Pumping at the Opportunity: An Overview of Insulin Pump Therapy

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Nesbitt School of Pharmacy

Photo: https://www.medtronicdiabetes.com/loop-blog/important-update-minimed-670g-availability-priority-access-program/
The presenter for this activity has been required to disclose all relationships with any proprietary entity producing health care goods or services, with the exemption of non-profit or government organizations and non-health care related companies.

No significant financial relationships with commercial entities were disclosed by any of the speakers.
Objectives

1. Discuss the components and functionality of Continuous Subcutaneous Insulin Infusion (CSII) devices in diabetes management
2. Determine appropriate candidates for CSII devices
3. Compare and contrast characteristics and features of currently available CSII devices
4. Describe the role of pharmacists in CSII device management and education
Participation Instruction

1. Go to slido.com on your mobile device or computer
2. Enter the participation code: T918
3. You are all set!
4. When prompted, refer to your mobile device or computer during the presentation to participate
Meet Patient LH

Patient Case Example
Patient LH

- **CC:** 58 y.o male who presents for a follow-up diabetes visit after he was initiated on an insulin pump
- **HPI:** Diagnosed with type 2 diabetes mellitus (T2DM) 6 years ago. LH switched from basal-bolus injections to an insulin pump ten days ago
- **PMH:** T2DM, hypertension (HTN), gastrointestinal reflux disease (GERD), osteoarthritis (OA)
Patient LH

- **Vitals:**
  - Pulse: 85 bpm
  - Blood pressure: 134/82 mmHg
- **Labs:**
  - A1c: 8.9% (H)
  - All other labs WNL
Patient LH

Medications:

1. Metformin 1000 mg by mouth twice daily
2. Humalog 100 u/mL for use in insulin pump
3. Lisinopril 5 mg by mouth daily
4. Rosuvastatin 10 mg by mouth daily
5. Aspirin 81 mg by mouth daily
6. Acetaminophen 650 mg by mouth every 8 hours as needed for pain
7. Ranitidine 150 mg by mouth daily at bedtime
Insulin Pump Basics

Components and Functionality
A programmable, computerized device that delivers insulin into the subcutaneous layer.
Functionality

Delivery of rapid or short acting insulin:

1. Steady, automatically, and continuously over 24 hours
   - Basal

2. Small dose given at the users demand
   - Bolus (mealtime and correction)

Functionality

• Pump setting are programmable and adjusted based on an individuals insulin needs
  • Basal rates
  • Insulin to carbohydrate ratios
  • Sensitivity factors
  • Target blood glucose ranges
Types

- Tethered
- Patch
**Types**

**Tethered**
- Insulin delivery to infusion site via tubing
- Programming and functionality controls via pump unit that holds insulin

**Patch**
- Tubeless
- Insulin delivery via wireless communication between insulin-containing patch and handheld device that controls programming


How Insulin Pumps Work [Internet]. Diabetes Digital Media Ltd. Available from: www.diabetes.co.uk

Photo: http://www.diabetesincontrol.com/closed-loop-pump-technical-difficulties-lead-to-high-rate-of-discontinuation/

Tethered-Components

- Pump Unit
- Reservoir
- Tubing
- Infusion Set
Tethered Components

- Battery-powered unit
- Contains circuit board, motor, and piston rod to operate programmed instructions
- Contains display screen and buttons for functionality
- Holds the insulin reservoir of the infusion set
Tethered Components

- Pump Unit
- Reservoir
- Tubing
- Infusion Set
Tethered Components

- Plastic chamber or cartridge that is inserted/screwed into pump unit
- Holds insulin
- Various volumes available based on total daily insulin dose (TDD)
Tethered Components

Reservoir

Photo: https://www.diabetes.shop/reservoirs/mmt-326a
Photo: https://diabetes-supply.com/product/tandem-t-slim-cartridge/
Tethered Components

- Pump Unit
- Reservoir
- Tubing
- Infusion Set
Tethered Components

- Thin, plastic tube/catheter
- Transfers insulin from reservoir to cannula of infusion set for delivery
- Various lengths based on patient preferences

How Insulin Pumps Work [Internet]. Diabetes Digital Media Ltd. Available from: www.diabetes.co.uk
Tethered Components

- Pump Unit
- Reservoir
- Tubing
- Infusion Set
Tethered Components

- The other end of tubing is attached to a connection device that attaches to a cannula
- Cannula sits in the subcutaneous tissue (no needle) and is held in place by an adhesive patch
- Various types available based on patient specific preferences (material, angle, insertion devices, cannula length, etc.)
Site Placement:
- Abdomen, upper buttocks, hips, outer thigh, back of arm
- Avoid scars, wounds, tattoos, areas of irritation/“rubbing”
- 2 inches around belly button
- Change and replace every 2-3 days to prevent scarring, infection, lipohypertrophy

