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Information for the U.S. products. Please refer to the Canadian product label for the list of ingredients and nutritional information for products available in Canada.

A GUIDE FOR FAMILIES WHO HAVE A CHILD WITH

Urea Cycle Disorder

CONTENTS

Abbott provides this booklet to health care professionals to help them counsel families, and to families to help them learn about UCD.

INTRODUCTION TO UREA CYCLE DISORDERS

Your child has a condition called a urea cycle disorder, which is one of a group of disorders of the urea (you-ree-ah) cycle, called UCDs for short. Children who have inherited a UCD can't use nitrogen in a normal way. Nitrogen is found in all 20 amino acids—the "building blocks" of protein—that occur commonly in the human body and the foods we eat. You will need to feed your child all the foods necessary for normal growth and development, but only in amounts that provide a level of protein he can safely use.

Learning some medical terms in nutrition and genetics will help you understand and manage your child's diet better. If you have any questions, write them down and ask the nutritionist (dietitian), nurse or doctor at the metabolic clinic.

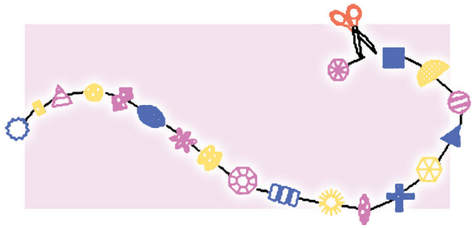


Figure 1. Amino acids are joined together like beads on a necklace to form protein. Enzymes act like scissors to remove amino acids from protein.

WHAT ARE UCDs?

UCDs are inherited disorders of nitrogen metabolism. Protein, and therefore nitrogen, is found in our hair, blood, skin, and muscles. Most foods contain protein. High-protein, high-nitrogen foods include dairy products, beans and peas, eggs, meat, nuts, soy products, seafood, nut butters, poultry, and seeds. Fruit, grains, and vegetables contain less protein and thus have less nitrogen. When we eat foods containing protein, during digestion this protein is split into smaller parts called amino acids. The amino acids are later put back together to form new protein. These new proteins are used to build and repair the body's tissues.

The amino acids not used in this way undergo reactions so they can be used as energy by the body. The first step in this process is the removal of nitrogen (N), which forms ammonia (NH_3). Ammonia, in turn, is formed into urea and excreted in the urine.

Splitting protein into amino acids requires a special substance called an enzyme (n-sime). Think of the enzyme as a pair of scissors snipping beads off a necklace (Figure 1). Another enzyme snips the nitrogen off the amino acid. This waste nitrogen is normally used by enzymes in the liver to make urea, which is excreted in the urine.

Six enzymes are involved in the process of forming urea from waste nitrogen (Figure 2) in the urea cycle. The six disorders

of the urea cycle are referred to by the initials or name of the missing enzyme:

- NAGS, N-acetylglutamate synthetase
- CPS, Carbamyl phosphate synthetase
- OTC, Ornithine transcarbamylase
- AS, Argininosuccinate synthetase
- AL, Argininosuccinate lyase
- Arginase

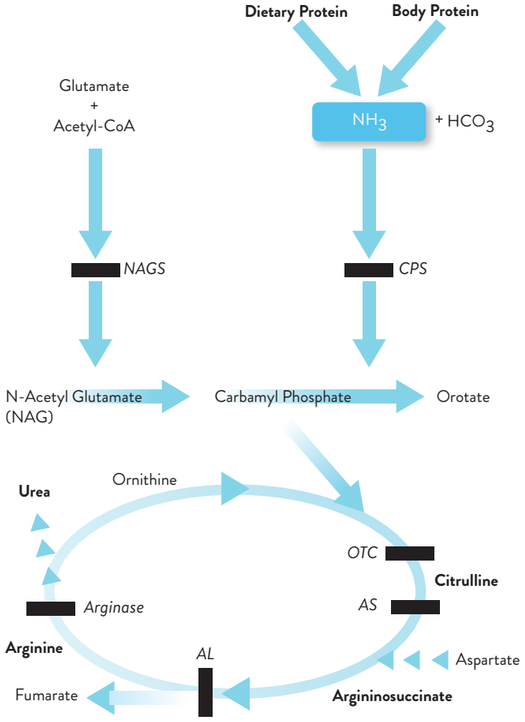


Figure 2. The urea cycle. Waste nitrogen is changed to ammonia (NH3), then to urea which is excreted from the body. Ammonia builds up when any enzyme doesn't work. The black boxes indicate sites of an enzyme that may not work.

Enzymes not working.
Protein (nitrogen) unable to be changed to urea, resulting in UCD.

Enzymes not working well.
Protein (nitrogen) may change to urea but not as efficiently because of lower enzyme activity.

Enzymes working.
Protein (nitrogen) changes to urea.

Figure 3. The urea cycle traffic light.

Whenever any one of the six enzymes is totally missing, present in inadequate amounts, or only partially works, the cycle is stopped and a UCD occurs.

Think of the situation as a traffic light (Figure 3). Green traffic lights (normal enzymes) allow N to be changed to urea. A yellow light (partial enzyme activity) may work to change most of the nitrogen into urea, but could cause a problem when there is excess waste nitrogen that needs to be removed. Any red light (too little or none of any one of the six enzymes) keeps N from being changed to urea. Therefore, ammonia increases and builds up in the blood and tissues and causes the symptoms of a UCD. The ammonia is like a poison in the body. Too much ammonia in the blood may cause loss of appetite, confusion, vomiting, and sleepiness.

