CGM: OVERVIEW AND KEY LEARNINGS TO DATE

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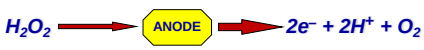
DISCLOSURES

- I have served as a consultant to Abbott Diabetes Care, Adocia, Bigfoot, and Roche.
- My institution has received research grant support from Medtronic.

HOW THIS ALL STARTED



CONTINUOUS GLUCOSE MONITORING SYSTEM (CGMS)

INITIAL CGM

- All “professional” the first few years: patient masked to the glucose readings until downloaded in health care professional’s office
- “Real-time” CGM introduced in 2006

INITIAL REAL-TIME CGM

WE'VE COME A LONG WAY IN THE PAST 12 YEARS

Professional CGM Devices Available in 2018

Libre Pro

iPro 2

CURRENTLY AVAILABLE PERSONAL CGM SYSTEMS

FreeStyle Libre

- 12-hour warm-up; up to 10 days wear (in the United States)
- Factory-calibrated, but patients are encouraged to perform fingerstick glucose measurement if they feel hypoglycemic
- MARD (mean absolute relative difference; a measure of accuracy): 9.7%
- Currently requires its own reader

CURRENTLY AVAILABLE PERSONAL CGM SYSTEMS, continued

Dexcom G4/G5 sensor and G4 or G5 transmitter)

- 2-hour warm-up; up to 7 days wear
- Calibration required every 12 hours
- MARD 9% when used with most recent software
- Stand alone with corresponding G4 or G5 receiver;
- G4 is compatible with Animas Vibe and Tandem t:slim insulin pumps; G5 is compatible with most Apple and Android products and the Tandem t:slim X2 insulin pump

CURRENTLY AVAILABLE PERSONAL CGM SYSTEMS, continued

Dexcom G6

- 2-hour warm-up; 10 days wear
- Factory-calibrated; no user calibration required
- MARD: 9.0%
- Easier application, acetaminophen blocking, predictive low alert
- Integrated CGM system designed to reliably and securely transmit glucose data to digitally connected devices and resources (e.g., automated insulin dosing systems, apps, insulin pumps, dosing algorithms)

CURRENTLY AVAILABLE PERSONAL CGM SYSTEMS, continued

Medtronic Enlite sensor and MiniLink or Guardian Link transmitter

- 2-hour warm-up; up to 6 days wear
- Calibration required every 12 hours
- MARD: 13.6%
- Compatible with Medtronic 530G and 630G insulin pumps

CURRENTLY AVAILABLE PERSONAL CGM SYSTEMS, continued

Medtronic Guardian Sensor 3 sensor and Guardian Link 3 transmitter

- 2-hour warm-up; up to 7 days wear
- Calibration required every 12 hours
- MARD: abdominal insertion 9.6 with 3–4 calibrations/day; 10.6 with 2 calibrations/day; arm insertion 8.7 with 3–4 calibrations/day; 9.1 with 2 calibrations/day
- Compatible with Medtronic 670G hybrid closed-loop insulin pump system

MOST RECENT APPROVED PERSONAL CGM

Guardian Connect

SOON-TO-BE AVAILABLE PERSONAL CGM SYSTEM

Eversense by Sensionics

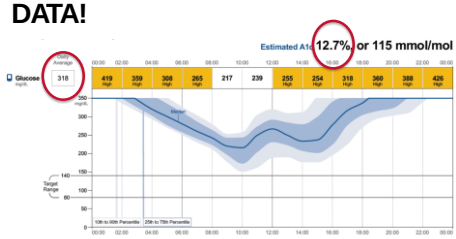
- Implantable for 90-day wear, insertion takes <5 minutes
- MARD: 8.5%; 2 calibrations/day, adjunctive labeling at first (will require fingersticks for insulin dosing)
- Smartphone only display, no acetaminophen interference

CASE 1: USING PROFESSIONAL CGM TO BETTER UNDERSTAND OUR PATIENTS

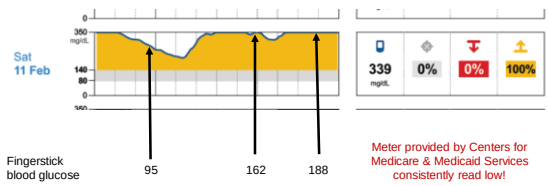
An 85-year-old man with type 2 diabetes, no cognitive concerns

- Switched to pre-mixed 70/30 insulin after hospitalization for infection 5 years ago
- Mean (SD) for blood glucose testing at home is 185 (60) mg/dL
- Testing an average 2.5 times/day on meter he first started to use 18 months ago
- A1C is now 11.8%
- What to do?

A1C IS CONSISTENT WITH THE CGM DATA!



CASE 1: WHAT WE LEARNED



Fingerstick blood glucose

95 162 188

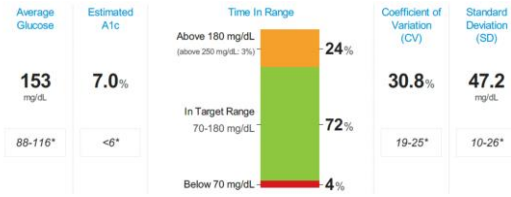
Meter provided by Centers for Medicare & Medicaid Services consistently read low!

