

CGMS and Insulin Pumps

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Conflict of Interest--None

Objectives

1. Overview of features of CGMS
2. Benefits and considerations for the use of CGMS
3. Discuss features of available professional and personal CGMs and insulin pumps.
4. Insulin pump features
5. Advantages & barriers: use of insulin pumps

CGMs

- No or few finger Sticks
 - Show glucose levels in real time or by scanning a glucose sensor to get the reading.
 - Measures interstitial fluid to determine BG
 - Tiny sensor under skin sends BG levels wirelessly to a pump, smartphone or other device
- Alarms
 - CGMs can alert you when your glucose is rising or falling rapidly, and when you hit a high or low limit, giving you an advanced warning to prevent low or high blood sugar (blood glucose).
- Trends
 - They also give you an idea about trends with your blood sugar levels that can help inform you and your diabetes team about changes that could help you reach your targets.
- Pumps
 - Several CGMs connect to insulin pumps and some use CGM data to automatically adjust background (basal) insulin, deliver a correction (bolus) dose of insulin, or temporarily stop insulin delivery if glucose drops too low.

<https://consumerguide.diabetes.org/>

CGMS

- CGM should be considered in children to adults
- Useful tool in those frequent hypoglycemia or hypoglycemia unawareness (alarm features)
- Measures percent of time in, above and below range

Benefits of CGM

- Significant reductions in hypoglycemia Type 1
 - 38% reduction of overall hypo
 - 40% reduction of nighttime hypo
- Type 2 less hypo too
 - 43% reduction overall hypo
 - 54% reduction in nighttime hypo

AADE Practice Paper; The Diabetes Educator Role in Continuous Glucose Monitoring,
July 2018

CGMS: Professional

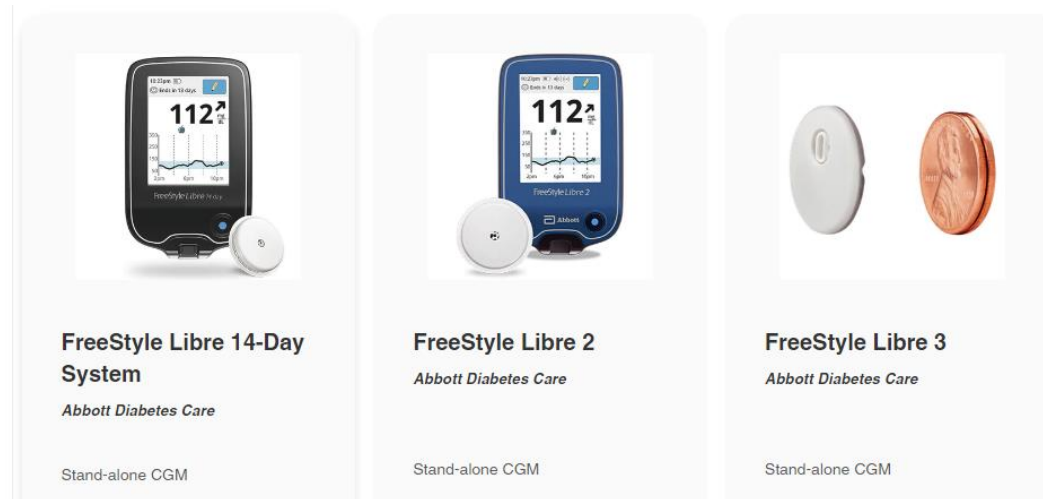
- Person with diabetes is outfitted with CGM for 3-14 days
- Readings are collected every 1 to 5 minutes
- Retrospective data downloaded to review and make treatment adjustments – Diabetes educator familiar with software and downloading.
- Blinded CGM – user can't see results and therefore they don't alter behavior
 - Unblinded – user sees glucose reading in real time on receiver and can take action
- Is billable for provider
- 2 major brands.
- 1 can be blinded or unblinded to the patient.
- Other can only be blinded to the patient

CGMS: Personal (1)



