2012 Lecture: Nutrition and Exercise Interventions for Diabetes

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Medical Nutrition Therapy for Diabetes

Goals of Medical Nutrition Therapy:
- Maintain near-normal blood glucose levels.
- Achieve optimal serum lipid levels.
- Achieve and maintain a reasonable weight for adults.
- Achieve normal growth and development in children and adolescents.
- Balanced nutrition and positive outcomes for pregnancy and lactation.
- Prevent and treat acute complications such as hypoglycemia and short-term illnesses.
- Strike a balance between food, medication, and exercise.
- Prevent, slow the development of, or treat co-morbidities such as hypertension, cardiovascular disease, and nephropathy.
- Promote balanced nutrition to optimize overall health.

Basic dietary guidelines

We obtain our nutrition through the foods we eat. Macronutrients provide energy for the human body to burn or to be stored. Essential calories and nutrients are consumed in the form of carbohydrate, protein, and fat. Carbohydrate and protein each provide 4 calories per gram. Fat provides 9 calories per gram. (Alcohol provides 7 calories per gram.)

Carbohydrate:

Carbohydrates are found in starches, grains, cereals, breads, fruits, milk, yogurt, vegetables and sugars. Monosaccharides are the smallest members of the carbohydrate family. Single unit sugars include glucose, fructose, and galactose. Disaccharides are two sugar units connected together. These double sugars are maltose, sucrose and lactose (the sugar in milk). The term *simple carbohydrate* refers to any of the *one* or *two* unit sugar mentioned above. *Complex carbohydrate* refers primarily to starch and fiber. Starch and fiber are both long chain lengths of simple sugars all connected together. With the exception of fiber which is indigestible, all forms of carbohydrate are digested to their smallest units: single sugars, and are then absorbed into the bloodstream. Circulating glucose is transported through the bloodstream to the awaiting cells, tissues and organs. Glucose is the body's preferred fuel source.

In the past, individuals with diabetes were told to avoid sugar or simple carbohydrates. This approach did little to control diabetes. In fact, research has shown that people with diabetes can enjoy modest amounts of sugar, in the context of a healthy meal plan and with respect paid to the total amount of carbohydrate eaten. Patients should no longer be handed pre-printed diet sheets, or simply advised to *quit eating sugar* as a method to treat diabetes. The understanding of dietary management, also called Medical Nutrition Therapy (MNT), has evolved, so that individuals with diabetes now have options, such as carbohydrate counting, to help manage their blood sugar levels.

Carbohydrate is the macronutrient that has the most impact on the blood glucose. For people with type 1 diabetes, the insulin dose must be carefully balanced with carbohydrate intake. Preferably, the insulin dose should be adjusted to the amount of carbohydrate in the meal, with consideration to the current blood glucose level and to any planned exercise. For patients taking fixed doses of insulin (often called *sliding scale insulin* which is based on the blood glucose reading), carbohydrate consistency is necessary. Carbohydrate intake must be comparable from one day to the next in order to balance with the insulin regimen. Fixed doses of insulin and inflexible meal plans are not optimal in managing type 1 diabetes. For people with type 2 diabetes, appropriate amounts of carbohydrate should distributed rather evenly throughout the day. Portion control is important and it is prudent to eliminate juices and regular soft-drinks as liquid concentrated sources of carbohydrate can raise the blood sugar quickly.

Generally, carbohydrate should provide 45-65% of total calories. The minimum established Dietary Reference Intake (DRI) for carbohydrate is 130 grams per day. That amount however, is a bottom line minimum and most people require more to meet the recommended 45-65% of calories. For example a woman who is dieting and eating only 1300 calories per day would be encouraged to eat 146-211 grams of carbohydrate per day (45-65% of 1300 calories). For some individuals, eating at the higher range of the carbohydrate budget ($\geq$ 55% of calories) may cause an increase in plasma triglycerides. Given that situation, the diet can be manipulated to eat at the lower range of the carbohydrate budget and increase the monounsaturated fats. (Such as the Mediterranean Diet which uses more olive oil, olives and nuts.)

Most patients with diabetes should learn how to count carbohydrates. There are alternative strategies for portion control for the low literacy patient. The plate method is one such approach and will be discussed later.

Carbohydrate Counting Tools:

- Food labels list serving size and total grams of carbohydrate.
- ADA Exchange Lists group foods into lists with similar macronutrient composition.
- Reference text/carbohydrate counting books are available.
- Fast food brochures and some restaurant menus list nutrition information.
- Cookbooks are available that provide nutrient breakdowns.
-PDA software
-Apps for smart phones are available
-Web-based nutrient composition calculators (such as www.calorieking.com)

Sugar:

Sugar and sugar containing products may be included in the context of a balanced diet. When sugar is consumed mixed with fat and grain (such as in a cookie) its effect on the blood sugar is different than when consumed alone (such as jelly beans). Fat delays digestion. Liquid sugars in sodas and concentrated sweets in some candies can cause a rapid rise in blood glucose. The main focus should be on controlling and counting carbohydrates and making healthy choices most of the time. Some people have trouble controlling sweets and are unable to eat "just one". If sweets are too tempting to be rationed into reasonable portions, it may be wise to keep the sweets out of the house. Desserts are often high in both sugar and fat and tend to be low in nutrients.

Targets for Other Macronutrients:

Fiber: 14 grams of fiber per 1,000 calories is the fiber goal for the general population. A food that has 5 or more grams of fiber per serving is considered a high fiber choice, foods with more than 2 grams of fiber per serving are good choices. A simple guideline is to make half of the grain foods "whole grains" when planning menus. Whole grain choices include brown rice, oatmeal, barley, quinoa, millet, and whole grain breads, pastas and tortillas. Legumes (beans and lentils) are excellent fiber sources.

Protein:
        National Institutes of Medicine recommend protein should provide 10-35% of total calories. The American Diabetes Association says that the typical American's protein intake of 15-20% of total calories should suffice for people with diabetes (given normal renal function). Limit protein intake to 0.8 g/kg/d for patients with nephropathy as excess protein can accelerate kidney damage. High protein diets are not recommended for people with diabetes. The effects of high protein diets on diabetes management and complications are not known.

Fat:

Fats provide flavor and increase satiety. Approximately 25-35% of total calories should come from fat. Lower fat intakes may be warranted if weight loss is desired or there is a history of high LDL Cholesterol. Choose mostly heart healthy types of fats and oils.
Less than 7% of calories should come from saturated fat.
Encourage restriction of saturated, hydrogenated and trans-fatty acids as they increase LDL.
Limit solid fats, animal fats, and dairy fats.
Dietary cholesterol should be limited to < 200 mg/day for individuals with diabetes, whereas the recommendation for the general public, without cardiac risk factors is < 300 mg/day.

The exact percentage of calories required from the three main macronutrients; carbohydrate, protein and fat, vary from one individual to the next.

Typical ranges:

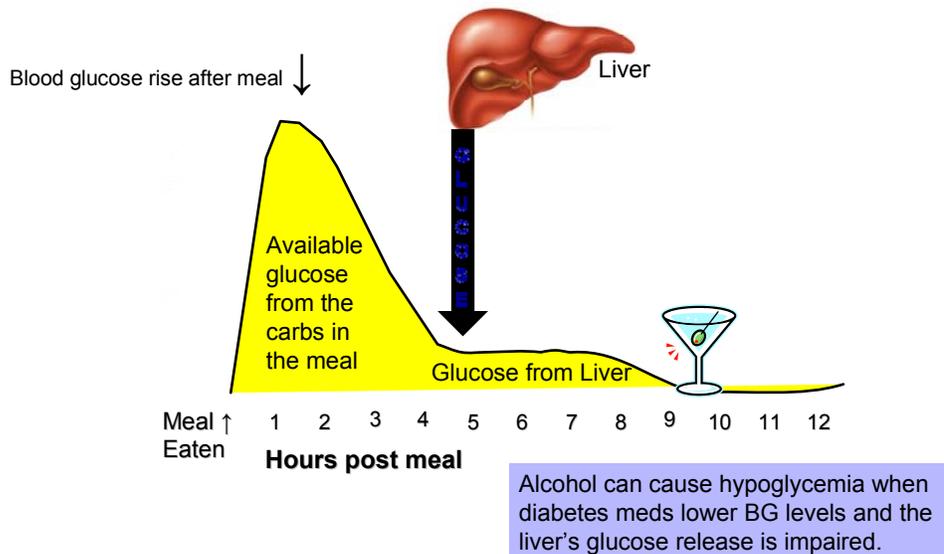|	
Carbohydrate	45-65 % calories
Protein	10-35 % calories
Fat	25-35% calories

Alcohol:

Drinking alcohol can lead to serious <u>low</u> blood sugar reactions if you take insulin or the types of diabetes pills that stimulate insulin production. Yet many adults with diabetes want to know if, and when, they can safely have an occasional drink.

- When carbohydrate foods are eaten, they digest and turn into *glucose*. This glucose is needed to fuel the brain, tissues, muscles and organs. The blood sugar levels are typically at their highest peak about **one to two hours** after the meal. It takes about 4 hours to completely use or store the glucose from the previous meal.

    (See diagram next page)

Alcohol Inhibits Gluconeogenesis
(which is the liver's ability to *make* glucose)

Blood glucose rise after meal ↓

Liver

g l u c o s e

Available glucose from the carbs in the meal

Glucose from Liver

Meal ↑ Eaten
Hours post meal
1 2 3 4 5 6 7 8 9 10 11 12

Alcohol can cause hypoglycemia when diabetes meds lower BG levels and the liver's glucose release is impaired.

- When there is glucose available after a meal, some of the glucose gets stored in the liver as *glycoge*n, a storage form of glucose. The liver will release the stored glucose from the liver when there is no more available glucose from a meal. In other words, about 4 hours after a meal, the meal is gone and the liver must release its stored glucose, via *glycogenolysis*, to keep the brain, tissues and vital organs supplied with this essential fuel. The liver also makes new glucose. Making new glucose is called *gluconeogenesis*. The liver will take amino acids, the building blocks of proteins and muscles, and convert the amino acids into glucose if needed. The bottom line: the body must never run out of glucose.

- When alcohol is consumed it must be broken down into safer components. Alcohol is actually quite toxic as alcohol, so our bodies want to quickly break it down into safe byproducts. The liver is where alcohol is processed. Alcohol is metabolized into acetaldehyde which can then turn into fat. Alcohol does *not* get metabolized to glucose so alcohol does not raise blood sugar. (Unless the "mixer" has carbs.)

- When alcohol is being processed by the liver, the liver is no longer able to freely release glucose into the blood. The process of gluconeogenesis is greatly reduced. This is the key risk of drinking alcohol. Simply stated, if you have no carbohydrate foods digesting and providing glucose to the blood, then you are relying on your liver to make and release glucose. The liver can't make glucose effectively if it is busy detoxifying alcohol. *With alcohol in the syst*em, **and** *the diabetes medications at work*, the blood sugar can quickly drop too low.

Other Safety Considerations:

✓ Alcohol can mask the symptoms of low blood sugar, so someone who has been drinking may not realize he/she is hypoglycemic.

✓ Drinking alcohol may impair good judgment and interfere with diabetes self management.

✓ Glucagon injections may not work effectively to raise the blood sugar since glucagon hormone stimulates the liver to release glucose and alcohol impairs that process.

