throughout pregnancy and the neonatal period, glucose levels are usually rapidly replenished. Infants of diabetic mothers (IDM) are usually LGA due to the excessive storage of fat resulting from fetal hyperglycemia. Pregnancies are often interrupted at 36 to 37 weeks because earlier deliveries are associated with a higher incidence of infant mortality. The hypoglycemia that results soon after birth is a function of the continuation of overproduction of insulin in the infant without the overproduction of glucose from the mother. Strict control of blood glucose levels in the mother, particularly throughout the third trimester, can help lower the severity of hypoglycemia in the newborn. Other conditions associated with IDM include hyaline membrane disease (due to prematurity), macrosomia (LGA), respiratory distress and other metabolic disorders (192,193,194,195,196).

Treatment of hypoglycemia includes recognition of infants at risk for the condition and immediate monitoring of blood glucose levels. Whether asymptomatic or symptomatic, feeding should be started with dextrose water. If unable to feed, intravenous administration of glucose should be started. Maintaining the infant's neutral thermal zone, minimizing cold stress and energy expenditure, protecting the IV site from inadvertent discontinuation and infiltration, assessing adequate intake and output values, and evaluating urine content of glucose (1/2 g % or higher indicates a need to decrease the amount of IV glucose being administered) all are measures that will aid the stabilization of the infant's condition (197,198,199).
Other measures to combat hypoglycemia that is unresponsive to normal treatment are available. Steroid therapy may be indicated in infant's who require a large amount of glucose to maintain normal levels. Steroids may decrease glucose utilization, increasing gluconeogenesis and elevating the infant's response to administered glucagon. Glucagon will release glycogen from the liver (200). When hypoglycemia results from hyperinsulinemia due to surgically correctable defects of the pancreas, stabilizing measures can be used (201). Administration of somatostatin and diazoxide will suppress pancreatic insulin release (202). Obviously, hypoglycemia resulting from an underlying illness should respond to treatment for that condition. (antibiotics for sepsis, etc.)

A standard for prognosis for infants with hypoglycemia is infants with hypoglycemia but without resulting seizures have an excellent prognosis with maintenance of adequate blood glucose levels. Infants who have seizures secondary to hypoglycemia have a fairly poor prognosis with as high as 50 percent having permanent neuological damage (203).
The goal of nutrition in the newborn is simply to duplicate intrauterine growth. Premature birth presents several complications; one of these is difficulty in maintaining adequate nutrition due to special limitations. One of these is gastrointestinal immaturity, or inability to move or absorb food and nutrients. Preterm infants have delayed gastric emptying into the intestines, causing repeated residual feedings and emesis. Therefore, the amount of feeding must be restricted and a lower level of nutrition is reached. Preterm infants also are deficient in the enzymes needed for digestion of carbohydrates and lipids. Another limitation in the preterm infant is pulmonary immaturity. Whenever an infant, term or preterm, is in respiratory distress, feedings must be limited as to keep minimal pressure on the diaphragm. Other medical problems also interfere with optimum nutrition. Patent ductus arteriosus, a serious cardiovascular problem in which the blood travels directly from the pulmonary artery to the aorta, bypassing the lungs, is treated by restricting fluid to close the duct. Congenital anomalies such as choanal atresia (non patent nares), tracheoesophageal fistula (upper esophagus ends and the lower esophagus is connected to the trachea and the stomach), or any GI structure deformation interferes with nutrition. Neuromuscular CNS disorders limit GI movement and CNS damage caused by hypoxia often results in a poor suck by the infant. Any infant that is septic and
compromised by cardiovascular disorders will also be lethargic and have little interest in feeding, regardless of its age (204).

Preterm infants have little prenatal stores of energy because they are born with so little subcutaneous fat. The normal caloric requirement for a preterm infant to maintain weight and support growth is 120 kcal/kg/day or 150ml/kg of 24 kcal/oz. formula (205,206,207). There are several factors that increase the caloric requirement. SGA infants and infants in respiratory distress will have a higher caloric requirement due to their increased activity in proportion to their size. Sustaining temperatures outside of the infants neutral thermal zone, hypothermia or hyperthermia, will also deplete energy faster because the extra calories are needed to stay warm or cool down. Increased loss of food through vomiting or diarrhea will also obviously result in a loss of calories and a need to up the caloric intake (208,209,210).

The selection of formula to use depends on several factors. An adequate caloric intake must be possible. Protein is necessary for rapid growth. Two types of protein are found. Cow milk contains only casein protein, a hard curd protein that is difficult to digest. Therefore, premature infant formula usually consists of 60 percent whey protein and 40 percent casein (211). Fats are also necessary to maintain growth and provide energy. Extra fat can be supplied by MCT Oil, or medium chain glycerides. The fetus is supplied with a majority of its calcium and
potassium stores in the third trimester of pregnancy, so premature formulas will have supplemental calcium and potassium. Generally, premature formula is indicated in feeding infants 1800-2000 grams or under 35 weeks gestation (212,213). The standard premature formula used in the SCN is Premie Enfamil with Iron (PEF with Fe). It has 24 kcal/oz. Standard formula, Enfamil with Iron, provides 20 kcal/oz. and is used for infants over 2000 grams or older than 35 weeks. Infants with poor weight gain may need 24 kcal/oz. Enfamil, which doesn't provide the supplements found in the premature formula, but has extra calories. All formulas can be supplemented with Polycose Powder (glucose) and MCT Oil to increase their caloric content which may be necessary with poor feeders. The disadvantage of this method is often increased stooling, so accurate intake and output amounts need to be recorded (214,215,216).

