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Legal Disclaimer: The information included in this manual is intended to inform and guide the health care professional in the use of ketogenic diet therapy. Ketogenic Seminars cannot be held responsible for the use or misuse of these guidelines. Due to constant advances in medicine, the information in this manual may be superseded by future developments.
Ketogenic Diet (KD) Therapy Plan
Inpatient pediatric initiation

PRE-ADMISSION
- Neurological/epilepsy evaluation and referral to KD program
- Baseline laboratory studies and metabolic evaluation to rule out defects that contraindicate KD therapy (beta-oxidation defects, carnitine deficiency, pyruvate carboxylase deficiency, porphria).
- Consultation for nutritional assessment
- Insurance pre-authorization

HOSPITALIZATION FOR INITIATION
- Admission orders are entered by Epilepsy RN
- Laboratory studies upon admission if not done prior (CBC, chemistries, lipids, lytes, AEDs)
- Vital signs q shift until eating 2/3 KD
- Glucose check q 2 hours if < age 1. Every a.m. if > than age 1.
- If glucose <50mg%, give 15mL apple juice and re-check in 1 hour. If failure to eat at least 75% of a meal or keto beverage, then re-check dextan q 4 hours. If NPO, give IV bolus of 50mL of D5W (no continuous dextrose) over 30 minutes and re-check in 1 hour.
- Urine specific gravity q void
- Urine ketones q void
- I&O
- Weight qd in the a.m.
- Pharmacy consult to review medications for carbohydrate
- Social work consult
- Maintenance fluids
- KD is initiated as follows:
  - Day 1: Regular breakfast + keto beverage & 1 keto meal
  - Day 2: 1/3 kcals from ketogenic beverage + 2 keto meals
  - Day 3: Full strength diet (3 keto meals)

Child must eat and keep down 3 full strength meals prior to discharge

POST-HOSPITALIZATION FOLLOW-UP PROGRAM
Child is scheduled for KD follow-up with neurologist/RD at 1 month and q 3 months
- KD surveillance labs: CBC, chemistries, lipids, lytes, carnitine, AED's, beta-hydroxybutyrate
- Growth parameters
- Nutritional assessment
- Neurological assessment
- Diet adjustment
- AED adjustment

TERMINATION OF THE DIET
- If after 12 weeks there is no improvement in seizure control, the KD should be discontinued
- With successful seizure control, continue diet for 2-3 years with gradual reduction of ratio after one year of optimal seizure control
- Taper off diet if an adverse effect cannot be rectified
Nutrition Service Responsibilities

CONSULTATION WITH CAREGIVERS PRIOR TO HOSPITALIZATION FOR KD
■ Obtain diet/nutrition and medication history
■ Complete nutritional assessment:
  ◦ Oral vs. enteral feedings or a combination of both
  ◦ Determine developmental feeding skills; diet modifications
  ◦ Weight, height, OFC, desirable body weight
  ◦ Macronutrient requirements
  ◦ Nutrition risk factors (underweight, poor weight gains, etc)
  ◦ Laboratory studies
  ◦ Carbohydrate contribution from current meds.
■ Review KD therapy with caregivers;
  ◦ KD restrictions; limited quantity and variety of foods, impact of diet on family lifestyle
  ◦ Fluid schedule
  ◦ Vitamin/mineral supplementation
  ◦ Possible adverse effects of KD (constipation, kidney stones, acidosis)
  ◦ Follow-up program: clinic visits

INPATIENT INITIATION OF THE KD
■ Calculate KD prescription
■ Calculate KD meals (10 to 30 to start with)
■ Incorporate diet modifications and restrictions into food selections (for calculations)
■ Determine appropriate KD ratio for age/condition
■ Calculate fluid needs
■ Instruct/demonstrate to caregiver:
  ◦ Food preparation
  ◦ Use of gram scale including calibration
  ◦ Vitamin/mineral supplementation and schedule
  ◦ Fluid management
  ◦ Signs & symptoms of hypoglycemia + treatment
  ◦ Signs & symptoms of excess ketosis + treatment
  ◦ Sick day guidelines
  ◦ Constipation prevention and treatment
■ Adjust diet during hospitalization for optimal tolerance
■ Advance diet to final goal of full strength
■ Coordinate KD formula procurement with home health agencies
■ Coordinate discharge readiness with neurology and nursing

FOLLOW-UP PROGRAM
■ Phone and/or e-mail follow-up diet management strategies
■ Neurology/KD follow-up clinic at 1 month, 3 months and every 3 months during therapy for fine tuning and laboratory surveillance
**Critical Pathway**