Photo: https://diabetes-supply.com/product/tandem-t-slim-cartridge/
Infusion Set

**Disconnecting:**

- All pumps have a disconnecting port
- Swimming, bathing, showering, exercising
- Stop/suspend insulin delivery
- May have to correct/treat high blood sugar when reconnected (missing basal insulin)
- Do not disconnect for more than 1-2 hours


Photo: https://www.endocrineweb.com/guides/how-disconnect-pump-plus-tips-traveling-pump-using-pump-school
Which infusion set is right for you?

**STEEL**

- Reactions to plastic cannula / History of bent cannula / Pregnant (up to 2nd trimester) / Small child

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**PLASTIC CANNULA**

- Less active / Alternative site usage / Poor dexterity
- Less active / Alternative site usage
- Active / Lean / Muscular / Pregnant (from 2nd trimester)

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**Sure-T® Infusion set**

Simple steel needle infusion set.

---

**Quick-set® Infusion set**

Our most popular infusion set.

---

**mio® Infusion set**

Convenient ‘all in one’ infusion set.

---

**Silhouette® Infusion set**

Flexible insertion angle infusion set.

---

**Low/Average BMI**

- 6mm: Wear insulin pump close to infusion site 18° or 23°
- 10mm: Wear insulin pump close to infusion site 23°
- 10mm: Wear insulin pump away from infusion site 32° or 45°

---

**Average/High BMI**

- 6mm: Wear insulin pump close to infusion site 18° or 23°
- 10mm: Wear insulin pump close to infusion site 23°
- 10mm: Wear insulin pump away from infusion site 32° or 45°
Patch Components

Control

Patch
Tethered Components

• Handheld remote control
• Contains display screen and buttons for functionality
• Similar to pump unit but does not hold insulin
• Wireless technology transmits commands to the patch pump
Patch Components

- Control
- Patch
Tethered Components

Patch

• Attached to the body with adhesive
• Contains insulin in reservoir, motor, and cannula that administers insulin into skin

How Insulin Pumps Work[Internet]. Diabetes Digital Media Ltd. Available from: www.diabetes.co.uk
<table>
<thead>
<tr>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarms, alerts, reminders</td>
</tr>
<tr>
<td>Event markers</td>
</tr>
<tr>
<td>Preset bolus</td>
</tr>
<tr>
<td>Bolus calculator</td>
</tr>
<tr>
<td>Remote bolus</td>
</tr>
<tr>
<td>Square/dual wave bolus</td>
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<tr>
<td>Active insulin on board</td>
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<tr>
<td>Temporary basal rates</td>
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<tr>
<td>Auto suspend</td>
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<tr>
<td>Associated glucose meters</td>
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<td>Daily history view</td>
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<tr>
<td>Data management</td>
</tr>
<tr>
<td>CGM compatibility</td>
</tr>
<tr>
<td>Suspend on/before low</td>
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<tr>
<td>SmartGuard™ Auto Mode</td>
</tr>
</tbody>
</table>

*NOTE: Features vary based on insulin pump*

CGM=Continuous glucose monitor
Features

Features

Photos: Minimed™ 670G System Simulator. Medtronic Inc.

<table>
<thead>
<tr>
<th>Start</th>
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<td>6:00 P</td>
<td>12:00 A</td>
<td>0.900</td>
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</table>
Features

Photo: Omnipod Simulator App. Insulet Corporation.
Patient LH asks, “Should I still be injecting my long acting insulin shot every day?”

Select the correct response

A. Yes- You should still be injecting basal insulin at your previous dose
B. Yes- Your basal insulin dose should have been decreased by 50%
C. No- The pump delivers continuous amounts of rapid-acting insulin that replicates basal insulin secretion
D. I do not know
Knowledge Check # 2

Patient LH asks, “How often should I change my infusion site?”

Select the correct response

A. Every day
B. Every 2-3 days
C. Every 7-14 days
D. When you run out of insulin in the reservoir
Patient LH is going to the beach for 1 week. His infusion set is currently located on his abdomen and he does not want his infusion set to be visible when he is shirtless. He asks, “What are other appropriate infusion site locations?”

Select ALL correct responses

A. Buttocks
B. Inner thigh
C. Outer thigh
D. Inner arm
Patient LH is going to the beach for 1 week. He asks, “Can I disconnect my pump when I swim in the ocean?”