Gestational age of the infant and birth weight are the two factors that need to be considered in deciding on proper feeding methods. As a general rule, the "suck, swallow, breathe" reflex is not adequate until the 35th week of gestation. Respiration rate should be under 60 breaths/minute or aspiration is a risk. Basically, nipple feedings take energy and should not be started if the infant will be compromised in another area (217,218).

Several methods of feeding infants are possible. Nipple feedings, or "po feeds", are reserved for infants 35 weeks gestation or older with a stable respiratory status and good suck/swallow reflex (219). Appropriate size and type of
nipple should be used. Soft nipples should be used to start out and harder nipples can be used when the infant sucks too hard and collapses a soft nipple. Small nipples are available for premature infants. Small infants need to be watched carefully for tiring; feeding should not last longer than 30 minutes (220,221).

Bolus gavage feedings, "og feeds", are appropriate for infants under 34 weeks, or with a respiratory rate over 70 breaths/minute, or with a decreased suck/swallow reflex due to several factors including prolonged intubation, cleft palate, sepsis, or neurological damage. These feedings can be given through an orogastric tube or a nasogastric tube. The former is preferred because nasogastric tubes can interfere with the infant's breathing. Gastric residuals, formula left in the stomach from the last feeding, should be checked by aspiration before each feeding and measured. These residuals contain gastric enzymes and should be refed to the infant along with new formula. The placement of the tube should also be checked before each feeding to verify that it was not passed into the trachea vs. the esophagus. The feeding should be allowed to flow slowly into the stomach without any force from the syringe. The infant also should be observed carefully for drops in oxygen saturation which is possible for 30 minutes after the feeding (222,223,224,225).

Continuous gavage drip feedings are indicated for infants that are very small (under 1200 grams), that require ventilatory support and are unable to tolerate bolus gavage feedings. Advantages to this method include conservation of
energy and reduction of fatigue, as well as less compromise of oxygenation (226).

Transpyloric feedings are indicated in infants who will have long term difficulty in po feedings, usually due to neuromuscular damage. A gastric (G) tube is surgically implanted in the stomach and feedings are given in a similar manner to gavage feedings. The tube insertion site is protected from infection by a sterile dressing and appropriate skin care (227,228).

Hyperalimentation, either peripheral or central, is indicated in infants who cannot tolerate feedings to the stomach. NPO is Latin for "nil per os" or "nothing by mouth." HAL fluids are prepared in the laboratory and contain ideal mixtures of protein, sugar, lipids, vitamins and minerals (229,230).

The volume of an oral feeding should be matched to the amount the infants stomach can tolerate, usually 3-5ml formula/ kg for infants under 1500 grams. Smaller infants are fed more often, usually every two hours, while term infants are usually fed "ALD" or "ad lib amounts on demand (when they cry or wake up)." Feedings in small infants are usually diluted to 1/4 strength so toleration of the formula can be observed. Feedings are advanced in strength (1/2, 3/4) and in volume as tolerated (231,232). The first nipple feeding in all infants with questionable respiratory status can be given with sterile water; if aspiration (sucking of feeding into the lungs) occurs, sepsis can be avoided (233,234).
After the feeding, all infants should be positioned on their right side or on their abdomen to aid in gastric emptying. Positioning the head of the bed up also aids in gastric emptying and decreases the possibility of reflux (emesis) (235).

Growth can be measured in three ways: weight, length and head circumference gains. A normal postnatal weight loss is expected but should not continue for more than 3 to 5 days and should not exceed 5 to 10 percent of the birth weight in infants over 1500 grams, 10 to 15 percent in infants under 1500 grams (236). Ideal weight gain is about 18 grams/day until the 32 week of gestation and then 36 grams/day until the 36 week of gestation (237).

Feeding intolerance is indicated by several factors. Repeated or large amounts of gastric residuals, abdomen distention, emesis, heme positive stools (presence of blood), respiratory problems, temperature instability, lethargy and irritability, and a unstable glucose level all indicated a need to reevaluate the feeding method and amount of formula (238,239).
Neonatal Apnea

Apnea is defined as cessation of breathing accompanied by bradycardia (low heart rate) and/or cyanosis. It is further defined in newborns as cessation in breathing for twenty seconds or longer (240). Periodic breathing is often misdiagnosed as apnea. It differs in the fact that breathing doesn't cease for longer than fifteen seconds and cyanosis and bradycardia do not occur (241). Apnea occurs in over eighty percent of newborns under 1,000 grams (242).