✓ If a person passes out from low blood sugar, other people may suspect intoxication and may not know to seek appropriate medical attention.

✓ Each alcoholic beverage takes 1 - 2 hours to finish processing in the liver. For that entire time the risk of low blood sugar exists. So, if you have 2 drinks, you double that time to 2 – 4 hours that you are at risk for low blood sugar. The more alcohol consumed, the bigger the risk for serious low blood sugar.
  - One Drink is considered
    - ➢ 5 ounces of wine *(wine has no carbs)*
    - ➢ 12 ounces of beer *(beer has about 13 g carb from grains)*
    - ➢ 1 ½ ounces of hard liquor *(gin, vodka, rum, etc have no carbs)*

Play it safer...never drink alcohol without having a carbohydrate meal or snack.

For individuals without other contraindications to alcohol consumption:

Women should not drink more than one drink in a day
Men should not drink more than two drinks in a day

Sodium Recommendations: < 1,500 mg/d is the general guideline when restricting sodium. The first tip is to stop using the salt shaker. Salt has about 2,300 mg sodium per teaspoon. Processed foods are usually high in sodium. Low sodium is defined as < 140 mg/serving.

Micronutrient Recommendations:

Micronutrients are organic compounds such as vitamins and minerals that are needed in small amounts for normal processes of the body. People can obtain adequate vitamin and mineral intake through a varied and balanced diet but it is fine to take a multiple vitamin/mineral complex that provide 100% of the dietary reference intakes (DRI's) if desired.

Routine vitamin/mineral supplementation for people with diabetes is not currently recommended by the ADA. Populations that may benefit from a multivitamin/mineral supplement include the elderly, pregnant or lactating women, strict vegetarians, individuals with digestive and absorptive abnormalities, and people on caloric restriction for weight loss purposes.

Documented deficiencies in potassium, magnesium, zinc, and chromium have been shown to aggravate carbohydrate intolerance and thus worsen blood sugar control. Zinc and chromium status are difficult to assess, however, most individuals with diabetes are not deficient in those minerals. Supplementation can only be expected to help with glycemic control if a deficiency exists. It is recommended to assure adequate nutrition through a balanced diet.

Antioxidants:

Diabetes *does* increase oxidative stress, but to date, clinical trials *have not* supported the need for supplementation of antioxidants to people who have diabetes.

Fluids:

When the blood sugar is elevated, the kidneys try to eliminate some of the glucose through increased urination. Hyperglycemia therefore increases the risks of dehydration. Individuals with diabetes should be encouraged to drink a minimum of 8-10 cups of fluid per day. Consider the carbohydrate intake of beverages chosen. Liquid concentrated carbohydrate sources such as juice, sports drinks, or regular soft drinks can exacerbate hyperglycemia.

Glycemic Index:

The glycemic index tables compare various individual foods and rank the foods according to the blood glucose response they cause. Foods that raise the blood sugar more are said to have a high glycemic index, while foods that provide a flatter blood glucose response are labeled low glycemic index foods. Proponents of the glycemic index believe that eating foods with a lower glycemic index may help control blood glucose. Critics of the glycemic index note that the foods were tested after being ingested individually and that mixed meals containing protein and fat would alter the digestion profiles of the index foods. Also, foods were measured in 50 gram carbohydrate portions which, for example, may have been 3 tablespoons of one food, while another food would need six or seven cups to equal that amount of carbohydrate. Therefore, when developing glycemic index tables, *foods were not necessarily measured in portions commonly eaten.*

It is safe to say that not all foods produce the same glycemic response.

Foods that digest faster will provide a more rapid blood glucose rise. Foods that digest slower will have a more blunted effect on the blood glucose and will likely provide more satiety.

Factors that appear to have the most influence on blood glucose response include:
- Form: liquids digest faster than solids
- Meal composition: fat slows gastric emptying
- Particle size: smaller particles digest faster
- Fiber content: fiber doesn't digest (doesn't contribute glucose); increases satiety

It is appropriate to consider the glycemic effect of individual foods in meal planning for diabetes; however the main focus should be on carbohydrate counting, and portion control.

Note: Pure protein such as egg white *does not* significantly slow digestion of the carbohydrate eaten at the same meal. Fat *does* delay gastric emptying. Meat, nuts, and cheese, for example, do slow down digestion, but it is because of the fat content, not so much the protein content. While a small amount of fat with a meal may be desirable, very fatty meals can lead to weight gain and possibly have adverse effects on cardiac health.

Glycemic Load:

One key drawback of the glycemic index table is that it did not test foods in normally eaten portions. For example, carrots are listed as having a high glycemic index. However, to eat 50 grams of carbohydrate from carrots meant you had to eat about 7 cups. Most people don't eat 7 cups of carrots at a time. The concept of the **glycemic load** was to take into account what effect a food would have if you ate it in a normal portion size. When only ½ cup of carrots was eaten, it turned out that carrots had a very low effect on the blood glucose: it has a "low glycemic load". Glycemic load tables are more informative than glycemic index tables, because glycemic load takes into account realistic portion sizes.

Glycemic index tables and glycemic load tables do not indicate the nutritional benefit of one food over another. For example, white sugar is lower than a baked potato in both glycemic index and glycemic load, but a potato is higher in nutrients than is sugar.

Artificial Sweeteners:

The FDA has approved five nonnutritive sweeteners for use in the U.S.: acesulfame K (Sunett, Swiss Sweet and Sweet One), aspartame (Equal, NutraSweet, Sweetmate and NatraTaste), sucralose (Splenda), saccharin (Sweet'N Low), and most recently stevia (Purevia, Truvia). All have been shown to be safe for consumption by humans. Diet sodas and sugar-free jello are examples of items sweetened with artificial sweeteners that also happen to be free of calories. Despite rumors of cancer causing effects of artificial sweeteners, reputable studies don't support that risk. In fact, aspartame is made only of two amino acids (phenylalanine and aspartic acid). Amino acids are protein building blocks and eaten abundantly in a normal diet. Stevia is a plant-based sweetener, and sucralose is made from sugar. One study did show bladder tumors in rats fed huge amounts of saccharin.

Sugar Alcohols:

Sugar alcohols produce a smaller glycemic response than sugar (sucrose). They provide about 2 calories per gram compared to the 4 calories per gram that regular sugar provides. However, a common side effect from consuming sugar alcohol is gas, bloating, and diarrhea. Products made with sugar alcohol often have labels that claim the product is sugar-free. While this is technically correct, the product still contains carbohydrate and carbohydrates still digest into glucose. When counting carbohydrate grams for determining insulin doses, it makes sense to count one-half of the carbohydrate that comes from sugar alcohol (count only half because sugar alcohol is hard to digest and some may remain undigested…thus the GI distress). Consumers should be aware that "sugar-free" foods that contain sugar alcohols still provide calories and often contain as many calories and fat grams as the "regular" product.

Agave Nectar:

Agave nectar has very little impact on blood glucose levels. It is made from the agave plant. The carbohydrate source is fructose. Fructose is a pentose sugar whereas other sugars are in hexose form. Hexose form, like glucose, is readily used by the body, but pentose form is not. Agave nectar, and crystalline fructose for that matter, are not converted to glucose, rather they are converted to a form of fat that contributes to triglycerides. Agave nectar may be an alternate to pancake syrup since it has little impact on blood glucose, but don't use agave nectar to treat hypoglycemia, because it won't work to raise the blood sugar.

Exercise:

Safety note: Patients should be screened for cardiovascular problems, peripheral arterial disease, retinopathy, nephropathy, neuropathy (both peripheral and autonomic) and have a complete foot exam prior to beginning an exercise regimen. Sudden death and silent myocardial ischemia can occur in patients with cardiac autonomic neuropathy. The presence of complications may impose certain restrictions on the types of activities attempted. For example, individuals with peripheral neuropathy should not jog, jump rope or do stair master as diminished feeling in the feet can cause poor positioning and damage the feet. Individuals with retinopathy should avoid straining such as heavy weight lifting which can increase intraocular pressure.

Exercise is a foundation strategy in treating type 2 diabetes because it improves insulin sensitivity and therefore has a positive effect on blood glucose control. It also improves lipids, blood pressure, and it is an important part of weight management. Exercise helps maintain lean body mass in the elderly. For many individuals who are not currently exercising, it is important to begin with even a small amount of increased activity and gradually work towards a more structured exercise routine. Even a 5 minute walk to the corner is a reasonable place to start for some very inactive individuals. Then week by week the duration can increase by 5 more minutes until the person is walking at least 30 minutes a day, most days of the week. It is important to find activities that are enjoyed and physically and financially feasible for each person.

The first step is increasing daily activity levels:
- Limit sedentary activities such as television or computer time.
- Do stretching exercises, or leg lifts while watching TV.
- Take the stairs.
- Get off the elevator one flight away from the destination and walk up the last flight.
- Do errands by foot or bicycle.
- Park the car at the far side of the parking lot.
- Get off the bus one stop away from the final destination and walk the rest of the way.
- Take an after-dinner walk with family or friends.
- Spend part of the lunch hour walking.
- Walk around the perimeter of the mall before shopping.
- Schedule family time doing something active.

The next step is building a regular exercise routine:

Exercise classes, health clubs, exercise videos, community pools, and sports may be desirable options for some, but simply *walking* can provide the many benefits offered by regular exercise. A pedometer can be used to measure activity, if desired. Aim for 10,000 steps per day.

1. **Aerobic exercise** should be encouraged. Swimming, walking, bicycling, rowing, low impact aerobics, armchair aerobics, or other aerobic exercise equipment may be suitable for most individuals in whom an exercise program is considered safe.

2. **Resistance exercise:** Sit-ups and push-ups, along with other resistance exercises can tone and preserve muscle tissue as well as improve insulin sensitivity. Weight training two to three times per week progressing to three sets of 8-10 repetitions is recommended, using a weight that is somewhat challenging.

* High resistance exercises or heavy weight training should be discouraged in individuals with complications that could be worsened by valsalva type activities. (i.e. retinopathy)

3. Frequency: To improve glycemic control in type 2 diabetes, and to assist in weight management and cardiovascular fitness, at least 150 minutes per week of moderate intensity aerobic exercise should be accumulated. Alternately, 90 minutes per week of vigorous aerobic activity at least 3 days per week can be performed. Strive for no more than two consecutive days of inactivity.

4. Intensity: Most patients should exercise moderately at 50-70% maximal heart rate. (Maximal heart rate is equal to 220 minus the individual's age.) Some patients may tolerate more strenuous workouts. Perceived exertion may be a simpler way for patients to monitor the intensity of their workouts. They should be able to carry on a conversation while exercising, without being in a state of breathlessness. However, they should be able to perceive that they are engaged in exercise. Exercising at >70% maximal heart rate is considered vigorous activity.

5. Duration: There should always be a 5-10 minute warm-up period before the main exercise session, and then a 5-10 minute cool-down period at the end. The goal for the main exercise session is sustained for 20-45 minutes. Patients should be encouraged to do whatever they can do, even if it is only 5 minutes, and then gradually add to the duration of their workout as stamina improves. If desiring weight loss, 60 minutes per day is better.

