Diabetes Technology and Tools

Eric L. Johnson, M.D.
Assistant Medical Director
Altru Diabetes Center
Associate Professor
University of North Dakota School of Medicine and Health Sciences
Grand Forks, North Dakota

Disclosures

- Advisory Panel: Novo Nordisk, Sanofi
- Speaker's Bureau: Novo Nordisk, Medtronic

- I have type 1 diabetes and have personally used a number of these products

Objectives

At the end of this presentation, the participant will be able to:

- Learn benefits and limitations of diabetes technologies
- Apply knowledge gained to clinical settings in diabetes practice
- Understand some basic CGM data

Many technologies

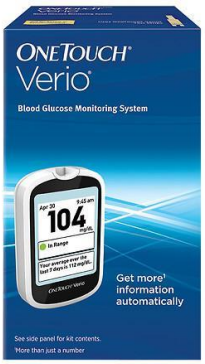
- Pumps
- CGM
- Smart Pens
- Smart Meters
- Apps
- Personal devices/trainers
- Open source DIY

Smart Meters, Apps, Fitness Trackers

Smart Meters

Dario-clip on to smartphone

Contour



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

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.

Patient ID: 141193
Date of Birth: Not Specified

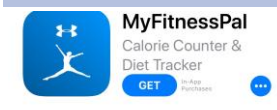
Logbook Report

Date	Breakfast (mg/dL) Pre	Breakfast (mg/dL) Post	Breakfast Units	Breakfast (g)	Lunch (mg/dL) Pre	Lunch (mg/dL) Post	Lunch Units	Lunch (g)	Dinner (mg/dL) Pre	Dinner (mg/dL) Post	Dinner Units	Dinner (g)	Bed & Sleep (mg/dL) Bed	Bed & Sleep (mg/dL) Sleep	Bed & Sleep Units	Bed & Sleep (g)
3/26/2015 Thursday	118 6:14 AM				75 10:03 AM	144 2:17 PM			150 4:20 PM	57 7:09 PM			163 9:28 PM	174 11:59 PM		
									147 5:14 PM	53 7:51 PM						
3/25/2015 Wednesday		117 7:07 AM				269 12:44 PM			143 3:53 PM	203 6:56 PM			68 9:55 PM	45 1:19 AM		
		168 9:54 AM												94 1:42 AM		
3/24/2015 Tuesday	122 6:01 AM	188 9:34 AM				251 12:19 PM			79 4:05 PM	127 7:37 PM				78 4:24 AM		
						139 1:50 PM			99 5:22 PM	161 8:44 PM						
3/23/2015 Monday	209 6:42 AM	382 9:40 AM			307 11:46 AM	177 1:24 PM			180 4:59 PM	180 7:42 PM						
						222 2:42 PM				151 8:54 PM						
3/22/2015 Sunday	154 6:24 AM	201 9:14 AM				202 12:32 PM			262 5:59 PM	64 8:12 PM			40 9:07 PM	113 2:44 AM		
						126 2:16 PM							72 9:28 PM			
3/21/2015 Saturday	205 5:09 AM	288 7:42 AM			193 10:50 AM	242 1:39 PM			87 4:15 PM				190 9:11 PM	112 4:06 AM		
3/20/2015 Friday	169 6:59 AM	215 8:30 AM			101 10:39 AM	147 1:55 PM			92 5:16 PM	84 8:15 PM				173 12:19 AM		
					55 11:33 AM											
3/19/2015 Thursday		165 7:20 AM			200 11:53 AM	61 2:43 PM				139 8:16 PM				179 1:51 AM		
		119 8:10 AM												203 3:48 AM		
3/18/2015 Wednesday	72 5:12 AM	67 8:39 AM			275 11:40 AM	213 2:18 PM				113 6:45 PM			73 10:40 PM	150 1:38 AM		
	98 6:39 AM	145 9:52 AM												177 4:21 AM		
3/17/2015 Tuesday	126 6:10 AM	199 9:03 AM				78 1:12 PM							95 10:52 PM	184 1:05 AM		
														217 3:11 AM		
														92 4:31 AM		
3/16/2015 Monday	67 6:52 AM	229 8:54 AM			49 11:44 AM	123 1:35 PM							114 11:00 PM	186 11:59 PM		
														274 2:53 AM		

Insulin reported here does not include any basal insulin.