Apnea in newborns, particularly in premature infants, is due to both paradoxical responses to decreased oxygen content and increased carbon dioxide in the blood, both occurring with prolonged cessation of breathing. In a full term infant greater than one month of age, decreased blood oxygen content (pO2) stimulates respiratory drive, while in a newborn, decreased pO2 initially stimulates respiratory drive, followed quickly by a decrease in respirations with periodic breathing followed by apnea. Newborns, especially premature infants, also do not increase their respiratory drive at the same increased pCO2 as in older infants (243). Physiological effects of apnea include a drop in blood oxygen content, decreased heart rate (bradycardia), decreased muscle tone and possible permanent CNS damage (244).

Common causes of apnea results from several broad categories. Apnea after twenty four hours of age is not caused by apnea of prematurity. Temperature instability, including hypothermia or hyperthermia is the most easily
corrected cause of apnea. Apnea in the first twenty four hours of age should always be considered due to sepsis until proven otherwise. Apnea is the most common presentation of group B beta strep sepsis (245). Metabolic deficiencies also can manifest themselves as apnea. Several cardiorespiratory disorders have apnea as a symptom, including respiratory distress syndrome, anemia, hypotension, upper airway obstruction, and pneumonia. Any disorder of the central nervous system, including seizures, drugs, meningitis, and intraventricular hemorrhage (IVH or a "bleed"), will also present apnea. Vagal reflexes due to placement of catheters or nipples will also cause apnea (246).

A good diagnostic workup for an apneic infants first includes a history and physical exam. First of all, examine the temperature of the infant and its environment. Hypo- or hyperthermia is the most common and most resolvable reason for apnea (247).

Any evidence of cardiorespiratory disease should be investigated. Check to see if the apneic episode was associated with such activities as feeding, suctioning, or stooling. Lab work can include a blood gas analysis, septic workup (complete blood count, blood cultures, and a spinal tap), and an electrolyte balance analysis (248).

Treatment of apnea starts with avoiding any stimuli that will result in the infants cessation of breathing. This includes maintaining temperature control, avoiding triggering reflexes (suction catheters, gavage tube placement, cold stimulus to the face, etc.), maintaining a
hematocrit of 40 to 45 percent, or providing constant stimulation (usually with a "Neowave" mattress, sort of a gentle rocking water bed that the infant sleeps on) (249, 250). If all other treatment proves ineffective, nasal CPAP (continuous positive airway pressure, see respiratory distress) may be initiated with mechanical ventilation used as the final treatment. Any infant that has had apneic spells should be a candidate for having a ambu bag at its bedside (251). Apnea is also counteracted with the drug theophylline, a spasmotic that works by relaxing the smooth muscle issue in the lungs. Caffeine citrate also serves the same purpose. These drug levels should be monitored for therapeutic levels as well as signs of toxicity. Symptoms of toxicity include tachycardia (heart rate constantly greater than 180 beats/minute) and seizures (252).

The first and foremost plan to counteract the ill effects of apnea is demonstrated in answering the infants apnea alarm. Often, the monitors will simply "not pick up" the infants respirations. This is shown when the apnea alarm goes off and the infant is found pink and obviously breathing. However, this is not always the case and undiagnosed apnea can later present itself in a much more grave situation, such as overwhelming sepsis or severe bradycardia and oxygen desaturation. When the monitor goes off, look at the infant first. Note respiratory effort, whether it is shallow and ineffective or deep and unlabored. Note the infants oxygen saturation (BIOX) and heart rate. Give the infant a chance to begin breathing on its own.
("self-limiting apnea", often due to decreased heart rate in deep REM sleep, is normal in some infants.) If the infant continues to be apneic, stimulation to the back, bottoms of the feet, or buttocks may be necessary. Alert a professional for assistance if the apneic episode is not resolved immediately and always inform a professional about the apneic episode so it can be relayed on to the other caretakers (253).
Respiratory Distress Syndrome (RDS), also known as hyaline membrane disease (HMD), is a breathing disorder of premature infants. It is caused by the inability to produce surfactant, the fatty substance that coats the alveoli of the lungs and prevents them from collapsing. Sufficient amounts of surfactant are usually not present until 35 weeks gestation, but this varies in infants. Occasionally, an infant as early as 28 weeks will not develop RDS and some full term infants will also have breathing difficulties (254). Of all premature infants (earlier than 37 weeks), 35 percent will develop RDS, and almost every infant under 30 weeks will develop RDS (255). These very early infants may also have pulmonary insufficiency of the premature (PIP), a form of RDS that results from not only lack of adequate amounts of surfactant, but poor connections between the alveoli and the surrounding capillaries. This syndrome usually doesn't become apparent until two to three days after birth and is very difficult to resolve (256).

Other factors beside prematurity can predispose an infant to RDS. Infants of diabetic mothers, even those close to full term, have reduced ability to produce surfactant due to the fluctuating levels of insulin in the womb (257). Extreme physical stress during delivery can temporarily cease surfactant production. This occurs, for example, in the case of twins. The second born usually experiences a more difficult birth and therefore is more likely to develop
RDS. However, mild, prolonged stress before birth can increase the infants exposure to the steroid hormone and increase their production of surfactant. Stresses such as maternal hypertension, prematurely ruptured membranes, mild fetal infection, or maternal heroin addiction all produce this type of stress (258).

