Diabetes Technologies
Insulin Pumps and Sensors

Beverly Thomassian, RN, MPH, BC-ADM, CDE
President, Diabetes Education Services
Diabetes Technologies – Continuous Glucose Monitors and Pumps

1. Discuss features of available professional and personal CGMs and insulin pumps.

2. List components of CGMs and insulin pumps

3. Describe appropriate candidates for CGM and insulin pump therapy

4. State four new terms associated with CG
Conflict of Interest and Resources

- Coach Bev has no conflict of interest
- Technology field is rapidly changing
- Photos in slide set are from Pixabay – not actual clients

Resources:

- AADE Practice Paper 2018- Continuous Subcutaneous Insulin Infusion (CSII) Without and With Sensor Integration
- AADE Practice Paper 2018- Diabetes Educator Role in Continuous Glucose Monitoring
- Diabetes Spectrum, Volume 32, Number 2, Summer 2019
- Company web sites – virtual demo
- AADE – DANA Diabetes Advanced Network Access
  [www.diabeteseducator.org](http://www.diabeteseducator.org) Need to be AADE Member to access
- Diabetes Forecast Consumer Guide 2019
- Pumping Insulin by John Walsh, PA, CDE – Diabetes Mall
- Gary Scheiner, MS, CDE – Integrated Diabetes Services
ADA Standard 7- Diabetes Technology

- Diabetes technology is the term used to describe the hardware, devices and software that people with diabetes use to help self-manage their diabetes and improve quality of life.

- Advances in technology will continue to revolutionize and improve the way diabetes care is delivered.

CGM = Continuous Glucose Monitor

7. Diabetes Technology: Standards of Medical Care in Diabetes—2019
American Diabetes Association
Diabetes Care Jan 2019, 42 (Supplement 1) S71-S80; DOI: 10.2337/dc19-S007
Pump and CGM Candidates - People with diabetes who use insulin replacement
Diabetes Educator take lead in integrating CGMs & Pumps into Practice

- Insulin Pump use is rapidly growing
  - 350,000 to 515,000 pump users in U.S
  - Many pump users also using Continuous Glucose Monitors (CGM)
  - First CGM approved by FDA in 1999

- CDE’s are already doing pattern management

- Add on technology natural next step

- With CGMs data points, easier to identify patterns (once you become used to reports)
For new users, Pump or CGM First?

- Start with CGM
- Helps with fine tuning and insulin needs
- Then add pump
CGM Candidates

- Type 1 or Type 2 on insulin therapy, especially
  - Experiencing frequent or prolonged hypoglycemia
  - A1c above target
- Individuals already on insulin pump
- Individuals who like to use technology
- Less finger sticks
- Athletes
- Eval insurance coverage
## Factors that Affect Blood Glucose

