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Case Study #16  
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### Case Study #16: Pediatric T2DM

1. What are the risk factors for developing type 2 DM as a child? What do the current ADA standards of medical care recommend concerning screening at-risk children?
  - a. Risk factors for developing type 2 DM as a child would be obesity, family history, race/ethnicity, and physical inactivity. The current ADA standards of medical care recommend screening children if they have a BMI > 85<sup>th</sup> percentile, or weight >120% of ideal for height plus two other risk factors. These other risk factors include family history of T2DM in the first or second relative, race/ethnicity of Native American, African American, Latino, Asian American, or Pacific Islander, or sign of insulin resistance. Screening should be completed at the age of 10 years old or at the onset of puberty if puberty occurs at a younger age and should be done every two years. The standards also prefer fasting plasma glucose for the method of testing. (Nelms, 2011, pg. 499).
2. Evaluate Adane's medical record. Identify which risk factors most likely led to the routine screening for DM during her physical.
  - a. Adane's most prominent risk factors would begin with her severely high BMI of 36.4. This is well above the 100<sup>th</sup> percentile and the ADA recommends that any BMI above the 85<sup>th</sup> percentile be tested. Her other risk factors would include her African American race, family history through her mother and grandmother who both also have T2DM. Adane's mother was also diagnosed with gestational diabetes during pregnancy. She displays multiple risk factors for T2DM, which is what led to the screening for the condition.
3. What are the ADA standard diagnostic criteria for T2DM? Which are included in Adane's medical record?
  - a. According to the ADA, the standard diagnostic criteria for T2DM are an A1C level 6.5% or above, a fasting plasma glucose 126 mg/dL or above, or an oral glucose tolerance test of 200 mg/dL or above. Adane qualifies with her A1C level at 6.9%, her estimated average glucose was 151 mg/dL, and glucose levels of 171 and 155 when tested; all of which are indicative of T2DM. (NDIC, 2014).

4. Adane's physician requested additional testing that included autoantibody levels and C-peptide. Explain why these tests were done and what the results indicate for Adane.
  - a. An autoantibody test would be beneficial to help differentiate if whether Adane has T1DM or T2DM. T1DM is an autoimmune disease thus the detection of autoantibodies would indicate T1DM rather than T2DM. Tests used to detect the autoantibodies would be the islet cell cytoplasmic autoantibodies (ICA), the insulin autoantibodies (IAA), and the glutamic acid decarboxylase autoantibodies (GADA), and the insulinoma-associated-2-autoantibodies (IA-2A). Adane is negative for each of these tests, further indicating the absence of T1DM. C-peptide is released when insulin is secreted as two polypeptide chains joined by disulfide bonds and the chains separate. This indicates the level of insulin production in the body. Therefore, Adane's high level of C-peptide indicates that her body is producing insulin but it is not being utilized. (Nelms, 2011, pg. 485).
  
5. Insulin resistance is a major component of T2DM. Explain this pathophysiology. How could you determine whether Adane is exhibiting insulin resistance?
  - a. Individuals with T2DM have the ability to produce insulin, however their tissues are insulin resistant. This causes an increased need for insulin so the pancreas produces more insulin, which explains high levels of C-peptide in type 2 diabetics. Eventually the pancreas loses its ability to produce insulin. This resistance is caused by a cell-receptor defect in which cells are no longer able to respond to insulin by translocating glucose transporters to their outer membrane, resulting in the inability to take up glucose. One could determine whether Adane is exhibiting insulin resistance by her lab values. If she is not utilizing the insulin being produced, her C-peptide levels will be normal to high and her fasting blood glucose and A1C levels would be high. This would indicate that her body is producing the insulin, but is resistant and not using the insulin. (Nelms, 2011, pg. 499).
  
6. Children with T2DM are at high risk for early cardiovascular disease. Why does this complication occur with diabetes? Evaluate Adane's lipid profile. How does this compare to the lipid goals for children with diabetes?
  - a. Children with T2DM are at a high risk for early cardiovascular disease because they often have other complications as a result of being overweight or obese. Other complications include high blood pressure, abnormal cholesterol and high triglycerides, obesity, lack of physical activity, and poorly controlled blood sugars all of which contribute to cardiovascular disease. Adane is obese and her cholesterol and triglyceride levels are both high. Her cholesterol is 210 mg/dL compared to the normal range of < 170 mg/dL and her

triglycerides are 175 mg/dL compared to the normal range <150 mg/dL. Cholesterol levels are difficult to establish for children because they tend to fluctuate through puberty however, the ADA suggests lipid goals for children with diabetes should have an LDL below 100 mg/dL and triglyceride levels below 150 mg/dL to be considered normal.