Some people, such as your child, either do not have any working enzymes or do not have enough to manage all the waste N that comes from eating normal amounts of protein foods or from body protein breakdown. In either case, the waste nitrogen cannot be excreted.

When N cannot be used to make urea, ammonia builds up to higher than normal levels. Too much ammonia can damage the brain and nervous system. People with a UCD who are not diagnosed in early infancy and who do not have their diet carefully managed will have excess ammonia in their blood.

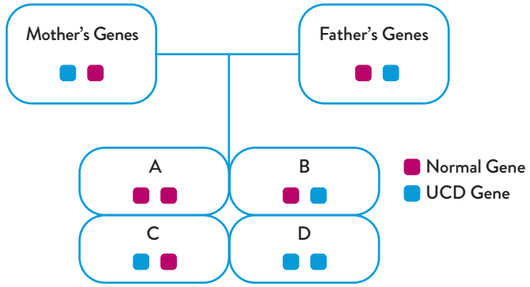


Figure 4. Genetic inheritance of UCD.

UCD: AN INHERITED DISORDER

All but one (OTC) of the urea cycle disorders are inherited from both the mother and the father, just like other features, such as eye and skin color. Genetic information, which determines each person's characteristics, is carried on pairs of genes in every body cell. These genes serve as blueprints, or patterns.

Each parent of a child with a UCD has one normal (●) and one altered UCD (●) gene. Each one of their offspring could have one of four gene sets (Figure 4).

A child who receives gene set A inherits two normal genes (●●). Her body will make enough enzymes to enable the urea cycle to function normally. She will pass a normal gene on to each of her offspring.

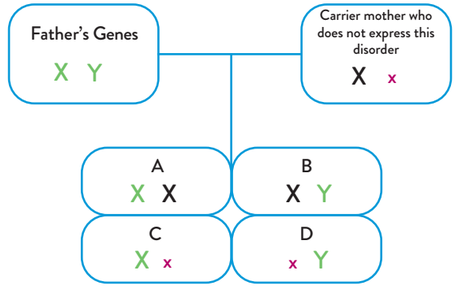
A child who receives gene set B or C inherits one normal (●) and one UCD (●) gene. His body will make enough enzymes to function normally, but he can pass on the UCD gene to his offspring. A person with this gene set—one normal and one UCD—is called a carrier. Being a carrier does not affect the person's health. **You, as parents of a child with a UCD, are carriers.** Brothers and sisters of your child with UCD may also be carriers.

A child with gene set D has UCD caused by the two UCD genes (●●), one from the mother and one from the father. Her body will not be able to get rid of excess nitrogen. She will also pass a UCD gene on to each of her offspring. Your child with UCD has this gene set.

One urea cycle disorder is inherited differently than the other disorders in the urea cycle. Ornithine transcarbamylase (OTC) deficiency, the most common urea cycle disorder, is an X-linked trait, meaning that the gene associated with this is located on the X chromosome. A female has two of the X chromosomes, while a male has one X and one Y chromosome.

Since boys only have one X, the disorder may be more severe for them. Girls have a second X, which seems to "turn off" the altered gene, making the disorder milder. Some females do not know they carry the altered gene. Again, think of the situation as a traffic light. Green lights (normal enzymes) allow N to be changed to urea. With yellow lights, the N may be changed to urea more slowly. When females are under stress (infections, menstruation, pregnancy, childbirth), ammonia levels may rise and symptoms can occur.

The father of an affected male will not have the disorder or be a carrier. The mother will be a carrier or have the altered gene only in her egg cells. There is also a small chance that OTC deficiency is a result of a brand-new change in the gene that occurred spontaneously when the baby was formed.



x = Altered OTC Gene

A= Daughter who does not have OTC and is NOT a carrier
B= Son who does not have OTC and is not a carrier
C= Daughter who is a carrier but does not have OTC
D= Son who has OTC

Figure 5. Genetic inheritance of OTC deficiency.

Table 1. General Guide to Foods on Protein-Restricted Diets

Foods That Are Not Allowed	Foods That Are Limited	Foods That May Be Eaten Freely
Dairy products (cheese, milk, ice cream, yogurt), soy milk and soy products, beans and peas, eggs, fish and seafood, meat, nuts, nut butters, poultry, seeds, tofu	Breast milk, infant formulas, bread, crackers, fruit, fruit juices, low-protein cereals, popcorn, potato chips, special low-protein foods, vegetables, vegetable juices	Gumdrop candy, hard candy, jelly, Kool-Aid®, lemonade, lollipops, Popsicles®, pure sugar and fat, soda

Therefore, half of the daughters have the altered gene and can pass it to the next generation. They may have a mild form of the disease or be symptom-free. The other half does not have the altered gene and will not have OTC deficiency. Half of the sons do not have the gene and will not have OTC deficiency. The other half of the sons have inherited the gene and will have OTC deficiency.

DIAGNOSIS OF UCDs

Most states require all babies to be screened for urea cycle disorders. In the states that do not include UCDs in their newborn screening, infants with UCDs often are diagnosed after they start showing symptoms of the disease.

If the initial screening tests show that a baby may have a UCD, additional blood and urine are collected for more precise measurements that will confirm the diagnosis. Some doctors may hospitalize the infant to confirm diagnosis so that treatment can be started sooner if the baby has a UCD.

SYMPTOMS OF UCDs

If diagnosis of a UCD is not made at birth, a diagnosis may be made after a child starts showing symptoms of a UCD.