12/21/2017 3:25 PM Page 1 Of 2
FreeStyle CoPilot Health Management System

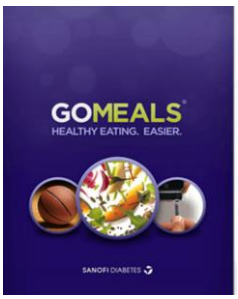
Apps



*Look these up in the app store on your smartphone

GLUCOSE BUDDY

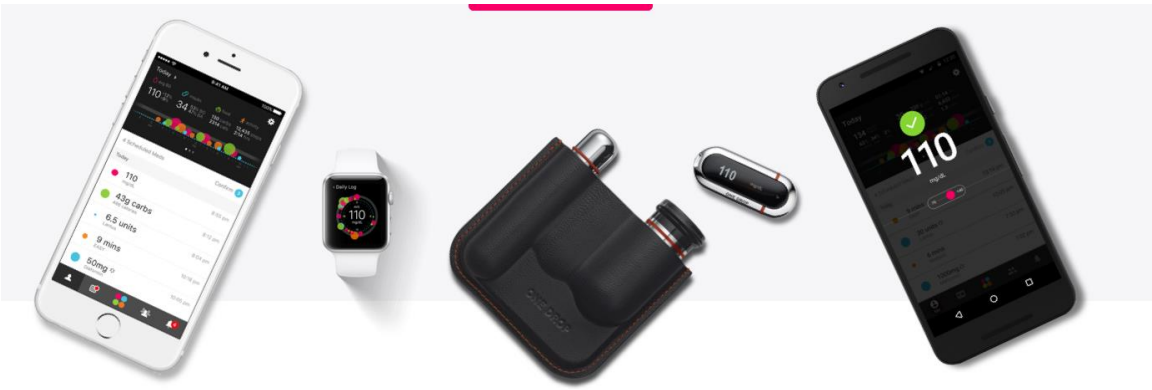
MyNetDiary



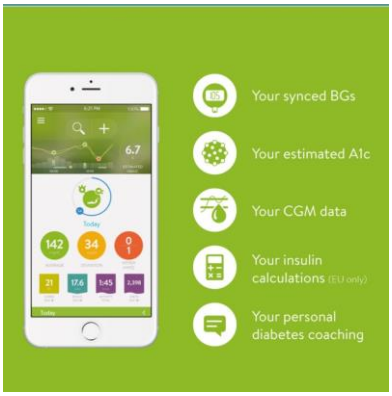
Food, activity

Apps/Meter/Subscription Service

One Drop System



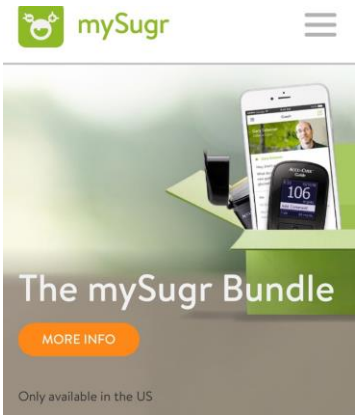
Apps



Mysugr
Most used diabetes app in the world

"Helping diabetes not suck"