(American Heart Association, 2013).

7. Adane's grandmother asks about medication for treating high cholesterol as her husband is on this medicine. What are the recommendations for the use of statin drugs in children?
  - a. Original recommendations advised against the use of statins in children due to concerns of toxicity in the liver and muscle growth. More recent research is discovering that children who receive statins in their early years have a lower risk of CVD. Because research is still being conducted, recommendations state that attempts to lower cholesterol should first be done with diet and increased physical activity.  
(American Heart Association, 2013).
8. Adane's urinalysis is positive for protein. What does this mean and how may this be related to her diabetes?
  - a. Protein in the urine is common among diabetic patients because diabetes can damage the filtration system of the kidneys. The excess glucose in the blood causes the kidneys filter too much blood. Eventually, the filters are damaged, start to leak, and useful protein is lost in the urine.  
(American Diabetes Association, 2014).
9. Should Adane and her family be taught about self-monitoring blood glucose? If so, what are the standard recommendations for daily frequency of testing? What would be the appropriate fasting and postprandial target glucose levels for Adane?
  - a. Adane should be taught about self-monitoring blood glucose. SMBG is the ideal method to help individuals know and attempt to achieve their blood glucose goals for various times of the day. Frequency of monitoring is suggested to test as often as needed to achieve glycemic goals, before and after physical activity, and to ascertain existence of hypoglycemia and reaction to treatment. The appropriate fasting and postprandial target glucose levels Adane are a preprandial glucose level between 70 – 130 mg/dL and a postprandial glucose level <180 mg/dL. (Nelms, 2011, pg. 494 & 500).
10. Outline the basic principles for Adane's nutrition therapy to assist in her T2DM.
  - a. The basic principles for Adane's nutrition therapy for her T2DM primarily focus on avoiding hyperglycemia and implicating weight

management since T2DM is strongly correlated with overweight and obesity. Moderate weight loss improves glycemic control and reduces CVD risk. Monitoring carbohydrate intake is also a major tool in nutrition therapy for T2DM. The use of the exchange system or carbohydrate counting help to control carbohydrate intake. Diabetic patients who have nephropathy should not exceed 0.8g/kg or 10% of total kcal for protein intake. A higher fiber intake has also proven beneficial in lowering serum glucose levels. Fibrous foods containing gums, beta-glucans, psyllium, resistant starches, and pectin appear to have the biggest impact on glucose serum levels by slowing the absorption of glucose from the small intestine. Finally, Adane's fat intake should be about 7% of her daily intake because she is at such a high risk for CVD. These strategies along with increased physical activity, diet modification through healthier diet habits, and proper insulin use comprise the nutrition therapy for Adane's T2DM. (Nelms, 2011, pg. 505-506).

11. Assess Adane's ht/age; wt/age; ht/wt; and BMI. What is her desirable weight?
  - a. Adane is 52" at 9 years old. This puts her at about the 50<sup>th</sup> percentile for her age according to the CDC growth charts.
  - b. Adane's weight is 140 lbs at 9 years old. This puts her well over the 100<sup>th</sup> percentile for her age.
  - c. As far as Adane's height for weight and BMI, she is 52" at 140 lbs. This makes her BMI 36.4, which is severely over the 100<sup>th</sup> percentile for her age. A BMI of 36 is considered obese.
    1. BMI:  
$$\text{BMI} = \text{Weight (lbs)} / [\text{Height (in)} \times \text{Height (in)}] \times 703$$
$$\text{BMI} = 140 \text{ lbs} / [52 \text{ in} \times 52 \text{ in}] \times 703$$
$$\text{BMI} = 140 \text{ lbs} / 2704 \text{ in} \times 703$$
$$\text{BMI} = 0.051 \times 703$$
$$\text{BMI} = 36.4$$
  - d. Adane's desirable weight should be between 60 and 70 lbs in order to place her at the 50<sup>th</sup> percentile for her height-for-age.
12. Identify any abnormal laboratory values measured upon her admission. Explain how they may be related to her newly diagnosed T2DM.
  - a. Adane's abnormal lab values include: high glucose, high cholesterol, high triglycerides, high HbA1c, high EAG, high C-peptide, protein in her urine, glucose in her urine, and prot chk in her urine. Adane's high cholesterol and high triglyceride levels are due to her obese condition from poor diet and lifestyle habits. Her elevated glucose level is one of the major indicators of T2DM. The glucose is not being utilized for energy. The HbA1c measures the plasma glucose concentration therefore the diabetes diagnosis explains the high HbA1c levels. The C-peptide can show how much insulin is being produced