Hyperammonemia or elevated ammonia levels affect the nervous system. Newborns with severe disease typically show symptoms after the first 24 hours of life. Children with mild or moderate disease may not show symptoms until early childhood. This childhood onset, called late-onset, can be seen in both boys and girls. Childhood episodes of hyperammonemia may be brought on by viral illnesses, or even exhaustion. An untreated infant or child may have some or all of these symptoms:

- Irritability
- Vomiting
- Lethargy (excessive tiredness)
- Seizures
- Hypotonia (poor muscle tone)
- Respiratory difficulty
- Coma
- Poor feeding

NUTRITION SUPPORT OF UCDs

Since the 1980s, a diet with reduced protein content (less nitrogen) has been used to prevent developmental delay and other problems associated with untreated UCDs. This diet, which is different for each person with a UCD, lowers the amount of ammonia in the blood to a range that may allow for normal growth and development. The special UCD diet for your child is very important.

Many foods contain protein. These foods also contain nitrogen. Therefore, the amounts of foods that contain protein must be limited in your child's diet. Table 1 is a general guide to foods that are not allowed, foods that are limited, and foods that may be eaten freely if obesity is not a problem.

Requirements for Energy, Protein, and Essential Amino Acids. A child with a UCD who eats enough protein to grow properly gets too much nitrogen. Foods high in protein include cheese, milk, soy milk, eggs, meat, poultry, fish, nuts, tofu, beans and peas, seeds, and nut butters. Foods low in protein include some cereals, fruits, fats, vegetables, and sweets. Foods low in protein do not contain enough essential amino acids (amino acids that the body cannot make) to meet your child's needs for growth. **Thus, it's necessary to use a special medical food that contains essential amino acids, vitamins, and minerals**.

To be sure your child is getting enough energy and protein for growth and development, the nutritionist carefully calculates the amount of each nutrient needed. Too little energy, protein, or essential amino acids can result in growth failure. Frequent diet adjustments are necessary, especially during the first few years of life when children grow rapidly. The nutritionist or metabolic doctor will make these diet changes based on your child's health, growth, protein intake, and blood levels of ammonia.

Cyclinex®-1 Amino Acid-Modified Medical Food With Iron is a medical food used to provide most of the essential amino acids for infants and toddlers. Cyclinex-1 contains only essential amino acids, so Similac® Advance® Infant Formula with Iron, breast milk, or other food sources of intact protein **must** also be fed to provide the specific amount of nitrogen your baby needs for growth and development. The nutritionist or metabolic doctor will tell you the exact amount you should include in your child's diet. Cyclinex-1 provides fat, carbohydrate, minerals, and vitamins. Supplemental minerals and vitamins are not usually needed when the diet is followed as directed.

Cyclinex®-2 Amino Acid-Modified Medical Food is a medical food used in treating children and adults with a UCD. This product contains only essential amino acids, so protein needs **must** come from other food sources. Your nutritionist will tell you which Cyclinex product is right for your child, as well as which foods and how much of each your child can eat. Cyclinex-1 and Cyclinex-2 do have minor differences in flavor. Some children may resist the change from Cyclinex-1 to Cyclinex-2. Your nutritionist will help you with ideas to make the change to Cyclinex-2.

Cyclinex-1 and Cyclinex-2 look and taste different than milk. Most children taking medical foods like them **IF** they are started early and **IF** their family has a positive attitude. They may seem distasteful to you, but it is very important not to show this to your child, either by word or action.

One mother disliked the odor of the medical food so much that she made a face every time she gave it to her son. Because of this, he refused the medical food for several days until the mother and her family realized what was wrong. As she said later, "We changed our attitude to thinking this wonderful diet will make it possible for our child to have a healthy life."

Flavorings such as Kool-Aid® Unsweetened Soft Drink Mixes, Wyler's® Unsweetened Soft Drink Mixes, and concentrated fruit juices can be added to Cyclinex. Remember to count the added protein if it is present in any of the flavorings. See recipes on page 14.

Cyclinex may be made into a paste and combined with some allowed fruits, such as applesauce or other fruit purees, or combined with instant pudding mixes. Check the label and be careful which pudding mixes you buy, as some contain more protein than others.

INTERNATIONAL SYSTEM OF MEASUREMENT (METRIC SYSTEM)

The metric system is the International System of Measurement. It is used for all medical and scientific measures.

In the metric system, solids are weighed in grams (g) or kilograms (kg) and liquids are measured in milliliters (mL)

Table 2. Metric to English Conversions

Metric		English
Solids		
1 g (0.001 kg)	=	0.035 oz
28 g	=	1 oz
454 g	=	1 lb
1000 g (1 kg)	=	2.2 lb
Liquids		
5 mL	=	1 tsp
15 mL	=	1 Tbsp
60 mL	=	1/4 cup
240 mL	=	1 cup
1000 mL (1 L)	=	4 1/4 cup (1.06 qt)

Feeding time should be a pleasant experience for you and your baby.

or liters (L). A list of common conversions from the metric system to the English system is given in Table 2. However, the best way to be sure your child is getting the proper amount of BCAA is to weigh food on a scale that reads in grams.

Medical Food Preparation. Mix a 24-hour supply of medical food at one time, or as instructed by your nutritionist.

Your nutritionist will tell you exactly how much Cyclinex and other formulas or breast milk to use.

Tips for preparing formula for infants:

- **Always follow the instructions on the label and mix formula according to the recipe provided by your nutritionist or metabolic doctor.**
- Wash your hands and all supplies carefully before preparing formula.
- **Do not** mix longer than indicated on the Cyclinex label.
- Always test the temperature of heated formula before feeding by shaking a few drops on your wrist.
- Overmixing causes the fat emulsion to break. Separation of the medical food mixture then occurs. Overmixing may also add air that destroys vitamins A and C.
- Heating above 100° F (37.8° C) or adding hot water may cause loss of vitamins A and C and lead to the Maillard reaction—a reaction in which some amino acids bind with carbohydrate, making them unavailable to the child.
- Mix in the approved natural protein (breast milk or infant formula) if recommended by your nutritionist or metabolic doctor.
- Refrigerate the medical food after mixing. Discard any unused medical food 24 hours after mixing because of nutrient loss.