<table>
<thead>
<tr>
<th>Monitor</th>
<th>DAY 1</th>
<th>DAY 2</th>
<th>DAY 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>LABS – baseline surveillance if not done previously (p.11)</td>
<td>Glucose check at bedside; q 2 hours if &lt;1yr</td>
<td>Glucose check at bedside; q 2 hours if &lt;1yr</td>
<td></td>
</tr>
<tr>
<td>Serum</td>
<td>CBC, chemistry panel, lipids, electrolytes</td>
<td>q 4 hours if &gt; 1yr</td>
<td>q 4 hours if &gt; 1yr</td>
</tr>
<tr>
<td></td>
<td>▪ Carnitine (total,free,acyl)</td>
<td>If no hypoglycemic events in past 24 hours, may increase checks by 2 hours. If below 50mg%, give 15cc apple juice and recheck in 1 hour. If NPO, give 50cc D5W then call HO.</td>
<td>If no hypoglycemic events in past 24 hours, may increase checks by 2 hours. If below 50mg%, give 15cc apple juice and recheck in 1 hour. If NPO, give 50cc D5W then call HO.</td>
</tr>
<tr>
<td></td>
<td>▪ AED levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Glucose check at bedside;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Q 2 hours if &lt; 1yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ q 4 hours if &gt; 1yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If below 50mg% give 15cc apple juice and re-check in 1 hour. If NPO, give 50cc D5W, then call HO.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urine</td>
<td>Urine acetone q void</td>
<td>Urine acetone q void</td>
<td>Urine acetone q void</td>
</tr>
<tr>
<td></td>
<td>Urine specific gravity q void</td>
<td>Urine specific gravity q void</td>
<td>Urine specific gravity q void</td>
</tr>
<tr>
<td></td>
<td>▪ If &gt; 1.020 encourage fluid compliance</td>
<td>▪ If &gt; 1.030 past 24 hours, consider IVF bolus (no dextrose)</td>
<td>▪ If &gt; 1.030 past 24 hours, consider IVF bolus (no dextrose)</td>
</tr>
<tr>
<td>Weight</td>
<td>Daily weight</td>
<td>Daily weight</td>
<td>Daily weight</td>
</tr>
<tr>
<td>Vitals</td>
<td>Vital signs q shift</td>
<td>Vital signs q shift</td>
<td>Vital signs a.m.</td>
</tr>
<tr>
<td>Diet &amp; Fluids</td>
<td>ORAL DIET</td>
<td>Oral Diet: Keto beverage in a.m. &amp; hs to equal 1/3 of goal calories plus 2 full strength keto solid meals.</td>
<td>ORAL DIET</td>
</tr>
<tr>
<td></td>
<td>Regular breakfast at home + 240cc fluid. Then 2/3 of goal calories from keto beverage divided into 3 servings or 1 full strength keto solid meal + 2 servings keto beverage.</td>
<td>▪ Keto beverage</td>
<td>Advance to full strength ketogenic meals.</td>
</tr>
<tr>
<td></td>
<td>ENTERAL DIET</td>
<td>Meal</td>
<td>ENTERAL DIET</td>
</tr>
<tr>
<td></td>
<td>One formula feeding at home. Mix 1/3 keto + 2/3 of patient's remaining formula (for the day). Divide into several feedings for optimal tolerance.</td>
<td>Meal</td>
<td>Advance to full strength keto formula.</td>
</tr>
<tr>
<td></td>
<td>FLUIDS</td>
<td>Keto beverage</td>
<td>FLUIDS</td>
</tr>
<tr>
<td></td>
<td>Maintenance fluids less fluids consumed at home divided over remainder of day. [Fluids can be incorporated into enteral formula or given as water flush after feedings or with medications.]</td>
<td>Meal</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Feeding and fluid schedule at bedside for parents to check.</td>
<td>Keto beverage</td>
<td>Feeding and fluid schedule at bedside for parents to check.</td>
</tr>
<tr>
<td>Training</td>
<td>Urine ketone testing – RN</td>
<td>Gram scale use – RD</td>
<td>Trouble-shooting – RD</td>
</tr>
<tr>
<td></td>
<td>Fluid schedule – RD</td>
<td>Ketogenic food prep – RD</td>
<td>Sick days – RD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamin/minerals – RD</td>
<td>Constipation – RD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pain relievers – RN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seizure diary – RN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emergency calls – RN</td>
</tr>
</tbody>
</table>

Patient is ready for discharge after physician evaluation and the following criteria are met;
1. Consumed and tolerated 3 full strength keto meals or feedings.
2. Normal glycemic (>50mg%) for previous 12 hours.
3. Ketones in urine are moderate to large. Absence of excessive ketosis
4. Caregivers are competent in managing ketogenic diet therapy.
Fine Tuning the Ketogenic Diet
An algorithm for follow-up care

Are seizures controlled?
  Yes
  Continue Diet
  No

Is child consuming 100% of diet?
  Yes
  No

Are ketones consistently large?
  Yes
  No

Are there temporary stressors?
  Yes
  No

Rapid weight gain or loss?
  Yes
  No

Adjust diet to improve intake;
  New food preferences
  Try creative recipes
  Utilize “Free Foods”
  Reduce ratio to liberalize diet
  i.e. from 4:1 to 3:1 or 3:1 to 2:1

Increase ratio or add MCT oil.
If too ketototic,
Reduce ratio;
Eliminate processed foods.

If no seizure improvement after 14 weeks taper ratio to eliminate ketosis (over 3 days)

Decrease /correct stress or or “ride it out”
Blood Chemistry Evaluation

Blood chemistry evaluation is essential for surveillance of nutritional status during ketogenic diet therapy. These evaluations may uncover problems not clinically apparent, such as elevated lipids, a carnitine or selenium deficiency. Blood chemistry evaluation is also essential to monitor the impact of antiepileptic drugs used concurrently with ketogenic diet therapy. Laboratory testing is usually most effective when used in a serial fashion. Results of a single laboratory test should be interpreted with caution. The following are common mistakes in laboratory evaluation of labs used for ketogenic diet surveillance.

- Using prealbumin as a substitute for albumin: Prealbumin has a half-life of about 2 days while albumin has a half-life of about 21 days.
- Artificially low calcium. Since 50% of serum calcium is bound to albumin, low calcium will likely accompany a low albumin: Serum calcium decreases 0.8mg/dL for every g/dL decrease in serum albumin below 4mg/dL.
- Many antiepileptic drugs are protein bound: A low albumin level may reveal lower than expected drug levels.
- Elevations in nutrient levels such as carnitine, calcium and vitamins may be due to the ingestion of a supplement containing the nutrient prior to blood draw.

The suggested surveillance of laboratory values during ketogenic diet treatment are similar to those selected for the surveillance of total parenteral nutrition.

- Electrolytes
- Lipids (fasting)
- Chemistries including liver enzymes, calcium, phosphorus, blood urea nitrogen, albumin, protein,
- Carnitine; total, free and acyl
- Complete blood count including platelets
- Betahydroxybutyrate

In addition to the above surveillance work-up, the following chemistries may be indicated. There are ketogenic diet implications with these laboratory indices that are reviewed in the following interpretations.