Clinical manifestations of RDS include retractions, grunting and flaring. Retractions are exaggerated sucking in of the chest and abdomen while trying to take a breath, indicating an increased effort to breathe. Grunting noises are made while exhaling as the infant tries to keep all the air from leaving the lungs in order to keep the alveoli open. Flaring of the nares occurs when the infant tries to draw more air into the lungs. Cyanosis, bluish discoloration due to lack of oxygen, is apparent in severe cases of RDS (259).

RDS progresses as the blood oxygen level drops, and the blood carbon dioxide level rises, causing the blood to become acidic. The alveoli will then collapse causing atelectasis, or sticking together. Hypoxia and death follow unresolved RDS (260).

There is no cure for RDS. Instead, it is treated until surfactant quantities are sufficient. The first level of treatment is oxygen therapy. Oxygen is present in "room air" at 21 percent. Higher concentrations of oxygen are delivered via mask, hood, isolette, or nasal canula, or "prongs". The oxygen is delivered at different flow rates also, measured in liters per minute (lpm) (261).
When an oxygenated environment is not adequately resolving RDS, manual breathing is initiated. Two forms are used. Continuous positive airway pressure (CPAP) involves a steady stream of pressurized oxygen or air directed into the lungs to keep the lungs inflated at all times. This prevents the lungs from collapsing (262). CPAP is most commonly used to treat apnea of prematurity because the continuous pressure keeps "reminding" the infant to breathe (263). It also is used when discontinuing the next form of respiratory support, mechanical ventilation.

A ventilator (respirator) is a machine that breathes for the infant at a set rate; it inhales for the infant by pushing air at a set pressure or PIP (peak inspiratory pressure) and provides constant basic pressure to keep the lungs open, or PEEP (peak expiratory pressure). The PEEP setting is similar to the setting for CPAP. Supplemental oxygen may also be given. An endotracheal tube (ETT) is placed into the infant's mouth, through the vocal cords, and into the trachea for ventilation. When this tube is in place the infant is unable to cry. The process of placing the tube is called intubation; removing the tube is called extubation. Extubation may be "elective" or "on purpose", or the infant may pull the tube out, or "self-extubate" (264). If the infant appears to be in distress and is receiving ventilatory support, proper placement of the ETT is necessary. If the infant is crying audibly, it has extubated and needs to be reintubated immediately. X-rays confirm ETT placement (265). When an infant is intubated, it can't remove its
own secretions by coughing and needs to have its ETT suctioned. Often, distress is resolved by suctioning; it may have been caused by a clogged airway (266). Infants on "vents" also need to have an orogastric tube placed in their stomach to draw air off the stomach that may interfere with breathing effort and ventilator support (267). These intubated infants can "overbreathe" on the vent. For example, the vent may only be giving the infant 10 breaths a minute but the infant will take 2-3 breaths on its own in between the ventilator breaths. This is a good sign that the infant can soon be extubated.

A fourth form of support is very new. It involves administering cow surfactant shortly after birth via the ETT. Artificial surfactant has recently been approved by the FDA (Exosurf) and has been shown to reduce the severity of RDS (268). Surfanta, the cow surfactant, is still in the experimental phase and requires a parental consent to be used. Certain criteria must be met before using either form of treatment, such as weight and oxygen-carbon dioxide exchange parameters. Multiple doses can be given, but are ceased as soon as the infant's condition improved or deteriorates outside of the parameters.

The oxygen-carbon dioxide exchange process is measured by arterial blood gases (ABG). This exchange in the bloodstream affects the acid content of the blood. Central "lines" are usually placed in all infants that will need constant blood work. This eliminates the need for repeated needle sticks. In newborns, central lines are placed in the
umbilical cord blood vessels, two arteries and one vein. A umbilical arterial line (UAL) and venous line (UVL) are started by threading a thin catheter into the aorta through the artery and into the liver through the vein. These are used for the frequent blood sampling as well as blood pressure monitoring and infusing fluids, nutrients (hyperalimentation), medicines, and blood (269,270,271). A noninvasive method of monitoring the infants condition is by pulse oximetry or "BIOX". This measures the hemoglobin saturation with oxygen. It is done with the use of infrared light sensing the red blood cells through the skin. Oxygen saturation should be maintained at 88-92 percent (SaO2) (272).

Any infant receiving treatment for RDS will undergo "weaning" or having its caretakers progressively try to lower ventilatory support and oxygen concentration needed. The purpose of weaning in to give the infant no more oxygen and pressures from the vent than needed. Prolonged treatment for RDS can lead to serious and/or permanent complications.

An immediate possible complication of ventilator use is pulmonary intestinal emphysema (PIE) or tiny air bubbles forced out of the alveoli and in between layers of lung tissue. This can cause a pneumothorax ("pneumo") when one or more of the alveoli burst, leaking into the chest cavity, causing the lung to collapse, collecting air between the lung and chest wall. This is observed by X-ray or by transillumination of the chest, simply placing a flashlight apparatus on the chest and observing the inconsistent shadowing of the lung. It is corrected first by needle
aspiration, placing a needle into the air pocket and suctioning the air off the chest, relieving the pressure. A chest tube may be necessary to continue the suctioning procedure until the alveoli repairs itself (273,274,275).