Feeding Your Infant. The way you feed your baby with a UCD is the same as for any baby. The Cyclinex-1 formula will be supplemented with breast milk or infant formula such as Similac Advance®. The nutritionist may have you mix the two formulas together. The Cyclinex-1 mixture stored in bottles in the refrigerator may be warmed before feeding.

- Shake the formula mixture and pour into a bottle.
- Set a bottle in a pan of cold water on the stove and gradually warm it or run hot tap water over the bottle.
- Never use a microwave oven to warm formula as this can result in hot spots that can burn your baby.
- Always test the temperature of heated formula before feeding by shaking a few drops on your wrist. The formula should feel lukewarm.
- If the Cyclinex-1 mixture drips freely, the nipple holes are the correct size. Shake the bottle well before feeding.

To feed your baby, sit in a comfortable place, hold her in the curve of your arm, and keep the nipple filled with the Cyclinex-1 mixture so that air will not be swallowed. You should burp your baby at least once during and again at the end of each feeding. Hold her upright against your shoulder or lay her face down on your lap and gently pat her back.

DO NOT WARM THE BOTTLE IN THE MICROWAVE.
Uneven warming may cause serious burns.

Introduction of Solid Foods. No baby is born with the ability to swallow solid foods. The swallowing reflex develops at 2 to 3 months of age. Before this time, the baby's "tongue thrust" causes the tongue to protrude, making swallowing food difficult. Waiting to feed solid foods until the baby is developmentally ready is best.

Cyclinex-1 is similar to infant formula and the amounts, as well as the kinds of cereals, fruits, and vegetables prescribed, are about the same as for any baby. Your baby's nutritionist or metabolic doctor will advise you about when your baby should start eating infant cereal and strained baby foods,

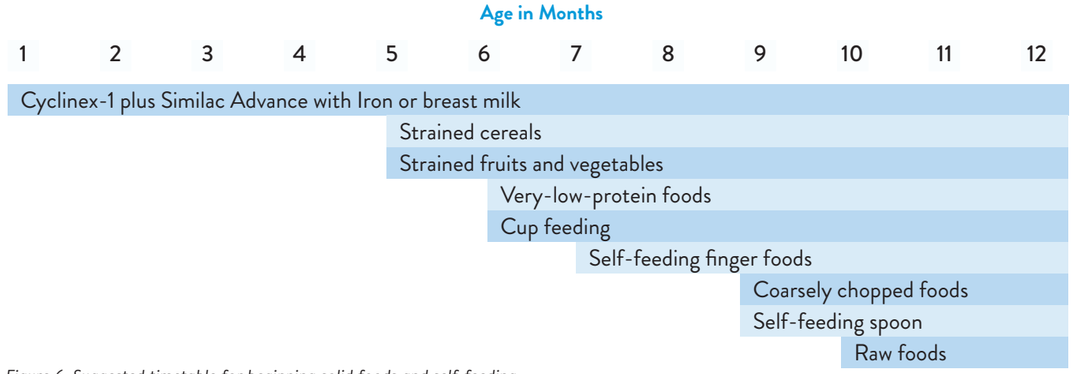


Figure 6. Suggested timetable for beginning solid foods and self-feeding.

and which foods to introduce. Guidelines for adding various foods to your baby's diet are given in Figure 6. However, your nutritionist or metabolic doctor may suggest different ages, so follow their advice.

At about 7 to 8 months of age, your child may begin trying to eat foods such as crackers, low-protein toast, or pieces of fruit without help. At about 9 months of age, he may begin using a spoon.

If your 9- to 12-month-old child has never eaten without help, dip her fingers into the food to give her the idea of finger feeding. Later, you can teach her to pick up a spoon and guide it to her mouth. Putting your child on your lap to guide her hand may be easier. Start with thick foods such as mashed potatoes since they do not slip off the spoon easily.

Do not worry if your child does not eat all of the foods you measure out; just estimate what was not eaten, replace the protein with another food, and write it down.

When your child is older, the differences between the protein-restricted diet and the diets of other children will be greater. Your child with a UCD will require Cyclinex all her life to provide most of her protein, mineral, and vitamin needs.

Diet Guide and Food Lists. At each clinic visit, you will be given guidance that spells out in detail what your child can eat. The amount and how to prepare the medical food mixture, and the types and amounts of food that your child is allowed, will be outlined. The nutritionist will help you work out a plan that meets your child's needs and fits into the family budget and lifestyle.

Lists of foods make meal planning easier and help you be sure your child's nutrient needs are met. You will have time to become familiar with the food lists and their nutrient content, because foods will be added slowly to your child's diet.

When your child is older, you may need to use Free Foods (see Table 1) to meet her energy needs. Free foods, which are high in energy and contain little or no protein, must not replace prescribed foods nor be used in large amounts. If your child eats too many of these free foods, he may become overweight, or the extra sugar may cause tooth decay. Special low-protein foods, including pasta, rice, crackers, cookies, and breads, can be added to the diet. These foods will help to satisfy your child's hunger.

If you have questions about the content of certain foods, the nutritionist can calculate the nutrient composition of the food and help you include it in the diet plan if it is not too high in protein.