Select the correct response

A. Yes- For a limited time you can suspend your pump, then disconnect your pump and tubing from your infusion site

B. Yes- For a limited time, but you will have to replace/change your infusion site with a new set when you are done swimming

C. No- Pumps should never be disconnected

D. I do not know
Pump Candidates

Appropriate Patient Selection
“Ideal” Candidates

Type 1 diabetes mellitus (T1DM)

Intensively managed insulin-dependent T2DM

> 4 insulin injections and > 4 SMBG measurements/day

Motivated/engaged in self-management

Able to operate pump functions (carb counting, fingersticks, etc.)

Maintain contact with physician

SMBG= Self-monitor Blood Glucose

Clinical Characteristics to Consider

- Pediatric patients with motivated and trainable caregivers
- Pregnant patients
- Labile blood glucose
- Frequent hypoglycemia/hypoglycemia unawareness
- “Dawn phenomenon”
- Competitive athletes
- Severe insulin resistance
- Cost/insurance coverage

Inappropriate Characteristics

- Unable/unwilling to perform necessary tasks
- Lack of motivation
- History of non-adherence
- Pump functionality interfering with lifestyle
- Unrealistic expectations
- History of severe psychological conditions

Knowledge Check # 5

Which of the following are potentially appropriate candidates for an insulin pump?  
Select ALL correct responses

A. 22 y.o male with T1DM with a history of schizophrenia and unwilling to check blood glucose frequently
B. 58 y.o male with T2DM currently prescribed Metformin and Lantus 10 units HS, technologically oriented
C. 8 y.o female with T1DM with a supportive family
D. 31 y.o female pregnant with T1DM who is motivated and adherent to her current insulin regimen
Available Products

Current Pump Models and Features
Medtronic Diabetes

MiniMed™ 530G

MiniMed™ 630G

MiniMed™ 670G

Paradigm Revel™

Photos: https://professional.medtronicdiabetes.com/
Medtronic Diabetes

MiniMed™ 530G
MiniMed™ 630G
MiniMed™ 670G

Paradigm Revel™
GOAL OF AUTO MODE

MiniMed™ 670G

Video: https://www.medtronicdiabetes.com/customer-support/minimed-670g-system-support/about-auto-mode
Omnipod® System

- Mobile apps to come
- Meter built into PDM
- Stand alone meter with Bluetooth
- AAA batteries in PDM
- Rechargeable battery in PDM
- PDM with button functionality
- Touchscreen PDM
- Food database
- Water proof pods (not PDM)
- No tubing

Omnipod DASH System™

PDM=Personal Diabetes Manager

Tandem Diabetes Care

Tandem Diabetes Care

- t:flex ®
- t:slim G4™
- t:slim X2™

Basal-IQ® Technology

Dexcom G4 ® compatibility

Dexcom G5® and G6® compatibility

Rechargeable battery

Watertight

Largest capacity insulin pump (480 unit cartridge)

Discontinued

CONCERNED ABOUT LnWS?

Video: https://www.youtube.com/watch?v=x3-sK26eF4U

t:slim X2™
Sooli Development

Photo: http://www.sooli.com/eng/product/insulin-iis.php

Dana Diabecare IIS
Sooli Development

- No data management source
- Water proof
- Rechargeable battery
- Half the weight of most insulin pumps
- Icon interface (no words)

Dana Diabecare IIS
Accu-chek Spirit Combo

Photo: https://www.accu-chek.com/insulin-pumps-integrated-systems/combo-system/support
- Meter/remote functionality
- Discontinued

Accu-chek Spirit Combo
Animas Corporation

Animas® OneTouch Ping®

Animas® Vibe®

- No data management
- Waterproof
- Abdomen or back of arm
- Designed for patients with T2DM
- Tubeless

- V-Go 40: 76 units total (40 units basal/day + up to 36 units bolus)
- V-Go 30: 66 units total (30 units basal/day + up to 36 units bolus)
- V-Go 20: 56 units total (20 units basal/day + up to 36 units bolus)
- No battery; mechanically operated
- Bolus in 2-unit increments by pushing button

DIY Insulin Pumps

- Do-it-yourself (DIY)
- Underground/hacking movement (1500 patients worldwide)
- Not FDA approved: unauthorized devices utilizing unauthorized automated insulin dosing algorithms (closed loop)
- Using old insulin pumps
- Combination of devices/products
- Not formally tested; poses risk

DIY Insulin Pumps

May 2019

FDA NEWS RELEASE

FDA Warns Against the Use of Unauthorized Devices for Diabetes Management

Response from DIY Stakeholders:
“We want you to report adverse events on DIY systems, if and when they occur. We do not support any kind of efforts to minimize or avoid discussing/reporting adverse events. Openly sharing – including any potential issues – is an equally important part of the “open” aspects of the DIY community.”