Built/developed by persons with diabetes

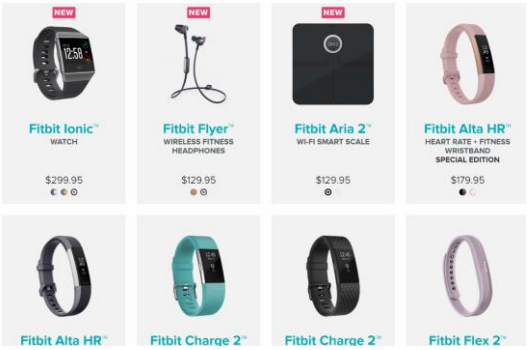


Fitness Trackers

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

Apple-use with Apple Watch

Fitbit



Smart Meters, Apps, Fitness Trackers

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

Insulin Smart Pens

Lilley

Novo Nordisk Echo Novo Pen 6

Can be used with Glooko app

Companion Medical

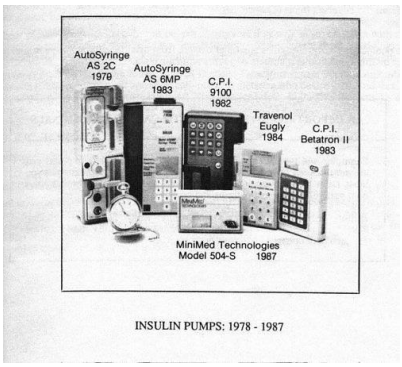
Insulin Dosing Apps

- Diabnext Clipsulin Insulin Dosing and BG App

- Eli Lilly Go Dose® Insulin Pen Dosing Calculator

Insulin Pumps and Continuous Glucose Monitors (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%

Pumps and Sensors

- Interfaced devices developed last decade
- Close to "closed loop" artificial pancreas that is consumer ready- hybrid system is pretty close
- High/low alarms, trends alarm (more rapid rise or decline)

Basic Setup Pump/Sensor

<Insulin infusion set

Medtronic 670g

- Hybrid closed loop insulin delivery system (step toward “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[1]

- Automatically adjusts your basal (background) insulin every five minutes based on your CGM readings.[1,#]
- Helps keep your sugar levels in your target range for fewer lows and highs — day and night.[1,#,‡]

See how Auto Mode works

SUSPEND BEFORE LOW[2]

- 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

Omnipod DASH

Tubeless
Personal Device Manager looks more like a smartphone display
Has a smartphone app, can share up to 12 friends/family

Tandem Tslim

- Touch screen
- Downloadable
- Interface with Dexcom CGM
- Control IQ- gives correction boluses (60% of calculated)
- Automatically switches to 5 hours active insulin time on Control IQ
- Still need to enter carbs
- “interoperability”

V-Go

The “anti-technology pump”

Dexcom Share®

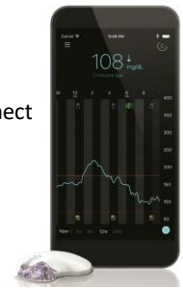
CGM (Sensor) Freestanding Systems*

*Can be used with injections or pump

DEXCOM 6
interfaces with Tslim pump
And Omnipod-
Doesn't need fingersticks
Share up to 10
Up to 10 days

Freestyle Libre-doesn't need routine fingerstick glucose
Works up to 14 days
No alarms- scanner or smartphone
Libre linkup share up to 20

Medtronic Guardian Connect
7 days
Share up to 5



Slide courtesy Dr. James Chamberlain

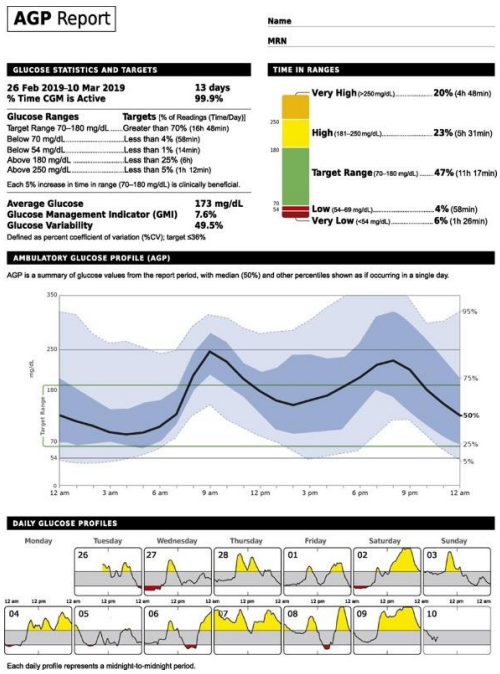
Eversense Implantable CGM

- Implanted in upper arm
  Data for up to 90 days
- Only CGM providing on-body vibe alerts when glucose is low or high
- Very accurate over a 90-day period with MARD of 8.5%
- Fingerstick if unsure of value vs symptoms