Be sure to check with the nutritionist before using any food that is not on the food lists provided.

Drug Therapy. Certain vitamins or medications for your child with a UCD may be recommended by your

metabolic doctor. Medications are available that help increase the excretion of waste nitrogen in the urine. Sodium phenylacetate, sodium benzoate, sodium phenylbutyrate [Buphenyl®], and glycerol phenylbutyrate (Ravicti®) may be prescribed by your metabolic doctor in combination with the special diet. Buphenyl or Ravicti are most commonly used orally. For NAGS deficiency, a medication which helps the enzyme work better, such as N-carbamylglutamate (carglumic acid), may be used.

The amount of drugs your child takes will change depending on his weight and blood NH3 level. Sodium phenylacetate and sodium benzoate may be given intravenously if your child has an acute episode of hyperammonemia.

Amino Acid Supplements. Depending on the type of UCD, amino acid supplements such as arginine and citrulline may be given. Except in the case of arginase deficiency, arginine and/or citrulline are needed to help the body make proteins and excrete urea. The metabolic nutritionist or doctor will help you with ways to give these supplements. Many parents add these to a small amount of formula for their child with a UCD.

CHECKING YOUR CHILD'S PROGRESS

Blood Tests. Because your baby grows rapidly during the first year of life, his blood will be tested frequently for ammonia and amino acid content. Many doctors will ask for a blood sample once a week during your baby's first 6 months, then every 2 weeks until he reaches 1 year of age. After 1 year of age, checking blood levels and diet records may be decreased to once a month if blood ammonia levels are well controlled. Your baby's metabolic doctor will determine how often your baby is tested. It is common to have the blood checked for ammonia content if your child is not feeling well.

Before taking the blood sample, you may be asked to accurately record your child's total food and beverage intake. On a form the clinic will provide, record the name of the food, the exact amount in household measures (cups, teaspoons, or tablespoons) or in grams that your child ate. You may also be asked to record the protein content based on the food lists or information given to you by the nutritionist.

Urine Tests. A urine test may also be requested by your physician as another measure to monitor metabolic control.

Blood Ammonia Levels. The amount of ammonia in the blood is an indirect measure of how much ammonia is present in body tissues. Of most concern is the brain, because too much ammonia is harmful to brain development. Because blood transports nutrients to the brain, the concentration of ammonia in the blood will give the doctor and nutritionist an idea of how much ammonia might be in the brain.

Recommended blood ammonia levels vary, but are normally not above 40 µmol/L. If the ammonia levels rise to approximately three times the normal level (>100 µmol/L), symptoms may occur. In addition, plasma glutamine (one of the amino acids) may be frequently monitored.

Blood ammonia levels that are **high** may indicate that your child is eating more foods that are high in protein than his body needs for growth. Illnesses, such as colds and flu, can also cause the body to break down its own protein, causing ammonia levels to rise. Sometimes a high ammonia is a sign that your child's medications need to be adjusted. When your child is not getting enough protein, because of rapid growth or inadequate intake of medical food, the blood ammonia level may also rise.

Clinic Visits. Because UCD is a lifelong condition that could harm growth and development, you will be asked to bring your child to the clinic frequently. If growth and development are normal and blood ammonia concentrations remain within the treatment range, the frequency of clinic visits may be decreased with time.

At clinic visits, your child may be given developmental, physical, and neurological tests. Family interaction, which is important to her development, may also be evaluated. The clinic can address any questions or concerns you may have. Diet changes will be made, if needed, and any questions you may have will be answered.

In addition to the metabolic specialist, you should have a local pediatrician or family doctor to provide required ongoing well-child care. This doctor should give immunizations at the usual times, or you may obtain them from the health department.

YOUR CHILD'S GROWTH AND DEVELOPMENT

By 4 to 6 months of age, your baby's birth weight will double. The child with a UCD whose protein (nitrogen) intake is well controlled and whose diet supplies adequate nutrients should grow as well as a child without a UCD.

During the second 6 months of life, the growth rate decreases. Your child may grow 1 inch (~ 2.5 centimeters [cm]) per month during the first 6 months and 4 inches (~ 10 cm) total during the second 6 months of life. This normal decline in the growth rate usually causes a decrease in appetite.

Although the requirement for energy (calories) and protein on the basis of body weight decreases, the total daily requirement for most nutrients increases with age. You will have to adjust food choices accordingly to ensure that your child has an adequate nutrient intake. The nutritionist will help you with food selections that are right for your child.

Weaning from Bottle to Cup. When the time comes to switch from the bottle, your child may need extra attention, as any child would. Weaning takes patience, especially if your child shows no interest in drinking from a cup or a glass.

Begin offering Cyclinex-1 from a cup when your child is between 5 and 8 months of age. Some parents find a training cup that has a lid and a spout to be very useful.

During weaning, your child may not want to take all of the prescribed Cyclinex in liquid form. You may have to use more of it in instant puddings, cereals, fruits, and soups. Some of the Cyclinex can be mixed into a paste with fruits and fed by spoon.

ADDITIONAL WATER MUST BE OFFERED WHEN CYCLINEX® IS FED AS A PASTE.
Consult your child's nutritionist.

A child of 15 to 18 months may drink more medical food from a cup if she is given a small pitcher of Cyclinex and is encouraged to pour it into a small cup without help. Many parents have found brightly colored straws, special cups, or sports bottles to be good transitional tools to help wean a child from the bottle.

Toddlers. Toddlers, children from 1 to 3 years of age, have a slow growth rate compared with that of infants. Toddlers may gain 4 to 5 pounds (1.8–2.3 kilograms [kg]) a year, compared with the infants' gain of 12 to 22 pounds (5.5–10 kg) per year.