6. Safety: For individuals leading very sedentary lifestyles, a graded stress test with electrocardiogram monitoring should be recommended prior to embarking on an exercise routine. Stress testing and a complete physical examination should also be done for individuals with a known history of heart disease, or for individuals suffering diabetic complications.

> The Surgeon General recommends that all Americans should engage in moderate exercise for 30 minutes per day, most (ideally all) days of the week. Exercise can be either accumulated through the day, or done in one 30-minute block of time.
>
> The American College of Sports Medicine recommends resistance training for all adults with type 2 diabetes. Resistance exercise improves insulin sensitivity, as does aerobic exercise.

Exercise is an important component to overall health and well-being, and for that reason, patients with type 1 diabetes should be encouraged to exercise. However, exercise adds yet one more variable to blood glucose management, so it is not accurate to say that exercise improves BG control in type 1 diabetes. Exercise increases insulin sensitivity, increases glucose disposal by the muscles, and may deplete liver and muscle glycogen stores; all of which effect glycemic control. The best way to decipher an individual's response to exercise is to diligently monitor blood glucose levels. Insulin doses and carbohydrate intake must be carefully balanced with exercise. Too little insulin or too much insulin can both precipitate blood glucose problems.

Inadequate insulin during exercise leads to a *decrease in glucose uptake by the muscles* and an *increase* in all of the following:

↑ Counter-regulatory hormones: glucagon, cortisol, growth hormone, catecholamines
↑ Hepatic glucose output
↑ Free fatty acid release
↑ Blood glucose levels
↑ Blood ketone levels

The net effect of *insufficient* insulin is *hyperglycemia* and *ketosis*. Individuals with type 1 diabetes should be advised not to exercise when ketones are present. Ketones indicate a relative lack of insulin, and to exercise would further exacerbate the metabolic disturbance. With very elevated blood glucose levels (>300 mg/dl), even if no ketones are present, patients with type 1 diabetes should be advised to take insulin and postpone exercise until hyperglycemia improves.

Excessive insulin during exercise leads to hypoglycemia. Careful blood glucose monitoring before, during, and after exercise can elucidate individual responses to various exercise modalities and provide valuable information for adjustments needed to diet and insulin therapy.

It may be preferable to reduce insulin doses for planned exercise, but for unplanned exercise, additional carbohydrate may likely be necessary. Patients should ingest additional carbohydrate if pre-exercise BG is < 100 mg/dl or anytime as needed to avoid hypoglycemia. Carbohydrate can be eaten before, during, or after exercise to meet needs, and replete glycogen stores. It is important that carbohydrate-rich foods be kept handy when exercising. When adjusting insulin, note which type of insulin will be acting at the time of the planned exercise and reduce that insulin dose. It is not uncommon for insulin doses to be reduced by 20 percent or more. Strenuous, long-duration exercise may require substantially less insulin, but insulin must not be omitted entirely. Insulin pump users can use temporary basal reduction rates.

Delayed hypoglycemia: If glucose use exceeds glucose intake during exercise, then liver and muscle glycogen stores may become depleted. A person can check their blood glucose level after exercise, but that shows the amount of glucose in the blood and blood glucose levels may be normal while glycogen levels may simultaneously be depleted. The body repletes glycogen with the next meals and snacks until stores are satisfactorily filled. Hypoglycemia may occur for up to 24-36 hours after strenuous exercise due to glucose being pulled out of the blood for glycogen repletion. Additionally, insulin sensitivity increases from exercise so it may be advisable to decrease insulin doses for time periods during and after the exercise.

Exercise Related Hyperglycemia: To complicate matters, very intense aerobic exercise at near maximal heart rate or heavy resistance weight training may cause a rise in blood glucose due to the hormonal response to the workload. Epinephrine, norepinephrine, glucagon, growth hormone, and cortisol stimulate glycogenolysis and gluconeogenesis. Glucose production may exceed actual need and result in a state of hyperglycemia during exercise. Very elevated blood glucose levels induce a state of insulin resistance which may require additional insulin to resolve.

Hypoglycemia:

People who take insulin or insulin secretagogues (pills that increase insulin production for people with type 2 diabetes) are at risk for getting low blood sugar. Therefore all individuals with type 1 diabetes must be prepared to manage hypoglycemia. In terms of type 2 diabetes, individuals on insulin, sulfonylureas, meglitinides, and phenylalanine derivatives are at risk for low blood sugar. Individuals with type 2 diabetes who are diet controlled or use only alpha-glucosidase inhibitors (acarbose), biguanides (glucophage/metformin), or thiazolidinediones (actos) typically will not become hypoglycemic.

Hypoglycemia is usually defined as a blood sugar value under 70 mg/dl. Small children, the elderly, or individuals with specific medical circumstances may be advised to keep their blood sugar levels above 100 mg/dl to minimize the risks associated with low blood sugar (risks such as an elderly person taking a fall because of hypoglycemia.).

Causes of Hypoglycemia:
- too much insulin, or oral agents that cause increased insulin secretion
- skipped or delayed meals
- medication dosing is not well-timed with meals
- insufficient carbohydrate intake
- unplanned, or strenuous exercise
- alcohol (as it impairs gluconeogenesis…the liver's ability to make glucose)

Treating Hypoglycemia

Check blood sugar first to confirm hypoglycemic episode
- eat or drink 15-20 grams of rapid acting carbohydrate
- wait 15-20 minutes, preferably, (but not longer than 60 min) and check blood sugar again
- if blood sugar is less than 100 mg/dl, repeat treatment

Always consider where the insulin is in terms of peak and duration. A blood sugar of 70 when the insulin is "peaking" will require more carbohydrate to correct, than a blood sugar of 70 when the insulin is almost at the end of its action. When treating low blood sugar, consider exercise. If the hypoglycemic event follows exercise, more carbohydrate may be required to achieve euglycemia. Young children may require less carbohydrate to correct lows because of their small body size. (5-10 grams of rapid acting carbohydrate may be enough.)

Many patients experience "rebound hyperglycemia" after very low blood sugar reactions. This is also referred to as the **symogi** effect. Hypoglycemia causes counter-regulatory hormones to stimulate the liver to release glucose from glycogenolysis and/or gluconeogenesis. Sometimes too much glucose is released. Some patients have high blood sugar levels after treating lows because it feels so uncomfortable to be low that it is easy to over-treat by eating too much carbohydrate. It takes time for the symptoms of low blood sugar to subside. The symptoms of sweating/shaking/rapid heartbeat are directly related to the hormone adrenalin (the flight or fight hormone), which is responding to the hypoglycemia by stimulating endogenous glucose release.

Severe hypoglycemia can lead to seizures, loss of consciousness or death. For a patient who is not coherent enough to take carbohydrates by mouth, a **glucagon** injection should be given. All people with type 1 diabetes need a glucagon kit (they expire annually) and family members must be trained on administration. Glucagon is a hormone, normally made by the alpha cells of the pancreas. Glucagon stimulates hepatic glucose release.

Some people with type 1 diabetes use *low dose* glucagon injections on themselves to help raise the blood sugar endogenously.

More Information Specifically for Treating the Patient with Type 2 Diabetes:

Insulin resistance is the hallmark of type 2 diabetes. Many patients also have insufficient insulin production. The longer the person has had the diabetes, the more likely that the pancreas is slowing down on its ability to produce normal amounts of insulin. Initially, with the onset of type 2 diabetes, the pancreas tries to make up for the insulin resistance and hyperglycemia by making more insulin. Circulating insulin levels are usually above normal in a newly diagnosed type 2. Over years of trying to compensate, the pancreas loses its ability to keep up with the insulin demand and eventually insulin production becomes impaired.

The majority of patients with type 2 diabetes are overweight, and often have associated co-morbidities including lipid abnormalities and hypertension. Obesity and sedentary lifestyles both increase insulin resistance. Weight loss and exercise should be considered foundation strategies in treating type 2 diabetes.

Weight Management:

Body mass index is a measurement of weight for height and is used for women and men alike. It doesn't accurately portray very short individuals (below 5 feet) or individuals that have a large amount of muscle mass.

Body mass index is calculated as (kilograms of weight) divided by (height in meters)^2

BMI below 18.5 is underweight
BMI 18.5 - 24.9 is normal weight
BMI 25.0 - 29.9 is overweight
BMI 30.0 - 34.9 is Grade 1 obesity
BMI 35.0 - 39.9 is Grade 2 obesity
BMI 40 and above is Grade 3 obesity

BMI tables can be found at the end of this syllabus chapter.

Obesity exacerbates insulin resistance. For patients with type 2 diabetes that are overweight or obese to begin with, moderate weight loss (5-7 % of body weight) has been shown to decrease insulin resistance, even if desirable body weight is not achieved.

People who are at risk for getting type 2 diabetes, those that have "pre-diabetes", may reduce their risk of progressing to diabetes by losing weight, exercising (minimum of 150 minutes per week) and implementing healthy diet and lifestyle changes.

Central obesity, heavy around the waist, or apple shaped physique holds the highest risk for obesity related morbidities. A quick assessment tool is ***waist circumference***. Men with a waist circumference greater than 40 inches, and women with a waist circumference greater than 35 inches are at the highest risk. Additionally the ***waist-hip ratio*** can be calculated. Waist measurement divided by hip measurements is the calculation. When the number is greater than 1.0 in men or 0.8 in women, the health risks increase.

It's important to assist patients in setting realistic weight targets. Weight loss can be a daunting proposition for someone who has always been overweight. They may be discouraged by the amount of weight that they should ultimately lose. It's better to think in small steps instead of choosing a seemingly impossible weight target. Health benefits can be realized with even modest amounts of weight loss. Experts recommend an initial weight loss goal of 5-10 percent of starting weight. For example, if the person weighs 220 pounds, aim for losing 11-22 pounds, then reassess. A suggested rate of weight loss is 0.5-2.0 pounds per week.

One pound of body fat stores approximately 3,500 kcals. Losing one pound per week would require a caloric deficit of 500 kcals per day. One approach for weight reduction is for the patient to embark on a hypocaloric diet**,** in which daily intake is less than daily energy expenditure. When calculating calorie goals, try aiming for a deficit of 250-500 calories per day to promote losing 1/2 – 1 pound per week. Or, for the highly motivated, aim for a deficit of 1,000 calories per day to lose 2 pounds per week. Try to limit fat intake to no more than 30% of daily calories. It is helpful to increase caloric consumption via exercise. Most women lose weight when eating 1,200-1,400 kcals per day, and men typically lose when limiting to 1,400-1,600 kcals per day. (See formulas for assessment at and of this syllabus chapter.)

When restricting calories for weight loss, a multivitamin and mineral supplement which supplies 100 percent of the DRI's (Dietary Reference Intake) may be recommended. It is advisable not to mega-dose vitamins and minerals without proper medical supervision.

When other methods have not been successful, some patients with BMI's $\geq$ 35 are considered for bariatric surgery. Glycemia has been improved through gastric surgery but there are no long-term studies regarding effects on type 2 diabetes.

Meal Planning Tools:

My Plate:

   Cutting calories should not lead to cutting nutrition. When trying to lose weight, it is important to eat a varied and well-balanced diet. My Plate is a tool developed by the USDA that can be used to guide food choices. See the new updated website:
www.choosemyplate.gov
The website also provides nutrition analysis resources, games, and tips sheets.