CGM Professional

- Can also use CGM by health professional to assess 7-14 days of blood glucose data
- We often do this for patients with control problems or those considering a pump +/- CGM

Ambulatory Glucose Profile



AGP Report

Name

MRN

GLUCOSE STATISTICS AND TARGETS

26 Feb 2019-10 Mar 2019 — 13 days
% Time CGM is Active — 99.9%

Glucose Ranges	Targets (% of Readings (Time/Day))
Target Range 70–180 mg/dL	Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)

Each 5% increase in time in range (70–180 mg/dL) is clinically beneficial.

Average Glucose	173 mg/dL
Glucose Management Indicator (GMI)	7.6%
Glucose Variability	49.5%

Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES

Very High (>250 mg/dL) — 20% (4h 48min)
High (181–250 mg/dL) — 23% (5h 31min)
Target Range (70–180 mg/dL) — 47% (11h 17min)
Low (54–69 mg/dL) — 4% (58min)
Very Low (<54 mg/dL) — 6% (1h 26min)

AMBULATORY GLUCOSE PROFILE (AGP)

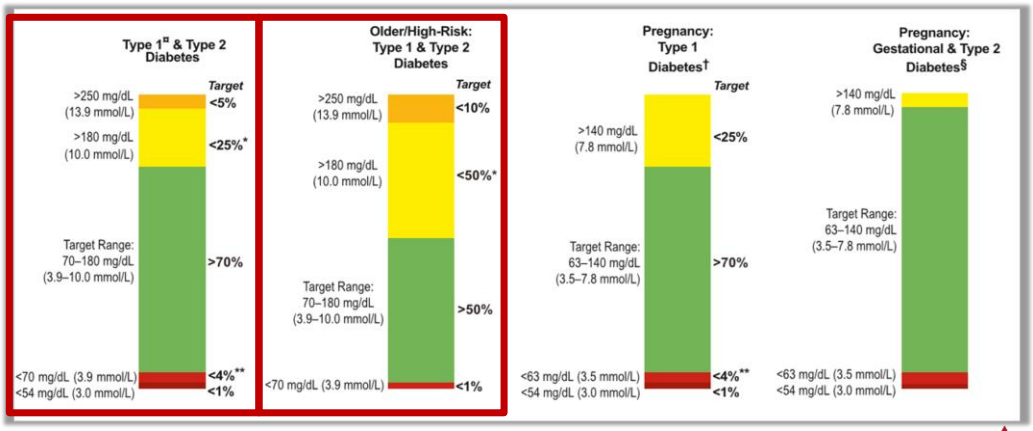
AGP is a summary of glucose values from the report period, with median (50%) and other percentiles shown as if occurring in a single day.

DAILY GLUCOSE PROFILES

Monday Tuesday Wednesday Thursday Friday Saturday Sunday

Each daily profile represents a midnight-to-midnight period.

CGM Time in Target International Consensus Panel Recommendations



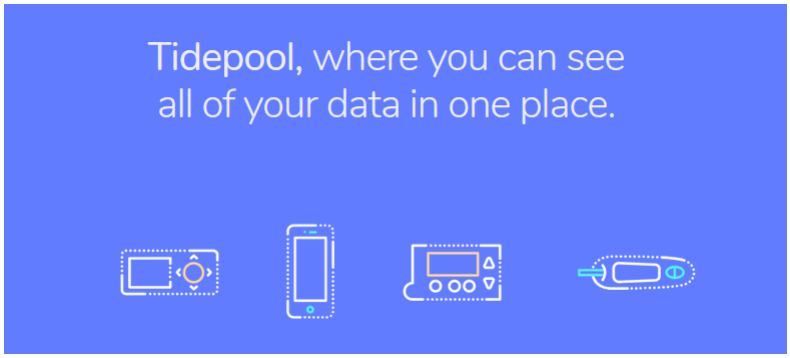
Battelino et al, Diabetes Care 2019;42:1593–1603

American Diabetes Association.