- Serum selenium (Note: pediatric selenium values are different from adult values)
- Serum zinc
- Serum Magnesium
- Neutrophil function
- 25(OH) – Vitamin D
<table>
<thead>
<tr>
<th>Blood Chemistry</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Albumin</strong></td>
<td>Albumin is made mainly in the liver. It maintains the oncotic pressure in blood vessels and is a carrier for some medicines including many antiepileptic drugs. Albumin is necessary for tissue growth and healing. $\star$ with dehydration; $\star$ with liver disease, infection, nephrotic syndrome, post-op edema, overhydration, malabsorption.</td>
</tr>
<tr>
<td><strong>Alkaline Phoshatase</strong></td>
<td>A zinc metalloenzyme for evaluation of hepatobiliary disease and bone disease. $\star$ with zinc deficiency. Very high levels may reflect periods of rapid growth i.e. adolescent growth spurt.</td>
</tr>
<tr>
<td><strong>Anion Gap</strong></td>
<td>Anion gap is calculated when an electrolyte panel is drawn, it represents the approximate sum of unmeasured anions whose charges with CL and HCO3 balance Na. Used for diagnosis of types of metabolic acidosis. $\star$ with lactic acidosis, starvation ketosis, toxic agents, renal failure and diabetic ketosis. $\star$ with hypoabuminemia, dilution, hypernatremia, very marked hypercalcemia, severe hypermagnesemia, IgG myeloma and polyclonal gamma globulin increases, lithium toxicity and bromism.</td>
</tr>
<tr>
<td><strong>ALT</strong></td>
<td>Alanine Aminotransferase is a liver function test that is more sensitive for the detection of hepatocyte injury than for biliary obstruction. ALT is more specific for liver injury than AST.</td>
</tr>
<tr>
<td><strong>AST</strong></td>
<td>Aspartate Aminotransferase's synonyms; AST, GOT, SGOT, Transaminase is used for the detection of parenchymal disease. A large number of commonly used drugs have been reported to elevate AST including isoniazid, phenothiazines, erythromycin, progesterone, anabolic-androgenic steroids, halothane, methylpoda, opiates, indomethacin, salicylates in children.</td>
</tr>
<tr>
<td><strong>Betahydroxybutryate</strong></td>
<td>Bethydroxybutryate is produced by the liver after consumption of a high-fat diet. Plasma ketone analysis is a more accurate quantification of ketosis than urine. One study reported that seizure control improvements correlated better with a betahydroxybutryate greater than 4mmol/L (1).</td>
</tr>
<tr>
<td><strong>Blood Urea Nitrogen</strong></td>
<td>Urea is formed in the liver and is the major non-protein product of protein breakdown. It is used for the diagnosis of azotemia and uremia and evaluation of liver function and renal function. $\star$ levels with glomerulonephritis, pyelonephritis, acute renal failure, severe congestive heart failure, ketoacidosis and dehydration, corticosteroids, gastrointestinal tract bleeding, Borderline high values may occur after recent ingestion of high protein meal or with muscle wasting. $\star$ levels with decreased protein intake, intravenous fluids, some antibiotics, and some instances of liver disease.</td>
</tr>
<tr>
<td><strong>Carbon Dioxide</strong></td>
<td>Carbon Dioxide (CO$_2$) determines acid-base balance and is calculated from pH, and pCO$_2$. In practice, 80-90% is present as bicarbonate (HCO3). $\star$ levels may represent respiratory acidosis with CO$_2$ retention, or metabolic alkalosis, i.e. prolonged vomiting. $\star$ levels may indicate respiratory alkalosis as in hyperventilation or metabolic acidosis i.e. diabetes or ketoacidosis.</td>
</tr>
<tr>
<td><strong>Carnitine</strong></td>
<td>Carnitine is an essential amino acid necessary in beta-oxidation of long chain fatty acids and energy production in cellular mitochondria. Low carnitine levels in skeletal muscle, liver, heart and kidney result in decreased ability of these tissues to utilize long-chain fatty acids as an energy source. Primary carnitine deficiency is due to an inherited defect. Secondary carnitine deficiency occurs when the demand for carnitine exceeds ability to synthesize (as with the ketogenic diet). Mild to severe muscle weakness and excessive lipid accumulation in muscle and other tissues is common to both deficiencies. A prospective review of patients on the KD reported that multiple antiepileptic drug exposure lowers total carnitine, but actual TC deficiency in patients initiating the KD is not common (2). Carnitine has been helpful in reducing the elevation of triglycerides that can occur during valproate therapy and therefore may assist with the utilization of fatty acids on the KD (3).</td>
</tr>
<tr>
<td>Blood Chemistry</td>
<td>Interpretation</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Calcium</strong></td>
<td>Calcium (Ca+) is a major cofactor in enzyme systems, muscle contraction, neurotransmission and normal clotting. With parathyroid, cancer, Vitamin D toxicity, high bone turnover, renal failure. With hypoparathyroidism, PTH resistance, Vitamin D deficiency, acute hyperphosphatemia, medications i.e. phenobarbital, dilantin, fluoride, radiographic contrast dyes, calcitonin. <strong>Note:</strong> Only ionized calcium is available for use in vital body functions, such as muscular contraction, cardiac function and blood clotting. An evaluation of an optimally selected 4:1 ketogenic diet revealed inadequate intake from prescribed food sources (6).</td>
</tr>
<tr>
<td><strong>Chloride</strong></td>
<td>Chloride (Cl-) is the major negative ion in the fluid outside the body's cells. Its main function is to maintain electrical neutrality, mostly as a counter-ion to sodium. Changes in the chloride level often accompany sodium losses and excesses. With dehydration, renal tubular acidosis (hyperchloremic metabolic acidosis), cardiac disease, anemia, with excessive infusion of normal saline, respiratory alkalosis, metabolic acidosis due to GI bicarbonate loss, Bromism (excess intake of bromide, usually with sub-standard anticonvulsants) and with Carbonic anhydrase inhibitors (i.e. Topamax, Zonegran). With overhydration, congestive failure, vomiting, fever, diabetes, Addison's disease, metabolic alkalosis, pneumonia.</td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
<td>Used to evaluate risk of coronary artery disease. Lipids should be drawn after a minimum of a 12 hour fast. A six month prospective study of children on the KD found significant increases in cholesterol with a decrease in the HDL. Less marked changes were found in children under the age of 2 years (4).</td>
</tr>
<tr>
<td>HDL</td>
<td>Serum ferritin is the form in which iron is stored in the tissues. When combined with the serum iron and percent saturation of iron binding capacity/transferrin, it can usually differentiate the microcytic hypochromic anemias.</td>
</tr>
<tr>
<td>LDL</td>
<td>Fasting or non-fasting status should be known when evaluating levels. Serum glucose levels during ketogenic diet therapy are lower than normal and have less fluctuation than levels drawn on a regular diet. Non-fasting glucose levels between 50-80mg% are typical with KD therapy.</td>
</tr>
<tr>
<td>Glucose</td>