because it is released when the disulfide bond is broken between the insulin chains. Therefore her high C-peptide levels are consistent with T2DM because it indicates that insulin is being produced, but it is not being utilized as indicated by the high levels of glucose in the blood. Protein and glucose in the urine is common among diabetic patients because diabetes can damage the filtration system of the kidneys. The excess glucose in the blood causes the kidneys filter too much blood. Eventually, the filters are damaged, start to leak, and useful protein is lost in the urine. (Nelms, 2011, pg. 483-485). (American Diabetes Association, 2014).

13. Determine Adane’s energy and protein requirements. Be sure to explain what standards you used to make these estimations. Should weight loss be a component of your estimation of energy requirements?

a. TEE for Overweight Females Aged 3-18 Years:

$$TEE = 389 - 41.2 \times \text{age} + PA \times 15.0 \times \text{Weight} + 701.6 \times \text{Height}$$

$$\text{Weight} = 140 \text{ lbs} / 2.2 \text{ lbs} = 63.6 \text{ kg}$$

$$\text{Height} = 52'' \times 0.254 = 1.32 \text{ m}$$

$$PA = 1.18 \text{ due to low physical activity level}$$

$$TEE = 389 - 41.2 \times 9 \text{ years} + 1.18 \times 15.0 \times 63.6 \text{ kg} + 701.6 \times 1.32 \text{ m} =$$

$$\mathbf{2070 \text{ kcal/day}}$$

Adane’s energy requirements are between 2,000 and 2,100 kcals per day.

b. Protein requirements for diabetic patients is 15-20% of daily kilocalories from animal and vegetable protein sources. (Nelms, 2011, pg. 490).

$$\text{Protein} = 2070 \text{ kcal} \times 15\% = 310.5 \text{ kcal}$$

$$= 2070 \text{ kcal} \times 20\% = 414 \text{ kcal}$$

$$\text{Protein} = 310.5 \text{ kcal} / 4 \text{ kcal/g} = 77.6 \text{ grams}$$

$$= 414 \text{ kcal} / 4 \text{ kcal/g} = 103.5 \text{ grams}$$

Adane should consume 77 – 104 grams of protein per day.

c. Typically weight loss is not recommended that children who are still growing and developing. Therefore, weight loss is not recommended. However, Adane’s intervention goals will focus on improving her dietary habits, increasing her physical activity, which will indirectly slow her rate of weight gain. (Weight Watchers Research Department, 2014).

14. Using Adane’s diet history, assess the approximate number of kilocalories her intake provided, as well as the energy distribution of calories for protein, carbohydrate, and fat using the exchange system. Compare this to the recommendations that you made in question #10.