CASE 2: HOW WE USE CGM IN TYPE 2 DIABETES

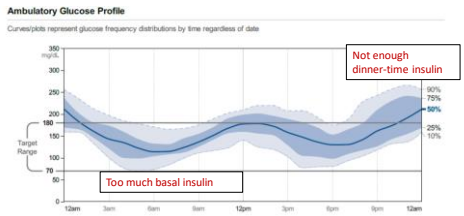
A 68-year-old man (retired surgeon) with type 2 diabetes for 20 years

- Multiple daily insulin injections (glargine/lispro)
- A1C: 8.5–9.5% for 10 years
- Also taking metformin/empagliflozin for diabetes
- Also has coronary artery disease, hypertension, and dyslipidemia, all treated and stable

AFTER 3 MONTHS ON FREESTYLE LIBRE, A1C DECREASES FROM 9.0 TO 7.4%



AMBULATORY GLUCOSE PROFILE



CASE 2: KEY POINTS

CGM can be very helpful in type 2 diabetes.

- Lifestyle changes are a common observation for many of these patients.
- With these changes, insulin reductions are often required. (Too much basal insulin is extremely common.)
- Still, it shows how prandial insulin may have been under-dosed even more previously.

CASE 3: CGM IN SPECIAL CIRCUMSTANCES

A 21-year-old man with Down syndrome, who had severe hypoglycemia 1 year ago while using an insulin pump with non-connected CGM and is now on a MiniMed 670G Hybrid Closed Loop insulin pump system

"Dashboard"

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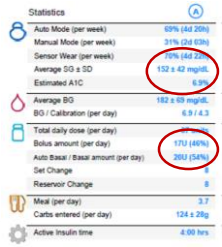
PUMP DATA SUMMARY



Need more aggressive insulin-to-carbohydrate ratio (ICR)?

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CASE 3: INSULIN AND CGM DETAILS

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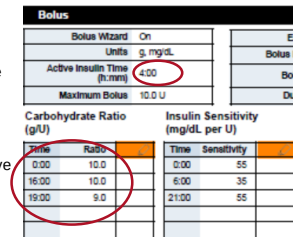
CASE 3: WHAT I DID

Shorter active insulin time

More aggressive ICR



Bolus

Bolus Wizard	On
Units	g, mg/dL
Active Insulin Time (h:mm)	4:00
Maximum Bolus	10.0 U

Carbohydrate Ratio (g/U)

Time	Ratio
0:00	10.0
16:00	10.0
19:00	9.0

Insulin Sensitivity (mg/dL per U)

Time	Sensitivity
0:00	55
6:00	35
21:00	55

KEY POINTS FROM CASE 3

A hybrid closed-loop system was very helpful for this patient.

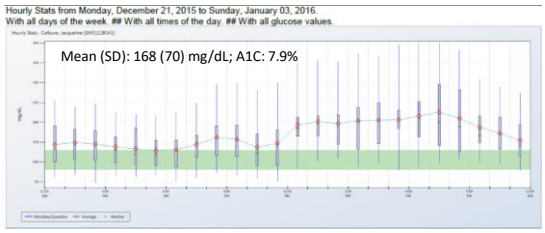
- Part of this success was tremendous family support for his care.
- This technology has minimized his hypoglycemia.
- As with most patients, not enough prandial insulin was provided before transitioning because of "over-basalization."

CASE 4: HOW CGM CAN HELP IN A VERY DIFFICULT SITUATION

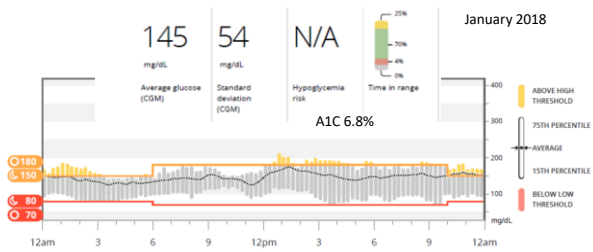
A 62-year-old woman with hypoglycemia unawareness

- Type 1 diabetes since the age of 11 years
- No interest in using an insulin pump
- A1C rarely <8% throughout 20 years
- 2014–2015: monthly severe hypoglycemia; insurance refused payment for CGM
- Dec 2015: after much discussion, CGM allowed

FIRST CGM DOWNLOAD: JANUARY 2016



AFTER INSTRUCTION IN HOW TO BEST USE TREND ARROWS, 2 YEARS LATER



CONCLUSIONS

- Both professional and personal CGM have become important technologies in diabetes therapy.
- Patients and their providers have a choice of which CGM to use, and more choices will be available soon.
- Downloading to review the data with patients is crucial, and each office/clinic must have an infrastructure to do this efficiently.
- Common themes will be seen, including asymptomatic nocturnal hypoglycemia, over-treatment of hypoglycemia, and poor prandial insulin techniques. Many patients with type 2 diabetes have major changes in lifestyle.
- Our current hybrid closed-loop technology will eventually evolve to a fully closed-loop system.

Thank You