<td>Lactase Dehydrogenase is found in all cells of the body, with extremely high levels found in specific tissues such as the heart, liver, kidneys, skeletal muscle and erythrocytes. Therefore, increased levels seen in the serum can be directly related to damage to one of these tissues.</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Magnesium (Mg) is the fourth most abundant mineral in the body with approximately 50% of total body magnesium found in bone. The other half is found predominantly inside cells of body tissues and organs. Only 1% of magnesium is found in blood. Magnesium is needed for more than 300 biochemical reactions in the body including muscle, nerve, cardiac, bone and immune system function. Magnesium also helps regulate blood sugar levels, promotes normal blood pressure, and is involved in energy metabolism and protein synthesis. An evaluation of an optimally selected 4:1 ketogenic diet revealed inadequate intake from prescribed food sources (6).</td>
</tr>
<tr>
<td>Blood Chemistry</td>
<td>Interpretation</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>Neutrophil Function</strong></td>
<td>The neutrophil functions as a phagocytic and bactericidal cell which is performed outside the circulation in tissues where microbial invasion occurs. According to one study, “consideration should be given to discontinuing iatrogenic causes of ketosis in patients with bacterial infections” due to reduced neutrophil function found in several patients on KD therapy and, in one patient, a severe bacterial infection which resolved with the cessation of the diet (5).</td>
</tr>
<tr>
<td><strong>Phosphorus</strong></td>
<td>Phosphorus (PO4) is an essential element which ranks second to calcium in abundance in human tissues. Depressed levels associated with intravenous glucose administration, vomiting, liver disease, and antacid abuse. Phosphorus follows glucose into the cell. Therefore, during administration of glucose or insulin, phosphorus levels may drop significantly. Other causes of decreased phosphorus are primary hyperparathyroidism, vitamin D deficiency, severe malnourishment, renal tubular disorders, dialysis and gram-negative septicemia. The signs and symptoms of phosphate depletion may include manifestations in the neuromuscular, neuropsychiatric, gastrointestinal, skeletal, and cardiopulmonary systems. An evaluation of an optimally selected 4:1 ketogenic diet revealed inadequate intake from prescribed food sources (6).</td>
</tr>
<tr>
<td><strong>Potassium</strong></td>
<td>Potassium (K+) is the principal cation (positive ion) of the fluid within cells and is important in controlling the activity of the heart, muscles, nervous system and just about every cell in the body. Potassium regulates the water balance and acid-base balance in the blood and tissues. Our bodies contain more than twice as much potassium as sodium with about 98% of total body K+ is inside our cells. Potassium is a cofactor in many reactions, especially those involving energy production, muscle building and bone calcification. Used for evaluation of electrolyte status. It should be monitored during treatment of acidosis. An evaluation of a 4:1 ketogenic diet revealed inadequate intake from prescribed food sources (6). * with Kidney disease, trauma to tissue especially burns, metabolic acidosis, Addison's disease, certain medications. * with a low-potassium diet, excessive loss of potassium, often associated with excess water loss, which “flushes” potassium out of the body. Typically, this is a consequence of vomiting and diarrhea, excessive sweating, and thiazide diuretics. Severe hypokalemia may cause muscle weakness, increased risk of hyponatremia with resultant confusion and seizures as well as disturbed heart rhythm including prolonged QT interval.</td>
</tr>
<tr>
<td><strong>Protein, Total</strong></td>
<td>Total serum protein test measures the total amount of protein in the blood. The two major groups of proteins in the blood are albumin and globulin. It is used for evaluation of nutritional status and liver function. * levels with dehydration and some cases of chronic liver disease. * levels with intravenous fluids, cirrhosis, liver disease, Chon's disease, chronic ulcerative colitis, starvation, malabsorption or malnutrition, hyperthyroidism, burns, severe skin disease, and other chronic diseases. Very low total protein (&lt;4g/L) and low albumin cause edema.</td>
</tr>
<tr>
<td><strong>Selenium</strong></td>
<td>Selenium is a trace element nutrient which functions as cofactor for reduction of antioxidant enzymes such as glutathione peroxidase and thioredoxin reductase. Selenium deficiency has been associated with cardiomyopathy during KD therapy (8). An evaluation of an optimally selected 4:1 ketogenic diet revealed inadequate intake from prescribed food sources (6).</td>
</tr>
<tr>
<td><strong>Sodium</strong></td>
<td>Sodium (Na+) is the major positive ion in the fluids outside of cells. Serum Na+ is evaluated for diagnosis of electrolyte balance; water intoxication and dehydration. Hypernatremia occurs in dehydration. Severe hypernatremia may be associated with volume contraction, lactic acidosis, azotemia, weight loss, and increased hematocrit as evidence of dehydration.</td>
</tr>
<tr>
<td>Blood Chemistry</td>
<td>Interpretation</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>Triglycerides are the storage form of fatty acids in the blood. Triglycerides should be drawn after a minimum 12 hour fast. Elevated triglycerides are a possible adverse effect of Valproic acid therapy and therefore may be exacerbated by the ketogenic diet. Extremely high triglyceride levels suggest the possibility of pancreatitis.</td>
</tr>
<tr>
<td>Uric Acid</td>
<td>Uric acid occurs as an end product of purine metabolism; with renal disease, toxemia of pregnancy, diet weight loss, fasting or starvation, after exercise, and in gout. with ingestion of high doses of aspirin, corticosteroids, renal tubular defects, Fanconi syndrome, heavy metal poisoning among other factors.</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Vitamin D is a prohormone which functions in multiple pathways including cognitive and immune function, and bone health. In a vitamin deficient state only 10-15% of calcium is absorbed through the gut which also reduces the absorption of phosphorus leading to reduced bone mineralization. Vitamin D3 (cholecalficlor) and D2 (ergocalciferol) are hydroxylated in the liver to the 25-hydroxy form and then to the 1, 25-dihydroxy form in the kidney. Long term use of antiepileptic drugs can interfere with this conversion. In addition, metabolic acidosis associated with the ketogenic diet causes osteopenia; therefore combination of Vitamin D insufficiency and metabolic acidosis are detrimental to bone health. An evaluation of optimally selected 4:1 ketogenic diet revealed inadequate intake from prescribed food sources (6).</td>
</tr>
<tr>
<td>Zinc</td>
<td>Zinc is an essential trace element involved in multiple metabolic pathways. Increased losses occur with biliary disease and diarrhea. Evaluate deficiency in patients with burns, parenteral nutrition, malabsorption, diets that are very low in animal proteins, cirrhosis, alcoholism, serious infections, growth retardation, hypogonadism in males, and certain skin lesions. An evaluation of an optimally selected 4:1 ketogenic diet revealed inadequate intake from prescribed food sources (6).</td>
</tr>
</tbody>
</table>