### 42 Factors That Affect BG

<table>
<thead>
<tr>
<th>Food</th>
<th>Biological</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑↑ 1. Carbohydrate quantity</td>
<td>↑ 20. Insufficient sleep</td>
</tr>
<tr>
<td>↑ 2. Carbohydrate type</td>
<td>↑ 21. Stress and illness</td>
</tr>
<tr>
<td>↑ 3. Fat</td>
<td>↑ 22. Recent hypoglycemia</td>
</tr>
<tr>
<td>↑↑ 4. Protein</td>
<td>↑ 23. During-sleep blood sugars</td>
</tr>
<tr>
<td>↑ 5. Caffeine</td>
<td>↑ 24. Dawn phenomenon</td>
</tr>
<tr>
<td>↓↑ 6. Alcohol</td>
<td>↑ 25. Infusion set issues</td>
</tr>
<tr>
<td>↓↑ 7. Meal timing</td>
<td>↑ 26. Scar tissue and lipodystrophy</td>
</tr>
<tr>
<td>↑↑ 8. Dehydration</td>
<td>↓↓ 27. Intramuscular insulin delivery</td>
</tr>
<tr>
<td>↑↑ 10. Medication dose</td>
<td>↑ 29. A higher glucose level</td>
</tr>
<tr>
<td>↓↓ 11. Medication timing</td>
<td>↓↓ 30. Periods (menstruation)</td>
</tr>
<tr>
<td>↓↓ 12. Medication interactions</td>
<td>↑ 31. Puberty</td>
</tr>
<tr>
<td>↑↑ 13. Steroid administration</td>
<td>↓ 32. Celiac disease</td>
</tr>
<tr>
<td>↑↑ 14. Niacin (Vitamin B3)</td>
<td>↑ 33. Smoking</td>
</tr>
<tr>
<td>↓↓ 15. Light exercise</td>
<td>↑ 34. Expired insulin</td>
</tr>
<tr>
<td>↓ 16. High-intensity and moderate exercise</td>
<td>↑ 35. Inaccurate BG reading</td>
</tr>
<tr>
<td>↓↓ 17. Level of fitness/training</td>
<td>↓↓ 36. Outside temperature</td>
</tr>
<tr>
<td>↑↑ 18. Time of day</td>
<td>↑ 37. Sunburn</td>
</tr>
<tr>
<td>↑↑ 19. Food and insulin timing</td>
<td>↓ 38. Altitude</td>
</tr>
<tr>
<td>↓↓ 39. Frequency of glucose checks</td>
<td>↑↑ 40. Default options and choices</td>
</tr>
<tr>
<td>↑↑ 41. Decision-making biases</td>
<td>↑↑ 42. Family relationships and social pressures</td>
</tr>
</tbody>
</table>

---

https://diatribe.org/42factors
Continuous Glucose Monitors

- Tiny sensor under skin measures interstitial glucose every few minutes
- A transmitter wirelessly sends glucose data to a receiver: smart phone, reader, insulin pump

3 elements: sensor, transmitter, receiver
Poll Question 1

Which of the following is a benefit of continuous glucose monitoring?

A. Eliminates need for self-monitoring of glucose via fingersticks.
B. Provides glucose readings as accurate as a lab value.
C. Interstitial glucose is more accurate than capillary glucose.
D. Contributes to decreased hypoglycemia.
Continuous Glucose Monitoring (CGM)

- CGM appropriate tool for children to adults
- Useful for those with frequent hypoglycemia or hypoglycemia unawareness (alarm features)
- Measures percent of time in, above and below range
- Assess individual’s readiness

CGM uses interstitial glucose – correlates with plasma glucose
Reporsts glucose in
- Real time (rtCGM) or
- Or intermittent scanning “flash” (isCGM)
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
Terminology

- rtCGM – real time
- isCGM – intermittently scanned
- ISF – interstitial fluid
- SG – Sensor glucose
- HCL – Hybrid Closed-Loop
- BGM gives single glucose reading from blood
- CGM uses interstitial fluid (ISF) to determine glucose every 5 minutes (288 times a day)
- Personal CGM – owned by individual
- Professional CGM – owned by med office
Poll question 2

In which of the following situations is the use of Continuous Glucose Monitoring not recommended?

A. In children
B. On dialysis
C. During puberty
D. For athletes
CGM devices not indicated for:

CGM has not been adequately studied in these groups:

- On dialysis
- Critically ill
- With implanted medical devices
- Pregnant

- ADA does state that rtCGM may be beneficial if used effectively to improve A1C levels and neonatal outcomes in pregnant women with diabetes.
CGM lags behind capillary readings

- Interstitial fluid (ISF) readings 5-10 minutes behind blood capillary
- Bigger gap in accuracy if BG rapidly rising or falling
- Rely on the CGM arrows to take action
**What do the arrows mean on CGM?**