The high pressures of the ventilator required to sustain the infants life initially can cause lung and bronchiole damage and may impede recovery. Damaged lung tissue dies and forms scars that interfere with the oxygen and carbon dioxide exchange between the lungs and bloodstream. Unlike adults, however, infants can continue to grow new lungs tissue until they are six years of age. This condition may present complications associated with chronic lung disease. Bronchopulmonary Dysplasia (BPD) refers to this condition. Infants that require long term vent support are referred to as "BPDers" and may require a tracheostomy, a surgically created opening in the neck to allow the placement of a tube below the vocal cords. This is done to decrease the damage caused by an ETT, as well as to prevent frequent extubations. As BPDers grow older, their activity level increases and a tracheostomy allows for mobility as well as oral feedings and increased social interaction possibilities. Because of their lifelong struggle to breathe, BPD babies are excessively irritable, easy to tire, hard to feed and slow to gain weight. BPD babies are a special challenge to the neonatal caretaker due to their unique medical limitations and their need for "normal" infant stimulation (276,277,278,279,280).

Finally, high oxygen concentration therapy can cause
retrolental fibroplasia (RLF) or retiopathy of prematurity (ROP) because higher than normal oxygen concentration constricts the growth of the blood vessels in the retina of the eye. After the infant has reached "term" (older than 40 weeks gestational age), ROP is less of a concern because most of the eye maturation is completed. Eye exams are routinely given to infants that required oxygen therapy (281,282,283).

Other special forms of RDS are meconium aspiration syndrome (MAS) and transient tachypnea of the newborn (TTN). MAS results when the infant is stressed enough during delivery to reach a level of asphyxia. This tends to relax the anal sphincter and stimulate peristalsis resulting in the passage of meconium (first form of stool) into the amniotic fluid. This also stimulates gasping and the result is aspiration of the meconium into the lungs. Obstruction may result, causing RDS. This is first treated by tracheal suctioning before the infant is stimulated to take its first breath. Persistent fetal circulation (PFC) often occurs with severe MAS because the lungs are incapable of proper gas exchange from the beginning of life. PFC is a condition where the blood circulates as it did before birth, bypassing the lungs. Treatment includes respiratory support, antibiotics for possible pneumonia, and chest percussion therapy to remove the meconium. Usually after a few days, the infant recovers and needs very little support.

TTN results from delayed removal or absorption of fetal lung fluid. A common feature of this syndrome is heavy
maternal medications (i.e. analgesics or anesthesia during delivery). Due to the resulting fetal depression, initial respiratory efforts are not sufficient to clear the lung fluid. Usually, oxygen therapy is necessary for up to three days.
Neonatal Jaundice and Hyperbilirubinemia

Hyperbilirubinemia is defined as an excessive amount of bilirubin in the blood (284). Newborns have a higher bilirubin level than older patients. In treating jaundice, present with bilirubin levels higher than 4-6mg/100ml (285), a distinction must be made in determining what is physiological jaundice and what is pathological, so treatment can be initiated if necessary.

There are two types of bilirubin. Unconjugated bilirubin (indirect) accounts for 90 percent of the bilirubin in the serum; conjugated (direct) bilirubin accounts for 10 percent (286). Most of the body's bilirubin is formed from the breakdown of erythrocytes (red blood cells). The life span of a normal neonatal red cell is approximately 80-100 days (287). The RBC breaks down into two fractions, the heme portion and the globin (protein) portion. Unconjugated bilirubin is formed from the heme fraction. Once formed, bilirubin is bound to albumin and can't leave the vascular bed or bloodstream. If the bilirubin level exceeds the albumin binding capacity, the unconjugated bilirubin may penetrate to extra-vascular tissues, including the brain. There will be an increase in the unconjugated bilirubin level if the albumin level is low, if certain drugs (salicylates) bind to the albumin, or if the unconjugated bilirubin level is very high (over 20 mg/100 ml) (288).

The unconjugated bilirubin is transported to the liver and conjugated (combined) with glucuronide. Now called
direct bilirubin, it is water soluble and is passed from the liver cell into the gastrointestinal tract where it is excreted (289).

The neonatal small intestine mucosa contains a considerable amount of the enzyme beta-glucuronide. This substance can convert the bilirubin glucuronide (conjugated bilirubin) back to unconjugated bilirubin, which is fat soluble and can be absorbed across the intestinal wall into the liver circulation. This is called a "enterohepatic shunt" and occurs when the direct bilirubin is not excreted fast enough, as in the case of delayed meconium passage (first stool which contains up to 0.5-1.0 mg of bilirubin/gm) (290).

An increase indirect bilirubin also will occur if hypoxia or hypoglycemia is present. This is due to the inability to produce enzymes necessary to catalyze the reaction that converts unconjugated bilirubin to conjugated bilirubin (291). Low liver enzyme levels will also slow this reaction down and cause an increase in the unconjugated bilirubin level (292).

