Disclosures

- I do not have any conflicts of interest or financial disclosures

- To receive contact hours for this continuing education activity, the participant must:
  - Attend the entire session
  - Complete the program evaluation at the completion of the event.

Objectives

- Differentiate treatment options for Type I and Type II diabetes

- Describe medications for diabetes in terms of mechanisms of action, nursing implications, and patient teaching principles

- Apply principles of insulin pump therapy

- Identify measures to prevent and treat hypoglycemia
A NEW FOCUS ON DIABETES CARE

**Definition:** Diabetes Mellitus is a group of diseases characterized by high blood glucose levels that result from defects in the body’s ability to produce and/or use insulin. Diabetes is a highly prevalent, debilitating and costly disease that increases the risk for other serious health conditions (e.g., heart disease, stroke, kidney disease, blindness, and lower-extremity amputation).

**Statistics:** Approximately 26 million children and adults in the US (6.3%) of the population have diabetes. Wichita County has a prevalence of 11.9% of the population with diabetes, which is higher than the state average of 8.7%. At United Regional, every day at least 30% of inpatients are being treated for abnormal glucose levels.

By 2030, it is estimated that 552 million people worldwide will have diabetes. The prevalence of diabetes worldwide increased dramatically in children between 2000 and 2009. Children with Type 1 DM had a 21% increase between these years, with a 50% increase in children with Type 2 DM (Pediatric Academic Society meeting, Vancouver, Canada, 2014). These dramatic increases mean of lifetime of difficult and costly treatment for the patient, caregivers, and health organizations.

**Implications:** All nurses, whether in the acute care, outpatient, long term care, school, or home health, or medical office setting, etc., have a role in the healthcare system to help the patient manage their diabetes. The goal of this course is to help the nurse to understand current guidelines and best practices in order to provide quality nursing care that is consistent with ADA guidelines, but individualized based on an assessment of the patient’s specific needs.

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**INSULIN OVERVIEW**

**Insulin classifications:**
1) basal (long-acting), examples: Lantus and Levemir
2) bolus (rapid-acting), examples: Novolog, Humalog, Apidra (short-acting), example: Regular insulin (Humulin R or Novolin R)
3) Intermediate, example: NPH (Humulin NPH or Novolin NPH)
4) Mixed Insulin, example: Novolog Mix 70/30; Humalog Mix 75/25; Humalog Mix 50/50 Novolin 70/30

- **BASAL (slow release)—**
  1. Provides “relatively” flat 24 hour coverage.
  2. Used to control blood sugars between meals and overnight.
  3. Can be dosed once or twice daily (if b.i.d., space 12 hours apart).
  4. Important to take basal insulin at consistent times.
  5. Does not have to be “timed” to food intake. Not intended to “cover” food intake. (Basal insulin is given, even if the patient is NPO).
  6. Bedtime snacks are not required with Lantus or Lantus at night (if the dose is correct). Should never have to “eat up” to insulin dose to prevent low Blood sugar.
  7. Do not mix Lantus or Lantus with any other insulin in the same syringe.

- **BOLUS (fast release)—** Used for two purposes—mealtime and correction
  1) Mealtime insulin (prandial) used to control BG related to food intake.
     - Patient must be eating at least 50% of the carbs on their plate.
     - Should be given at the start of the meal or immediately after they have eaten (if you are not sure if the patient will eat 50% of the carbs). Do not give if greater than 30 minutes has passed since completion of the meal.
  2) Correction insulin (sliding scale). This insulin corrects a high glucose (above target) when blood sugars are checked before meals or at bedtime.
     - Correction insulin should be given regardless of appetite/intake or NPO status.
     - The duration of Novolog/Humalog is 4 hours. Do not administer additional correction sooner than 6 hours apart.
     - The duration of Regular is 6 hours. Do not administer additional correction sooner than 6 hours apart.
     - This is considered “stacking” insulin, and can lead to hypoglycemia.
     - If the physician/provider orders 2 hour postprandial BG checks, these checks are timed from the start time of the meal and are used to evaluate the effectiveness of the mealtime insulin dose and should not be corrected with additional insulin.
     - It is NEVER necessary to give someone food or snacks when administering correction insulin. Giving food with “correction” insulin defeats the purpose of the correction (because BG is already too high). The FSBG must be checked within 30” prior to a meal. Do Not check if patient has already started eating.
Mealtime and correction should be given as one dose (to avoid 2 sticks!)