Devices

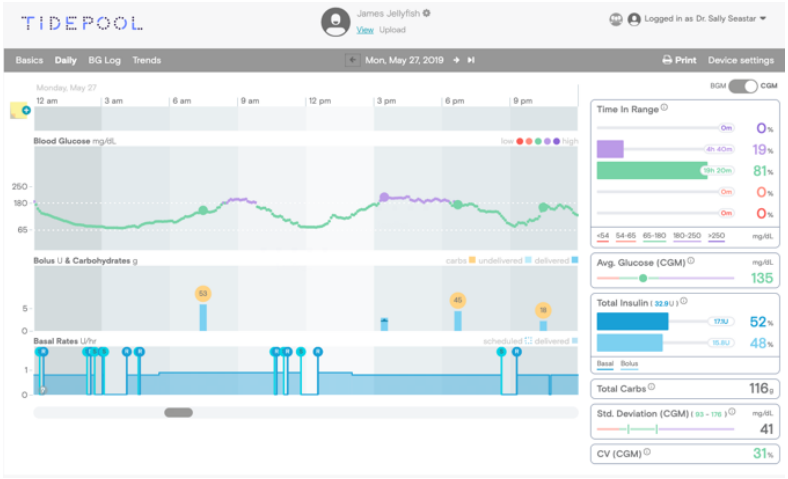
- All of these devices have youtube videos

Other Data Management Systems



Open source, non-profit

Tidepool Data View



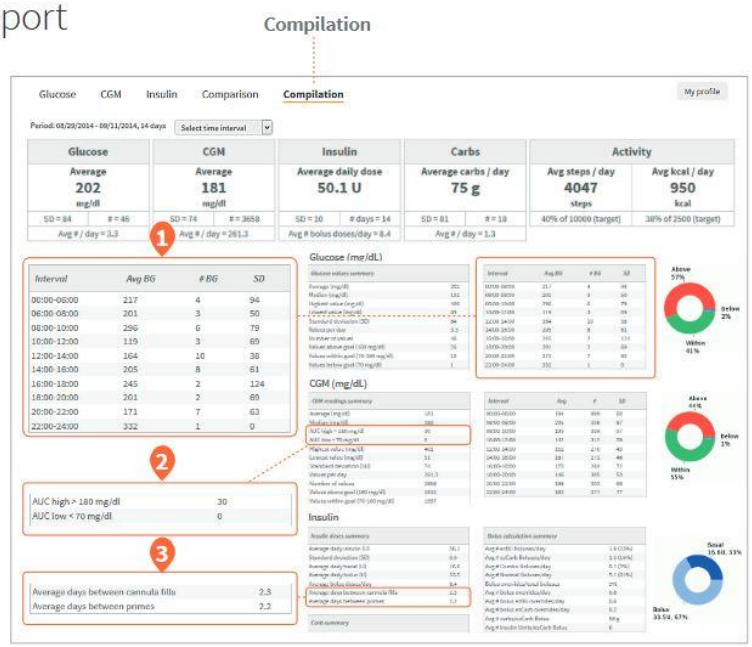
Compilation report

A summary of aggregated data from glucose meters, insulin pumps and CGMs. Allows the user to get an overall picture of the data uploaded for that time period.

1. View average BG and SD by time of day.
2. View detailed CGM data such as average by time of day and AUC (area under the curve).
3. View detailed insulin pump and carb information such as average days between cannula fills and average days between primes.

