



## Role of Health Educators in Assisting Youth and Adolescents with Diabetes

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### ABSTRACT

*Management of diabetes in children requires balancing nutrition, physical activity and medication on a daily basis in order to achieve blood glucose targets. The health educator can assist children and their families in meeting their diabetes management goals by better understanding the current recommendations and tasks involved to achieve them. Whereas children with type 1 diabetes require multiple injections of insulin per day or use of an insulin pump, children with type 2 diabetes may require an oral medication, insulin or both. Nutrition and physical activity recommendations are similar for children with diabetes as they are for all healthy children. Meal planning for children with diabetes usually involves a method of carbohydrate counting, since this is the main nutrient that raises blood glucose. Short term management outcomes for children with diabetes include the prevention of hypo- and hyperglycemia, while long term outcomes include the prevention of micro and macro-vascular complications.*

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### INTRODUCTION

Children with diabetes need to balance food, medication and activity on a daily basis to keep their blood glucose in, or close to, a desired target range. This paper reviews current medication management, nutrition and physical activity recommendations for children with diabetes. Diabetes management outcome recommendations also are reviewed, along with ways that the health educator can assist children and their families to achieve their individualized nutrition, physical activity and diabetes management goals.

### MEDICATION MANAGEMENT

All children with type 1 diabetes must take insulin for survival. Children with type 2 diabetes who require medication to control their blood glucose may take either an oral medication, insulin, or both. Today, new types of insulin and new delivery systems help to keep blood glucose levels in the desired range. These options, however, may require more frequent blood glucose monitoring and more assistance for the child with diabetes.

Insulin has three dimensions of impor-

tance to the successful management of diabetes: *onset*, the length of time before insulin

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reaches the bloodstream and begins lowering blood glucose levels; *peak*, the time at which insulin is at its maximum strength in terms of lowering blood glucose levels; and, *duration*, the number of hours that insulin continues to lower blood glucose levels.

Most children with type 1 diabetes require multiple injections, or they receive their insulin through a programmable insulin pump. For children using injections, there are several types of insulin that may be used in combination. The different types of insulin have been formulated to have immediate (rapid-acting or short-acting insulin), intermediate, or long (basal insulin) onset and duration of action. A coordinated combination of different types of insulin is used to allow for adequate treatment of diabetes at meals, snacks, during periods of physical activity and throughout the night. For children using an insulin pump (a computerized device), a small amount of rapid or short-acting insulin is programmed to infuse 24 hours per day (basal rate) and additional doses (boluses) of rapid or short-acting insulin are programmed before eating meals and snacks or when high blood glucose levels are attained. By being aware of how medications play an important role in managing diabetes and the challenges that a child faces everyday, the health educator can help to provide a supportive atmosphere for the child to handle this complicated disease.

## DIABETES NUTRITION RECOMMENDATIONS

The American Diabetes Association (ADA) states that nutrition recommendations for children and adolescents with diabetes should focus on achieving blood glucose goals (without excessive hypoglycemia), lipid and blood pressure goals and normal growth and development.<sup>1</sup> Today, meal plans for children with diabetes are individualized to accommodate food preferences, cultural influences, physical activity patterns and family eating patterns and schedules. Nutrient recommendations for children with diabetes are based on requirements for all healthy children and adolescents because there is little research

on the nutrient requirements for children with diabetes.<sup>1</sup>

General nutrition recommendations from the United States Dietary Guidelines for Americans and the United States Department of Agriculture for all youth 4-18 year-olds include: 3 to 10 oz. of grains, 1 to 2.5 cups of fruit, 1.5 to 4 cups of vegetables, 3 to 7 oz. of lean meats and 2 to 3 cups of milk/dairy per day. Recommendations specify that at least half of all grains consumed should be whole grains, most dairy choices should be fat free or low fat, and vegetables and fruits with a rainbow of colors should be included.<sup>2,3</sup>

Total fat intake should be 25% to 35% of a child's calories per day, mostly from polyunsaturated and monounsaturated sources such as nuts, fish and vegetable oils. Less than 10% of calories should come from saturated fats (mostly found in animal products such as beef, cheese and butter) and trans-fatty acid (found in fried foods such as French fries and baked goods like crackers, cookies and other processed foods); consumption should be kept as low as possible. Sodium intake should be 1900-2300 milligrams per day or less (depending on age) to help prevent hypertension.<sup>2</sup>

Studies indicate that children and adolescents with diabetes fail to meet their nutrition goals. They are eating more total and saturated fat than recommended and many have inadequate intake of Vitamin E, fiber, fruits, vegetables and grains.<sup>4,5</sup> Encouraging children and families to meet dietary recommendations (increase fruit, vegetables, whole grains) and to decrease their intake of fats and sweets will help them stay at a healthy weight, and obtain the nutrients they need to achieve optimal growth.