Jaundice only appears in 50 percent of babies because serum bilirubin levels must exceed 4-6 mg/100 ml before it is visible in the pigment in the skin (293). Physiological jaundice is caused by elevated unconjugated bilirubin levels due to excess red blood cells in the newborn bloodstream and requires treatment, usually phototherapy. Pathological hyperbilirubinemia can be caused by ABO or Rh incompatibility and requires a replacement of the RBC by transfusion. Rh disease
occurs when mother (usually Rh-) is sensitized by receiving mismatched blood, abortion of a Rh+ fetus, or by her first Rh+ fetus. She will produce antibodies against the Rh+ newborn's red blood cells and cause an abnormally high level of broken down cells. It is important to remember, however, that most mothers that are Rh- and have Rh+ fetuses usually have no problems with hemolytic disease because it can be prevented with Rhogam before the birth of the second child (294). ABO disease is much less severe than Rh disease and may occur with first pregnancy since anti A and anti B antibodies are naturally occurring. Usually the mother is O and the fetus is A or B (295). Sepsis, liver disease, bowel obstruction, high hematocrit, large doses of vitamin K, and metabolic disease all interfere with the excretion of bilirubin and/or cause and increase in the bilirubin level (296).

Some rules of thumb in diagnosing hyperbilirubinemia are:

1) A full term infant will have an indirect bilirubin level of 2-12 mg/100 ml and will reach it's peak level at 3-4 days of life. A preterm infant will have an indirect bilirubin level of 2-15 mg/100 ml and will reach it's peak level at 5-6 days of life.

2) An elevated bilirubin level (greater than 5-10 mg/100 ml) the first day of life is never physiological jaundice.

3) A bilirubin level above 12 in the full term infant and above 15 in the preterm infant is probably not physiological jaundice.
4) A bilirubin level less than 15 in the preterm infant or less than 12 in the term infant may not be physiological jaundice.

5) An elevated direct bilirubin level is not physiological jaundice.

6) Persistent jaundice beyond the eighth day of life in full term infants and beyond fourteen days of life in preterm infants is not physiological jaundice (297). Jaundice that is not physiological is pathological and can't be resolved with standard hyperbilirubinemia treatments. Instead, it is a result of, most often, liver malfunction and will continue to occur until the liver is repaired. For this reason, not only the indirect bilirubin level will rise, but so will the direct level (298).

A diagnostic workup for jaundice at one day of life includes an exam for lethargy, cyanosis, large liver or spleen, and signs of sepsis. Direct and indirect bilirubin levels should be followed and blood type and Rh of both mother and infant should be evaluated (299). A indirect and direct Coombs test should be run on the mother. A direct Coombs measures antibodies that are attached to RBC but does not determine types of antibodies on the RBC. A indirect Coombs determines specific antibodies that are in the plasma but not on the RBC. By process of elimination, presence of antibodies can be confirmed and hemolytic disease of the newborn (ABO incompatibility) is probable (300). A full septic workup (CBC, blood cultures, urine screen, lumbar puncture, chest X-ray) should also be included (301). Other studies can
include reserve albumin binding capacity, hepatic workup, and hemolytic workup (302).

Treatment for hyperbilirubinemia included exchange transfusions and phototherapy. While specific protocol according to serum bilirubin level and the infant's age are followed, these are just guidelines. Individually, any infant that has perinatal asphyxia, RDS, metabolic acidosis, hypothermia, sepsis or birthweight under 1500 grams should be treated more conservatively (303).

An exchange transfusion involves the removal of about 40 percent of the infant's RBC. At the end of two transfusions (85 percent exchange), the serum bilirubin level should be about 50 of the pre-exchange level and probably will rebound to 70-80 of the pre-exchange level, depending on the amount of pigment stored in the extravascular tissues and the remaining "vigor" of the hemolytic process that caused the hyperbilirubinemia (304). The transfusion takes place by drawing off a five percent blood volume and replacing it with an equal volume repeatedly (305). An exchange is only indicated in serum bilirubin levels of 10-14 at 24-48 hours of age, 15-19 at 48-72 hours of age, or 20+ at greater than 72 hours of age (306). Risks include infection, electrolyte abnormalities, cardiac arrhythmias, hemorrhage, acidosis, hypoglycemia, hypocalcemia, and low temperature. Vital signs, blood glucose, and color should be monitored. Calcium and electrolytes may be necessary to administer during or after the exchange (307).

Normally, jaundice will respond to phototherapy. The
blue light of the "bililite" seems to decompose bilirubin by photo-oxidation. This definitely will resolve physiological jaundice and seems to resolve hemolytic diseases (308). It should not be initiated until a pattern of rising bilirubin has been demonstrated (309). The infant is placed 18 inches under the bililite with eyepatches on and all clothes off. Possible harmful effects are bilirubin breakdown products hurting the infant, damage to the eyes, skin rashes, hyperthermia, and electrolyte imbalance. Eye patches should be applied with the eyes closed underneath to prevent corneal ulceration. The baby will have frequent, loose stools while excreting the excess bilirubin. Skin should be cleaned promptly after each stool to prevent breakdown. The infant must be turned regularly to keep all areas of the body exposed equally (310). Albumin may also be administered to keep the serum level adequate (311).