- NPH (intermediate) (Humulin is Eli Lilly, Novolin is Novo Nordisk)
  - morning dose is administered with breakfast.
  - evening dose is given either with supper meal or bedtime.
  - Begins working (onset) in approximately 1.5 hours, but peak and duration are variable. Peak - 2 to 12 hours. Duration - 14-24 hours.
  - some patients on NPH may benefit from h.s. snack (if NPH is taken at supper, instead of bedtime)
  - roll vial briskly 10+ times before drawing into syringe.

- Mixed insulin—example: Novolog Mix 70/30 (70% intermediate/30% rapid)
  - to be administered with AM and PM meals only.
  - when given with supper meal, this insulin peaks around 2 a.m., therefore this patient requires an h.s. snack to prevent nocturnal hypoglycemia.
  - roll vial briskly 10+ times before drawing into syringe.

GENERAL REMINDERS ABOUT INSULIN:

1) Insulin injection sites must be rotated to prevent scar tissue. Try to keep injections about 2 inches apart. Never aspirate after administering the insulin and avoid massaging or rubbing the injection site.

2) Keep insulin needle (whether using a pen device or syringes) under the skin after the injection for 6-10 seconds to help prevent insulin from leaking from the site.

3) Once opened, a bottle of insulin can be stored at room temperature. (Approx. 30 days)

4) Unopened vials of insulin or insulin pens should be stored in the refrigerator until they are opened for use.

5) Once a pen device goes into use, do NOT return to the refrigerator. Leave at room temperature. Insulin pen device should be “primed” before each use.

KEY NURSING POINTS RELATED TO FINGERSTICK BLOOD GLUCOSE CHECKS:

ADA Recommended Targets for Blood Sugar Control in Adults with Diabetes

<table>
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<tr>
<th>Before eating</th>
<th>Normal</th>
<th>Target</th>
<th>When to take Action</th>
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<tr>
<td>&lt;100mg/dl</td>
<td>80-130mg/dl</td>
<td>&lt; 70 or greater than 150mg/dl</td>
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**A pre-meal BG check needs to be done when the patient has not eaten carb-containing food or drink for 4 hours. (Carb-free snacks allowed, ex. Nuts, cheese, meat) Therefore:

1. Encourage the patient to NOT eat sooner than 4 hours between meals in order for BG to be accurate. Consistent carbs at consistent times is beneficial to blood sugar control.

2. Bedtime blood sugar must not be checked sooner than 4 hours after the patient has eaten his/her dinner.

**TREATMENT OF HYPOGLYCEMIA**

ADA guideline is to treat blood sugar less than 70mg/dl in diabetes patients.

Key Points for Nursing:

- Assess for symptoms—patient might be sweaty, shaky, irritable; have decreased level of consciousness, headache, hunger, visual changes.
- Check BG right away (if possible!)
- Rule of 15—15 grams of fast-acting sugar, then retest in 15 minutes. If BG is less than 70mg/dl, will require 30 grams of fast-acting sugar. Recheck in 15 minutes. Continue to treat and re-test until BG is greater than 70mg/dl. Once 70mg/dl or above, give snack or meal that contains protein and fat to help stabilize blood sugar.
- Try to determine precipitating factor in order to prevent future hypoglycemia.
- Is the hypoglycemia part of a pattern that requires a medication adjustment?
- Follow your facility’s policy for documentation of the event.

**15 gram treatment options—4 ounces of juice (1/2 cup); 4 ounces of regular soda; 1 tablespoon jam/pickle/honey/sugar/etc.; 1 cup of skim milk; 4 glucose tablets.

**A “meal tray” is NOT treatment for low blood sugar. Remember to treat first according to Rule of 15 before introducing fat or protein into the digestive process.
Insulin pump therapy was first introduced to patients in 1978. Pump therapy has changed considerably since then. Pumps are smaller, easier to use and many more patients use the pump than ever before.