Blood chemistry references:
### Ketogenic Diet Surveillance Labs
At initiation then after 1 month, then every 3 months

<table>
<thead>
<tr>
<th>DATES</th>
<th>CBC</th>
<th>HGB  11.5-14.5</th>
<th>HCT  33-43</th>
<th>MCV  76-90</th>
<th>PLATELETT  15-450</th>
</tr>
</thead>
</table>

| CHEM PROFILE | Glu | BUN  5-20 | PHOS  4-7 | CA++  9-11.5 | URIC ACID  2.6-6.8 | T.PRO  5.9-7.7 | Alb  3.8-5.4 | LDH  425-975 | CHOL  125-195 | Ast/Alt |

| LIPOID PANEL | Chol  125-195 | TGY  32-116 | HDL  0-40 | VLDL  3-20 | LDL  60-140 | Apo A  115-193 | Apo B  58-103 | Plasma Appearance |

| LYTEs | Na  135-145 | K  3.5-5 | Cl  98-108 | CO₂  20-28 | ANION GAP |

| CARNITINE | Total  21-72 | FREE  14-55 | ACYL  0-26 |

| BHB  4-10mmol/L |

| AED's | VPA | Topiramax | Phenobarb | Lamictal | Felbatol | Phenobarb |

| 25(OH) VIT-D |

| MINERALS (Q 6MOS): | Selenium | Zinc | Magnesium |
# Potential Complications of Ketogenic Diet Therapy

Complications that have been reported in the literature are reviewed below. Possible solutions and more importantly, preventative strategies are outlined.

<table>
<thead>
<tr>
<th>Potential Complications</th>
<th>Solutions/Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constipation</td>
<td>Ensure adequate hydration and high-fiber vegetables. Incorporate avocado into diet (15-30gm/d), flax or chia seeds (5-10gm/meal). Reduce or eliminate constipating medications. Incorporate medium chain triglycerides into diet (5-30gm/meal).</td>
</tr>
<tr>
<td>Decreased Growth Rate</td>
<td>Increase energy and protein. Ensure 100% intake. Check serum zinc level and supplement if necessary.</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>Ensure adequate calcium, phosphorus, magnesium and vitamin D. Encourage weight bearing activity. Correct acidosis.</td>
</tr>
<tr>
<td>Acidosis</td>
<td>Avoid or reduce Topamax and Zonegran. Acidosis might occur w/ illness when unable to take po therefore allow Pedialyte to maintain hydration, glucose &gt;50, and prevent excessive ketosis. Follow/treat acidosis. Buffers include adequate fluid, phosphorus supplementation, bicarbonates and citrates.</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>Hyperlipidemia and hyper triglyceridemia are risk factors. Check amylase and lipase. Check for drug causes. Initiate carnitine therapy. Reduce fat ratio of the diet. Consult GI.</td>
</tr>
<tr>
<td>Lethargy</td>
<td>Ensure 100% intake of diet. Ensure adequate energy and protein levels. Ensure for RDA of vitamins/minerals. Evaluate for carnitine deficiency and supplement if low. Evaluate for drug toxicity. Evaluate for abnormal liver functions i.e. ammonia and acidosis.</td>
</tr>
<tr>
<td>Hypoproteinemia</td>
<td>Ensure 100% of diet and vitamin/mineral supplement intake. Check for adequate energy and protein. Evaluate for intake of high biological value protein. VPA can cause low albumin.</td>
</tr>
<tr>
<td>Optic Neuropathy</td>
<td>Ensure thiamin supplementation (included in multivitamin)</td>
</tr>
<tr>
<td>Increased Infections</td>
<td>Ensure that diet (calories/protein) and vitamin/mineral supplementation meet estimated requirements. Discontinue diet if persistent. Check 25(OH)-D.</td>
</tr>
<tr>
<td>Elevated Lipids</td>
<td>See protocol p. 13.</td>
</tr>
<tr>
<td>Bruising</td>
<td>Ensure that diet (calories/protein) and vitamin/mineral supplementation meet estimated requirements. Valproic Acid may cause bruising. Check 25 (OH)-D.</td>
</tr>
<tr>
<td>Carnitine Deficiency</td>
<td>Ketogenic diet theoretically demands more carnitine. Check pre-diet and at regular intervals during tx. Supplement if needed. Valproic Acid may deplete carnitine.</td>
</tr>
<tr>
<td>Prolonged QT Interval</td>
<td>Literature suggests this effect found in malnourished patients. Ensure that diet (calories/protein) and vitamin/mineral supplementation meet estimated requirements. A study is underway in Germany to evaluate the QT interval and selenium level of individuals on ketogenic diets (2014).</td>
</tr>
</tbody>
</table>

Management of Elevated Lipids

A fasting lipid panel should be drawn prior to ketogenic diet therapy as a baseline. Lipid panel should include cholesterol, triglycerides, high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoprotein (VLDL), and Apolipoprotein A and B. Recent studies have shown that the ratio of apoliprotein A to apolipoprotein B correlates better with increased risk of coronary artery disease than the total cholesterol and LDL/HDL ratio.

A repeat lipid panel should be drawn at one month post ketogenic diet therapy and every three months afterwards. Since very few children present with elevated lipids, non-fasting surveillance labs (including the lipid panel) can be drawn at the convenience of the family on the day of the scheduled clinic visit. If the lipid panel reveals elevated lipids, then a repeat fasting lipid panel is warranted.