Kernicterus is the yellow staining of the brain due to deposits of indirect bilirubin in the brain. In order to cross the brain barrier, this bilirubin is not combined with albumin and is called "free bilirubin." While only 0.01 percent of the indirect bilirubin is free bilirubin, there are very few tests to measure the free bilirubin level in the newborn (312). This is the most severe outcome of hyperbilirubinemia and clinical manifestations initially include lethargy, poor feeding, high pitched cry, and vomiting. Later, after months or years, conditions such as irritability, seizures, impaired mental function, deafness and movement disorders may occur (313).
doesn't occur in infants with indirect bilirubin levels under 20, but has occurred in infants with a level as low as 9 (314).
Neonatal Sepsis and Infection Control

Neonatal sepsis can be defined as "a systemic disease of the newborn associated with the presence in the blood or other tissues of pathogenic microorganisms or their toxins, however, the term is most commonly used to mean the presence of a positive blood culture for bacteria (bacteremia) in association with clinical manifestations of infection"(315).

Seventeen percent of perinatal deaths are associated with amniotic fluid infection (316). Other infections cause 1.5 percent of all perinatal infections (317). The mortality varies with the gestational age of the infant. Neonatal sepsis claims the lives of 4.3/1,000 preterm infants, while 0.8/1,000 live births of term infants expire from the same infections (318). The mortality also varies depending on the causitive organism and the location of the birth.

Neonates are especially at risk for sepsis for many reasons. Before birth, a fetus is in a primarily sterile environment and is put another environment at birth filled with organisms that readily colonize the infant. In addition, the immunologic system of an infant is not fully mature at birth, especially in a sick or premature infant. Certain antibodies do not cross the placenta and are not readily available to the infant. The newborn's leukocytes (WBC) do not function well in phagocytosis (infection fighting) and other organism fighting mechanisms are depressed (319). Infants in an NICU are also at risk because of invasive procedures, monitoring, and increased contact with other sick infants (320).
The primary causitive organism varies with each decade, but the most frequent causitive organisms are *Escherichia coli*, Group B streptococci, *Staphylococcus aureus*, and *Staphylococcus epidermis*. *Listeria monocytogenes* is a common meningitis causing organism (321).

Sepsis differs in presentation by early vs. late onset. Early onset infections usually occur during the first five days after delivery. Symptoms usually occur in the first 48 hours after infection and the infection is frequently caused by Group B strep, *E. coli*, and Haemophilus organisms. Late onset infections usually occur after five days postnatally, but more often around two weeks of age. The causitive agents usually tend to be nosocomial pathogen (acquired due to environment in hospital) and enteric (body fluids) flora (322).

Group B Streptococci infections have one of the highest mortality among newborn infections (30 to 50 percent) (323). The infection manifests itself usually early as sepsis or pneumonia. Chest X-rays will appear similar to those of hyaline membrane disease (HMD or RDS) and 30 percent of the afflicted infants may later develop meningitis (324). The late onset of Group B strep presents itself as meningitis and has a significant morbidity of 30-40 percent (325). Group B strep accounts for 30-50 percent of all early onset cases of sepsis (326). Four to 29 percent of all pregnant women colonize the organism, while only one to two percent become infected (327).

Exposure to microorganisms occurs before delivery via amniotic fluid infections or maternal bacteremia, during
delivery due to perinatal or maternal flora, and after delivery due to the infant's environment (328).

Risk factors for sepsis are present in all stages of life from conception. Amniotic fluid infection can occur due to rupture of membranes for longer than 24 hours before birth. The lack of intact membranes allows direct access of vaginal bacteria to the fetus (329). A maternal fever, malnutrition or urinary tract infection also place the infant in the high risk group for sepsis (330). Birth asphyxia, including hypoxia and acidosis, will further depress the immune system (331). After birth, invasive procedures such as central catheterization, intubation and tracheal suctioning, and surgery also increase the risk for sepsis (332).

Clinical situations suggesting particular risk for sepsis include premature labor without explanation, prolonged rupture of membranes, premature rupture of membranes, fetal tachycardia, foul smelling amniotic fluid, meconium stained amniotic fluid without explanation and birth asphyxia (333). A sepsis risk protocol has been designed to aid in the decision on whether to treat the infant for sepsis, but individual cases vary (334). Another general rule is if a preterm infant demonstrates any of the risk factors, it should undergo a sepsis workup and undergo therapy. If a term infant demonstrates more than two risk factors, it also should be treated as septic (335).

Frequent signs and symptoms of sepsis include fever, jaundice, poor feeding, respiratory distress, apnea, cyanotic episodes, abdominal distension, vomiting, rash,
irritability, diarrhea, lethargy, hypo- or hyperthermia (336), glucose instability, hypotension, tachycardia, and poor peripheral perfusion (337). Ominous signs include pallor (gray color), shock, convulsions, bulging fontanelle and nucal (neck) rigidity (338).

A "traditional" septic workup includes the following: cultures of all normally sterile bodily fluids, complete blood count and differential, and a chest X-ray (339). Positive bacterial cultures of cerebral spinal fluid (CSF), urine, or blood confirm sepsis but many difficulties can arise when attempting to culture a small sample, with bacterial that are difficult to grow (anerobes) and due to possible administration of maternal antibiotics, cultures may remain negative, yet clinical signs of improvement after antibiotic therapy is completed point to treated sepsis (340).