<table>
<thead>
<tr>
<th>Arrows</th>
<th>Description</th>
<th>Example Calculation</th>
</tr>
</thead>
</table>
| ↑↑     | Blood glucose is rising >3 mg/dL per minute | If CGM reading is 100, but 2 arrows pointing down.  
• In 10 minutes glucose will be 70  
• (10 minutes x 3 mg/dL) |
| ↑      | Blood glucose is rising 2–3 mg/dL per minute |  |
| →      | Blood glucose is rising 1–2 mg/dL per minute |  |
| →      | Blood glucose is changing <1 mg/dL per minute |  |
| ↓      | Blood glucose is falling 1–2 mg/dL per minute |  |
| ↓      | Blood glucose is falling 2–3 mg/dL per minute |  |
| ↓↓     | Blood glucose is falling >3 mg/dL per minute |  |

**FIGURE 1.** Sample CGM trend arrows. (See the manuals of individual devices for the specific ways they depict trends.)

---

*Personal Versus Professional Continuous Glucose Monitoring: When to Use Which on Whom*

Rebecca Longo, Scott Sperling  
*Diabetes Spectrum* Aug 2019, 32 (3) 183-193  
**DOI:** 10.2337/ds18-0093
MARD is used to gauge accuracy in Meters and CGM devices

- MARD is the *mean absolute relative difference* of sensor readings compared to simultaneously measured laboratory glucose values.
- (Most sensors range from 8-10%)
- MARD calculations less accurate as glucose rapidly changes or goes into hypoglycemic range
- Rely on arrows to take appropriate action

Lower MARD rating is better
New ADA Guideline for those using CGMs
- 70% of time - Keep BG 70-180

Help individuals problem solve to keep glucose in range

Limit amount of time with hypo/hyperglycemia

7. Diabetes Technology: Standards of Medical Care in Diabetes—2019
American Diabetes Association
Diabetes Care Jan 2019, 42 (Supplement 1) S71-S80; DOI: 10.2337/dc19-S007
Continuous Glucose Monitors

Dexcom G5
Approved by Medicare

FreeStyle Libre 14 day
14 day dias

Dexcom G6
Poll question 3

- What is the difference between professional and personal CGM system?
- A. Professional systems can be blinded to user
- B. Personal systems have higher MARD values
- C. Professional systems are more costly for individuals
- D. Personal systems have limited accuracy
Professional CGM

- Person with diabetes is outfitted with CGM for 6-14 days
- Readings collected every 1 to 5 minutes
- Diabetes educator familiar with software and downloading.
- Retrospective data downloaded to review and make treatment adjustments
- 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
- If already using a pump, choose CGM that integrates

AADE Practice Paper; The Diabetes Educator Role in Continuous Glucose Monitoring. July 2018
Professional CGM Considerations

- Consider cost, disinfection issues
- Keep food activity log during use
- Staff needs to know how to download and interpret data
- Evaluate insurance coverage first. After a minimum of 72 hours, bill using code 95250
- Interpretation of data can be done remotely or in person using billing code 95921

AADE Practice Paper; The Diabetes Educator Role in Continuous Glucose Monitoring, July 2018
How to Onboard a Person from BGM to CGM – Assess Interest and Readiness

- Start by wearing professional device
  - Alarms, where to wear, adhesive, setting individualized alerts
  - Group appointments helpful
- Then review different personal device options
- Provide training
- Return appointment to download data and troubleshoot
CGM Professional | Abbott Freestyle LibrePro

- Equipment – sensor, reader
- 14 day wear, blinded
- 12 hr warm up, no calibration
- Disposable sensors
- MARD Accuracy 12.3%
- No alarms high/low
CGM Professional - Dexcom G4

- Equipment – sensor, transmitter, receiver
- 7 day wear, blinded or not
- 2 hr warm-up, 2 calibrations per day
- Cleaned between uses
- MARD Accuracy 9%
- Alarms customized by provider/wearer

https://provider.dexcom.com/products/professional-cgm
CGM Professional – Medtronic IPro2