### Possible Reasons for Elevated Lipids

<table>
<thead>
<tr>
<th>Possible Reasons for Elevated Lipids</th>
<th>Adjustments in Therapy to Improve Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Fasting Levels</td>
<td>Repeat levels after 12 hours of fasting.</td>
</tr>
<tr>
<td>Receiving Excessive Calories</td>
<td>Reduce calories, recheck level in 1 month.</td>
</tr>
</tbody>
</table>
| Receiving Valproate Medication      | - If elevated triglycerides, reduce valproate (valproic acid or divalproex sodium). Repeat fasting level.  
                                        - Initiate carnitine therapy. |
| Familial History or Unknown Reason  | - Initiate carnitine therapy  
                                        - Initiate Omeg-3 fatty acids (pharmaceutical grade)  
                                        - Gradually replace fats w/ MCT oil and/or coconut oil and mono and polyunsaturated fats (i.e. olive oil)  
                                        - Or reduce ratio (i.e. 4:1 to 3:1) and replace saturated fats i.e. with mono and polyunsaturated fats (i.e. avocados, olive oil)  
                                        - Limit cholesterol rich foods; bacon, sausage, egg yolks  
                                        - Increase use of fish  
                                        - Re-check fasting levels in 1 month |

**Caution:** Use of statin drugs to treat elevated cholesterol may raise glucose and negate ketosis.
Ketogenic Management During Fasting

Overview of ketogenic diet (KD) therapy
The KD is medical therapy for children with intractable epilepsy and for metabolic disorders including pyruvate dehydrogenase deficiency and glucose-1 transporter deficiency. This high fat diet regimen (70-90% of calories) forces the body into a dietary induced ketosis. The acidosis that occurs when the diet is first initiated corrects itself within days and is not sustained.

The diet is manipulated with different ratios and calorie levels (much like the dosing of an anti-seizure medication) to achieve optimal seizure control. The diet is usually maintained for a 2-3 year period then tapered gradually to a non-ketotic diet but can be lifetime therapy for certain patients. The literature is reporting that 50% of people placed on the diet experience a 50% or greater improvement in seizure control. Those with successful seizure control often have their anti-seizure medications reduced and in some cases completely discontinued. The goal of these guidelines is to maintain ketosis and prevent the effects of excessive ketosis which include hypoglycemia and acidosis.

Managing NPO for procedures or surgery

1. **Fasting:** Clear liquids includes “sugar free, caffeine free”, therefore diet caffeine-free sodas, sugar-free gelatin, ice chips, and water are allowed.

2. **Medications:** Must be in lowest carbohydrate form such as crushed swallow tablets or I.V. form (no chew tabs, syrups, elixirs). Check with the pharmacy before ordering new medications.

3. **Intravenous solutions:** Dextrose solutions should be avoided unless fasting for greater than 12 hours when it may be necessary to maintain stable glucose level (i.e. 2.5% or 5% solution). Lactated ringers are carbohydrate free. Check electrolytes and treat acidosis if present.

4. **Glucose levels:** Check prior to surgery and every 1-2 hours after surgery until stable. If <50mg%, add 2.5% or 5% dextrose to maintain blood sugar between 50-70mg%. Glucose levels usually increase post-surgery due to stress response from increased cortisol levels.

5. **Arterial pCO²:** Check prior to surgery then every 2 hours. Extended fasting may lead to excessive ketosis and acidosis. Intravenous bicarbonate should be administered to correct acidosis.

6. **Fluid volumes:** Implement a maintenance “fluid schedule” to ensure adequate hydration throughout the day. There have been reported cases of children on the KD who have had breakthrough seizures after receiving large volumes at one time, therefore acute overhydration should be avoided. Maintenance fluid calculations (Holiday Seger method):
   - 1-10kg 100ml/kg
   - 11-20kg 1000ml + 50ml/kg for each kg>10kg
   - >20kg 1500ml + 20ml/kg for each kg >20kg

**Advancement of diet:** For oral feeders, start with sugar-free, caffeine-free clear liquids or low carbohydrate electrolyte beverage then advance to 1/2 keto meals without the butter then full keto meals. For enterally fed patients, start with low carbohydrate electrolyte solution or half strength Pedialyte (pediatrics), then advance to 1/2 strength ketogenic formula, then to full strength ketogenic. Ketogenic beverage (cream + pasteurized liquid egg) or commercial ketogenic formula are liquid meals that can be used for oral or enteral diets.
Ketogenic Initiation
Patients in Induced Coma for Status Epilepticus

PRE-DIET
- Evaluation by neurologist or epileptologist.
- Metabolic laboratory tests including serum carnitine, lactic acid, pyruvic acid, fatty acids, chemistries, lipids, electrolytes, CBC, 25-OH Vitamin D, AED levels.
- Consultation with KD dietitian to determine appropriate formula, calories and ratio. Two commercial formulas are available: KetoCal (Nutricia), and RCF Soy Formula Concentrate (Abbott) which requires fat and carbohydrate modulars. A 4:1 formulation is recommended unless protein needs cannot be met when goal calories are achieved in which case a lower ratio should be used (such as 3:1 or 2:1 with MCT oil to enhance ketosis). Enteral nutrition delivery is the preferred method over parenteral since higher ratios may be achieved with formula versus the high glycerol content of lipid solutions. Enteral delivery via the jejunum at a continuous rate versus gastrostomy feeding is preferred to prevent potential aspiration into the lungs.