Can compile from many different devices (not Medtronic)

Diasend by Glooko



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

Patient Selection

- Selecting proper patients is important to maximize success
- Proper training and followup are critical for success

Getting Started

Think About Who Is On Your Team

- The primary provider
- Nurse
- Certified diabetes educator
- Nutritionist
- Advanced practice nurse or physician assistant
- Others (behavioral health, social worker)

Not every practice will have these team members

Get The Necessary Technology For Your Practice

- CGM's and Smart meters often have downloadable data sets
- The responsibility of downloading or compiling the data in-office can fall on a certified diabetes educator, but more likely in many primary care practices, a nurse or medical assistant can be trained to manage these devices
- All of the major device manufacturers have software that can be installed on an in-house computer where the data can be downloaded to paper or an electronic file (i.e., pdf) that may be uploaded into a medical record or uploaded to a commercial site
- Once you have done a few of these and develop a routine, the flow is usually good
- Doing in advance is best, but if done in office, may do encounter first and review data at end of appointment

CGM interpretation can be billed, many third- party payers cover such services

- What is included with CPT® code 95251?
- CPT® code 95251 is the analysis, interpretation and report for CGM for a minimum of 72 hours of data. An appropriate CGM analysis, interpretation and report should include the following elements:
- Patient's name
- Date of birth
- Medical Record #
- Indication for the device placement
- Name/Type of device placed

Patient case: Maria

Patient case: Maria

- 68 year old Hispanic female
- Type 2 diabetes x 8 years
- Hx of HTN, dyslipidemia, albuminuria, transient ischemic attack
- GFR 45
- BMI 30
- A1C 8%
- Notes “lows”, often midday or overnight
- Medications
  - Atorvastatin 20mg daily
  - Lisinopril 10mg daily
  - Aspirin 81mg daily
  - Metformin 1000mg BID
  - Glimiperide 4 mg daily
  - Basal insulin 28 units hs

Patient case: Maria

Which of the following glucose metrics is thought to be at least as important as the A1C level?

A. Average glucose
B. Percent of time sensor is worn
C. Glucose variability measured by standard deviation or coefficient of variation
D. Time in Range

Patient case: Maria

Answer: E All of the above when combined into a standardized CGM report

Patient c

- A1C Goal -- factors to co
- Support system
- Vascular complications
- Comorbidities
- Life expectancy
- Diabetes duration
- Risks associated with hypoglyce

Stop!

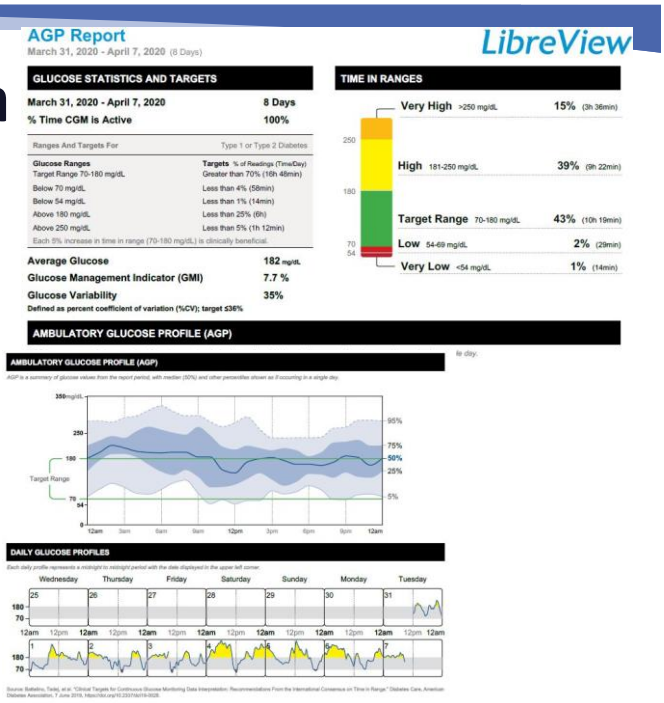
- What is going on with her?
- She has an elevated A1C with occasional lows
- What else in her history is concerning?
- What would be some good next steps?

Patient case: Maria

- Based on this CGMpro data,

what are some things we might do next?