Knowledge Check # 6

True or false: All insulin pumps are waterproof.
Select the correct response

A. True
B. False
Knowledge Check # 7

True or false: All insulin pumps have integrated CGM technology. 
Select the correct response

A. True
B. False
Pharmacist Role

Opportunities for the Pharmacist
Pharmacist’s Role

• Counseling on proper insulin pump use and wear
• Dose adjustments, nutrition counseling, physical activity recommendations via patterns/trends
• Promote diabetes self-management and medication adherence
Billing and Revenue

Two options:

1. As part of DSME/T

2. Paid to pump trainer directly

DSME/T = Diabetes Self-Management Education/Training
The DSMT Program must:

• Be accredited by the AADE or ADA
• Have a partnership with a Medicare provider

The patient must have:

• Diabetes
• Written referral for DSMT
<table>
<thead>
<tr>
<th>Code</th>
<th>Details</th>
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<tbody>
<tr>
<td>G0108 (First year)</td>
<td>• Individual DSMT</td>
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<tr>
<td></td>
<td>• Billable in 30 minute increments (Medicare allows 1 hour)</td>
</tr>
<tr>
<td>G0109 (First year)</td>
<td>• Group DSMT (≥ 2 patients)</td>
</tr>
<tr>
<td></td>
<td>• Billable in 30 minutes (Medicare allows 9 hours)</td>
</tr>
<tr>
<td>G0108/G0109 (Subsequent years)</td>
<td>• Billable in 30 minutes (Medicare allows for any combination of 2 hours)</td>
</tr>
</tbody>
</table>
Paid to Pump Trainer

- The pump training is paid by the pump company to the individual pump trainer or to the clinic
- May be accepted by private insurers
- Does not have to be recognized by ADA or AADE (like a DSMT Program)
- A pump trainer can be reimbursed by the pump company for 2 months of training
- Aside from billing directly for insulin pump training, the other educational services provided can count as E&M services (99211-99215)
## Paid to Pump Trainer

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<tr>
<td>98960</td>
<td>Education and training for patient self-management by qualified, non-physician health care professional using standardized curriculum, face-to-face with pt (could include caregiver/family) each 30 min.; <strong>individual patient</strong></td>
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<tr>
<td>98961</td>
<td><strong>2-4 patients</strong></td>
</tr>
<tr>
<td>98962</td>
<td><strong>5-8 patients</strong></td>
</tr>
</tbody>
</table>

**NOTE:** Physician/health care provider must prescribe education and training

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Cavanagh J, et. al. FAQ: Alternatives to "incident-to" billing for revenue generation in non-facility (physician-based) ambulatory clinics for pharmacists. Available from: ashp.org
Kliethermes MA. Understanding health care billing basics. Pharm Today. 2017; 23 (7):57-68
Telgener P. Growing Your DSMT Program Under Healthcare Reform. AAED. Available from: www.diabeteseducator.org
### Interpretation

#### Glucose Measurements

<table>
<thead>
<tr>
<th>BG Readings</th>
<th>Sensor Duration (h:mm)</th>
<th>Manual Boluses</th>
<th>Bolus Wizard Events</th>
<th>With Food</th>
<th>With Correction</th>
<th>Overridden</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
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<td>6</td>
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<td>4</td>
<td>4</td>
<td>2</td>
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<td></td>
<td>5</td>
<td>4</td>
<td>1</td>
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</tr>
</tbody>
</table>

#### Bolus Events

<table>
<thead>
<tr>
<th>Fill Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>rewind</td>
</tr>
<tr>
<td>cannula fills</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

Interpretation

Top Number: BG Meter Reading
Highlighted in gold if above target or red if below target

Middle Number: Carbohydrates
In black background

Bottom Number: Bolus insulin delivered

![Image of a glucose monitoring chart with explanations of different numbers and actions for varying blood glucose levels.]