INITIATION ORDERS (in addition to standard monitoring protocols)
- Serum blood glucose: check q 4 hours; if under age one, q 2 hours.
  If glucose <40mg%, give 15mL apple juice via enteral feeding tube and re-check in 1 hour. If NPO, give IV bolus of 40mL of D5W (no continuous dextrose) over 30 minutes and re-check in 1 hour. Glucose levels between 50-75mg% are typical during KD therapy. Persistent glucose levels below this range indicate the need for increased calories.
- Urine specific gravity q void
- Urine ketones q void
- I&O
- Pharmacy to review medications for carbohydrate content and advise carbohydrate-free alternatives. Note:
  ①Pentobarbital IV solution contains propylene glycol which prevents ketosis. This effect will dissipate as this medication is weaned.
  ②Propofol is administered in a 10% fat emulsion and also contains glycerol (carb) and lecithin (protein). There is one report of a death related to use of ketogenic diet with concomitant propofol in an intubated patient.
  ③Steroids used during extubation will increase glucose levels and negate ketosis.
- Maintenance fluids [1000 plus 50 (wt-10)mL/day]: + additional 20% if needed.
- IV Fluids: no continuous IV dextrose; use sodium chloride solutions.
- Enteral nutrition route: jejunum feeding tube placement recommended (verses gastric) to minimize the risk of aspiration of formula into lungs. Formula to be administered via continuous drip. Consider advancing to gastric feedings when conscious and stable. If parenteral nutrition is necessary, consider supplementing enterally with MCT oil.
- Formula initiation: For comatose patients, initiate formula at 50% of maintenance RDA at full strength over 20 hours/day. Increase calories by 10% each day that sedation is tapered. The goal is to maintain glucose levels between 50-75mg% (which corresponds with strong ketosis) and to achieve goal calories within 5-7 days of initiation of the diet. Portable glucometers may reveal higher glucose readings than laboratory analysis (i.e. by 10 points).
- IV sedation taper to begin prior to or on day of diet initiation. Monitor for metabolic acidosis; Arterial CO₂ and pH. Acidosis should self-correct when goal calories are reached unless patient is receiving a carbonic anhydrase inhibitor (i.e.topiramate, zonisamide, Diamox). Bicarbonate treatment may be necessary to correct acidosis. Citrates contain citric acid which is metabolized as carbohydrate.
Ketogenic Initiation
Patients in Induced Coma for Status Epilepticus continued

POST-HOSPITALIZATION FOLLOW-UP PROGRAM
Schedule routine follow-up in epilepsy clinic:
- KD surveillance labs: CBC, chemistries, lipids, electrolytes, carnitine, AEDs, betahydroxybutryate.
- Growth parameters: weight, height, OFC under age 2.
- Nutritional assessment; diet advancement to po feedings if appropriate, adjustments to support growth (calories, protein, micronutrients) and ketogenic ratio.
- Neurological assessment and antiepileptic drug adjustment.

TERMINATION OF THE KD
- Taper off diet if an adverse effect cannot be rectified i.e. over 3 days.
- If after 2 weeks there is no improvement in seizure control, the KD should be discontinued by tapering the ratio i.e. over 3 days.
- With successful seizure control, continue diet with gradual reduction of ratio after one year of optimal seizure control.
- Without successful seizure control the diet may be tapered over the same time period as initiation.

SUMMARY:
Use of ketogenic diet for emergency treatment of status epilepticus is growing rapidly. There are twelve retrospective publications reporting efficacy in children and adults since 2008 with the majority of patients becoming seizure-free. Response in these cases is seen within 2 weeks of initiation of the diet via enteral feeding tube. Treatment error causes for failure to respond may be due to insufficient ketosis related to excessive carbohydrate from medications or excessive calories from formula.
Ketogenic Initiation
Protocol for Infants

PRE-DIET

- Evaluation by neurologist or epileptologist.
- Metabolic laboratory tests including serum carnitine, lactic acid, pyruvic acid, fatty acids, chemistries, lipids, electrolytes, CBC, 25-OH Vitamin D, AED levels.
- Consultation with KD dietitian to determine appropriate formula, calories and ratio.

Two commercial formulas are available: KetoCal (Nutricia), and RCF, Soy Formula Concentrate (Abbott) [which must be diluted with water and modulated with a fat and carbohydrate source]. A 4:1 formulation is recommended unless infant has gastro-esophageal reflux disease (GERD) in which case a lower ratio should be used initially until tolerance is achieved (such as 3:1 or 2:1 with MCT oil to enhance ketosis). An antacid is also recommended with GERD.

*Note:* The protein content of KetoCal 4:1 Liquid is casein and whey; and the 4:1 and 3:1 powder contain whole milk protein. The protein content of RCF is soy protein isolate and the percent is variable depending on the recipe that you create. Breast feeding can be continued with ketogenic diet. If the infant is soy and milk tolerant, an elemental formula with MCT oil is advised. Protein should be provided to meet Dietary Reference Intake; carbohydrate should be provided at a minimum of 2 grams daily.

INITIATION ORDERS (in addition to standard monitoring protocols)

- Serum blood glucose: check q 2 hours until stable within 50-75mg/dL for 24 hours.
  If glucose <50mg/dL, give 2gm carbohydrate equivalent from prior formula and re- in 1 hour (i.e. as 30mL of previous infant formula). If NPO, give IV bolus of 40mL of D5W (no continuous dextrose) over 30 minutes and re-check in 1 hour. Glucose levels may drop during this process but should trend upwards and stabilize within 3 days of full strength calories. Persistent glucose levels below 50-75mg/dL indicate the need for more calories.
- Urine specific gravity q void should be in the normal range.
  *Note:* The KD has a strong diuretic effect.
- Urine ketones q void.
  *Note:* Ketosis in infants is notably lower than that in older children yet the benefits of the diet are still realized.
- I&O
- Pharmacy to review medications for carbohydrate content and to advise on carbohydrate-free alternatives.
  *Note:*
  - Pentobarbital IV solution contains propylene glycol which prevents ketosis. This effect will dissipate as this medication is weaned.
  - Propofol is administered in a 10% fat emulsion and also contains glycerol and lecithin.
  - There is one report of a death related to use of ketogenic diet with concomitant propofol in an intubated patient.
- Maintenance fluids [100mL/kg]: + additional 20% if needed.
- IV Fluids: no continuous IV dextrose.
- Formula initiation: Graduate ketogenic formula in increments of 1/3 over 3 days combining it with the infant's formula to balance daily caloric goal of maintenance needs. For example, if the goal is 400kcals of .67kcal/mL formula than 600mL of combined formula will be needed daily; **Day 1:** 200mL keto + 400mL regular formula.
  **Day 2:** 400mL keto + 200mL regular formula.
  **Day 3:** 600mL of ketogenic formula.
Ketogenic Initiation
Protocol for Infants Continued

- Feeding schedule:
  1. Oral diet: ad lib feedings with a minimum and maximum range provided that is appropriate for age i.e.
     20-24 ounces/daily.
  2. Enteral diet: bolus feedings of equal volume spaced appropriate at appropriate time
     intervals for infant's age.
  3. Continuous feedings may be provided if necessary to accommodate feedings beyond
     gastric placement (i.e. duodenal or jejunal).