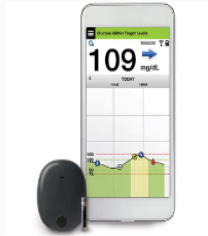
FEATURES	Dexcom G6	Dexcom G7
Calibration required	No	no
Long transmitter range	yes	Yes
Warm up time	120 minutes	30
Transmits data continuously	Yes	Yes
Receiver or phone app	Receiver or phone app	Receiver or phone app
Share data with family	If using app	If using app
Alarm alerts for lows and high	Yes	Yes
Approved Age	2 and older	2 and older
Lifespan	10 days	10 days
Wear Location	Abdomen Upper buttocks (age 2-17)	Back of arm Upper buttocks (Age 2-6)

CGMS: Personal (2)



FEATURES	14 day	Libre 2	Libre 3
Calibration required	No	no	no
Long transmitter range	No	Yes	yes
Warm up time	60 minutes	60	60
Transmits data continuously	No must scan	No must scan	yes
Reader or phone app	Reader or phone app	Reader or phone app	Phone app only (reader coming soon)
Share data with family	If using app	If using app	If using app
Alarm alerts for lows and high	No	Yes, even without scanning	Yes
Approved Age	18 and older	4 and older	4 and older
Lifespan	14 days	14 days	14 days
Wear Location	Back of arm	Back of arm	Back of arm

CGMS: Personal (3)