The Hand Method:

   Another option for low literacy clients, or clients that don't require stringent carbohydrate counting is the hand method. The client's own hand can serve as a serving size template. Take dinner for example, the fist size is the target portion for the starch serving, the palm of the hand indicates a limit on the meat or low fat protein source, and the added fats are no bigger than the thumb. No limit on salad or non-starchy vegetables. A small fruit or one cup of low fat milk can be added. (This level of accuracy may suffice for some type 2's but would not provide the detail necessary for tight BG control with type 1's.)

The Exchange System:

   Exchange system meal plans can be used to assure balanced nutrition as well as control calories and carbohydrates. The following menu-planning tables can be used to stay within a specified calorie goal. These meal plans provide a balanced diet and each calorie level provides approximately 50 percent of the calories from carbohydrate, 20 percent of the calories from protein, and 30 percent of the calories from fat. (These ranges are consistent with the diabetes association and heart association.) By eating the suggested number of servings from each exchange food group, the calories are automatically controlled. To improve blood glucose control, the portions should be divided between at least 3 meals, or if desired, 3 meals plus snacks. Carbohydrate consistency and carbohydrate distribution throughout the day are important tools in blood glucose management for type 2 diabetes.

(A sample exchange list can be found at the end of this syllabus chapter.)

   The table on the following page provides meal plans that assume nonfat milk, and half of the meat allowance comes from the lean meat list and the other half comes from the medium fat meat list.

Sample Exchange Meal Plans:

Calories	Starch Portions	Fruit Portions	Milk Portions	Vegetable Portions	Meat & Protein Portions	Fat Portions
1200	5	3	2	2	4	3
1300	6	3	2	2	4	3
1400	6	3	2	2	5	4
1500	7	3	2	3	5	4
1600	7	3	3	3	5	4
1700	8	3	3	3	5	5
1800	8	3	3	4	6	5
1900	9	3	3	4	6	5
2000	9	4	3	5	6	6
2100	10	4	3	5	6	6
2200	11	4	3	5	6	7
2300	12	4	3	5	6	7
2400	12	4	3	5	8	8
2500	13	4	3	5	8	8

- For those individuals who do not use milk, one milk exchange can be traded for 1 protein exchange *plus* 1 fruit or starch exchange. However, those individuals may need calcium supplementation.

Other strategies for caloric restriction:

Eat slowly, and stop when satisfied.
Eat only while seated at a table.
Use smaller plates and bowls.
Drink calorie-free beverages.
Choose higher fiber, and higher water content foods.
Read labels for calories and fat grams.
    0-3 grams of fat per serving indicates a low fat choice (or per *ounce* for meat/cheese)
    4-7 grams of fat….indicates a medium fat selection
    8 or more grams of fat……indicates a high fat selection
Look for reduced fat and nonfat products.
Choose lean meat and skinless poultry.
Choose nonfat or 1% dairy products.
Limit alcohol.
Use low fat-cooking methods and avoid fried foods.
Limit added fats.
Eat more vegetables and salads.

Non-hunger eating:

Sometimes people eat in response to situations or events other than hunger. If it is only an occasional event, it is likely harmless, however excessive eating linked to either situational cues or emotional cues can contribute to weight gain.

Situational eating refers to eating that is triggered by a time, place, or situation. Examples:
- Eating in the break room at work just because there is food and others are eating.
- Habitually buying snacks at the movies, or snacking in front of the TV.
- Eating at parties, receptions, or meetings, when not hungry.

Emotional eating refers to eating when stressed, angry, lonely, depressed, or excited.

Keeping a record of eating habits including the place, time, event, or emotion that coincided with the eating can help to identify if there is a problem with non-hunger eating. If a problem is identified, it is important to learn strategies for dealing with those situations, without reaching for food.

Weight loss programs:

There are many organized weight loss programs, some of which are very good, and others that are a waste of time, money, and effort. A few may even be dangerous. On the plus side, safe and effective weight loss programs may offer dieters the advantage of frequent contact, guidance, and support. Classes and support groups may increase the chances of success.

Individual assessment and counseling sessions are an important part of any weight loss program. It's important to select a program that employs trained health-care professionals who provide sound advice on health and nutrition. Watch out for programs that push their own supplements or products.

Tips for screening weight loss programs:

- Qualified health professionals should staff the program.
- The program should encourage each participant to seek approval from his or her health-care provider to ensure that the weight loss program will not compromise his or her health.
- The program clearly defines the risks and benefits of its plan.
- The program has a behavior modification component.
- The program teaches healthful eating habits.
- The program incorporates physical fitness and exercise.
- The program addresses strategies for long-term success, to prevent regaining weight.
- The program uses regularly available foods and doesn't rely on expensive foods that you must purchase from its organization.
- The program ensures an appropriate level of calories, protein, carbohydrate, fiber, and key vitamins and minerals.
- The program explains all costs.

Fad diets:

Given the epidemic of obesity, it is no surprise that people fall prey to fad diets. But, as with most things, when it sounds too good to be true, it probably isn't true. Furthermore, there's no such thing as a pill, vitamin, or supplement that *burns fat*. Finally, just because a diet book becomes a national bestseller doesn't mean that the diet is healthy, safe, or based on scientific evidence.

People may in fact lose weight on a fad diet. Once the person's diet has some restrictions placed on it and an individual is *paying attention* to what they eat, weight loss may ensue. However, the diets may not be nutritionally sound, or worse yet, they may pose significant risks.

Recently there has been attention on high protein, low-carbohydrate diets. Proponents of these diets say that carbohydrates are bad because they cause insulin secretion, which stores calories and ultimately leads to weight gain.

In fact, what determines a person's weight has much more to do with how many calories are ingested versus how many calories are burned. Most health organizations recommend that 10-35 percent of our calories come from protein. Higher protein diets may pose health risks. For example, very low carbohydrate diets tend to be high in animal products, which means they are higher in cholesterol and lower in fiber and usually lack the important vitamins and minerals found in grains, starchy vegetables, fruits, and milk. High-protein diets may also cause the kidneys to work too hard at filtering out nitrogenous waste products, which can be risky for individuals with kidney disease or diabetes. High protein diets can also increase uric acid levels and exacerbate gout or kidney stone formation. Additionally, excess protein intakes cause calcium resorption from the bones and raise the risk of osteoporosis. If only done for the short term, low carb diets aid in weight loss about as well as low fat diets. However, health implications beyond one year of low carb dieting need further study.

Managing Lipid Abnormalities

Heart disease is still the number one cause of death in the United States. It is estimated that 65% of people with type 2 diabetes die from heart disease. Diabetes and hyperlipidemia are independent risk factors for heart disease. Proper nutrition is an important key in preventing and treating heart disease.

National Cholesterol Education Program

The National Institutes of Health (NIH) oversees the National Cholesterol Education Program (NCEP). Lipid panels should be drawn after an 8-10 hour fast. Values listed in the following tables are mg/dl.

LDL cholesterol: *"the bad cholesterol"*
< 100	Optimal *(*for high risk individuals < 70 is optimal)*
100-129	Near Optimal
130-159	Borderline High
160-189	High
≥ 190	Very High

Total cholesterol
< 200   Desirable
200-239   Borderline High
≥ 240   High

HDL cholesterol: *"the good cholesterol"*
< 40   Low (at risk)
≥ 60   High (Desirable)

Men should strive for HDL > 40
Women should strive for HDL > 50

Triglycerides
< 150   Normal
150-199   Borderline High
200-499   High
≥ 500   Very High

Dietary fat classifications:

Saturated fatty acids (SFA):
    The term saturated fat refers to the chemical structure of the fat chain. Hydrogen is bonded to carbon at all of the possible bonding sites. Saturated fats can raise LDL cholesterol levels. When saturated fats are processed and packaged by the liver, the liver produces more cholesterol endogenously.

SFA's are typically *solid* at room temperature. *Animal fats* are highly saturated whether they are solid, or not. Some vegetable sources of fat are saturated. Examples of saturated fats include butter, meat fat, chicken skin, cream cheese, sour cream, coconut oil, palm oil, cheese, whole milk, and cream. Tips for reducing saturated fat include using lean meats, nonfat/low fat dairy products, and limiting butter and tropical oils.

Unsaturated fatty acids:
    The term 'unsaturated' is used to refer to the chemical structure of the fatty acid. Unsaturated means that the fat molecule contains double bonds. Monounsaturated fatty acids contain only one double bond, while polyunsaturated fats have more than one double bond. Unsaturated fats are typically liquid oils at room temperature.

Monounsaturated fatty acids (MUFA):
    These fats are considered heart healthy fats. Examples include olive oil, canola oil, olives, avocados, peanuts, and peanut oil.

Polyunsaturated fatty acids (PUFA):
    Vegetable oils are the primary sources of PUFA. These fats do not raise LDL. Examples are soybean oil, safflower oil, corn oil, sunflower oil, and cottonseed oil.

Omega-3 fatty acids

Omega-3 fats are a type of polyunsaturated fat that is considered heart healthy. Fish that come from cold, deep water are excellent sources of omega-3 fat. Salmon, tuna, herring, sardines, halibut, lake trout, pompano, striped sea bass, and mackerel are examples. It is recommended to eat at least six ounces of fish per week. Vegetarian sources of omega-3 fats are available in flax seeds, walnuts, soybeans, and their respective oils, as well as in canola oil. Omega-3 fats may help to lower serum triglycerides. Omega-3 fats also help to prevent blood clotting which reduces heart disease risk. Sometimes healthcare providers recommend fish oil supplements for very high triglyceride levels. Common doses are 2-5 grams/day.

Hydrogenated fats and Trans fats:

Hydrogenated fats are made by forcing hydrogen atoms into liquid vegetable oils (which started as polyunsaturated fats). Double bonds that exist in the chemical structure become hydrogenated. Trans-fats often result from this process. Trans refers to the placement of the hydrogen atoms on the chain. Trans-fats can adversely affect serum cholesterol. Examples of hydrogenated fats are shortening and some brands of margarine. These fats should be limited. Soft tub and liquid margarines are lower in hydrogenated fat than stick margarine. Look for margarines that say "no trans fat". Labels are now required to list the grams of trans-fats in the product.

> *The primary dietary goal in treating elevated LDL should be limiting saturated fats, hydrogenated fats and trans-fats!*

Dietary cholesterol:

Cholesterol is a sterol. The liver makes cholesterol. Therefore, only animal products have cholesterol. Plant foods do not provide any cholesterol. The foods that have the highest amounts of cholesterol are organ meats, shrimp, squid, egg yolks, and large portions of meat or poultry (portions exceeding 8 ounces per day). Dietary cholesterol can adversely affect serum cholesterol profiles, but not to the extent that saturated, hydrogenated or trans-fat can. Without risk factors for CHD, dietary cholesterol should be kept at 300 mg per day, or less. With risk factors for CHD (diabetes is a risk factor) dietary cholesterol should be kept to no more than 200 mg per day.