- Monitor for metabolic acidosis: Arterial CO$_2$ and pH. Acidosis should self correct within a few days unless
  patient is receiving a carbonic anhydrase inhibitor which can exacerbate acidosis (i.e. Topamax, Zonegran,
  Diamox). Bicarbonate treatment may be necessary to correct acidosis.

- Pancreatic enzyme should be considered for neonates who have an elevated amylase (especially those who
  are enterally fed) or the inclusion of MCT oil.

POST-HOSPITALIZATION FOLLOW-UP PROGRAM
Schedule routine follow-up in epilepsy clinic:

- KD surveillance labs: CBC, chemistries, lipids, lytes, carnitine, AED's, betahydroxybutryate,
  25-OH Vitamin D.

- Growth parameters: weekly weight, height, OFC under age 2.

- Nutritional assessment; diet advancement to po feedings if appropriate, adjustments to support growth
  (calories, protein, micronutrients) and efficacy (ratio).

- Neurological assessment; AED adjustment.

TERMINATION OF THE KD

- Seizure control should be apparent within 2 weeks of the first day of 100% KD. If no improvement in seizure
  control is achieved within 3 months, the diet may be reversed over a period of 3 days by re-introducing the
  previous formula in thirds.

- The adverse effect of seizure medications may be exacerbated by the diet and should be addressed.
  Phenobarbital in particular can exhibit toxicity in combination with ketogenic diet therapy and this
  combination has the least success with controlling seizures over other medications.

- Tapering off of the diet is advised if an adverse effect cannot be rectified.

- With successful seizure control, continue diet for 2-3 years with gradual reduction of ratio after one year of
  optimal seizure control.

- Infants with a diagnosis of Glut-1 Deficiency Syndrome or Pyruvate Dehydrogenase Deficiency should be
  maintained on the diet longer term.
Outpatient Initiation of Ketogenic Therapies

Initiation of ketogenic diet therapies outside of hospital care is practiced in many centers, especially for adults and is gaining acceptance as a cost-effective protocol. A variety of approaches are described below. Laboratory screening is advised to screen for potential problems that could be worsened by fasting or by the diet such as acidosis, hyponatremia, elevated lipids or a carnitine deficiency. In addition, the ketogenic diet is contraindicated in disorders of fatty acid beta-oxidation, primary carnitine deficiency, pyruvate carboxylase deficiency, porphyrias and certain mitochondrial defects.

Diet therapy must be preceded with printed and verbal guidelines including appropriate contact information during and after-hours for urgent questions.

Fasting may be implemented to deplete glycogen stores and stimulate ketosis however this effect may also induce nausea and exacerbate the adverse effects of concurrent medications. Initiation the diet without fasting may be better tolerated by people who are underweight, already suffering with nausea, or are otherwise sensitive to changes in therapy. Sufficient hydration and close monitoring of glucose and ketosis are necessary during the initiation.

Various methods may be implemented for gradual replacement of carbohydrates with fat. A step-wise progression can be adopted over days or weeks depending on the individual’s motivation and their support system.

**Step 1:** Eliminate sugar and foods that contain added sugars.

**Step 2:** Eliminate processed foods – add 1-2 Tablespoons of seed oil to each meal.

**Step 3:** Restrict diet to prescribed fat, protein and carbohydrate.

Another method is to incorporate one prescribed ketogenic meal into the diet each day for a week, then two meals for a week then three.

The choice of ketogenic diet is one that should be made with the patient after they have been educated on the options. The Modified Ketogenic Diet booklet published by The Charlie Foundation provides liberal but structured guidance in selecting estimated serving sizes to achieve sufficient protein, fat and carbohydrate. The Classic Ketogenic Diet involves weighing all foods on a gram scale and uses structured meal plans. KetoDietCalculator™ is an online tool that provides excellent support for this option. Some individuals may chose start out with one approach then change to the other.
SOFT
Group B Vegetables: cut into small pieces (or mashed or pureed)
- Cooked broccoli
- Cooked or canned carrots
- Cooked cauliflower
- Cooked or canned green beans (i.e. Green Giant low sodium, canned)
- Cooked squash

10% Fruit: cut into small pieces (or mashed or pureed)
- Kiwi – ripe, skin removed
- Avocado, Hass (firmness varies depending on ripeness)

FIRMER
10% Fruit: cut into small pieces
- Honeydew melon
- Nectarine, skin removed
- Papaya, skin removed
- Peach, skin removed
- Strawberries (not for children under 1yr of age)
- Watermelon
- Popcorn; popped, remove the hard kernel then weigh
- Chicken; dark meat, skin removed

CRUNCHY
Although these are much higher in carbohydrate than the above items, a few pieces can be worked into a meal or snack with a fat source.
- Cheerios® – General Mills
- Rice Krispies® – Kellogg’s
- Almond Crackers – recipe included in KetoDietCalculator and on charliefoundation.org

SWALLOW STUDY SNACK:
You can incorporate one or more of the above foods into a ketogenically balanced snack by including a fat source.
- Pureed infant vegetables and fruit are the simplest to use.
  Increased textures may be needed for advanced testing.
- Whipped heavy cream and mayonnaise are soft foods that may be spoon fed.
  Children with feeding tubes can receive fat (vegetables oils or MCT oil) enterally.

EXAMPLES OF 25 CALORIES 4:1 SNACKS:
1. 7gm 36% heavy cream, whipped + 2 gm Applesauce – unsweetened
2. 7gm 36% heavy cream, whipped + 4 gm Gerber Green Beans
3. 3gm Hellman’s Mayonnaise + 5gm Creamed Spinach, Gerber 2nd Foods
4. 16gm Avocado, Hass - mashed