Food	Exchange	Protein	Carbohydrate	Fat	Calories
Breakfast					

Fruit-punch (1c)	1 c = 2 CHO	0 g 0 kcal	30 g 120 kcal	0 g 0 kcal	120
Frosted Flakes (2c)	2 c = 4 starch	4 g 16 kcal	60 g 240 kcal	4 g 36 kcal	292
Whole Milk	1 c = 1 milk	8 g 32 kcal	12 g 48 kcal	8 g 72 kcal	152
<b>Morning Snack</b>					
Toast (2 slices)	2 slices = 2 starches	0 g 0 kcal	30 g 120 kcal	0 g 0 kcal	120
Butter	1 tsp. = 1 fat	0 g 0 kcal	0 g 0 kcal	5 g 45 kcal	45
Jam	1 tbsp = 1 CHO	0 g 0 kcal	15 g 60 kcal	0 g 0 kcal	60
<b>Snacks</b>					
Chocolate chip cookies (2 cookies)	2 cookies = 2 CHO, 1 fat	0 g 0 kcal	30 g 120 kcal	5 g 45 kcal	165
Cheetos (2 small bags)	2 oz. = 2 starch, 4 fat	4 g 16 kcal	30 g 120 kcal	20 g 180 kcal	316
Fruit punch (3c)	3 c = 6 CHO	0 g 0 kcal	90 g 360 kcal	0 g 0 kcal	360
Popsicles (2)	2 = 1 CHO	0 g 0 kcal	15 g 60 kcal	0 g 0 kcal	60
<b>Lunch</b>					
Peanut butter (2tbsp)	2 tbsp = 4 fat	0 g 0 kcal	0 g 0 kcal	20 g 180 kcal	180
Bread (4 slices)	4 slices = 4 starch	0 g 0 kcal	60 g 240 kcal	0 g 0 kcal	240
Mayo (1 tbsp)	1 tbsp = 3 fat	0 g 0 kcal	0 g 0 kcal	15 g 135 kcal	135
Banana	8 oz. banana = 2 fruit	0 g 0 kcal	30 g 120 kcal	0 g 0 kcal	120
Fruit punch (2c)	2 c = 4 CHO	0 g 0 kcal	60 g 240 kcal	0 g 0 kcal	240
Chips	1 oz. = 1 starch and 1 fat	1 g 4 kcal	15 g 60 kcal	5 g 45 kcal	109
<b>Dinner</b>					
Fried pork chop (2oz.)	2 oz. = 2 high fat meat	14 g 56 kcal	0 g 0 kcal	16 g 144 kcal	200
Greens	1 cup raw = 1 nonstarchy vegetable	2 g 8 kcal	5 g 20 kcal	0 g 0 kcal	28
Potatoes	½ large = 2 starch	2 g 8 kcal	30 g 120 kcal	0 g 0 kcal	128
Cornbread	1 ¾" cube = 1	0 g	15 g	5 g	105

	starch	0 kcal	60 kcal	45 kcal	
Butter	1 tsp. = 1 fat	0 g 0 kcal	0 g 0 kcal	5 g 45 kcal	45
Iced tea with sugar	1 tbsp. sugar = 1 CHO	0 g 0 kcal	15 g 60 kcal	0 g 0 kcal	60
<b>Bedtime</b>					
Pizza rolls	4.5 oz. = 3 CHO, 1 lean meat, 2 fat	7 g 28 kcal	45 g 180 kcal	10 g 90 kcal	298
Coke	1 can = 2.5 CHO	0 g 0 kcal	37.5 g 150 kcal	0 g 0 kcal	150
<b>Totals:</b>		<b>Protein</b>	<b>Carbohydrate</b>	<b>Fat</b>	<b>Calories</b>
		168 kcal	2498 kcal	1062 kcal	3728
		4% of total kcal	67% of total kcal	29% of total kcal	

Adane's diet exceeds her estimated intake requirements by about 1,500 kcals per day, which will severely impact her obese condition as well as her T2DM. Her protein intake is low while her carbohydrate intake is too high. Though her fat intake is within the 25-35% range, it appears that she is consuming an excess amount of saturated fats. She has a very limited intake of fruits and vegetables. Adane will need to decrease her intake of high calorie, high fat foods and increase her lean protein, fruit, and vegetable consumption. (Nelms, 2011, pg. A109-A122).

15. Prioritize two nutrition problems and complete the PES statement for each.
  - a. **NC-3.3:** Overweight/Obesity related to physical inactivity and excessive energy intake as evidenced by patient's BMI.
  - b. **NI-1.4:** Excessive energy intake related to poor food choices and food and nutrition related knowledge deficit as evidenced by 24-hour diet recall and high BMI of 36 kg/m<sup>2</sup>.
  
16. Determine Adane's initial nutrition therapy prescription using her diet record from home as guideline, as well as your assessment of her energy requirements.
  - a. Initial nutrition therapy prescription for Adane would include consuming 2,000-2,100 kcal/day based on her current weight and height and low active lifestyle. Adane should consume 77-104 grams of protein per day to meet 15-20% of her total kcal from protein sources. Her fat consumption should be 57.5-80.5 grams of fat per day to meet 25-35% of her total kcal from fat sources with less than 7% coming from saturated fats. The remaining 45-55% kcals should come from carbohydrates, which is 233-285 grams of carbohydrate per day. Based on Adane's diet recall, she needs to replace her high fat, high calorie snacks and meals with lower fat, lower calorie

options. She also drinks many sugar-sweetened beverages thus, she should decrease her consumption of sugar-sweetened beverages by limiting and replacing the them with water. Adane should also increase her fruit and vegetable consumption.