Eversense E3 CGM System

Senseonics

Stand-alone CGM

Features

Calibration Required: Yes

Finger-Stick Confirmation Required:
No

Long Transmitter Range: Yes

Short Warm-Up Time: No

Transmits Data Continuously: Yes



Guardian Connect CGM System

Medtronic Diabetes

Stand-alone CGM

Features

Calibration Required: Yes

Finger-Stick Confirmation Required:
Yes

Long Transmitter Range: Yes

Short Warm-Up Time: Yes

Transmits Data Continuously: Yes



Guardian Sensor 3 with Guardian Link 3 transmitter

Medtronic Diabetes

Integrated CGM

Features

Calibration Required: Yes

Finger-Stick Confirmation Required:
Yes

Long Transmitter Range: Yes

Short Warm-Up Time: Yes

Transmits Data Continuously: Yes

Built-In Meter: No

Wirelessly Communicates With Meter:
No

Approved for Use in Kids Under 18:
No

Sends Data to Smart Device: Yes

Shares Data With Family Via App: Yes

Transmits Data Continuously: Yes

Built-In Meter: No

Wirelessly Communicates With Meter:
No

Approved for Use in Kids Under 18:
Yes

Sends Data to Smart Device: Yes

Shares Data With Family Via App: No

Transmits Data Continuously: Yes

Built-In Meter: No

Wirelessly Communicates With Meter:
No

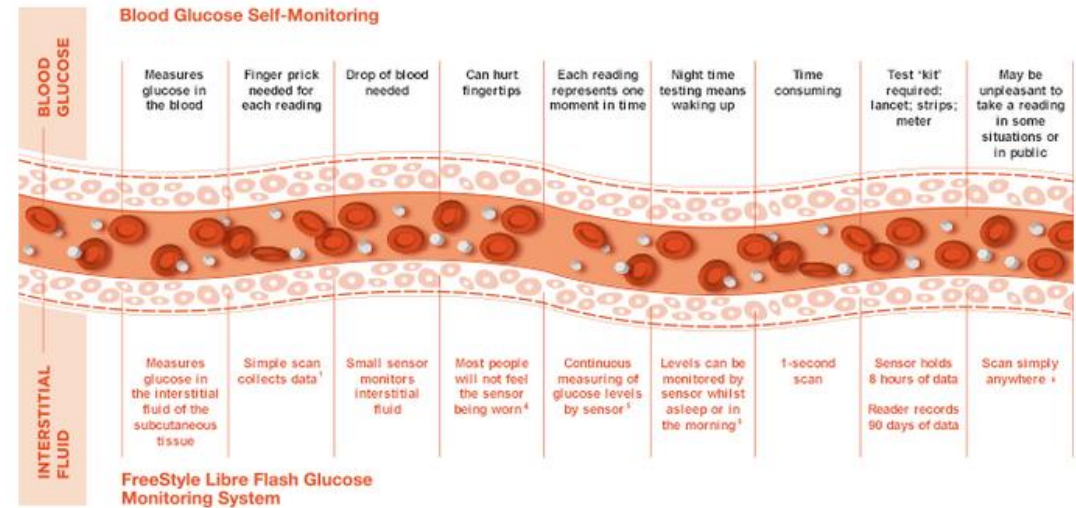
Approved for Use in Kids Under 18:
Yes

Sends Data to Smart Device: Yes

Shares Data With Family Via App: Yes

CGMS: Personal

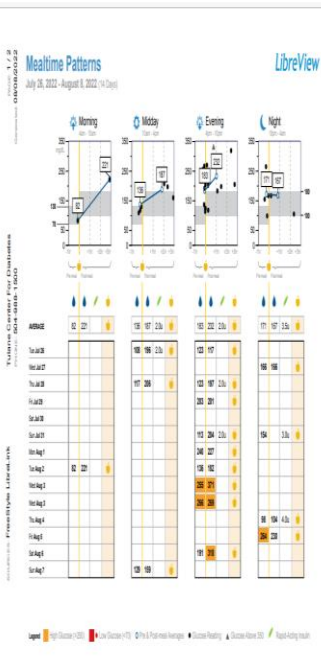
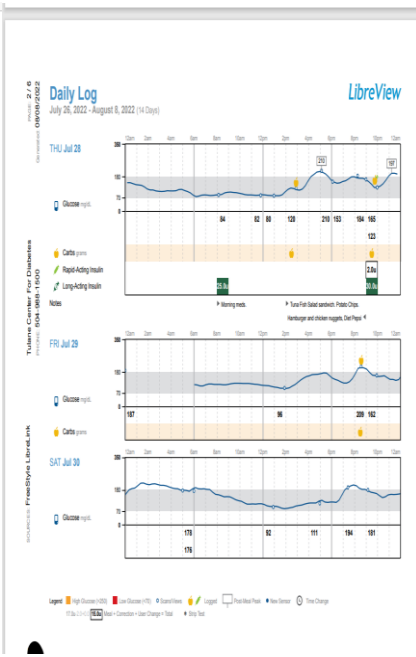
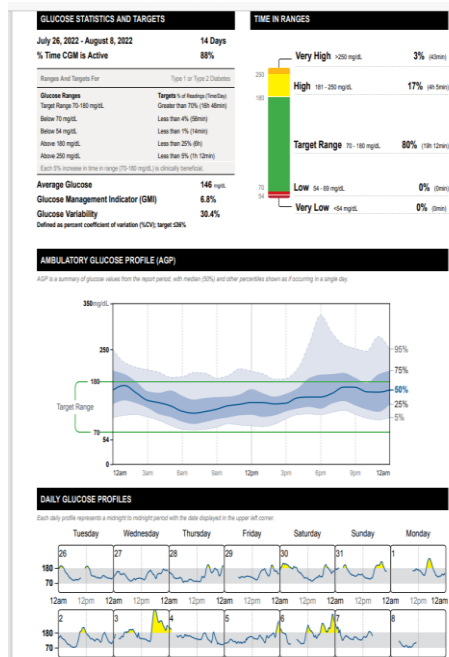
- Benefits include less time in hypo /hyper glycemia
- A1c improvements
- Warning – rapid glucose changes
- Real time data
- 5-10 minute lag between BG and Interstitial Glucose (SG)



CGMS: Considerations

- CGM decreases need for BG Checks.
- But, following situations warrant a fingerstick:
 - Calibration or BG symbol appears on screen
 - Symptoms don't match CGM readings
 - Not all data appears on screen (glucose, arrows, etc)
- Be on look out for alarm distress/burnout