The prevalence of childhood obesity is increasing rapidly worldwide, as is diabetes.<sup>6</sup> This phenomenon appears to be caused by a combination of over-nutrition and insufficient physical activity. For children with diabetes, other contributing factors may be over-insulinization, snacking and excess calorie intake to avoid or treat hypoglycemia.<sup>7</sup> In addition to the nutrition recommendations above, strategies to help chil-

dren achieve and maintain a healthy weight include some of the following practices:

- Eat a healthy breakfast every day
- Eat low fat or fat free snacks such as fruit, vegetables, popcorn, or yogurt
- Decrease fast food visits
- When eating sweets, do so with a small serving at the end of a meal

## DIABETES MEAL PLANNING APPROACHES

To achieve optimal blood glucose control, the American Diabetes Association recommends monitoring carbohydrates by carbohydrate counting, exchanges, or experience-based estimation as a key strategy.<sup>8</sup> Carbohydrate counting is the main form of meal planning prescribed for children with type 1 and type 2 diabetes. In the past, meal planning for diabetes was much less flexible, and children often were prescribed a rigid meal plan to match insulin dosing. Today, the prevailing approach is to match insulin to the child's nutrition (carbohydrate) intake. Because carbohydrate is the nutrient that the body converts to blood sugar, families of children with diabetes who take insulin are taught how to balance their insulin with the amount of total carbohydrates that their child is eating.

To count carbohydrates families first need to learn which foods contain carbohydrates. Sources of carbohydrate that convert to blood glucose include *starches* (grains, starchy vegetables, beans and lentils) and *sugars* (fruits, milk, yogurt and sweets). Fiber is also a type of carbohydrate that is an important part of any healthy food plan, but does not significantly contribute to blood glucose. Non-starchy vegetables such as broccoli and lettuce contain a small amount of carbohydrate, yet are typically an excellent source of dietary fiber. Whereas children with diabetes can eat foods that have added sugars, those foods should be included in moderation, as recommended for children without diabetes. Regular sodas, juices and other sugary drinks contain large amounts of carbohydrates, raise blood sugars quickly, are low in nutrition and are difficult to bal-



ance with insulin. Most diabetes health care professionals recommend that children with diabetes avoid these “liquid carbs,” unless they are used to treat a low blood sugar.

There are two main methods of meal planning using carbohydrate counting: following a consistent carbohydrate meal plan or using an insulin-to-carbohydrate ratio to adjust insulin for variable carbohydrate intake. Which method a child uses will depend on the insulin regimen the child uses and the family’s skill level. Many families start with a consistent carbohydrate meal plan.

On a consistent carbohydrate meal plan, the child with diabetes eats a set amount of carbohydrates at each meal and snack. This amount is individualized to the needs of the child. The amount of rapid acting insulin (meal insulin) that the child takes only changes for the blood glucose level. This method of carbohydrate counting often is used with children with type 1 diabetes who are on fixed dose regimens, or with children with type 2 diabetes who take only oral medication. With fixed-dose insulin regimens, it is important to maintain consistency in the timing and content of meals and snacks. The student should eat lunch at the same time each day. Snacks often are necessary and must be eaten to balance with the peak times of insulin action and with physical activity. Sample carbohydrate ranges for meals and snacks are listed in Table 1.<sup>9</sup>

Insulin-to-carbohydrate ratio, which is part of a basal-bolus regimen, is more physiologic and gives the child more life-

style flexibility. These children will have an individualized insulin-to-carbohydrate ratio and blood glucose correction factor for dosing of their rapid-acting insulin. Basal-bolus insulin management includes giving multiple daily injections (MDI) of rapid acting insulin with a basal insulin, or using an insulin pump. The child’s diabetes health care provider determines how much rapid-acting insulin the child needs to cover carbohydrates (insulin-to-carbohydrate ratio) and how much rapid-acting insulin he needs to lower blood glucose to the desired range (blood glucose correction factor). Insulin-to-carbohydrate ratios vary from child to child. For example, a five-year-old may use an insulin-to-carbohydrate ratio of 1 unit per 30 to 45 grams of carbohydrate, whereas teenagers may use 1 unit for each 7 to 15 grams of carbohydrate. Exhibit 1 contains a case study with a dosing calculation using an insulin-to-carbohydrate ratio and blood glucose correction. With MDI and pump therapy, children do not have to follow a fixed schedule for meals and snacks.