- Equipment – sensor, transmitter, receiver
- Blinded
- 2 hr warm-up, 3-4 calibrations per day
- Cleaned between uses
- MARD Accuracy 11.05%
- No alarms

Download to Carelink from meter or manually

https://professional.medtronicdiabetes.com/ipro2-professional-cgm
Minimed Professional Download
How to start CGM in practice

- One idea – Start with Libre Pro in office
  - Not too expensive
  - Good reimbursement
  - Provides retrospective data
- Diabetes Educators can
  - Insert sensor
  - Download report
  - Review data with client
  - Problem solve
  - Route to Provider for billing and interpretation
Getting Clinic Ready - Next steps

- Set up clinic to download device
- Determine which CGMs your clinic will use
- Set up account and get ready for downloads
- Other download options
  - Tidepool software – FREE
    - can download CGM Data and Glucose Meters as well
  - Glooko software to download data – subscription required
Blip, where you can see all of your data in one place.

- **Dexcom**
  - G4 and G5
  - Mac and Windows

- **Insulet**
  - Omnipod
  - Mac and Windows

- **Tandem**
  - t:slim and t:flex
  - Mac and Windows

- **Medtronic**
  - Paradigm 522 and 723, 530 and Enlite sensor
  - Mac and Windows

- **Bayer Contour**
  - Contour, Link, Next, USB and Next USB
  - Mac and Windows

- **Abbott**
  - Precision Xtra, Freestyle Lite and Freedom Lite
  - Windows

- **Animas**
  - Ping and Vibe
  - Mac and Windows

- **OneTouch**
  - VerioIQ, Ultra2, Ultra Mini
  - Mac and Windows

  Coming soon
Personal CGM Considerations

- Ease of use and application
- Calibration or not? If yes, check fingerstick as required and enter into receiver
- Interfering substances?
- Can insulin be dosed based on CGM reading?
- Cost and insurance coverage
- Convenience
Diabetes Educators Role

Teaching Points:
- Sensor site & insertion
- Connection of transmitter to receiver
- Difference between SG* and BG
- Understand CGM data and trends
- Calibration timing, frequency, accuracy

Diabetes Educators assist with downloading, interpretation, education and empowerment.

Evaluation of results is billable only by a MD, NP, PA.

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

SG = interstitial glucose
Personal rtCGM Benefits

- Continuously transmit glucose data to a personal receiver, smartphone, smartwatch or other compatible device
- Sound alerts and alarms in response to rising or falling glucose levels
- Data can be shared with caregivers and clinicians
Personal isCGM - FreeStyle Libre Flash

- Self insert sensor
- No calibration needed
- Wave wand over to get current reading and retrospective data for past 8 hours
- Wearable up to 14 days
- LibreLink app shows user entered events, cloud based for sharing (up to 20 people can track) from iphone or android

https://www.freestylelibre.us
Personal isCGM - FreeStyle Libre Flash

- Stores 90 days of data
- No alerts (may be option for those with alarm fatigue)
- FDA approved for insulin dosing
- Medicare covers if take insulin 3xs a day and check BG 4 x’s daily
- Interfering substances include salicylic acid, high dose vitamin C

https://www.freestylelibre.us
Personal rtCGM | Dexcom G 4,5

- FDA approved to dose insulin
- 2 calibrations per day
- Receiver or mobile app, share with 5 devices
- G5-6 Integrates with Tandem T-slim X2 insulin pump
- Sensor wear for 7 days G 4, 5
- Transmitter and display device need to be within 20 feet of each other
- Download into Glooko
- Interfering substances: acetaminophen, high dose vita C
- Medicare covers if take insulin 3xs day, SMBG 4 xs a day
- MARD 9% adults, 7.7% peds
Personal rtCGM - Dexcom G-6