Soluble fiber:

Eating a diet rich in soluble fiber may help to lower serum cholesterol levels. The process involves bile, a digestive juice that helps transport dietary fat. Bile is secreted into the upper intestine to help with processing dietary fats. Normally, during digestion, bile salts are reabsorbed in the lower part (ileum) of the small intestine. Bile can be used over and over because it is secreted and then reabsorbed. When soluble fiber is present in the intestine, bile salts are trapped in the fiber and instead of being reabsorbed, bile salts are excreted in the stool. New bile must be made to replace that which was lost. Bile is made from cholesterol, so in producing new bile, the serum cholesterol is naturally lowered. Good sources of soluble fiber include cereal grains, oatmeal, oat bran, rice bran, dried beans, split peas, lentils, barley, carrots, broccoli, sweet potatoes, citrus fruits, papayas, strawberries, and apples. Soluble fiber supplements also do the trick.

Stanols and Sterols

Plant stanols and sterols block absorption of dietary and biliary cholesterol. An intake of 2 grams/day of stanols and sterols may help lower LDL and total cholesterol. Gel caps and supplemented foods, such as Benecol and Take Control margarine are sources.

MANAGING BLOOD PRESSURE

One out of every four adult Americans has **hypertension** (HTN) which is defined as BP $\geq$ 140/90. The incidence is increased to one out of every three African Americans. People with diabetes are twice as likely to have HTN as their counterparts. Elevated blood pressure increases the risk of small vessel disease as well as large vessel disease. For example, untreated HTN hastens the progression of diabetic kidney disease. Lifestyle modifications should be employed to manage HTN, but if blood pressure is not adequately controlled, antihypertensive drugs should be added. Specifically ACE-inhibitors (angiotensin converting enzyme inhibitors) and ARB's (angiotensin receptor blockers) are blood pressure lowering medications that have been shown to help protect kidney function.

The blood pressure target for individuals with diabetes is 130/80 or less.

The main lifestyle modifications that reduce blood pressure are weight loss and regular exercise. It's also important to limit sodium and alcohol.

Sodium
The recommended sodium intake for diabetes meal planning is $\leq$ 1,300 mg/day.

The average American eats up to 6,000 mg of sodium per day. The majority of that sodium comes from packaged and processed foods. Table salt has about 2,300 mg sodium per teaspoon. Reducing, or eliminating, added salt is the first step in following a low sodium diet. It's also helpful to look for "low sodium" products. When reading labels, low sodium is defined as $\leq$ 140 mg sodium per serving.

Tips for reducing dietary sodium intake:
- Use uncured meats and avoid pickled vegetables.
- Get rid of the salt shaker.
- Season with fresh or dried herbs, or add lemon, garlic, ginger, onions, or flavored vinegar.
- Look for low sodium, reduced sodium, or "no salt added" products.
- Don't add salt to the cooking water for rice, pasta, or cooked cereals.
- Make homemade soups, or buy low-sodium canned soups.
- Rinse canned foods that have been processed with added salt.
- Buy salt-free seasoning shakers.
- Limit salted convenience foods like instant rice, pasta, and potato dishes.
- Steer clear of fast food restaurants

Potassium

A diet high in potassium may help reduce the risk of high blood pressure. As of October 2000, the FDA (U.S. Food and Drug Administration) allows food labels to claim that foods high in potassium and low in sodium may reduce the risk of high blood pressure and stroke. The label claim can only be used on foods that have at least 350 mg of potassium and no more than 140 mg of sodium.

Foods high in potassium:
Apricots, avocados, bananas, cantaloupe, kiwi, mangos, oranges, strawberries, artichokes, tomatoes, potatoes, sweet potatoes, legumes (peas, lentils, and beans), parsnips, winter squashes, milk, yogurt, meat, poultry, and fish.

Caution: People with kidney disease are often prescribed low-potassium diets and must limit high-potassium foods. Note that salt substitutes are often made from potassium chloride, so they would need to be restricted as well.

Omega-3 fatty acids:
Omega-3 fats may help to reduce high blood pressure. Include fresh fish 2-3 times per week to cash in on this benefit.

DASH diet:

Dash stands for "Dietary Approach to Stop Hypertension". Research from the National Heart Lung and Blood Institute has shown that a diet *low* in total fat, saturated fat, and cholesterol, and *rich* in low fat dairy foods, fruits and vegetables, substantially lowers blood pressure. The DASH daily meal pattern recommends 2-3 servings of nonfat or low fat milk dairy foods, 4-5 servings of fruit, 4-5 servings of vegetables, 7-8 servings of grains and grain products, 2 or less, servings of lean meat-poultry-or-fish, and 2-3 servings of fat. It also incorporates 4-5 servings per week from nuts, seeds, or dried beans, and limits sweets to 5 portions per week.

TYPE 2 DIABETES IN CHILDHOOD:

The rate of obesity among American children has more than doubled in the last 25 years. One out of every four children is overweight or obese. As the incidence of obesity rises, the incidence of obesity-related diseases rises. Type 2 diabetes, HTN, and lipid abnormalities are all associated with obesity and threaten potential long-term complications. The duration of diabetes is a strong predictor of risk for developing complications. How much more likely is someone to develop complications if that person is diagnosed with type 2 diabetes at age 15 instead of age 45? No one knows for sure, but giving type 2 diabetes a 30-year head start can't help. Fortunately, we have good studies showing that complications are preventable. Appropriate and aggressive education, treatment, and control must start immediately.

Screening children for type 2 diabetes. All children who are *overweight* and *over 10 years old* should be screened *every 2 years* if they have *any 2 of the following risk factors*:

- Family history of type 2 diabetes
- Member of a high-risk ethnic group
- HTN
- Lipid abnormalities
- Polycystic ovary syndrome (syndrome of menstrual irregularities, obesity, hirsutism and multiple ovarian cysts)
- Acanthosis nigricans (dark, plaque-like skin lesions often associated with obesity)

Blood Glucose Targets for Kids

To reduce the risks associated with hypoglycemia in children, slightly higher BG targets may be considered. Children aged 6 and under have a harder time recognizing and acting on hypoglycemia. Hypoglycemia in young children can also affect cognitive development. For safety's sake it makes sense to accept slightly higher blood glucose levels rather than face the added risks of hypoglycemia in young children. As for the teen years, it is acknowledged that hormonal fluctuations of growth and puberty make tighter control difficult to achieve as puberty hormones cause more insulin resistance. The ADA has established BG guidelines for kids.

BG Targets for Children	Before Meals	Overnight	HbA1c
Toddlers: < 6 yrs	100-180	110-200	< 8.5
School Age: 6-12 yrs	90-180	100-180	< 8
Teens: 13-19 yrs	90-130	90-150	< 7.5

Insulin treatment for children with type 1 diabetes is individualized just as it is in adults. In treating pediatric diabetes, there are added stressors and obstacles to overcome as most children spend a good portion of the day away from home in daycare or school. Many schools do not have full time nurses. The American Disabilities Act protects children with diabetes who are in a public school system. Children must receive the needed supervision to safely care for their diabetes. That means some adult, whether a nurse or not, must be trained to assist in blood glucose monitoring and insulin administration. Parents can obtain a **504 Plan** (available online, or from pediatric specialties clinics). The plan delineates the responsibilities of the family as well as the school in terms of the child's care. The primary care provider, or endocrinology team assist in setting up individual treatment guidelines on this 504 plan so caregivers at school know how to react to blood glucose values, hypoglycemia, seizures etc.

Children with type 2 diabetes may or may not be using insulin or oral agents. Bringing lunches versus receiving school lunches should be considered individually. Unfortunately, many food choices in some school districts are just too high in fat and calories.

Most children eat less fruits and vegetables and more fat than is recommended. Fast foods and convenience foods are contributing to the obesity crisis in our youth. Kids are skipping important meals like breakfast and lunch and filling up on high-sugar and high-fat snack foods.

Here are a few suggestions to improve childhood nutrition:

- Don't skip meals. Eat three meals per day (plus snacks if desired).
- Choose healthful, low fat snacks.
- Choose at least five servings per day from a combination of fruits and vegetables.
- Choose lean meats and low fat dairy products most of the time.
- Limit added fats and fried foods.
- Include higher fiber and higher water content foods.
- Eat fewer fast food meals.
- Discourage eating out of boredom or for emotional reasons.
- Limit eating in front of the television.
- Choose diet soft drinks instead of regular sodas and sugary beverages.
- Don't use food as a reward or punishment.
- Don't force kids to clean their plates! Provide healthful menu selections and let kids choose from those selections and choose how much they want to eat. Children need to learn to quit eating when they're full, by following their appetite cues.
- Print an age and gender specific food pyramid at www.mypyramid.gov and follow it.

Lastly, it's important to incorporate favorite foods in reasonable amounts, even if those foods aren't the most healthful choices. If a child has a well-balanced, healthful diet most of the time, there's room to fit a candy bar or a couple of cookies into the meal plan. If favorite items don't get negotiated into the meal plan, those items tend to get eaten anyway. The kids just don't tell you. It's better to fit the item in at a designated snack time or mealtime. Treats can be traded for the usual carbohydrate snacks. Over-restricting treats can lead to feelings of anger and isolation. Imagine being the only child at the birthday party who is not allowed to eat cake. The psychological impact of being singled out is more damaging than fitting a piece of cake into the meal plan for a child with diabetes.

Pregnancy with Pre-Existing Diabetes

Tight Blood Sugar Control Is Critically Important.

Women who have diabetes are at increased risk for poor pregnancy outcomes. Preconception counseling and a complete medical examination are important prior to planning a pregnancy. Women who already have microvascular complications from their diabetes may be encouraged to avoid pregnancy, because pregnancy can exacerbate and accelerate certain complications. Women with type 2 diabetes who use oral agents are usually switched to insulin prior to becoming pregnant. Historically, oral agents have been contraindicated in pregnancy. Some retrospective data shows safe use of Metformin and Acarbose; and some clinicians prescribe Glyburide. The debate on whether oral agents are safe and efficacious continues, because to date there are no randomized clinical trials to address the safe use of oral agents during first trimester organogenesis. Some medications are clearly contraindicated in pregnancy and should be discontinued prior to conception. These include commonly used antihypertensives: ACE-inhibitors, and angiotensin receptor blockers (ARB's) as well as lipid lowering statins.

Insulin doses will increase gradually, and approximately double, over the course of the pregnancy because of the increasing levels of pregnancy hormones such as, human placental lactogen, estrogen, progesterone, cortisol and prolactin, all of which increase insulin resistance.

It is critically important to counsel women with type 1 or type 2 diabetes to use contraception at all times, and that prior to trying to conceive, tight blood glucose control should be achieved and maintained for at least 3 months. Fetal mortality rates have greatly improved over the years because of advances in technology, defined treatment standards, along with an increased understanding and implementation of diet modifications, home blood glucose monitoring, and the use of the insulin preparations that are available today.

The target hemoglobin A1c is < 7% both prior to pregnancy and during pregnancy. An A1c of < 6% is recommended if hypoglycemia can be kept at a minimum, which might be hard to achieve in a woman with type 1 diabetes. Frequent self-monitoring of blood glucose is necessary to detect blood glucose fluctuations. Stringent blood glucose control is important throughout the pregnancy.

Early Pregnancy Risks: First Trimester

- Uncontrolled blood glucose levels during first trimester organogenesis increases the risks of miscarriage, and of congenital malformations. The baby's vital organs are completely formed by the end of the first trimester. In fact, studies show that the rate of malformations increases on a continuum with rising A1c's exceeding 1% point above normal non-diabetic women. Normal non-diabetic A1c is < 5.7 %.
- Unfortunately, as many as two thirds of women with pre-existing diabetes have unplanned pregnancies. This increases the risks that birth defects may have already happened prior to realization that conception had occurred. Common birth defects include defects of the lower spine, spina bifida, anencephaly (the brain doesn't develop), heart defects (especially holes between chambers), organ position reversal, and renal defects.