Growth during this period involves changes in body form. Legs lengthen and body fat decreases. Energy needs are decreased because of the slower growth rate. However, mineral and vitamin needs increase.

Toddlers seek independence and are very curious about their environment. Because toddlers want to do things for themselves, encourage your child to feed himself.

Preschoolers. Preschoolers also have a slow weight gain of 4 to 5 pounds (1.8–2.3 kg) per year. On the other hand, their total energy needs are greater than those of toddlers. Because your preschooler's nutrient and energy needs are greater, the nutritionist may tell you to increase foods with a high

nutrient content. These foods are packed with vitamins and minerals and are energy dense.

Let your preschooler make some decisions. For example, permit him to choose which cereal, fruit, or vegetable to eat.

Be aware that most preschoolers want to do things at their own speed. Be prepared to have your child spend so much time talking that little is eaten. This is normal behavior.

Social Interaction at Mealtime. Mealtime is an important part of every child's social development and, whenever possible, the family should eat together. Younger children can learn how to feed themselves by watching older brothers and sisters.

Make meals for your child with a UCD as similar as possible to the family's meals. Menus for him can be planned from those for the rest of the family. For example, whenever possible, use the same fruits and vegetables for everyone. You can also prepare a low-protein pasta or meatless dish that is similar to the one served to other family members. The family's help and support are very important to maintaining the child's diet.

TEACHING YOUR CHILD DIET MANAGEMENT

Explaining the diet to your child can begin by calling allowed foods "special" or "just for you." From the time she is very young, teach her to ask about unfamiliar foods before eating them. As your child grows older and is able to understand the concept of a missing or nonworking enzyme, explain UCD. Some materials that you may find helpful are listed on page 17.

Toddlers and Preschoolers. Permit your preschooler to make food choices such as what fruit to eat. Plan meals that have variety in color, texture, flavor, and preparation methods. A child who is involved in food selection and preparation will be more interested in trying a new food. Involve your child in planning menus so he can become familiar with foods allowed and excluded. Let him help with grocery shopping, setting the table, and preparing the food.

At about 4 years of age, children want to serve themselves. Teach your child the proper food portions. One way to do this is to use a "token" system. Tokens, symbolizing 0.1, 0.5, or 0.6 g of protein, may be used by your child to "purchase" foods containing these amounts.

School Age. When your child reaches school age, she will become more independent in many things she does, including choosing and eating foods. As she begins to develop logic and math skills, it is important that she use these skills to understand the diet. Encourage your child to help prepare the medical food and calculate the amount of protein in foods. As your child gets older, she should understand what levels of ammonia are normal and the consequences of high ammonia levels.

Adolescence. Adolescence may be a difficult time for both the child and the parents, regardless of a UCD! The influence of friends and the struggle for independence may make dietary compliance a challenge. Teens may feel that UCD makes them different from their friends. Eating out with friends is part of growing up. Help your child develop the skills for eating out, traveling, and "sticking" to the diet when not at home. Sometimes teenagers with UCD would rather tell people they are a vegetarian or vegan than explain about UCD. Help your teenager deal with her peers and not be self-conscious about her condition. Finding a peer with UCD through support groups can be a great comfort for a teen. Ask the clinic for resources and suggestions.

FEEDING PROBLEMS

Parents may be tempted to treat their child as a "sick" child and not follow their usual patterns of child rearing. The child with UCD is a normal child who needs to manage food intake carefully. Ask your child's doctor, nutritionist, public health nurse, or social worker for support and help if any of the following problems should occur.

Loss of Appetite. Loss of appetite can result from a variety of causes, including illness; eating too many sweet foods or desserts that satisfy appetite and decrease the desire to eat the foods prescribed; and getting too much Cyclinex, which may depress the appetite for other foods.

Unusual Hunger. This may be an indication that the diet needs to be adjusted—the amount of Cyclinex may need to be increased because the table foods prescribed are not satisfying needs. Providing low-protein foods is a great way to manage hunger without increasing protein intake.

Refusing Medical Food. A child may refuse Cyclinex because of normal variations in appetite, especially if average intake over a week is adequate. If Cyclinex is not offered regularly, a child may decide to refuse it. Improperly mixed Cyclinex can also be a cause—too much water makes the volume too great; too little water makes the medical food mixture too thick. A child may refuse Cyclinex as an attention-getting device, especially if he senses that his parents are anxious for him to drink the Cyclinex mixture. Remember, Cyclinex plays an important role in providing most of your child's nutrition needs. If refusal of the medical food continues to be a problem, the use of a feeding tube may need to be considered.

Refusing Solids. A child may experience normal variations in appetite or taste for certain foods. Or, the prescribed amount of Cyclinex may be too high and the energy it provides may cause her to lose her appetite.

Toddlers and preschoolers periodically have one of two characteristic feeding behaviors that cause parents concern. They may decide to stop eating—go on a "food strike"—or they may go on a "food jag." Food jags and strikes are common among young children.

During a food strike when your child refuses to eat, offer food at usual mealtimes and if she refuses the food, take it away. Allow only water between meals. She will become hungry and then eat. **Remember that Cyclinex supplies most of your child's nutrient needs, so her medical food should never be restricted.**

Do not give in to the food strike and offer Free Foods or foods that are not on the protein-restricted diet. The nutritionist can help you during this trying time; so do not hesitate to call. It is also very important for family members to support each other in managing a food strike. If the child is allowed to eat foods not on the diet, blood ammonia levels will not be controlled.