- No calibration
- 10 day sensor wear
- 1 step insertion
- Alerts for high/low
- FDA Approved to dose insulin
- No interfering substances
- Integrates with Tandem t-slim X2
- Transmitter and display device need to be within 20 feet of each other

https://www.dexcom.com/g6-cgm-system

Medicare to cover late 2019
Eversense Implantable CGM

ADVANCED technology:
Fluorescence-based sensor lasts up to 180 days - up to 25 times longer than ordinary systems

ADVANCED comfort:
Professionally inserted just under the skin gives you freedom from weekly insertions

ADVANCED peace of mind:
Removeable smart transmitter with on-body vibe alerts

On-body vibe alerts can be life-saving
In addition to alerts you can see and hear, the smart transmitter gives you the added security of on-body vibe alerts, even when your mobile device isn’t near. Eversense is the only CGM to offer this feature.

Receives and transmits data every five minutes - giving you readings virtually in real time.

https://global.eversensediabetes.com/
Personal rtCGM - Eversense Implantable

- 3 month physician implanted sensor
- Blue tooth enabled with mobile app, ability to share
- Sends raw data by Radio Frequency to smart transmitter on skin
- Sends SG to mobile device
- 90 day wear time

Calibrations:
- 24 hour Warm-up
- Then 2 calibrations per day
- Not approved for insulin dosing
- Yes, absolute and predictive alerts
- MARD 8.8%
- No Medicare coverage
Eversense CGM System Caution

- Not indicated for those receiving
  - immunosuppressant therapy
  - chemotherapy, or
  - anticoagulant therapy
  - Systemic glucocorticoids
- Or for those with another active implantable device (e.g., an implantable defibrillator)
Personal rt CGM - Medtronic Guardian

- Bluetooth Guardian Connect for IOS
- Sensor wear for 7 days
- Integrates with Mimimed 630-G/670-G
- 2 hr warm up, 2 calibrations day
- Not FDA approved for insulin dosing
- CareLink software to share data and updated plan
- Alarms for high, low, predictive alerts
- Apps - Sugar.IQ, mySugr
- Not covered by Medicare
- MARD 09.6 -10.5%
<table>
<thead>
<tr>
<th></th>
<th>FreeStyle Libre</th>
<th>Dexcom G6</th>
<th>Dexcom G5</th>
<th>Medtronic Guardian Sensor 3</th>
<th>Eversense</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of system</strong></td>
<td>isCGM</td>
<td>rtCGM</td>
<td>rtCGM</td>
<td>rtCGM</td>
<td>rtCGM</td>
</tr>
<tr>
<td><strong>Approved for insulin dosing?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Calibration requirements</strong></td>
<td>None</td>
<td>None</td>
<td>At least twice daily</td>
<td>At least twice daily</td>
<td>At least twice daily</td>
</tr>
<tr>
<td><strong>Compatibility with mobile devices</strong></td>
<td>Reader, Apple smartphone (14-day system only)</td>
<td>Receiver, Android and Apple smartphones, smartwatches, and Tandem t:slim X2 insulin pump</td>
<td>Receiver, Android and Apple smartphones, smartwatches, and Tandem t:slim X2 insulin pump</td>
<td>Guardian Connect app on Apple iOS devices</td>
<td>Android and Apple iOS smartphones, smartwatches, and other devices</td>
</tr>
<tr>
<td><strong>Real-time remote data sharing?</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Integration with insulin pump?</strong></td>
<td>No (Tandem t:slim X2)</td>
<td>Yes (Tandem t:slim X2)</td>
<td>Yes (Minimed 630G and 670G)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Predictive low glucose alert?</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Covered by Medicare?</strong></td>
<td>Yes, for people who take insulin at least three times daily and perform SMBG four times daily</td>
<td>To be covered in late 2019</td>
<td>Yes, for people who take insulin at least three times daily and perform SMBG four times daily</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
CGM Teaching Points

Overview
- Setting, managing alerts
- Coping and problem solving
- Avoidance of overcorrection
- How to share data

Importance of arrows
- Direction and speed of upward and downward arrows
- Upward trending arrows
  - Pump malfunction
  - Insufficient insulin
  - Missed meal bolus
- Downward trending arrows
  - Take appropriate action