To count carbohydrate amounts accurately, children and their families are taught how to read the “Nutrition Facts” on food labels for total carbohydrate grams. Families should measure or weigh foods periodically to estimate portion sizes and carbohydrate content accurately. Families also should have a book or reference list that they can refer to for unlabeled foods. Many schools now are providing carbohydrate information

for school lunch and breakfast, or it can be obtained through the food service director.

### PHYSICAL ACTIVITY RECOMMENDATIONS

Children with diabetes are encouraged to participate in the same forms of physical activity as children without diabetes. Currently, it is recommended that children and adolescents participate in at least 60 minutes of moderate intensity physical activity most days of the week, preferably daily.<sup>2</sup> Children and adolescents with diabetes should stay active for many reasons: to maintain a healthy weight; feel stronger, healthier, and more positive about themselves; sleep better; and experience less stress.

To ensure that children get the daily recommended amount of physical activity, the whole family is encouraged to participate. There are many activities that can be a part of spending time together as a family, even if members have different levels of expertise. For example, families can walk, hike, or bike together. Children can be taught to start out slowly and to advance to the full 60 minutes per day.

Physical activity should be enjoyable, and it is helpful to include children in planning the activity and where it takes place. If a child has a particular interest, he or she should be encouraged to pursue that interest. Being active does not have to be expensive. Activities such as playing tag, throwing a ball, jumping rope and walking are inexpensive ways to get kids moving.

**Table 1. Meal Carbohydrate Amounts by Age**

	Age: 5-12 years old	Age: Teens
Boys	45 to 60 grams of carbohydrate at each meal	60 to 75+ grams of carbohydrate at each meal
Girls	45 to 60 grams of carbohydrate at each meal	45 to 75 grams of carbohydrate at each meal

Carbohydrate amount must be individualized based on caloric needs, preferences, and activity levels. Snacks, if needed usually are 15 to 30 grams of carbohydrate. The child’s diabetes health care provider helps to determine the amount of carbohydrate that is right for each child at each meal.



Many children spend much of their time watching television and playing video and computer games. The American Academy of Pediatrics recommends that children limit screen time to  $\leq 2$  hours per day.<sup>10</sup> Decreasing sedentary activities will lead to an increase in physical activity. Encouraging children to increase their daily activity level by taking the stairs instead of the elevator, walking the dog, or helping around the house also can help them to stay at a healthy weight.

Before starting a new program of physical activity, the child's parent or guardian should be instructed to check first with their diabetes health care provider. There may be adjustments to a child's meal plan and/or medications that need to be made to prevent hypoglycemia. Often it is recommended that the child's blood glucose level be monitored before, during, and after physical activity, especially when first beginning a program.

## SHORT-TERM DIABETES MANAGEMENT OUTCOMES—DAILY CHALLENGES

### Hypoglycemia

In the 2005 position statement by the American Diabetes Association, near-normal glucose control was recommended for children with diabetes.<sup>1</sup> However, achieving optimal glycemic control is not without risks, the greatest being hypoglycemia (low blood glucose). On a daily basis, parents and caregivers must carefully balance their child's glycemic control with their child's unique vulnerability to hypoglycemia.<sup>1</sup>

Young children have difficulty recognizing hypoglycemia and as a result, parents and other caregivers, including school personnel, must be educated about signs and symptoms of this acute diabetes complication. To address these unique needs of the developing child, the ADA has developed age-specific glycemic goals that can be used together with the health care plan provided by the child's health care team<sup>1</sup> (Table 2).