CGMS: Reports



Overview

14 days | Tue Jul 26, 2022 - Mon Aug 6, 2022

Glucose

Average Glucose

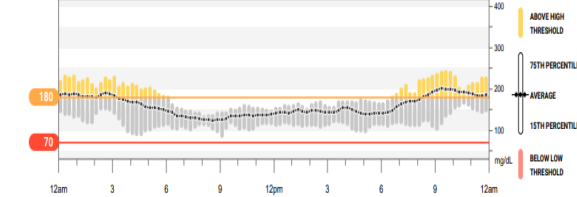
158 mg/dL

Standard Deviation
48 mg/dL

GM
7.1%

Top Patterns

This graph shows your data averaged over 14 days

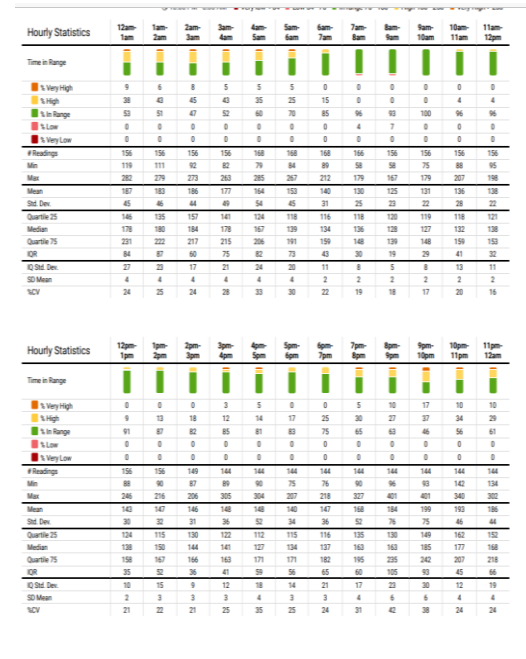


Sensor Usage

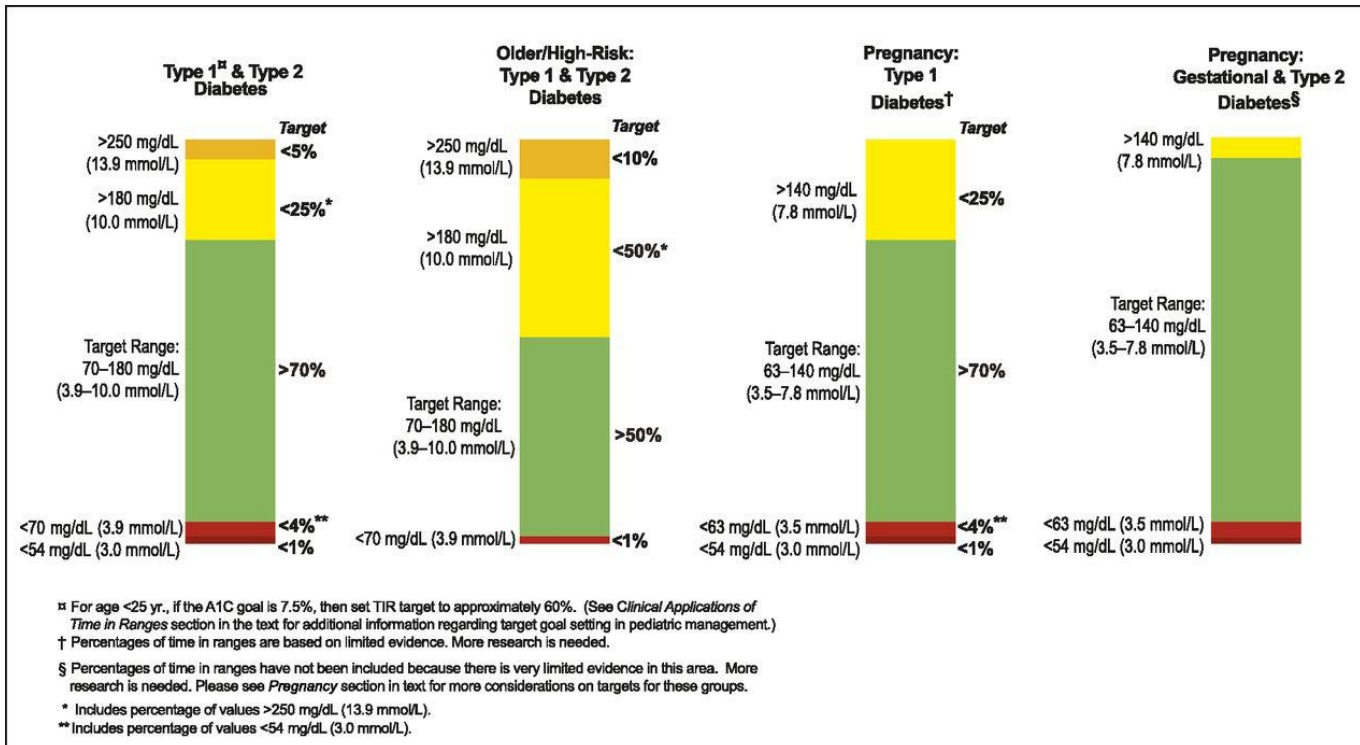
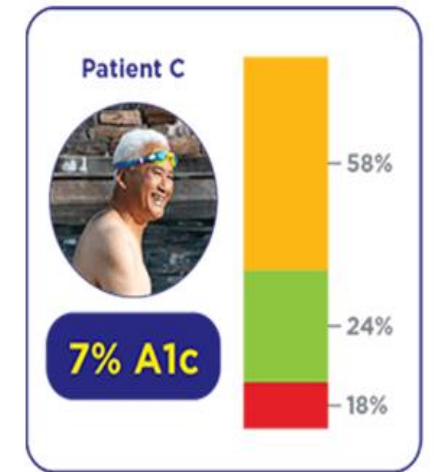
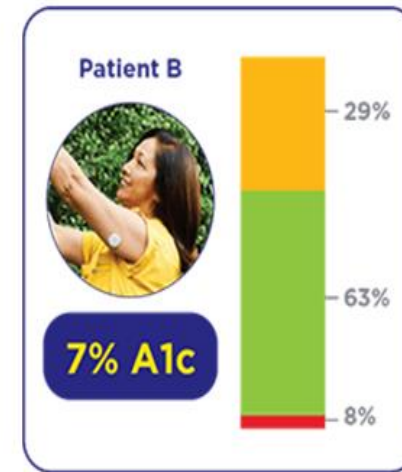
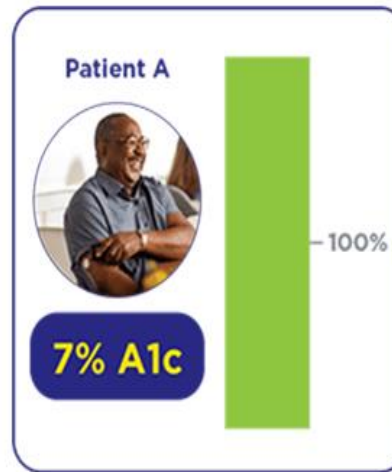
Days with CGM data
93/13/14