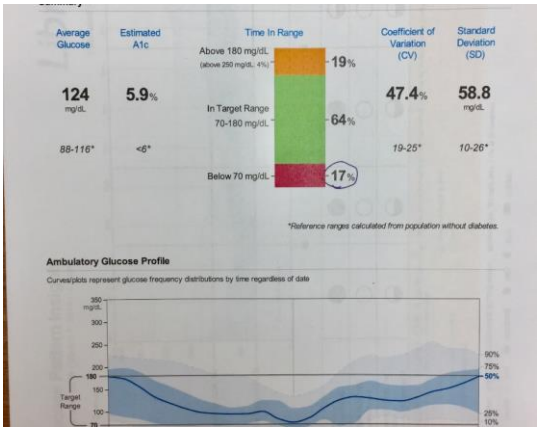
- Is this patient a good CGM candidate?
- If yes, why?



Patient case Maria

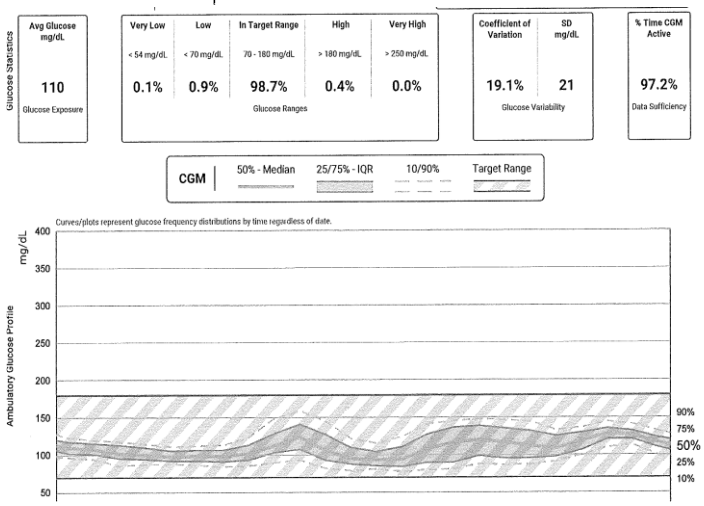
Insulin and glimiperide were increased

A1C is better, but what's wrong now?



WOW

dexcom | captūrAGP®



Typical Ambulatory Glucose Profile interpretation template documentation may look something like this

- Ambulatory Glucose Profile
- Dates of data review: ***
- Average SG: *** mg/dl.
- Coefficient of Variation (goal <36%): *** %
- *** % of time wearing CGM

- Glucose Ranges:
- SG below 54 mg/dl. (goal less than 1%) --*** %
- SG below 70 mg/dl. (goal less than 4 %) --*** %
- SG between 70-180 mg/dl. (goal is greater than 70%) --*** %
- SG above 180 mg/dl. (goal is less than 25%) --*** %
- SG above 250 mg/dl.(goal is less than 5%) --*** %

- Interpretation:
- ***

Medicare Coverage Requirements for Personal Therapeutic* CGM

- Have a diagnosis of diabetes, either type 1 or type 2
- Use a home blood glucose monitor and conduct four or more daily tests
- Be treated with insulin with at least 3 daily injections/doses a day or a constant subcutaneous infusion (CSI) pump
- Require frequent adjustments of the insulin treatment regimen, based on therapeutic CGM test results
- Have been seen in office within 6 months, and
- Continue to be seen at least every 6 months in order to continue to receive coverage

*only CGM systems that have FDA approval for therapeutic use (fingerstick replacement) are covered

American Diabetes Association.

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 your patients

Standards of Care

American Diabetes Association
Diabetes Care 2020 Jan; 43(Supplement 1): S77-S88.

https://care.diabetesjournals.org/content/43/Supplement_1/S77

Diabetes Forecast Consumer Guide 2020
http://www.diabetesforecast.org/2020/02-mar-apr/consumer-guide-2020.html

Wrigley Field, Home of The Chicago Cubs

Contact Info

- E-mail: eric.l.Johnson@med.und.edu

- Facebook: https://www.facebook.com/DrJNDDiabetes

Thank you!