Hypoglycemia usually can be treated easily and effectively. Early recognition of its symptoms and prompt treatment are necessary for preventing severely low blood glucose levels. Severe hypoglycemia that is not treated promptly can lead to uncon-

<b>Exhibit 1. Case Study</b>	
<p>Carlos is on MDI and he needs to calculate how much rapid acting insulin to take for his school lunch. Below are his dosing recommendations for carbohydrate intake and blood glucose, along with the carbohydrate content of his meal, pre-meal blood glucose level, and dosing calculations.</p>	
<p><b>Recommended rapid-acting insulin dose:</b></p>	
<p>Insulin-to-carbohydrate ratio = 1 unit of rapid acting insulin per 15 gm carbohydrate*            Blood glucose correction = 1 unit of rapid acting insulin per 50 mg/dl over 150 mg/dl blood glucose*</p>	
<p><b>School Lunch</b></p>	<p><b>Carbohydrate Content</b></p>
6 baked chicken nuggets	15 grams
½ cup mashed potatoes	15 grams
½ cup green beans	5 grams
½ cup canned fruit in natural juices	15 grams
1 carton 2% white milk	12 grams
<b>Total</b>	<b>62 grams</b>
<p>Pre-meal Blood Glucose = 250            Total Carbohydrate Intake = 62 grams</p>	
<p><b>Dosing Calculations:</b></p>	
<p>Insulin needed for carbohydrates = <math>62 \div 15 = 4</math>            Insulin needed to lower blood glucose to target level = <math>250 - 150</math> (target) = <math>100 \div 50 = 2</math>            Total Dose = 4 (insulin needed for carbohydrates) + 2 (insulin needed for high blood glucose) = 6</p>	
<p>* Insulin-to-carbohydrate ratios and blood glucose corrections are individualized for each child. This example should not be used as a recommendation for dosing.</p>	

sciousness and convulsions, which can be life threatening. One of the greatest frustrations for the child, caregiver, or school personnel can be the occurrence of hypoglycemia despite scrupulous efforts to maintain optimal glycemic control<sup>13-15</sup> (Table 3 and Table 4).

### Hyperglycemia

Hyperglycemia, also called "high blood glucose," is a result of too little insulin or glucose-lowering medication, illness, infection, injury, emotional stress, ingestion of food that has not been covered by the appropriate amount of insulin, or decreased physical activity.

Symptoms of high blood glucose include increased thirst, frequent urination, nausea, blurry vision and fatigue. In the short term,

hyperglycemia can impair cognitive abilities and affect academic performance. Over a long period of time, even moderately high blood glucose levels can lead to serious complications such as heart disease, stroke, blindness, kidney failure, and amputations.

### Blood Glucose Self-Monitoring

Parents and caregivers can evaluate their child's blood glucose control by reviewing the daily blood glucose monitoring results on an ongoing basis. Weekly or periodic review of the child's blood glucose data can help the caregiver and the health care provider, including diabetes educators, to make treatment decisions. The child's individual response to their meal and snack choices, medication and physical activity

**Table 2. Blood Glucose Goals for Children**

Age	Before Meals	Bedtime Goal	HgbA1C
Toddlers and Preschoolers (< 6 years)	100-180 mg/dl	110-200 mg/dl	< 8.5 (but > 7.5)%
School-age (6-12 years)	90-180 mg/dl	100-180 mg/dl	< 8%
Adolescents and young adults (13-19 years)	90-130 mg/dl	90-150 mg/dl	< 7.5%

Source: American Diabetes Association: 2009 Clinical Practice Recommendations

Note: Individual goals may be different than the ones shown. Obtain specific guidelines from the child's diabetes health care provider.

**Table 3. Management of Hypoglycemia**

Teach causes of hypoglycemia:
<ul style="list-style-type: none"> <li>▪ Eating too little or delaying a meal</li> <li>▪ Diabetes medications               <ul style="list-style-type: none"> <li>▪ Insulin</li> <li>▪ Oral diabetes medications</li> </ul> </li> <li>▪ Unplanned or extra physical activity</li> <li>▪ Unknown</li> </ul>
Teach symptoms of hypoglycemia:
<ul style="list-style-type: none"> <li>▪ Feeling shaky and/or sweaty</li> <li>▪ Nausea</li> <li>▪ Extreme hunger</li> <li>▪ Heart pounding or racing</li> <li>▪ Blurred vision</li> <li>▪ Confusion and/or inability to concentrate</li> <li>▪ Impaired judgment</li> </ul>
Teach the "Rule of 15":
<ul style="list-style-type: none"> <li>▪ If blood glucose level is:               <ul style="list-style-type: none"> <li>▪ Less than 70 mg/dl – treat with 15 grams of carbohydrate*</li> <li>▪ Less than 50 mg/dl – treat with 30 grams of carbohydrate</li> </ul> </li> <li>▪ Check again after 15 minutes</li> <li>▪ If still less than 70 mg/dl, repeat treatment</li> <li>▪ If next meal is not within 1 hour, eat a small snack with protein, such as cheese and crackers, or a small peanut butter sandwich</li> </ul>
* See Table 4 for examples of 15 grams of carbohydrates.