Avg. calibrations per day
0.0

1 best glucose day was July 28, 2022
glucose data was in the target range about 98% of the day



CGMS: Reports



https://www.freestyleprovider.abbott/us-en/what-is-cgm.html?gclid=EAlaIQobChMI0YTTu7_J-QIVnhXUAR13AQQVEAAYASAAEgKNO_D_BwE&gclid=aw.ds

Contraindications

- Libre (14 day, libre 2, Libre 3)
- Must be removed prior to MRI, CT scan, or high frequency electrical heat (diathermy) treatment.
- Severe dehydration
- The level of inaccuracy depends on the amount of the interfering substance active in the body.
 - Taking ascorbic acid (vitamin C) while wearing the Sensor may falsely raise Sensor glucose readings (500 mg or higher).
 - Taking salicylic acid (used in some pain relievers such as aspirin and some skin care products) may slightly lower Sensor glucose readings.
- Test results did not indicate interference for methyldopa (used in some drugs to treat high blood pressure) or tolbutamide (infrequently used in some drugs to treat diabetes in the US) at maximum circulating levels. However, concentrations of potential interferents in interstitial fluid are unknown compared to circulating blood.
- Libre 2 & 3 approved for use in pregnancy
- Dexcom (G6, G7)
- Must be removed prior to MRI, CT scan, or high frequency electrical heat (diathermy) treatment.
- (G6) Hydroxyurea-- Medication used in the treatment of diseases including cancer and sickle cell anemia.
- **Acetaminophen--** Taking higher than the maximum dose of acetaminophen (e.g. > 1 gram every 6 hours in adults) may falsely raise your sensor glucose readings. Standard dose is OK.
- G7 approved for use in pregnancy

Insulin Pumps

- An insulin pump continuously releases short- or rapid-acting insulin throughout the day and night to help you reach your blood sugar (blood glucose) targets.
- Meal and correction insulin can be delivered with ease by pushing buttons.
- Wearing a pump can give you more freedom with your meal planning and physical activity.
- It may also lead to increasing the amount of time you spend in your target blood sugar range (usually 70–180 mg/dL) over time and lowering your A1C.
- There are two types of insulin pumps: those connected to the body with tubing or worn directly on the body.
- Several insulin pumps communicate with a continuous glucose monitor (CGM).
- These pumps may use CGM glucose data to automatically adjust background (basal) insulin, deliver a correction (bolus) dose of insulin or temporarily stop insulin delivery if glucose drops too low.