Health Professionals recommend pumps for patients with:

1. Sub-optimal glycemic control
2. Dawn Phenomenon, with elevated fasting blood sugars
3. Insulin resistant patients with type 2 diabetes or prediabetes
4. Night time hypoglycemia
5. Post-prandial hyperglycemia
6. Widely fluctuating blood sugars (“brittle” diabetes), even in those with a “good” A1C
7. Insulin requirement of less than 30 units per day or large doses requiring > 100 units per day
8. Frequent travel
9. Variable work schedule (especially shift work)
10. Frequent meals (ex. use of for athletes)
11. Reminders to bolus for carbs and test blood glucose (alarm reminders)
12. Tracking insulin doses, carbs, glucose levels, and other information critical to glucose control. (Pump History review capability)
13. Preventing, delaying or reversing complications
14. Improving control during growth and puberty in children and adolescents
15. Managing gestational diabetes with its erratic food absorption
16. Preparing for conception or during pregnancy
17. Frequent hospitalizations
18. Frequent swings in blood sugars for diabetics
19. Improved quality of life due to increased flexibility (examples: convenience, less frequent “sticks”, improved matching of insulin delivery to body’s variable needs, assistance with carb calculations, etc.)
Purpose of Insulin therapy:

Insulin delivery must mimic the way the body naturally works. In non-diabetes patients, beta cells release precise amounts of insulin to cover basic needs:

1) background insulin is released as a steady flow to control blood sugars 24/7 by directing the uptake of glucose as fuel.
2) Short bursts of insulin to match the carbohydrate content of food eaten.

Purpose of MDI or pump therapy is to provide “background control” through long acting insulin by injection (Lantus, Levemir or intermediate NPH) or basal settings programmed in the pump. Also, to provide boluses (quick release of insulin, example Novolog, Humalog, Apidra or Regular) for food consumed or for correction to lower a high blood sugar.

Some disadvantages of Insulin Injections and advantages of Pump therapy:  

1. Inconvenience of MDI (requires an insulin bottle and syringe/ or pen device be available at all times, even at restaurants).
   * More convenient: Pump is attached to the body and newer models are very discreet.

2. Lack of precision with MDI (lowest dose is ½ unit using a pediatric syringe or pen).
   * More precision with Pump: can deliver insulin in increments as small as 0.025 (twenty five thousandths) of a unit.

3. Variable daily activity levels are hard to control with 1 or 2 injections of a long-acting insulin. Once the injection is given, it cannot be “taken back” and will continue to work until it has worn off.
   * Basal delivery from a pump can be more easily matched to the changing background needs of those who have Dawn’s Phenomenon, who work different shifts, who engage in physical activity at different times, etc. The pump can be suspended, if needed.

4. Unusual circumstances such as illness, periods of stress, steroid therapy, etc. are harder to control with injections.
   * Pump has a “temporary” Basal feature for increases or decreases to the background basal settings.

1. Patients often “tire” of taking numerous injections daily and may skip injections
   * Pump sites are typically changed every 1-3 days (depending on the total dose of insulin required by the patient) Patient needs to check BG 4 times a day for best results and enter carbs, and the pump will deliver the dose needed based on the ICR and ISF programmed in the pump.

2. Tendency not to take additional injections between meals for snacks consumed.
   * Can easily program additional carbs consumed into the pump, which will deliver the additional insulin for the snacks, etc.

3. Easy to “forget” if injections were given or not.
   * Pump records a “history” of boluses for patients to review.

4. Excess bolus insulin and insulin stacking with MDI, leading to hypoglycemia.
   * Pump features such as the ICR, ISF and IOB to help deliver precise carb bolus amounts, and keeps track of active insulin from previous boluses when a new bolus is attempted to prevent stacking of insulin.
DRAWBACKS TO PUMPING: Patient must be motivated (learning curve) and be able and willing to check blood sugars at least 4 times a day and count carbs.