Latter Pregnancy Risks: Second and Third Trimesters

- In the latter half of the pregnancy, uncontrolled blood sugar levels can lead to macrosomia (fetal weight > 4000 grams, 8.8 pounds). Macrosomia is associated with increased birth trauma; shoulder dystocia (dislocation), clavicular fracture, brachial palsy (paralysis of arm) and higher rates of Cesarean section. Other complications include polyhydraminos (excess amniotic fluid), stillbirth, and neonatal hypoglycemia, jaundice, polycythemia (increase in HCT/RBC's), hypocalcemia, cardiac hypertrophy and respiratory distress syndrome.

- Diabetes increases the incidence of maternal HTN and preeclampsia, (a serious medical condition that can result in very high blood pressure, edema, and proteinurea). Fetal mortality rates are high if the mother develops preeclampsia, so if she does develop it, emergency C-sections are often performed.

- Because pregnancies complicated by diabetes are considered high risk, home deliveries are generally not advised.

Gestational Diabetes (GDM)

Gestational diabetes (GDM) is defined as glucose intolerance with onset or first recognition during pregnancy. In other words, even if a woman had Type 2 diabetes prior to pregnancy but she didn't know it, the high BG detected during pregnancy would still be called GDM. After delivery if the diabetes doesn't go away, she can be reclassified as having Type 2 diabetes. GDM occurs in about 7% of all pregnancies in the United States, but can range between 1-14% depending on the population studied. Screening for GDM takes place between 24-28 weeks gestation. Women who are high risk for undetected Type 2 diabetes should be screened as soon as they find out they are pregnant.

Women don't typically develop GDM until later in pregnancy, which means their babies don't share the *early* pregnancy risks associated with women with preexisting diabetes. In other words, women with GDM don't have increased risks of birth defects since they don't have elevated blood glucose levels during the first trimester organogenesis. But, women with GDM do share the same risks associated with poor control in the latter parts of their pregnancies, such as macrosomia and stillbirth.

Pregnancy hormones increase the demand for insulin. Insulin requirements typically double by the third trimester. Normally, a pregnant woman's pancreas will step up the insulin production to meet those demands. If the woman's pancreas cannot produce enough insulin to keep her blood sugar in the normal range, then blood glucose levels will elevate during pregnancy, which is known as gestational diabetes. The foundation of treatment for GDM is mainly dietary and involves strict control of carbohydrate intake. It is typical that 40-50% of calories are allocated to carbohydrate, and the carbohydrates are distributed between three meals, and three snacks to minimize postprandial blood glucose excursions. When diet alone fails to control blood glucose levels, insulin is the preferred therapy. Insulin does not cross the placenta and doses can be adjusted to achieve optimal glycemic control at specific times of the day.

Up to 50% of women with a history of GDM go on to get type 2 diabetes within 5-15 years. After delivery, women with GDM should be counseled to achieve and maintain a reasonable body weight, exercise, and eat healthfully. If a woman gets GDM in one pregnancy it is likely that she will get GDM again in future pregnancies. It is important for these women to be screened for type 2 diabetes prior to planning another pregnancy and ongoing annually. The American Diabetes Association recommends that all adults who are at risk for developing type 2 diabetes should be screened at least every three years. Children born to women with GDM have a higher risk of developing obesity or type 2 diabetes in their adolescent and adult years.

Risk factors for GDM:

Overweight or obese
Ethnicity: African American, Native American, Asian American,
            Hispanic American, Pacific Islander
Age > 25
Family history of diabetes
History of abnormal glucose tolerance
History of delivering a baby > 4000 grams, (8.8 pounds)
History of poor obstetrical outcomes such as still birth

Screening:

High-risk women should be screened at their 1st prenatal visit, as they may have Type 2 diabetes and not realize it, in which case early intervention can protect the developing fetus. Women who are not at high risk for developing GDM are routinely screened between 24-28 weeks gestation.

UCSF uses the following tests to screen for GDM

Step 1 Glucose Challenge Test

The patient is given a 50-gram glucose load and BG is measured one hour later.

If BG $\geq$ 140 mg/dl go to step 2

Step 2 Oral Glucose Tolerance Test (OGTT)

Patient is given 100-gram glucose load.
The BG is tested fasting, and then hourly for 3 hours.
If 2 or more BG values are elevated, the diagnosis of GDM is made.

Abnormal Values in mg/dl for OGTT

Fasting	$\geq$ 95	
1 hour	$\geq$ 180	*At least two abnormal values*
2 hour	$\geq$ 155	*are needed to diagnose GDM.*
3 hour	$\geq$ 140	

* Note:

If the BG is $\geq$ 180 after the first 50 g load test:
-bring patient back for OGTT and check fasting blood glucose.
If FBG $\geq$ 95 then don't do the 100 gram load.
A value $\geq$ 180 from the first test and a FBG $\geq$ 95 gives the necessary 2 abnormal values needed to diagnose GDM without drinking the 100 g glucose load at the OGTT.

New ADA Screening Guideline for GDM

An international consensus group revised GDM diagnosis criteria, and in 2011 the ADA adopted these recommendations, which were based on study findings from the HAPO Study. (Hyperglycemia and Adverse Pregnancy Outcomes Study) Thus far, ACOG (American College of Obstetrics and Gynecology) has *not* adopted the new guidelines, nor has UCSF, but other hospitals have. Only one abnormal value is needed to rule in for GDM.

<u>1 Step 75 g OGTT</u>

<u>*Abnormal Values in mg/dl for OGTT*</u>

Fasting $\geq$ 92
1 hour $\geq$ 180
2 hour $\geq$ 153

Notice that the new guidelines decide that only one abnormal value will result in the diagnosis of GDM and that the fasting and 2 hour cut-offs have been lowered. This new criteria should result in many more women ruling in for GDM.

Blood Glucose Treatment Targets for Diabetes in Pregnancy:

Pregnant women with any form of diabetes should achieve tight blood glucose control. The targets established by the American Diabetes Association are as follows:

Fasting BG   < 95

1-hour PPBG   <140

2-hour PPBG   <120

For women who exceed the BG targets, insulin should be started. Insulin use may necessitate more frequent BG monitoring; possibly pre-meal to adjust doses, when signs or symptoms of low BG occur, and occasionally in the middle of the night to monitor insulin action. Blood glucose values tend to increase as the pregnancy progresses. Therefore it is important to continue monitoring blood glucose even if initial results are all within target.

Ketones:

Ketones are byproducts from burning fats. Normally, fats are metabolized to the safe byproducts CO_2 and H_2O. In order to produce those safe byproducts, there must be carbon available from the carbohydrate foods eaten. Without sufficient carbohydrate intake, fats are metabolized incompletely and ketones form. Ketones are acidic. Women who under-eat carbs in order to control BG may end up producing ketones. Women who don't eat enough calories during pregnancy can also develop ketones as they break down their body fat stores. Higher levels of maternal ketones may pose a risk to the fetus. Urine can be checked with a dipstick to detect the presence of ketones, and the level (trace, small, moderate, large). Some women under-eat in attempts to stay off insulin. Insufficient weight gain is an indication of under-eating. Weight should be checked at every prenatal clinic visit. It is also important to limit the over-night fast to not more than 10 hours or pregnant women may develop ketones. This results because the developing baby uses up maternal glucose and fuel stores throughout the night. Some clinics have women check for fasting ketones daily, with a urine dip stick. While other clinics just check the urine for ketones at prenatal clinic visits. Pregnancy (and starvation) ketosis differs from diabetic ketoacidosis (DKA). DKA can occur in women with type 1 diabetes who omit insulin, miss shots, use faulty or expired insulin, or who have insulin pump malfunctions. In a situation when there is a *complete lack of insulin*, no glucose is available to muscle cells, and fats breakdown rapidly and can produce high levels of ketones and eventually DKA.

Weight gain goals

In May 2009 the Institutes of Medicine released their new guidelines for maternal weight gain during pregnancy.

Weight Gain Goals for Single Fetus Pregnancies

Underweight women (BMI < 18.5)   28-40 pounds

Normal weight   (BMI 18.5-24.9)   25-35 pounds

Overweight women   (BMI 25.0-29.9)   15-25 pounds

Obese women   (BMI > 30.0)   11-20 pounds

Assuming women gain 1.1-4.4 pounds during the first trimester, the weekly rate of weight gain during the second and third trimesters should be:

Underweight women: 1.0-1.3 pounds per week

Normal weight women: 0.8-1.0 pounds per week

Overweight women: 0.5-0.7 pounds per week

Obese women: 0.4-0.6 pounds per week

Record keeping:

Women are asked to keep detailed food and blood glucose records. They should be recording what they eat with *portion sizes* listed and *grams of CHO* counted. Blood glucose results should be listed. Women are asked to bring records, and blood glucose monitors to all visits. They are also instructed to fax their records every week. During clinic visits, the meters are occasionally checked for proper usage, and the memory of the meter is cross-referenced against the woman's written records to assure accuracy. Some women have been noted to falsify written records to hide values that were out of range, or because they didn't check their blood glucose at that assigned time. Trying to stay off insulin is one of the most common reasons women fabricate results.

Medications:

Insulin is the medication of choice for controlling BG during pregnancy because it does not cross the placenta and it is highly effective in controlling BG levels. Oral agents for treating diabetes are generally contraindicated in pregnancy. One study showed safe and efficacious use of Glyburide, but to date, UCSF only rarely uses Glyburide in pregnancy, for example, if a patient refuses insulin. Metformin (Glucophage) is often used to treat insulin resistance in women with polycystic ovarian syndrome (PCOS) who are trying to become pregnant. The drug is often continued through the first trimester.

Medical Nutrition Therapy (MNT) for Diabetes and Pregnancy:

MNT should assure that food choices are well balanced and provide adequate levels of key nutrients for pregnancy. Carbohydrate intake should be distributed throughout the day and intake should be consistent from day to day. MNT should assure proper weight gain, and ideally, normoglycemia.

1). Assess caloric requirements. Calculate baseline needs; add 300 calories/day for the 2nd an 3rd trimester in pregnancy (don't add 300 calories if obese or already has had excessive weight gain during the pregnancy). A minimum of 1,700-1,800 calories is typically needed for adequate weight gain and to prevent ketosis. Most women need 2000-2500 calories per day for pregnancy.

Approximate macronutrient distribution:

CHO 40-50 %   (some clinicians prefer to restrict to 40-45%, **a minimum of 175 g**)

Pro 20-25 %   (**a minimum of 71 grams** is needed in pregnancy)

Fat 30-35 %   (emphasize monounsaturated sources) If weight gain is

                      excessive, counsel on lower fat diet strategies.

Note: the dietary reference intake (DRI) for carbohydrate intake in pregnancy has been studied and established that women should not eat below 175 grams of carbohydrate per day. The DRI for protein in pregnancy is 71 grams per day.

Carbohydrate grams for various calorie levels.

The following CHO goals provide 40-50 % of the total calories.