17. Outline the initial steps you would use to teach Adane and her family about nutrition and diabetes. What education materials could you use?
  - a. First and foremost, Adane's intervention will focus on managing her T2DM and avoiding hyperglycemia. Because she is only 9 years old, Adane's family will be a large contributor to her success in managing her condition. The intervention strategies will include the entire family to make sure they are all on the same page. Instruction on meal planning, carbohydrate counting, and the exchange system will be vital tools for controlling her blood glucose levels. Educational materials on the exchange system and carbohydrate counting would be given to Adane and her family as well as a sample meal plan that Adane could work with to manage her condition. Adane will also need to increase her physical activity to help with her weight management as well as her diabetes. Therefore, physical activity suggestions of 30 minutes a day at least a few times a week will be given along with a list of different activities that could accomplish the 30 minutes.
  
18. Considering that Adane will not be started on medication, is it necessary to teach her family about hypoglycemia, sick-day rules, and exercise?
  - a. Though Adane will not be started on medication, it is still necessary to teach her family about hypoglycemia, sick-day rules, and exercise because they will need to understand all realms of the condition in order to most successfully manage it. Hypoglycemia is rare for those with T2DM, however it may still occur, thus Adane and her family must have a clear understanding of hypoglycemia and prevention. Sick-day rules are still important to understand because blood glucose levels should be tested every 4-6 hours to prevent hyperglycemia as well as hypoglycemia. Finally, physical activity has proven to have a positive impact in managing T2DM because it enhances muscle blood glucose uptake during exercise due to improved glucose sensitivity. Physical activity will be one of the major focuses in Adane's intervention in order to manage her weight as well as her T2DM. (Nelms, 2011, pg. 500).
  
19. Adane's mom is worried that none of the children will ever be able to have birthday cake or other sweet treats. She feels that she cannot offer these to other children if Adane cannot have them. What would you tell her?
  - a. I would tell her that Adane may have sweet treats in smaller portions on special occasions. Large quantities of sugar are not recommended for T2DM, however sweets in moderation are still appropriate. I may also suggest some diabetic friendly recipes and products that may still



allow Adane to enjoy treats without sending her blood glucose levels off the charts.

20. Write an ADIME note for your initial nutrition assessment.

a. Assessment:

1. 9 yo. Female diagnosed with Type 2 Diabetes Mellitus and Obesity.
2. Height: 52"; Weight: 140 lbs; BMI: 36.4 kg/m<sup>2</sup>
3. Labs: high blood glucose: 171 mg/dL, high cholesterol: 210 mg/dL, high triglycerides: 175 mg/dL, high HbA1c: 6.9%, high EAG: 151, high C-peptide: 2.75ng/mL, positive protein, glucose, and prot chk found in the urine.
4. Estimated energy requirements of 2,000-2,100 kcal/day and 77-104 grams of protein/day

b. Diagnosis

1. T2DM related to elevated blood glucose, poor diet, family history, and physical inactivity as evidenced by abnormal lab values, 24-hour recall, and patient medical history.
2. **NC-3.3:** Overweight/Obesity related to physical inactivity and excessive energy intake as evidenced by patient's BMI.
3. **NI-1.4:** Excessive energy intake related to poor food choices and food and nutrition related knowledge deficit as evidenced by 24-hour diet recall and high BMI of 36 kg/m<sup>2</sup>.

c. Intervention:

1. Educate patient and family on successful strategies for managing T2DM. Provide educational materials on meal planning, carbohydrate counting, and the exchange system.
2. Suggest lower fat, lower calorie options for snacks and meal planning. Educate patient on the implications of sugar-sweetened beverages and suggesting limiting them to no more than 1 per day and replacing others with water. Finally, suggest increasing fruit and vegetable consumption.
3. Recommend at least 30 minutes of physical activity per day for client. Options for physical activity may include walking, bike riding, playing tag or hide and seek, or any other sports or hobbies that require movement.

d. Monitoring/Evaluation:

1. Provide patient with a food log to track compliance with a carbohydrate controlled diet. This may also help to track dietary changes. Evaluate compliance at follow-up session based on the log.
2. Measure patient's weight to monitor weight maintenance.

3. Reevaluate patient's laboratory results to track blood glucose maintenance as well as previously stated abnormal lab values.
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21. Adane's grandmother suggests that perhaps Adane should have "stomach surgery" so that she will lose weight more quickly. What are the recommendations for pediatric bariatric surgery?
    - a. Based on the current EAL recommendations, gastric bypass surgery is not typically considered appropriate for children under the age of 13 years old. I would not recommend weight loss surgery for Adane unless her condition significantly declined and she was not losing weight with nutrition intervention alone. (EAL, 2014).

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