Evolution of Insulin: From Human to Analog. Joseph M. Tibaldi, MD
American Journal of Medicine, 2014

Insulin Pumps (1)



MiniMed 770G System

Medtronic

300-unit reservoir

Features

Combo pump-CGM: Yes

Tubing Required: Yes

Auto Basal Insulin Suspension: Yes

Auto Basal Insulin Adjustment: Yes



Omnipod 5

Insulet Corp.

200-unit reservoir built into pod

Features

Combo pump-CGM: Yes

Tubing Required: No

Auto Basal Insulin Suspension: Yes

Auto Basal Insulin Adjustment: Yes



t:slim X2 Insulin Pump With Control-IQ

Tandem Diabetes Care

300-unit reservoir

Features

Combo pump-CGM: Yes

Tubing Required: Yes

Auto Basal Insulin Suspension: Yes

Auto Basal Insulin Adjustment: Yes

Insulin-to-Carb Ratio in Fractions: Yes

Built-In Meter: No

Communicates With Meter: Yes

Contains Food Database: No

View Data Via Smartphone App: Yes

Shares Data With Family Via App: Yes

Approved for Use In Kids Under 18:
Yes

Remote Bolus Function: No

Remote Updates Option: Yes

Insulin-to-Carb Ratio in Fractions: Yes

View Data Via Smartphone App: Yes

Shares Data With Family Via App: Yes

Remote Bolus Function: Yes

Remote Updates Option: Yes

Insulin-to-Carb Ratio in Fractions: Yes

Built-In Meter: No

Communicates With Meter: No

Contains Food Database: No

View Data Via Smartphone App: Yes

Shares Data With Family Via App: No

Approved for Use In Kids Under 18:
Yes

Remote Bolus Function: No

Remote Updates Option: Yes

Insulin Pumps (2)



CeQur Simplicity

CeQur

Wearable insulin delivery patch

Features

Tubing Required: No



V-Go

Zealand Pharma

56, 66, or 76 total units of insulin,
depending on model (24-hour use)