Reimbursement
- CPT code 95249 for training on personal CGM.
- Billing must be done under MD, NP, or PA
- Medicare, commercial payors limit RDs billing under their own NPI
CGM Trouble Shooting

- Sensors can fall off early
  - Average use 10-14 Days
  - Sometimes get bad sensor
  - Reach out to company for replacement
- Stay hydrated to get more accurate readings
- Have backup plan
  - Meter near by in case numbers seem off, sensor falls off
  - Explore different adhesives (skin tac) may decrease irritation
  - Simpatch put over, helps keep sensor on longer
Poll Question 4

- JR is on an insulin pump and CGM therapy. JR starts feeling very tired and thirsty. His CGM is reading in the 100-160 range. What action should JR take?
  - A. Check his capillary blood glucose
  - B. Rest and drink 16 ounces of water
  - C. Take a 15-30 minute walk
  - D. Go to the emergency room
Personal CGM 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
  - If not FDA approved for insulin dosing
- Be on look our for alarm distress/burnout
Smart Pens Connect via bluetooth

- smartphone app keeps track of insulin dose and time ad
- https://gocap.me/

InPen
Now onto Insulin Pumps

Considerations

- Canula options
- Insertion device or manually
- Disconnect mechanism
- Tubing length

A Clinical Overview of Insulin Pump Therapy for the Management of Diabetes: Past, Present, and Future of Intensive Therapy
Cari Berget, Laurel H. Messer, Gregory P. Forlenza
Diabetes Spectrum Aug 2019, 32 (3) 194-204; DOI: 10.2337/ds18-0091
History of Insulin and Pumps

Evolution of Insulin: From Human to Analog. Joseph M. Tibaldi, MD
American Journal of Medicine, 2014
Due to health disparities, adoption of insulin pump therapy varies across geographic and socioeconomic landscapes.

Disadvantaged groups have less access to insulin pumps and associated technologies.

These disparities need to be addressed along with insulin affordability.
Poll Question 5

Starting pump therapy requires:

a. Ability to detect and treat hypo
b. At least a high school education
c. Established use of Continuous Glucose Monitor
d. Regular schedule
Clinical Indications for Insulin Pump

- Connected with medical team
- Not reaching targets in spite of Multiple Daily Injection (MDI) elevated A1c
- Nocturnal hypo
- Dawn phenomena
- Excessive glucose variability
- Irregular schedules (students shift workers)
- Monitors BG 4 times a day (or uses CGM)
Clinical Indications for Insulin Pump

- Preconception planning and pregnancy
- Frequent hypo or hypo unawareness
- Extreme insulin sensitivity
- Needle aversion
- Gastroparesis, early neuropathy, nephropathy
- Renal transplantation

AADE Practice Paper 2018- Continuous Subcutaneous Insulin Infusion (CSII) Without and With Sensor Integration
Insurance Coverage Issues

- Most carriers cover pumps
- Under terms of Durable Medical Equipment (DME) coverage
- Patch pump companies are covered under prescription plan
- Insurance requirements
  - Unable to normalize bg
  - Hypo or unawareness
  - Need for flexible insulin reg
  - Planning a pregnancy
- Some plans may not cover soon after dx
Medicare Coverage

- Covers pumps for type 1 and insulin requiring type 2
- Serum C-peptide need to be $<110\%$ of lower limit of normal (if normal renal function) or positive beta cell antibodies
- Complete comprehensive DSMT
- Will cover supplies if using pump before enrolling
- Upgrades every 4-5 years
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
Poll Question 6

Which of the following is true regarding insulin pump therapy?

a. Users don’t have to monitor as often
b. Approved for those 18 and older
c. Improved A1c
d. Decreases risk of weight gain
Realistic Expectations

