycemic events

Hypoglycemic events

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Case #5 (cont'd)

Some strange things-
- Long suspends
  on days with many boluses (up to 14!)

- Supports need for timely set changes?
  Many useless
  corrections when set needs to be changed?

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Other Data Management Systems

Tidepool, where you can see all of your data in one place.
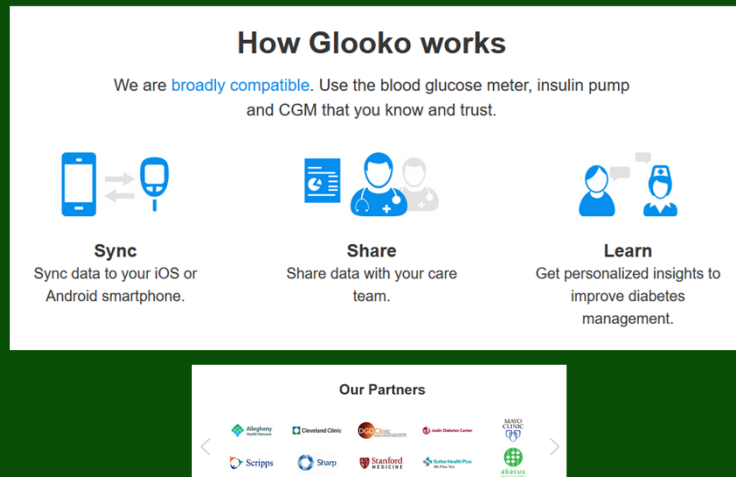
Open source, non-profit

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Other Data Management Systems

Glooko can use meters, pumps, CGM to one platform

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Closed Loop

(not on the approved market yet)

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"Artificial Pancreas"
"Bionic Pancreas"
"Closed Loop Pump/Sensor"

- These are all the same thing
- These look a lot like the pumps and sensors we use now, they just have "hopped up software"
- Suspend for lows, correction for highs
- Computer/smart phone interfaces
- Likely will need to be 2 hormone (insulin + glucagon)

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Meta-analysis of 40 artificial pancreas studies

- https://www.bmj.com/content/361/bmj.k1310

- "Artificial pancreas systems are an efficacious and safe approach for treating outpatients with type 1 diabetes."

BMJ 2018; 361 (Published 18 April 2018)

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DIY Open Source Closed Loop Pump/CGM

- Many out there
- None FDA approved

- http://www.diabettech.com/looping-a-guide/comparing-the-loop-and-openaps-algorithms/

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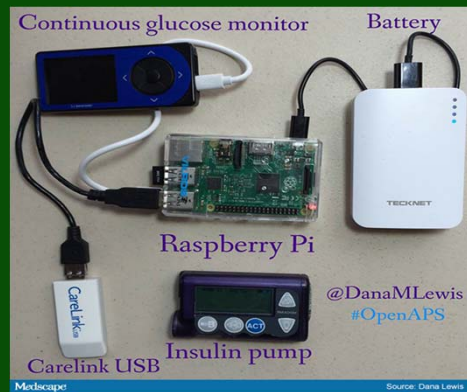
Bigfoot Biomedical

Not FDA approved yet

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Open Source Closed Loop

Not FDA approved

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Open Source Closed Loop

https://getrileylink.org/

Not FDA approved

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Who should have a pump and/or sensor?

Patient Selection

- Patients who are not meeting goals on multiple daily injections
- Usually patients who are good with followup (phone/text/in person/e-mail/appointments)
- Patients with a lot of blood glucose variability
- Patients with asymptomatic hypoglycemia
- Usually start pump first, add sensor later (2 to 4 weeks, although sometimes the other way around)

Patient Selection

- Selecting **proper patients** is important to maximize success

- Proper training and followup are **critical** for success

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Patient Diabetes Experience with Pumps and Sensors

- Complete "reframing" of diabetes
- Usually a much higher awareness of diabetes right away
- "Zen" diabetes-more in the mindful "flow" of diabetes all of the time
- Not something in a "box on a shelf" that they look at once in awhile or crisis management

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Tips For Pump and Sensor Success