Features

Combo pump-CGM: No

Tubing Required: No

Auto Basal Insulin Suspension: No

Auto Basal Insulin Adjustment: No

Insulin-to-Carb Ratio in Fractions: No

Built-In Meter: No

Communicates With Meter: No

Contains Food Database: No

View Data Via Smartphone App: No

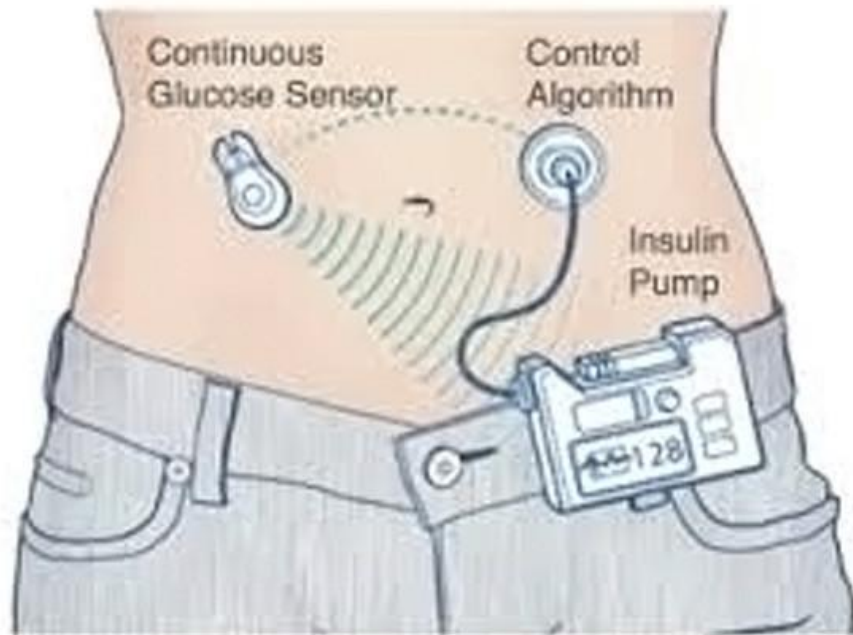
Shares Data With Family Via App: No

Approved for Use In Kids Under 18:
No

Remote Bolus Function: No

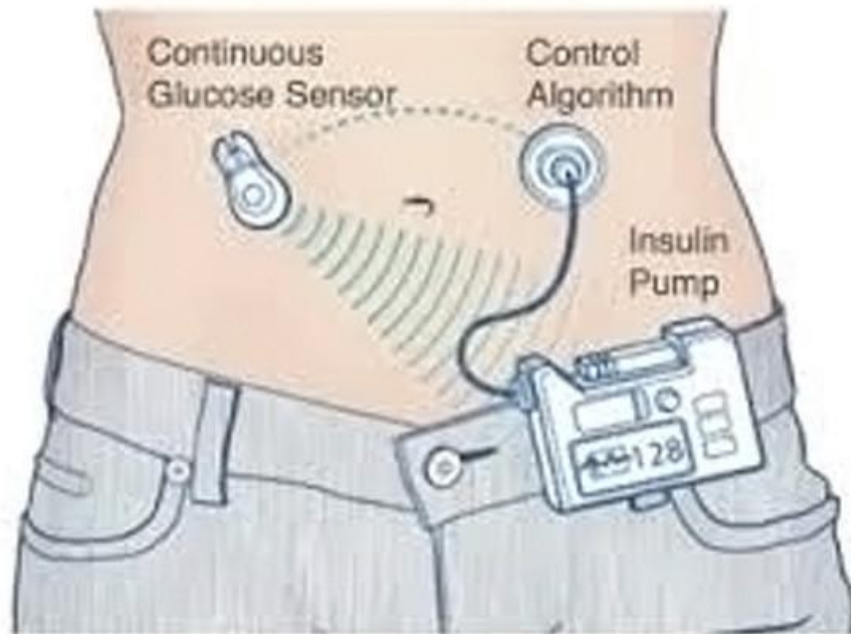
Remote Updates Option: No

Advantages of Pump therapy



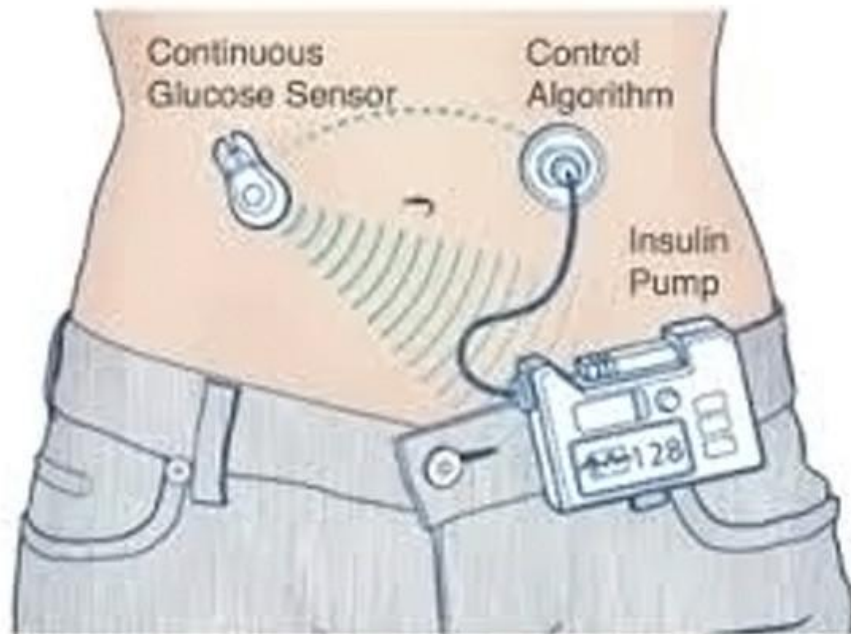
- A1c improvement
- Less glucose variability
- Reduction in duration and frequency of severe of hypo
- 50% drop in severe hypoglycemia
- Quality of life improves
- Precise can deliver .05, .025, or .01 units