Calorie Level	Daily Grams Carb	# Carb Exchanges
1700	175-213	11-14
1800	180-225	12-15
1900	190-238	13-16
2000	200-250	13-17
2100	210-263	14-18
2200	220-275	15-18
2300	230-288	15-19
2400	240-300	16-20
2500	250-313	17-20
2600	260-325	17-22

It is prudent to wait at least 2 hours between carbohydrate intake at meals and snacks in order to allow glucose clearance from the previous carbohydrate intake. However, protein and fat foods (foods that don't contribute appreciable carbohydrate content) can be eaten when desired.

2.) Distribute CHO between 3 meals and 2-4 snacks. Adjust as needed.

> For example, a possible starting CHO distribution may be:
>
> Breakfast   45-60 g (see note on breakfast below.)
> Snack   15-30 g
> Lunch   45-60 g
> Snack   15-30 g
> Dinner   45-60 g
> Snack   15-30 g

3.) Breakfast considerations:

Morning hormonal elevations further increase insulin resistance and glucose intolerance. Many women require stricter guidelines at that specific meal. To combat post breakfast BG elevations, if a problem has been established, consider limiting carb to 15-30 g at the breakfast meal. Other tools include avoiding milk, fruit, and highly processed foods (refined breakfast cereals and white bread/bagels) at breakfast. A meal of protein and a whole grain starch may be better tolerated than a breakfast that includes refined grains, cold cereals, milk or fruit.

4.) Avoid all juice, regular soda and sugar-sweetened beverages.

5.) Whole grains tend to be better tolerated than white, refined grains. Encourage brown rice, cooked whole grains, and whole wheat breads and pastas.

6.) Avoid candies, cookies, pastries, and sweets in general. Make healthier food choices…make the carbs count towards good nutrition. Besides, many of the dessert-type items tend to cause BG spikes above target ranges. For women who have difficulty completely abstaining, small servings of desserts can be tried (10-15 g carb) and blood glucose monitoring can reveal if that item is tolerated. Desserts that are higher in fat tend to be better tolerated because fat delays digestion. Generally, desserts should be discouraged.

7.) Many women find that it is easier to control blood glucose levels if fruit is eaten in portions of 15-g carb sizes and distribute portions throughout the day rather than eating multiple servings of fruit at one time. The same goes for milk. Try to limit to 8 ounces at a time. Fruit and milk are both important to include in a healthy diet during pregnancy but too much at one time can exacerbate blood glucose excursions because they digest quickly and can cause a sharp rise in BG.

8.) Sweeteners:

The following artificial sweeteners have FDA approval in pregnancy:

aspartame (Equal), acesulfame k+ (Sweet One), sucralose (Splenda) and stevia (Truvia).

Saccharin (Sweet n' Low) is not recommended because it crosses the placenta (although no harmful effects have been documented).

Caution women that labels that claim an item is "sugar-free" may still have high amounts of carbohydrate. Sugar-alcohol sweetened products do still affect the blood glucose levels, although maybe not as much as regular sweetened products. Sugar alcohols may cause gas, cramping and diarrhea.

Exercise in Pregnancy:

Exercise, unless contraindicated, is a helpful tool in controlling blood glucose.
Exercise enhances insulin sensitivity and glucose disposal.
Exercise guidelines:
- Choose light to moderate intensity, and low-impact aerobic activities.
- Try to aim for 15-30 minutes duration.
- Choose activities that are safe, and don't pose risk of falling or abdominal injury.
- Don't choose exercises that require lying on back for long periods of time, as maternal and fetal blood flow is diminished.

Some women have been known to exercise too vigorously or for frequent or long duration in order to lower BG. Excessive exercise may pose risks for pregnancy but in addition to that, over-exercising uses up glucose to the point that there may not be enough left for the normal needs of pregnancy. Above normal levels of activity will necessitate and increase in carbohydrate intake.

Postpartum care:

1.) Women with GDM should be encouraged to breastfeed.

2.) ADA recommends screening women for type 2 diabetes 6-12 weeks postpartum and then every 3 years. At UCSF we have women with GDM screened for type 2 diabetes 6 weeks postpartum with a 75 gram glucose load. We screen again at 6 months postpartum and *annually* with a fasting blood glucose check. We strongly recommend screening prior to subsequent conceptions to make sure type 2 diabetes hasn't developed. Getting pregnant with uncontrolled blood glucose levels puts the baby at risk for congenital anomalies.

Preventing Type 2 Diabetes:

Since women with GDM are at significant risk for developing type 2 diabetes within 5-15 years…they should be counseled on strategies to minimize their risk: weight loss as needed, exercise guidelines and healthful eating habits.

Women should first strive to lose the weight gained during pregnancy. If arriving at pre-pregnant weight still leaves the woman overweight or obese, then strive for losing 5-10% of that weight. Aerobic exercise should be included for at least 30 minutes per day. Some studies, including the Diabetes Prevention Program (DPP) showed that taking Metformin may also help prevent the onset of type 2 diabetes in high risk individuals. Generally, adding this medication is recommended only in those with impaired glucose tolerance (post meal BG in range of 140-199 mg/dl) and impaired fasting glucose (range of 100-125 mg/dl) with high BMI >35, and age under 60 years old.

For more information: The American Diabetes Association has clinical practice recommendations (2004) on *Gestational Diabetes* and *Preconception Care of Women with Diabetes*. Position statements are printed every January in Diabetes Care and are available online.

Appendix 1

<u>American Diabetes Association Position Statements</u>
The American Diabetes Association provides position statements outlining key principles and standards of practice on many diabetes-related topics. The annual set of guidelines is released every January and printed in Diabetes Care. To access the most recent statements, go to www.diabetes.org click on the section for health care professionals, and then click on clinical practice recommendations. Click "position statements". For the previous years' papers, click the "archive box" at the top of the screen; choose the year, then the January Supplement.

Appendix 2

Medical Nutrition Therapy (MNT) and Treatment Goals complications
The following information can serve as a guideline for appropriate diet interventions for the comorbidities associated with diabetes.

Nephropathy:
- Blood glucose control
- Protein intake limited to 0.8 g/kg
- Blood pressure control *(≤ 130/80)*
- ACE-inhibitors or ARB's (BP meds that are particularly protective of the kidneys)
- *Lab goals: Urine albumin <30*
     Serum Creatinine 0.5-1.4 mg/dL,
     Creatinine Clearance 100-125 mL/min (measures GFR)

Hypertension:
- Weight loss (if overweight)
- Sodium restriction of 1,500 mg/d
- Alcohol restriction
- Exercise
- Smoking cessation
- Adequate intakes of potassium, calcium, and magnesium (may help)
- *Goal blood pressure is <130/80*

Gastroparesis:(an autonomic neuropathy effecting digestion)
- Small, frequent meals, chew well
- Low fat diet
- Low fiber intake
- Liquid or blended consistency
- Adjustments of insulin to meal timing

Hypercholesterolemia:
- Low saturated fat intake (under 7% of calories)
- Low cholesterol diet (under 200 mg/d)
- Increased soluble fiber
- Include plant stanols and sterols 2 g/d (Benacol, Take Control, or pills)
- Weight control
- Exercise
- *Goal LDL < 100 (< 70 if multiple cardiac risk factors)*
- *Goal HDL > 40 for men, > 50 for women; the higher, the better*

Hypertriglyceridemia:
- Limit alcohol
- Weight control
- Exercise
- Reduce CHO intake to 40-50 % Kcals. Limit sugar/refined grains.
- Improve glycemic control
- For severe hypertriglyceridemia (> 500): strict reduction in all fats/oils.
- *Goal triglycerides < 150*

Appendix 3

Estimating Carbohydrate Intake Goals

The National Academy of Sciences-Food and Nutrition Board and the
American Diabetes Association recommends that 45-65 % of total calories come from
carbohydrate. The **Minimum** Daily Reference Intake is 130 grams per day for non-pregnant,
(175 for pregnancy).

Calorie Level	40%	45%	50%	55%	60%	65%
1000	130	130	130	138	150	163
1100	130	124	138	151	165	179
1200	130	135	150	165	180	195
1300	130	146	163	179	195	211
1400	140	158	175	193	210	228
1500	150	169	188	206	225	244
1600	160	180	200	220	240	260
1700	170	191	213	234	255	276
1800	180	203	225	248	270	293
1900	190	214	238	261	285	309
2000	200	225	250	275	300	325
2100	210	236	263	289	315	341
2200	220	248	275	303	330	358
2300	230	259	288	316	345	374
2400	240	270	300	330	360	390
2500	250	281	313	344	375	406
2600	260	293	325	358	390	423
2700	270	304	338	371	405	439
2800	280	315	350	385	420	455
2900	290	326	363	399	435	471
3000	300	338	375	413	450	488

Body Mass Index (BMI)

Body mass index is calculated as (kilograms of weight) divided by (height in meters)^2

BMI → Height (inches) ↓	19	20	21	22	23	24	25	26	27	28	29	30	35	40
	Weight (pounds) ↔													
58	91	96	100	105	110	115	119	124	129	134	139	143	167	191
59	94	99	104	109	114	119	124	129	133	138	143	148	173	198
60	97	102	107	112	118	123	128	133	138	143	148	153	179	204
61	100	106	111	116	122	127	132	137	143	148	153	158	185	211
62	104	109	115	120	126	131	136	142	147	153	158	164	191	218
63	107	113	118	124	130	135	141	147	152	158	163	169	197	225
64	111	116	122	128	134	140	145	151	157	163	169	174	204	233
65	114	120	126	132	138	144	150	156	162	168	174	180	210	240
66	118	124	130	136	142	148	155	161	167	173	179	186	216	247
67	121	127	134	140	147	153	159	166	172	178	185	191	223	255
68	125	131	138	144	151	158	164	171	177	184	190	197	230	263
69	128	135	142	149	155	162	169	176	183	189	196	203	237	270
70	132	139	146	153	160	167	174	181	188	195	202	209	243	278
71	136	143	150	157	165	172	179	186	193	200	208	215	250	286
72	140	147	155	162	169	177	184	191	199	206	213	221	258	294
73	144	151	159	166	174	182	189	197	204	212	219	227	265	303
74	148	155	163	171	179	187	194	202	210	218	225	233	272	311
75	152	160	168	176	184	192	200	208	216	224	232	240	279	319
76	156	164	172	180	189	197	205	213	221	230	238	246	287	328

BMI below 18.5 is considered underweight.
BMI 18.5 - 24.9 is considered normal weight.
BMI 25.0 - 29.9 is considered overweight (increased risk).
BMI 30.0 - 34.9 is considered Grade 1 obesity (high risk).
BMI 35.0 - 39.9 is considered Grade 2 obesity (very high risk).
BMI 40 and above is considered Grade 3 obesity (extremely high risk).

STARCHES

15 g carbohydrate
3 g protein
 trace fat
 80 calories

Breads & Flours

Bun (hotdog/hamburger)	1/2 bun
Flour/corn meal/wheat germ	3 Tbsp
Bagel	1/4
English muffin	½
Naan	1/4
Pita bread, 6 inch size	1/2 pocket
Roll	1 small
Taco/tostada shell	2 crisp shells
Tortilla (corn/flour)	1 (6 inch)
Bread (wheat, white, rye)	1 slice
Reduced calorie bread	2 slices (40 calories/slice)
Pancakes	1 (4 inch size)
Waffle	1 (4 ½ inch square)
Biscuit	1 (2 ½ inch across)
Corn bread	1 (2 inch cube)
Stuffing	1/3 cup prepared

Using a food scale: bagels, bread, & bagets, are 15 g carbohydrate per ounce.