On a food jag, a child wants to eat the same food or foods for long periods. If the foods are nutritious and are appropriate for the UCD diet, there is no reason for concern. Remember that most of your child's nutrient needs are met by Cyclinex.

Inappropriate Feeding Behavior. Inappropriate behaviors, such as refusing to give up the bottle and/or difficulty in eating solids, chewing, or self-feeding, may result from a variety of causes. These can include a delay in offering table foods, difficulty in teaching the child to drink Cyclinex

by cup, or not allowing the child to feed himself either with fingers or spoon. Always keep a positive attitude and make feeding a pleasurable event.

Try not to feed a child longer than necessary at mealtime to encourage self-feeding. Remember that small amounts of food are usually wasted when a child first learns to feed himself, but this is normal. Keeping food records will help your nutritionist estimate your child's intake.

A child may be using his diet as a way of getting attention or manipulating parents. If your child has any of these problems, call the nutritionist. The nutritionist will give you support and offer suggestions to help solve the problem.

THE ROLE OF THE FAMILY AND OTHER CARE PROVIDERS IN MANAGING UCD

Parents carry the bulk of the responsibility, so they should try to share in preparing meals and monitoring the diet. Other children in the family, as well as the child with a UCD, should learn about the diet as soon as they are old enough to understand it. Older brothers and sisters should be encouraged to feed the child with a UCD so they become familiar with foods allowed and excluded. Make sure they understand the importance of the diet for their brother's or sister's health. Brothers and sisters should be taught not to feel sorry for the child with a UCD because he is on a special diet. Treat your child with a UCD as normally as possible.

Grandparents love to spoil their grandchildren. It may be difficult for them as they sometimes feel the child with the UCD is "missing out." It is important that they understand the diet and become actively involved as much as possible. A grandmother may be the ideal person to experiment with low-protein cooking and provide special low-protein treats.

Explain UCD to relatives, friends, daycare providers, baby-sitters, and all teachers. They should become familiar with foods allowed and excluded and understand the importance of the diet. Give a list of the foods allowed and excluded to anyone who feeds your child and explain the list as well as the exact menu.

Tell everyone who cares for your child that even "just a little bite" of a high-protein food is not allowed. Emphasize what can happen if your child does not stay on the diet.

YOUR CHILD'S DIET DURING ILLNESS

A body temperature greater than 98.6° F (37° C) or a rectal temperature over 100° F (37.8° C) is a fever. During a fever, the body's rate of using food for energy speeds up. If extra energy is not supplied during illness, the body will break down its own muscle and fat stores for energy. Muscle breakdown needs to be prevented in children with a UCD because it will release too much nitrogen into the blood. The ammonia made from this nitrogen is carried to the brain where it may have a harmful effect. Give your child extra low-protein food, formula, and fluids during illness. This extra food energy will decrease the amount of muscle tissue broken down for body energy.

Feeding an ill child can be very difficult. Often a child with fever is restless and has a loss of appetite. The illness might also include stomach upset, nausea, or even vomiting. A child can become very dehydrated due to the high body temperature and the lack of adequate fluid intake.

If you suspect a cold or virus, or if your child has a fever, it is important to call your pediatrician or metabolic doctor immediately. Illness in a child with UCD can be very serious. Your metabolic doctor or nutritionist will help you decide how to manage it. Ask your nutritionist for a "sick-day plan" to use during illness. A sick-day plan provides adequate calories to meet energy needs and helps keep your child out of the hospital. Ask about using medication such as acetaminophen (Tylenol®) to reduce fever.

Here are some suggestions of things to do when your child is ill with fever.

- Do not force-feed food or Cyclinex, especially if your child is nauseated or vomiting. Soda crackers may be the only food he will feel like eating. Encourage intake of any allowed foods that your child is willing to eat.
- Encourage your child to continue drinking his medical food if he tolerates it.
- Offer Pedialyte® Oral Electrolyte Solution with added carbohydrate, such as dextrose or table sugar (3 Tbsp sugar to 8 fl oz of Pedialyte); Pro-Phree®; non-cola carbonated beverages; sugar-sweetened carbonated beverages; Kool-Aid®; Tang®; tea with sugar; vegetable broth; or fruit juices with some sugar added.
- Dilute the Cyclinex mixture, or use liquid Jell-O® if it is tolerated.
- Freeze any of the beverages listed and make into chipped ice. Frequently feed small amounts of this chipped ice to provide energy and prevent dehydration.
- As your child's appetite improves, gradually return to the usual diet plan.

Emergency Letter. Individuals with UCD should have an emergency letter with them at all times. This letter provides important information such as the name of the condition, explanation of symptoms, the importance of timely treatment and treatment strategies, and your metabolic doctor's contact information. In times of illness or stress that may require hospitalization, this letter can be presented. This letter can be provided by your metabolic team.

A LOOK TO THE FUTURE

Continuing the Diet. Continuing the Diet. UCD is a serious health concern. Treating the child as early in life as possible helps to prevent developmental delay and neurological damage. Not following the diet may lead to nervous system damage at any age. Lifelong nutrition support must be adapted to each person's needs. Metabolic doctors and nutritionists provide support that will help your child have a normal, productive life.

Alternative treatment with a liver transplantation may be mentioned by your metabolic doctor. The urea cycle and the enzymes involved are present in the liver, so a liver transplant may be an effective treatment for UCDs. Your doctor will discuss the risks and benefits of a liver transplant and help you decide what is the best treatment option.

Family Planning. The chance that two carriers of a UCD will have a child with a UCD is 1 in 4, or 25% for each pregnancy (Figure 4). The chance that two carriers will have a child who is a carrier is 1 in 2, or 50% for each pregnancy.