Insulin Pump Barriers



- Standard pump cost
 - Getting started cost \$5,000 - \$7,000 for pump (avg \$6,000)
 - Supplies 1-2 thousand dollars a year (200 a month)
- Other costs, extra test strips, cgm sensors, transmitters, accessories
- Weight gain
 - Easier to eat spontaneously
- Changes infusion set and tubing 5-10 mins
- More provider time
- Persistence and careful monitoring
 - no long acting insulin

Insulin Pump Barriers



- How much insulin does it hold?
- CGM results displays on pump screen
- Reminder options
- Remote on glucose meter, device, apps, smart phones
- Ease of data download and readability
- How does it look, feel, clip features
- Alarms and other features

Insulin Pump Report

Device Settings - Uploaded: Nov 06, 2021 6:02 pm PST

Jt Profile				Active at the time of upload
Start Time	Basal Rate	Correction Factor	Carb Ratio	Target BG
Midnight	0.850 u/hr	1u:50 mg/dL	1u:20.0 g	120 mg/dL
1:30 AM	0.500 u/hr	1u:50 mg/dL	1u:20.0 g	120 mg/dL
5:00 AM	0.400 u/hr	1u:50 mg/dL	1u:20.0 g	120 mg/dL
9:00 AM	0.715 u/hr	1u:50 mg/dL	1u:20.0 g	120 mg/dL
10:00 AM	0.715 u/hr	1u:50 mg/dL	1u:20.0 g	120 mg/dL
3:00 PM	0.800 u/hr	1u:60 mg/dL	1u:25.0 g	120 mg/dL
9:00 PM	0.750 u/hr	1u:60 mg/dL	1u:25.0 g	120 mg/dL
Calculated Total Daily Basal		15.97 units		
Duration of Insulin: 3:00 hours Carbohydrates: On Max Bolus: 25 units				

Settings	
Alerts	Pump Settings
Alert: Auto-Off Off	Quick Bolus On 0.500 u
Alert: Low Insulin 20 u	Screen Timeout 120 sec
Reminders	Feature Lock Off
Low BG Off	Pump Volume: Button Low
High BG Off	Pump Volume: Quick Bolus Low
Site Change Reminder On 3 days 11:00 AM	Pump Volume: Bolus Low
Missed Meal Bolus: Reminder 1 -	Pump Volume: Reminders Vibrate
Missed Meal Bolus: Reminder 2 -	Pump Volume: Alerts Vibrate
Missed Meal Bolus: Reminder 3 -	Pump Volume: Alarms Vibrate
Missed Meal Bolus: Reminder 4 -	
After Bolus BG Off	
Status Off	CGM Settings
CGM Alerts	Transmitter ID 8LSW00
High Alert On 300 mg/dL Never	CGM Volume Vibrate
Low Alert On 90 mg/dL Never	
Rise Alert On 3 mg/dL/min	
Fall Alert On 3 mg/dL/min	
Sensor Out of Range On 30 minutes	Control-IQ Settings
	Control IQ On
	Weight 154 lbs
	Total Daily Insulin 62 u
	Sleep Schedule 1 On M Tu W F - 8:00 PM - 5:30 AM
	Sleep Schedule 2 On Su Th Sa - 10:00 PM - 9:00 AM

What's covered?

Document everything in detail!



Criteria for coverage for CGMS

- T1DM is covered
- T2DM—varies
 - Usually requires being on insulin but some are accepting any DM injections. –OR--
 - History of lows, unawareness and/or at risk of lows.
- Other conditions may require a PA.
- Medicare usually must go through DME company.

What's covered?

Document everything in detail!



Criteria for coverage for Insulin Pumps

- T1DM is covered but may require proof with concurrent c-peptide and BG.
- T2DM—varies
 - Easier to get coverage with Omni Pod since it goes through pharmacy not usual mode.
- Other conditions may require a PA.

Resources

- ADA consumer guide to technology
<https://consumerguide.diabetes.org/>
- Company web sites – virtual demo
- [Diabetes Forecast Consumer Guide](#)
- [My TSA Mobile App](#)
- **American Red Cross Shelters:** Contact the American Red Cross directly at 1-800-RED-CROSS.
- **Resource For Health Care Providers:**
 - **Insulin Supply Hotline:** During a disaster, call the emergency diabetes supply hotline 314-INSULIN (314-467-8546) if you know of diabetes supply shortages in your community (i.e. shelter, community center). Hotline is for health care providers only.

Thank You!