- > 180mg/dL: Multiple readings (most extreme shown)
- < 70mg/dL: Manual bolus or bolus with correction
- Suspended: Suspend
- Threshold Suspended: Threshold Suspend
- Exercise: Exercise
- Partial day: Partial day
- Pump rewind: Pump rewind
- Skipped meal: Skipped meal

Photo: https://professional.medtronicdiabetes.com/ed-module-professional-reports
### Interpretation

<table>
<thead>
<tr>
<th></th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Dinner</th>
<th>Daily Totals</th>
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<tbody>
<tr>
<td><strong>Monday</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/09/2015 AM</td>
<td>11.7</td>
<td>11.5</td>
<td>10.6</td>
<td>Average (5): 10.8mmol/L</td>
</tr>
<tr>
<td>12 PM</td>
<td>6.6</td>
<td>5.5</td>
<td>6.9</td>
<td>Insulin: 71.6 IU, Bolus: 59%</td>
</tr>
<tr>
<td>6 AM</td>
<td>1.8</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tuesday</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/09/2015 AM</td>
<td>14.9</td>
<td>9.6</td>
<td>11.8</td>
<td>Average (5): 9.4mmol/L</td>
</tr>
<tr>
<td>12 PM</td>
<td>7.3</td>
<td>6.8</td>
<td>11.0</td>
<td>Insulin: 74.4 IU, Bolus: 59%</td>
</tr>
<tr>
<td>6 AM</td>
<td>11.8</td>
<td>5.5</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td><strong>Wednesday</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/09/2015 AM</td>
<td>14.4</td>
<td>5.2</td>
<td>9.4</td>
<td>Average (5): 9.3mmol/L</td>
</tr>
<tr>
<td>12 PM</td>
<td>14.0</td>
<td>5.2</td>
<td>12.6</td>
<td>Insulin: 65.7 IU, Bolus: 54%</td>
</tr>
<tr>
<td>6 AM</td>
<td>3.0</td>
<td>3.5</td>
<td>4.8</td>
<td></td>
</tr>
<tr>
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<tr>
<td>13/09/2015 AM</td>
<td>8.9</td>
<td>3.5</td>
<td>9.4</td>
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<tr>
<td>12 PM</td>
<td>3.2</td>
<td>3.5</td>
<td>12.8</td>
<td>Insulin: 64.0 IU, Bolus: 53%</td>
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<tr>
<td>6 AM</td>
<td>3.0</td>
<td>3.5</td>
<td>4.3</td>
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<tr>
<td><strong>Friday</strong></td>
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<tr>
<td>14/09/2015 AM</td>
<td>10.1</td>
<td>5.3</td>
<td>43.44</td>
<td>Average (2): 7.2mmol/L</td>
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<tr>
<td>12 PM</td>
<td>4.5</td>
<td>5.10</td>
<td>43.77</td>
<td>Carbs: 37g</td>
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<tr>
<td>6 AM</td>
<td>1.2</td>
<td>5.1</td>
<td>4.70</td>
<td>Insulin: 70.7 IU, Bolus: 59%</td>
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Photo: https://professional.medtronicdiabetes.com/ed-module-professional-reports
## Interpretation

### Basal

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<tr>
<td>09:00</td>
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### Bolus

#### Insulin Sensitivity (mg/SLU)

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<th>Sensitivity</th>
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#### Carb Ratio (g/L)

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<th>Ratio</th>
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<td>00:00</td>
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<tr>
<td>11:30</td>
<td>10.9</td>
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<tr>
<td>16:30</td>
<td>10.3</td>
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### Missed Bolus Reminder

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<th>End (h:mm)</th>
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<tr>
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<td></td>
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</table>

### BG Target (mg/dL)

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### Utilities

- **Alert Type:** Beep + Long
- **Threshold Suspend (mg/dL):** 60
- **Low Reserve Warning:** Inactive
- **Amount:** 20 U
Mobile Apps

• **Turn your phone into an insulin pump!**
  - t:simulator™ App (Tandem Diabetes Care, Inc.)
  - Minimed™ 670G System Simulator (Medtronic, Inc.)
  - Omnipod Simulator App (Insulet Corporation)
  - Any many more!
LH’s pump is downloaded in office. Is changing his infusion site at an appropriate frequency based off of the report download? **Select the correct response**

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**A. Yes**  
**B. No**
Summary

Overview and Conclusion
• The technologic advancements of CSII devices can have an impact on optimizing blood glucose control

• By understanding the specific features of various insulin pump devices, pharmacists can identify appropriate patient candidates and provide personalized patient education, as well as, disease management
Future of Insulin Pumps

- Mobile applications
- Closed loop systems/automated insulin delivery
- Interoperable insulin pump
  - Feb. 2019, t:slim X2™ insulin pump is the first to receive approval in a new device category called alternate controller enabled infusion (ACE) pumps

Tandem Diabetes Care. FDA's new ACE pump classification for the t:slim X2 insulin pump. Available from: www.tandemdiabetes.com
Complete Reference List


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- Kliethermes MA. Understanding health care billing basics [Internet]. Pharm Today. 2017; 23 (7):57-68