- Tool not a cure
- Still need to check BG
- More freedom, but still can’t graze
- Blood sugars will be in target more frequently, but not perfect
- Connected to a device
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)

- **Patch/disposable pump**
  - Approx $1000 up-front
  - Approx $400 / month for disposable supplies

- **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 Components

- User interface (buttons/screens)
- Insulin cartridge/reservoir
- Tubing (non-patch pumps)
- Infusion device infuses insulin below skin
- Integrated meter (some)
- Integrated CGM (some) display data on pump screen
- Hybrid closed loop (HCL) delivers automated basal (some)
Common Pump Features

- Variable basal delivery
- Immediate or prolonged bolus delivery
- At least 4 yr warranty
- Temporary basal adjustment
- Bolus calculation feature
- Memory with record
- Downloadable
- Warning for low battery, low insulin & occlusion
- Safety mechanism to prevent accidental delivery
- 24 hour support, full training, 30 day guarantee
Infusion Device and Pump Preparation

- Clean with soap and water
  - If at risk infection, Hibiclens, Phisohex, Betadine
- Allow to dry
- Insertion devices
  - Manual or device aided
  - 1 time or multiple use
    - Helpful for young children, needle phobias
- Fill cartridge with insulin
- Prime tubing
- Connect to infusion device – make sure secure
Canula Options

Flexible Plastic/teflon
- Needs introducer needle
- “More comfortable”
- Safer for those involved in contact sports
- Some have allergy

Steel
- Manual insertion
- Simple to insert
- Less likely to crimp or occlude
- Nickel allergy can be a problem
When to Change Pump Infusion Set

- Change infusion set every 48 hours – 72 hours
- Or if site irritation or blockage
- Make sure to rotate within area to prevent lipodystrophy
- Stay 1 -2 inch away from previous site. Keep old infusion set on to help determine next site
- Use a grid pattern to maximize space in site
Which Insulin Approved for Pumps

Rapid Insulin

- Analogs preferred
- U-200 Lispro can be used off label
- Regular can be used, but has delayed peak
- U-500 off label, harder to manage postprandials

FDA Approval

- Lispro in pump 3 days
- Aspart 6 days
- Glulisine up to 2 days, pregnancy category C
- All have similar efficacy, consider cost
Pump variables to consider

- How much insulin does it hold?
- CGM results display on pump screen?
- 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?
Poll Question 7

- What of the following is true about insulin pumps?
- A. They deliver basal insulin based on algorithms.
- B. Users can scan food and the pump determines bolus amount.
- C. Insulin delivery is stopped if BG is below 70
- D. Basal and bolus rates can be programmed
Valeritas V-Go

- Infusion Set integrated into patch pump
- 4.6 mm, 90-degree stainless steel canula
- Bolus is 2 units per button press
- No CGM pairing or hypo suspension

Load up insulin and go
Change daily- disposable
https://www.valeritas.com
Insulin Pumps

Medtronic 670 G
With Guardian Sensor
Contour Next Link

Tandem Tslim X2
with Dexcom G6

Medtronic 630 G
Guardian Sensor
Contour Next Link

530G with Enlite
CGM
(discontinued
sales 2018)

Insulet OmniPod
System and
OmniPod Dash
Omnipod System with PDM

- No tubing
- Automated infusion set insertion
- Holds up to 200 units
- Waterproof 25 feet for 60 mins

Pod is small, device Freestyle meter built into hand held programmer

- Disposable Pod worn 2-3 days
- Communicates wirelessly with the Personal Diabetes Manager PDM used to program pump settings and wirelessly manage insulin delivery.
- 6.5mm, 45-degree angle, soft cannula
- Min basal/bolus increment 0.05 units
- No direct pairing with CGM
- No hypo suspension
- Data can be uploaded to Insulet Provided Glooko
- Data viewed by up to 12 people

https://www.myomnipod.com/Omnipod-system
Omnipod Dash

- No tubing
- Automated infusion set insertion
- Holds up to 200 units
- Waterproof 25 feet for 60 mins