Tips For More Pump Success

- Change sites every 2 to 3 days
- Protect from extreme heat and cold
- Use advanced features- these can't be replicated with injections
- Don't take correction boluses too close together
- If taking a lot of correction boluses, need to revisit mealtime dosing
- Long time disconnects should be avoided, except in specific situations

Tips for More Successful Sensor Use

- Calibrations are MUCH better if done during a time of blood sugar stability
- Change sites on the appropriate schedule
- **If calibrations are done when blood sugars are changing relatively rapidly, you may actually be amplifying error**
- Wash hands/avoid hand sanitizer for best fingerstick results

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Tips for More Successful Sensor Use

- If patients tell you their alarms are going off all the time
- **It's usually not the pump and sensor that are the problem-**

their insulin/activity/food are what need to be changed

Shutting of the alarms is not the answer!

Reframe diabetes awareness

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My Experience

- All of these devices are good
- Different features
- I've been a pumper since 2000
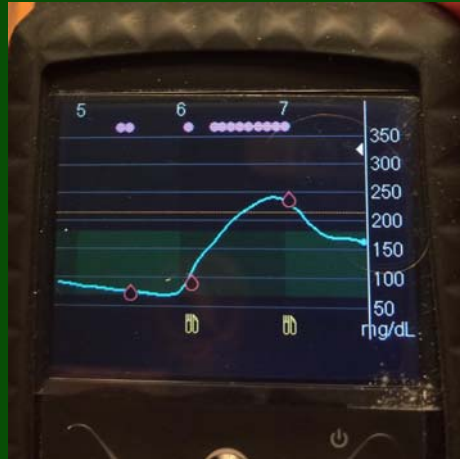- Using CGM since 2006

Typical Overnight

Things go wrong!
Forgotten full meal carb entry

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Car ride

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Beyond A1C

- Time spent <70 (<5%)
- Time spent in target (i.e., 71-180) (65-75%)
- Time spent above target (i.e., >180

- We may have been rewarding hypoglycemia with "celebrating" very low A1C (i.e., <6 %)

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Diabetes Success

- Technology connects the user with their diabetes, not separates them from it
- All types of technology for all types of patients- it's not just pumps and sensors
- Work with your diabetes team to find what is best for you

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Diabetes Care, December 2017

• Maturation of CGM and Glycemic Measurements Beyond HbA$_{1c}$—A Turning Point in Research and Clinical Decisions
Matthew C. Riddle, Hertzel C. Gerstein and William T. Cefalu
Diabetes Care 2017 Dec; 40 (12): 1611-1613. https://doi.org/10.2337/dci17-0049

• Improving the Clinical Value and Utility of CGM Systems: Issues and Recommendations
A Joint Statement of the European Association for the Study of Diabetes and the American Diabetes Association Diabetes Technology Working Group
John R. Petrie, Anne L. Peters, Richard M. Bergenstal, Reinhard W. Holl, G. Alexander Fleming and Lutz Heinemann
Diabetes Care 2017 Dec; 40 (12): 1614-1621. https://doi.org/10.2337/dci17-0043

• Standardizing Clinically Meaningful Outcome Measures Beyond HbA$_{1c}$ for Type 1 Diabetes:
A Consensus Report of the American Association of Clinical Endocrinologists, the American Association of Diabetes Educators,
the American Diabetes Association, the Endocrine Society, JDRF International, The Leona M. and Harry B. Helmsley Charitable Trust,
the Pediatric Endocrine Society, and the T1D Exchange
Gina Agiostratidou, Henry Anhalt, Dana Ball, Lawrence Blonde, Evgenia Gourgari, Karen N. Harriman, Aaron J. Kowalski, Paul Madden,
Alicia H. McAuliffe-Fogarty, Molly McElwee-Malloy, Anne Peters, Sripriya Raman, Kent Reifschneider, Karen Rubin and Stuart A. Weinzimer
Diabetes Care 2017 Dec; 40 (12): 1622-1630. https://doi.org/10.2337/dc17-1624

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Wrigley Field, Home of The Chicago Cubs

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Contact Info

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Thank you!

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