1. It is a mechanical device that depends on several components to work properly. Though not common, there are instances of pump failures.
2. Attachment to a ‘device’ may seem inconvenient or embarrassing.
3. Ketoacidosis remains a higher risk for a Type 1 insulin pump wearer (the pump only uses fast-acting insulin). The longer-acting insulin such as Lantus or Levemir can help protect against ketoacidosis. If the pump delivery is interrupted for any reason, the blood sugar can start to rise as the insulin levels fall (the duration of Novolog and Humalog being only 4 hours).
4. As the insulin levels fall and glucose is no longer available for fuel, the body will start to burn fat for energy. As more and more fat is consumed, production of acid by-products (ketones) build up in the bloodstream, leading to a dangerous and life-threatening condition called Diabetic Ketoacidosis.
5. Site issues—infection and irritation is a greater risk with a pump because an infusion set typically remains in place for 2-3 days.
6. Expense of the pump and ongoing supplies.

BASIC SAFETY MEASURES FOR YOUR PUMP PATIENT:

In our facility, a patient may stay on the insulin pump (with a physician order) if the patient or their family member/caregiver is physically and mentally able to perform the basic functions of pump therapy (entering blood sugars and food carbs for the bolus doses) and changing the infusion set/site. Our patients are required to bring their own supplies, since these are not stocked in the hospital.

KEY POINTS:

1.) No additional subcutaneous or IV insulin is to be administered when the patient is on the pump.
2.) When removing an insulin pump for MRI or X-rays, the pump must be removed immediately after the procedure.
3.) Leave the pump in place and infusing even if the patient is NPO.
4.) Cognitive or physical decline (unless a family member is managing the pump) require pump removal and conversion to multiple-dose injections.
5.) Interruption of insulin delivery due to infusion set/site problems or pump malfunction can lead to the development of DKA in as little as 4 hours.
6.) Treatment of hypoglycemia promptly. Patterns of hypoglycemia (more than twice in the same time frame in a week) require a setting adjustment and must be reported to the PCP.
7.) Treat hyperglycemia promptly. Patterns of hyperglycemia (not explained by something such as forgetting to bolus for food) also require setting adjustment and should be reported to the PCP.
8.) If the insulin pump is removed due to patient condition, etc., insulin therapy must be continued by IV or Sub Q. Failure to continue insulin may result in DKA.
9.) All pumps have an 800 Help number on the back of the pump for help/questions regarding the mechanics of the pump (how to clear alarms, what alarms mean, etc.).

Site Problems:
1.) Preferred site is the abdomen as insulin absorption is faster, more predictable, and not as affected by activity (such as walking) as other body parts.
2.) Avoid 2 inch area around belly button and each new site should be at least one inch from last site placement.
3.) Assess infusion site to look for signs of infection, irritation, dislodgement, leakage.
INSULIN PUMP HIGH BLOOD SUGAR CHECKLIST

The first sign of a pump problem is usually an “unexplained” high blood sugar. When unexplained high sugars occur, keep site problems, mechanical problems and bad insulin in mind as possible causes. (**Ask patient/family member to check the Bolus History to see if the patient did bolus for their last meal.) Also, was the blood sugar check done at an appropriate time? (example, not shortly after patient ate meal, high carb snack, etc.)

1). If blood sugar is 300 or greater and is “unexplained”:
   - Check pump tubing for kinks or air bubbles
   - Check site for dislodgement, redness or leakage
   - Patient needs to take “correction” insulin via the pump
   - Check urine for ketones. If ketones are moderate to large, call MD immediately
   - Encourage water intake, if physical condition permits
   - RECHECK BG IN 1 HOUR after patient took the “correction dose” of insulin

If BG has not improved and is the same or higher: Most suspect that insulin was not delivered:
   - Give correction insulin using a syringe/vial (give the dose that the patient was to have received from the pump, that was not delivered)
   - Patient to disconnect infusion set and insert new reservoir and infusion set in NEW SITE
   - Check urine ketones
   - Continue to encourage water intake (if condition permits)
   - Continue to monitor blood sugars every hour and take correction through pump until blood sugars have returned to target range. Continue to test for urine ketones until negative