can reveal an ongoing pattern of highs or lows. There are many reasons that blood glucose levels can vary, including inaccurate meal insulin dosing due to inaccurate carbohydrate counting. If results are not reviewed frequently, patterns are easily missed and opportunities for changes in diabetes

medication and food plans are also missed.<sup>1</sup> Youth with diabetes should follow these guidelines for blood glucose self-monitoring:<sup>1</sup> use glucose levels to make insulin dose adjustments for rapid-acting or short-acting insulins and after observing patterns over several days to adjust doses of long-acting

insulins; test at least four times a day; and periodically test two hours postprandial (i.e., after meals), before and after exercise and between 1:00 AM and 3:00 AM.

### LONG-TERM OUTCOMES – REDUCING RISK OF COMPLICATIONS IN THE FUTURE

#### *Hemoglobin A1C*

Lowering hemoglobin A1C (HgbA1C) to an average of ~7% has been shown to reduce micro-vascular and neuropathic complications of diabetes and possibly macro-vascular complications.<sup>11</sup> However, as stated previously, less stringent HgbA1C goals may be more appropriate for children due to their difficulty in being able to recognize the symptoms of hypoglycemia by themselves. The American Diabetes Association's 2008 standards of care recommend performing a HgbA1C quarterly with children.<sup>11</sup>

#### *Growth*

Medication and food plans for youth with diabetes must be updated continually. Growing children will need to have adjustments to therapy made from developmental and physical assessment data (height and weight plotted on a CDC growth chart), laboratory and blood glucose meter data, as well as lifestyle factors (changing food preferences, fluctuating levels of physical activity and school schedules).<sup>1,12</sup> Parents may restrict food at meal time or at snack time in an attempt to achieve desired glycemic targets, when all that is needed is an adjustment in oral diabetes medications or insulin doses. Insufficient caloric intake, as well as glucosuria, can impair the child's normal linear growth.



Table 4. Sources of Carbohydrates

Carbohydrate Source	Amount	Grams of carbohydrate	Calories
Glucose Tablets 1 tablet = about 5 grams carbohydrate; check the label	3 to 4 tablets	15	60
Fruit Juice	½ cup	15	60
Soft Drinks (not diet or sugar free)	½ can	20	70
Sugar 1 teaspoon = 4 grams of carbohydrate	1 tbsp.	15	60
Sport Drinks	1 cup	15	60
Milk, Non-fat	1 cup	12	90
Milk, 1%	1 cup	12	105
Fruit Roll-Ups 1 roll = ½ ounce; check label	1	12 to 15	50 to 75
Raisins	2 tbsp.	15	60

Source: Evert AB, Hess-Fischl A. *Pediatr Diabet*. Chicago, IL: American Dietetic Association; 2005.

### Role of the Family: Transitioning Self-care Behaviors

Ongoing involvement of the family or caregiver is a crucial component in achieving optimal glycemic control. The level and amount of parental involvement will evolve as the child grows older.<sup>1</sup> Education and ongoing communication with all the individuals in the youth's life will help to carry out treatment plans in a successful and consistent manner. Diabetes medication and food plans must adapt to the growing child's needs.

### SUMMARY

Whereas there have been many advances in diabetes management over recent years and children with diabetes have more flexibility in their lifestyle, eating schedules and nutrition intake, diabetes remains a complicated disease to manage. To achieve optimal blood glucose control, children with diabetes and their families need to be skilled at balancing medication, food and physical activity on a daily basis. By understanding the current guidelines and recommendations for nutrition, physical activity, and

medication management, health educators can assist children and families better to achieve optimal blood glucose control in children with diabetes.

### RESOURCES

#### Websites

CalorieKing Wellness Solutions. Available at <http://www.calorieking.com> (free nutrition information)

National Diabetes Education Program (NDEP). Available at: <http://www.ndep.nih.gov/diabetes/youth/youth.htm> (free resources)

#### Books

Brackenridge BP, Rubin, R. *Sweet Kids: How to Balance Diabetes Control and Good Nutrition with Family Peace*, 2<sup>nd</sup> ed. Alexandria, VA: American Diabetes Association, 2002.

Borushek A. *The Doctor's Pocket Calorie, Fat, & Carbohydrate Counter*. Costa Mesa, CA: Family Health Publications, 2008.

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