Before a couple who has a child with a UCD has any more children, they should take time to seriously think about the special parenting tasks that parents of a child with a UCD must manage. Genetic counseling is recommended to review the risks and to discuss several reproductive options that are available before and during pregnancy.

While there is no test that can determine if another child will be affected with a UCD before a pregnancy, prenatal testing for a UCD may be possible during the early part of the pregnancy. A couple may want to discuss and consider all their options with their metabolic doctor and genetic counselor before having another pregnancy.

If you decide to have another child, give yourselves time to adjust to the special needs of the first child. Parents will want to be skilled in diet management for UCD before having another child.

Childbearing by Women with a UCD. For women with a UCD, having children may cause problems. A major concern for women with UCD is the stress of a pregnancy on her metabolic control. Nutritional requirements can rapidly change during the course of a pregnancy. Pregnant women must be carefully monitored for their own safety, as well as the health of their baby. Successful pregnancies require attentive diet monitoring during the prenatal, labor, delivery, and postpartum periods.

Kool-Aid®-Flavored Cyclinex®-1

Yield: 8 fl oz

32 g Cyclinex-1
2 Tbsp, **level**, sugar[1]
1/8 tsp Kool-Aid or Wyler's® **Unsweetened** Soft Drink Mix

Add water (room temperature) to ingredients to make 8 fl oz. Mix in a blender at lowest speed no more than 4 seconds. Or, shake briskly in a closed container for 10 to 12 seconds. Serve chilled.

Nutrient	*1 fl oz*	*8 fl oz*
Protein, g	0.30	2.4
Energy, kcal	33	260

[1] Osmolality (concentration of particles in solution) may be too high if more sugar is added, which may cause bloating and diarrhea.
[2] The amount of drink mix may be varied according to taste preference.

Fruit Juice-Flavored Cyclinex®-2

Yield: 8 fl oz

30 g Cyclinex-1
3 fl oz concentrated apple, grape, or orange juice
Water (room temperature) to make 8 fl oz

Warm juice concentrate to room temperature. Place all ingredients in a blender at lowest speed no more than 4 seconds. Or, shake briskly in a closed container for 10 to 12 seconds. Serve chilled.

Nutrient	*Apple juice*	*Grape juice*	*Orange juice*
Protein, g	5	5.2	7
Energy, kcal	305	325	300

[1]Please check with your dietitian or doctor before using this recipe in infants.

Kool-Aid®-Flavored Cyclinex™-2

Yield: 16 fl oz

40 g Cyclinex-2
1/4 cup, level, sugar[1]
1/2 tsp Kool-Aid or Wyler's **Unsweetened** Soft Drink Mix[2]

Add water (room temperature) to ingredients to make 16 fl oz. Mix in a blender at lowest speed no more than 4 seconds. Or, shake briskly in a closed container for 10 to 12 seconds. Serve chilled.

Nutrient	*16 fl oz*
Protein, g	6
Energy, kcal	400

[1] Osmolality (concentration of particles in solution) may be too high if more sugar is added, which may cause bloating and diarrhea.
[2] The amount of drink mix may be varied according to taste preference.

Additional Tips for Flavoring Cyclinex Medical Food

- Add chocolate or strawberry syrup.
- Mix Cyclinex with fruit to make a "smoothie."
- Freeze flavored medical food into "slushies" or "popsicles."
- Add dry Cyclinex to pudding (lemon, tapioca, vanilla, etc) mixture. Prepare pudding with non-dairy creamer.

Use low-protein food lists to calculate protein content of flavorings.

Support Groups/Newsletters

National Urea Cycle Disorders Foundation
75 S. Grand Ave.
Pasadena, CA 91105
Phone (800) 386-8233
Fax: (626) 578-0823
E-mail: info@nucdf.org
Web site: www.nucdf.org

Low-Protein Food Suppliers

Canbrands Specialty Foods, Inc.
3500 Laird Rd.
Mississauga, Ontario, Canada L5L 5Y4
Phone: (905) 829-6003
Email: helpdesk@canbrands.ca
Web site: www.canbrands.ca

Dietary Specialties
8 S. Commons Rd.
Waterbury, CT 06704
Phone: (888) 640-2800
Web site: www.dietspec.com

Ener-G® Foods, Inc.
5960 First Avenue South
Seattle, WA 98108
Phone: (800) 331-5222; (206) 767-3928
Fax: (206) 764-3398
E-mail: customerservice@ener-g.com
Web site: www.ener-g.com

Med-Diet™ Laboratories, Inc.
3600 Holly Lane, Suite 80
Plymouth, MN 55447
Phone: (800) 633-3438 (MED-DIET); (763) 550-2020
Fax: (763) 550-2022
E-mail: info@med-diet.com
Web site: www.med-diet.com

PKU Perspectives
PO Box 696
Pleasant Grove, UT 84062
Phone: (866) PKU-FOOD; (801) 785-7722
Fax: (866) 701-3788
Web site: www.pkuperspectives.com

Taste Connections, LLC
Phone/Fax: (310) 371-8861
E-mail: tasteconnect@verizon.net
Web site: www.tasteconnections.com

IMPORTANT PHONE NUMBERS

Nutritionist: _____

Metabolic Doctor: _____

Pediatrician: _____

Police: _____

Fire: _____

Hospital: _____

Other: _____

_____

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Dietary Modification of Protein

Hypercalcemia

Ketogenic Diet Management Carbohydrate Disorders

Dietary Modification of Carbohydrate and Fat

Use under medical supervision.

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