- Operated by touchscreen locked-down Android PDM that is wirelessly connected by Bluetooth
- Pairs with Contour Next One glucose meter
- Has mobile applications that allow simultaneous viewing of Dexcom G5 mobile app data with pump data on PDM
- No hypo suspension
- Hybrid closed loop (HCL) in development

https://www.myomnipod.com/Omnipod-system
Patch Pump - Omnipod

Benefits
- No tubing
- Automated infusion set insertion
- Lower upfront cost
- Smaller, more discreet
- No siphon or disconnecting
- Change site every 2-3 days

Considerations
- Can’t disconnect
- Bigger skin patch
- Less canula choice
- If trouble applying insulin device, insulin lost.
- Higher disposable supply cost than traditional.
Tandem t:slim X2™ w/Dexcom CGM

- fingersticks
- 10-day sensor wear
- Simple auto-applicator
- View and share data on smart devices with up to 10 followers.
- Can pair with Dexcom G5 and G6
- Paired Low Glucose Suspension (Basal IQ)
- HCL in clinical trials
Tandem t:slim X2™

- Touchscreen pump with color screen
- Rechargeable battery via USB port
- Water resistant: 3 feet for 30 mins
- Bluetooth wireless technology
- Acetaminophen blocking (up to 1000mg every 6 hours)
- Minimum basal insulin delivery 0.025 units
- Minimum bolus insulin delivery 0.05 units
- Updatable software: can update pump features using a personal computer (eg can add Basal IQ functionality)
- Infusion set choices
  - 6-mm, 9-mm, flexible, 90-degree cannula with inserter device
  - 13-mm, 17-mm angled, soft cannula; can be inserted manually or with inserter device
  - 6-mm Teflon cannula, 90-degree with manual insertion
Minimed Pumps

Medtronic 670 G
With Guardian Sensor
Contour Next Link

Medtronic 630 with
Guardian Sensor
Contour Next Link

530G with Enlite
CGM
(discontinued
sales 2018)
Minimed 630 & 670

- Battery operated pump
- Holds 300 units insulin
- Operates with buttons on front of pump
- Minimum insulin delivery 0.025 units

Infusion set choices

- 6-mm, 9-mm, flexible, 90-degree cannula with inserter device
- 13-mm, 17-mm angled, soft cannula; can be inserted manually or with inserter device
- 6-mm Teflon cannula, 90-degree with manual insertion
Minimed Pumps

- Blood glucose meter pairing
  - 630 & 670G
    - Contour Next Link 2.4
  - 530G
    - Contour Next Link

- CGM Pairing
  - 630 and 670G
    - Guardian 3 CGM
  - Minimed 670G HCL auto basal insulin delivery with user delivered mealtime boluses

530G (with Enlite CGM discontinued new sales 2018)
Medtronic 670G Hybrid Closed Loop Insulin Pump System

SmartGuard™ features:

**AUTO MODE**
- 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**
- Stops insulin up to 30 minutes before reaching your preset low limits.
- Automatically restarts insulin when your levels recover without bothersome alerts.¹
- Helps you avoid lows and rebound highs.¹

▶ See how Suspend Before Low works

Contour Next Link 2.4 meter
Guardian Sensor 3 – Change every 7 days
Hybrid Closed Loop Delivery

- HCL insulin delivery systems may be considered in children 7 years or older and adults to improve BG.
- Consists of 3 components:
  - Insulin pump
  - Continuous glucose monitor
  - Algorithm that determines insulin delivery
- These systems, insulin delivery can be suspended, increased or decreased.
- Future – truly automated closed loop system
Thank you for joining us on Maiden Voyage

- In 2019, Coach Bev made a professional and personal commitment to create a Diabetes Technology Course.
- Thank you for sharing feedback and insights that would enhance this program.
Thank You

- Please email us with any questions.
- info@diabetesed.net
- www.diabetesed.net