Starchy Vegetables, Beans, Peas and Lentils   (Cooked)

Potatoes	1/2 cup or ½ medium or ¼ large
Corn and Peas	1/2 cup
Winter squash & pumpkin	1 cup
Yams, sweet potatoes	1/2 cup
Baked beans	1/3 cup
Beans (kidney, pinto, garbanzo)	1/2 cup
Split peas & lentils	1/2 cup
Lima beans	2/3 cup

Dried Beans/Split Peas/Lentils also count as 1 protein exchange

Grains & Pasta   *(Cooked)*

Barley	1/2 cup
Bulgur or Kasha	1/2 cup
Oatmeal or Grits	1/2 cup
Rice: white/brown/wild	1/3 cup
Pasta/noodles/spaghetti	1/3 cup
Millet/Couscous	1/3 cup

Snacks

Popcorn	3 cups popped
Graham crackers (2 ½ in. square)	3 squares

FRUIT AND FRUIT JUICES

15 g carbohydrate
0 g protein
0 g fat
60 calories

Fruit	**Serving**
Apple	1 small
Applesauce, unsweetened	1/2 cup
Apricots, fresh	4 whole
Apricot, dried	8 halves
Banana	1/2 large or 1 very small
Blackberries	3/4 cup
Blueberries	3/4 cup
Cantaloupe	1 cup cubed or 1/3 melon
Cherries	12 medium
Dates	3
Figs	2 medium
Fruit cocktail	1/2 cup
Grapefruit	1/2 large
Grapefruit sections	3/4 cup
Grapes	17 small
Honeydew	1 cup cubed
Kiwi	1
Mango	1/2 small or 1/2 cup
Nectarine	1 small
Orange	1 small
Papaya	1 cup or ½ fruit
Peach	1 medium
Pear	1 small or ½ large
Plantain (cooked)	1/2 cup
Pineapple, fresh	3/4 cup
Pineapple, canned	1/2 cup
Plums	2 small
Prunes	3
Raisins	2 Tbsp
Raspberries	1 cup
Strawberries	1 ¼ cup
Tangerines	2 small
Watermelon	1 ¼ cup

Fruit Juice (*liquid = fast absorption*)

Apple, orange, or pineapple	1/2 cup
Cranberry juice cocktail, grape, or prune	1/3 cup
Diet cranberry juice cocktail	1 cup

MILK AND YOGURT

Fat-free and Low-fat Selections (Best Choice)

12 - 15 g carbohydrate
 8 g protein
0-3 g fat
90 calories

Fat-free/low-fat buttermilk	1 cup
Fat-free milk	1 cup
Low fat/1 % milk	1 cup
Evaporated fat-free milk	1/2 cup
Fat-free dry milk powder	1/3 cup dry
Yogurt, fat-free, flavored, sweetened with nonnutritive sweetener and fructose	2/3 cup
Yogurt, plain, fat-free	2/3 cup
Soy milk, low-fat of fat-free	1 cup

Reduced-Fat Selections

12 – 15 g carbohydrate
 8 g protein
 5 g fat
120 calories

2% Milk	1 cup
Yogurt, plain low-fat	3/4 cup
Sweet acidophilus milk	1 cup

Whole Milk Selections (Limit Use: High in Saturated Fat)

12 - 15 g carbohydrate
 8 g protein
 8 g fat
150 calories

Whole milk	1 cup
Evaporated whole milk	1/2 cup
Yogurt, plain (made from whole milk)	3/4 cup
Kefir	1 cup
Goat's milk	1 cup

SWEETS, DESSERTS, AND OTHER CARBOHYDRATES LIST

Angel food cake, unfrosted	1/12th cake	30 g carb
Brownie, small, unfrosted	2 in square	15 g carb, 5 g fat
Cake, unfrosted	2 in square	15 g carb, 5 g fat
Cake, frosted	2 in square	30 g carb, 5 g fat
Cookie	2 small	15 g carb, 5 g fat
Cookie, sugar free	3 small	15 g carb, 5-10 g fat
Cranberry sauce, jellied	¼ cup	22 g carb
Cupcake, frosted	1 small	30 g carb, 5 g fat
Doughnut, plain cake	1 med	22 g carb, 10 g fat
Doughnut, glazed	3 ¾ in	30 g carb, 10 g fat
Energy breakfast bar	1 bar	22 g carb, 0-5 g fat
Fruit cobbler	½ cup	45 g carb, 5 g fat
Fruit juice bars	1 bar	15 g carb
Fruit spreads, 100% fruit	1 ½ Tbsp	15 g carb
Gelatin, regular	½ cup	15 g carb
Gingersnaps	3	15 g carb
Granola bar	1 bar	22 g carb
Honey	1 Tbsp	15 g carb
Ice cream	½ cup	15 g carb, 10 g fat
Ice cream, light	½ cup	15 g carb, 5 g fat
Ice cream, low-fat	½ cup	22 g carb
Jam or jelly, regular	1 Tbsp	15 g carb
Milk, chocolate, whole	1 cup	30 g carb, 5 g fat
Pie, fruit, 2 crusts	1/6 of pie	45 g carb, 10 g fat
Pie, pumpkin or custard	1/8 of pie	30 g carb, 10 g fat
Pudding, regular	½ cup	30 g carb
Pudding, sugar free	½ cup	15 g carb
Rice milk, low-fat	1 cup	15 g carb
Salad dressing, fat-free	¼ cup	15 g carb
Sherbet, sorbet	½ cup	30 g carb
Sports drink	1 cup	15 g carb
Sugar	1 Tbsp	15 g carb
Sweet roll or Danish	1	37 g carb, 10 g fat
Syrup, light	2 Tbsp	15 g carb
Syrup, regular	1 Tbsp	15 g carb
Vanilla wafers	5	15 g carb, 5 g fat
Yogurt, frozen	½ cup	15 g carb, 0-5 g fat
Yogurt, frozen, fat-free	1/3 cup	15 g carb

NON-STARCHY VEGETABLES

5 g carbohydrate
2 g protein
0 g fat
25 calories

Per 1/2 cup cooked, or 1 cup raw, or 1/2 cup vegetable juice

Vegetables

Artichoke and Artichoke hearts
Asparagus
Beans (green, wax, Italian)
Bean sprouts
Beets
Broccoli
Brussel sprouts
Cabbage - all types
Carrots
Cauliflower
Celery
Cucumber
Eggplant
Greens (mustard, kale, collard)
Kohlrabi
Leeks
Mushrooms
Okra
Onions
Peppers (all varieties)
Rutabaga
Salad Greens (endive, escarole, lettuce, romaine and spinach)
Snow peas
Sauerkraut
Spinach
Summer squash
Swiss chard
Tomato sauce
Tomatoes
Turnips
Water chestnuts
Zucchini

MEATS AND MEAT SUBSTITUTES LIST

Very Lean Selections (Good Choice)

0 g carbohydrate
7 g protein
0-1 g fat/trace
35 calories

Fat-free cheeses (0-1 g fat/oz)	1 ounce
Egg whites	2
Egg substitute	1/4 cup
Fat-free/low-fat cottage cheese	1/4 cup
Skinless white meat poultry	1 ounce
Fish & shellfish (most varieties)	1 ounce
Low-fat lunch meats (0-1 g fat/oz)	1 ounce
Skinless pheasant, venison,	1 ounce
Buffalo and ostrich	

Lean Selections (Good Choice)

0 g carbohydrate
7 g protein
3 g fat
55 calories

Lowfat cheeses (3 g fat/oz)	1 ounce
4.5% fat cottage cheese	1/4 cup
Parmesan cheese	2 Tbsp
Lowfat lunch meats (3 g fat/oz)	1 ounce
Oysters	6 medium
Herring, salmon, or catfish	1 ounce
Beef	1 ounce
- round, sirloin, tenderloin	
- flank, chuck roast, T-bone	
- porterhouse, rump roast	
Pork	
- ham, tenderloin, Canadian bacon	1 ounce
Lamb	1 ounce
- roast, leg, chop	
Veal	1 ounce
- lean chop, roast	
Poultry: dark meat skinless	1 ounce
Skinless Duck or Goose	1 ounce

MEATS AND MEAT SUBSTITUTES LIST

Medium Fat Selections

0 g carbohydrate
7 g protein
5 g fat
75 calories

Reduced-fat cheese (5 g fat/oz)	1 ounce
Ricotta cheese	1/4 cup
Mozzarella	1 ounce
Feta cheese	1 ounce
Egg	1
Tofu	4 ounces, ½ cup
Tempeh	1/4 cup
Reduced-fat lunch meats (5 g fat/oz)	1 ounce
Fried fish	1 ounce
Beef (most cuts)	1 ounce
- ground, corned beef	
- prime rib, short ribs, meatloaf	
Pork	1 ounce
- chops, top loin	
- cutlets, Boston butt	
Lamb	1 ounce
- rib roast, ground	
Veal cutlet	1 ounce
Poultry with skin	1 ounce

High Fat Selections (Limit use)

0 g carbohydrate
7 g protein
8 g fat
100 calories

Cheese (all regular varieties)	1 ounce
- Jack, cheddar, Swiss	
- American, Brie, muenster	
Lunch Meat	1 ounce
- bologna, sausage	
- salami, knockwurst	
- hot dogs, bratwurst	
Bacon	3 slices
Pork spareribs	1 ounce
Peanut Butter	1 Tbsp

FATS

0 g carbohydrate
0 g protein
5 g fat
45 calories

Unsaturated Fats

Monounsaturated Oils:	1 tsp
Olive oil	
Canola oil	
Peanut oil	
Polyunsaturated Oils:	1 tsp
Corn, Safflower	
Sunflower, Sesame	
Soybean	
Avocado	2 Tbsp
Margarine, soft tub or squeeze	1 tsp
Reduced-fat margarine	1 Tbsp
Mayonnaise	1 tsp
Reduced-fat mayonnaise	1 Tbsp
Salad dressings	1 Tbsp
Reduced-fat salad dressings	2 Tbsp
Olives	8-10 large

Nuts and Seeds (contain a small amount of protein and carbohydrate)

-Almonds	6
-Cashews	6
-Peanuts	10 nuts
-Pecans	4 halves
-Walnuts	4 halves
-Peanut butter	1/2 Tbsp
-Pumpkin seeds	1 Tbsp
-Sunflower seeds	1 Tbsp

Saturated Fats (Limit Use)

Butter	1 tsp	Coconut Shredded	2 Tbsp
Margarine, stick	1 tsp	Whipped Cream	3 Tbsp
Sour cream	2 Tbsp	Cool Whip Light	5 Tbsp
Light sour cream	3 Tbsp	Bacon (crisp)	1 strip
Lard	1 tsp	Salt Pork	1/4 oz
Bacon grease	1 tsp	Chitterlings	2 Tbsp
Cream, half	2 Tbsp	Palm Oil	1 tsp
And half		Coconut Oil	1 tsp
Shortening	1 tsp	Cream Cheese	1 Tbsp
Coconut milk	1 Tbsp	Light Cream Cheese	1 1/2 Tbsp