Antigen detection tests also have proven to be helpful when cultures are negative. Other diagnostic tests are available but may lead to "false positive" results if maternal infection with only fetal exposure has occurred. An elevated WBC count may be present, and the ratio of other blood cells at different levels of maturation can be used diagnostically (341). Latex agglutination tests are conducted on all presumed septic infants because it can aid in the diagnosis of Group B strep infections. Adding a small amount of antibody attached to polystyrene beads will clump when or if the bacteria is encountered. This is usually done with a sample of urine (342).

Management of bacterial sepsis is usually started in
the cases of premature infants, multiple risk factors indicating sepsis, positive diagnostic tests results or clinical signs of sepsis (343). Treatment is usually started before a definite etiology is determined. Wide spectrum antibiotics are used, including a penicillin (ampicillin) and an aminoglycoside (gentamicin) (344). These antibiotics cover most microorganisms infections, including Group B streptococci. If staphylococcus infection is suspected, vancomycin treatment is usually initiated. Antibody toxicity is monitored carefully due to the risks of kidney damage (345). Other general supportive care is usually indicated, including fluid and electrolyte balance, respiratory support, and blood pressure maintenance. Transfusions of blood with needed antibodies and complement (immune system component) may also be necessary (346). Therapy duration is decided upon after considering response to treatment and the purpose infective organism. Usually, infants who don't demonstrate any clinical signs of sepsis will have three days of antibiotic therapy. Further treatment is indicated based on the severity of the infection and the condition of the infant. Treatment for bacterial meningitis and Group B strep includes a standard of 21 days of antibiotic therapy (347).

TORCH is an acronym for "chronic nonbacterial perinatal infections" It stands for Toxoplasma, Other, Rubella, Cytomegalovirus, and Herpes. "Other" denotes syphilis, hepatitis B, and varicella-zoster (chicken pox). All these infections seem to present themselves clinically in a
similar manner, making the acronym very useful (348).

Toxoplasma gondii is a parasite capable of causing intrauterine infection. It's incidence is 1 in 1,000 live births. Infection in the mother is often not detected. It is most commonly transmitted by a feline host, usually a cat. If cat feces are ingested, the parasite invades several parts of the mother's body and is passed over the placenta. Often, toxoplasma is called "the cat box disease." It is also transmitted in unpasteurized milk or raw or undercooked meat and eggs. Clinical manifestations included signs of overwhelming sepsis, including seizures, anemia, jaundice, cerebral calcifications, and hydrocephaly. Survivors may have deafness, mental retardation or visual difficulties later in life. The morbidity for this disease is extremely high. Treatment includes use of drugs and supportive measures (349).

Hepatitis B infection occurs in the third trimester of pregnancy or during birth if the infant swallows maternal blood. There is an 85 percent chance the infant will be a chronic carrier if the mother is a chronic carrier; only 25 percent of the infants of nonchronic carrier mothers are chronic (350).

The placenta sheds the rubella virus for months and disseminates it to the fetus. Congenital malformations most often occur in the first trimester, while second trimester exposure is associated with peripheral defects, central hearing defects, and microcephaly (351). Prevention includes emphasis on refraining from becoming pregnant for at least
two months after receiving the rubella vaccine. There is no treatment for neonatal rubella (352).

Cytomegalovirus (CMV) is a member of the herpes group and may occur in the placenta with or without transmission to the fetus. Approximately 90 to 95 percent of the infants are asymptomatic and mothers infected are almost always asymptomatic. The worst prognosis is for infants who are symptomatic at birth. Symptoms include IUGR, microcephaly, optic atrophy, and cerebral calcifications (353).

Herpes carries the highest mortality rate for neonates with 75 to 80 percent of the infants who acquire the infection dying (351). Seventy percent of the infections are Type II (genital) (352). It is transmitted by close contact of the mucos membranes and presents itself often like bacterial sepsis or meningitis. Slightly more than 50 of those infected have skin lesions (356). Infants of mothers who have active, primary as apposed to recurrent infection are most at risk. The more prolonged the delivery is after the rupture of membranes and premature birth place the infant at further risk. Prevention can be attempted with caesarean section delivery to avoid contact with the vaginal walls. Isolation and antiviral treatment with chemotherapy, specifically Acyclovair, along with other supportive measures are the only treatment usually employed (357).

Requirement for spread of infection generally include a source of infection (i.e. nursing staff, other patients, visitors, linen, or community instruments), a susceptible cost (i.e. newborn infants, especially preterms), and a
means of transmission. There are four main routes of infection. Contact transmission includes direct physical contact, indirect contact and droplet contact. A vehicle route includes spread via contaminated item, such as blood, formula, or instruments. Airborne transmission includes droplets via the air, such as dust particles. Vector transmission is defined as anything that transports infectious organisms from one location to another. People, air, animals, dust or insects can all be vectors (358).

Routine, everyday infection control includes several practices. Scrubs are worn in the nursery with cover gowns worn over the scrubs when leaving the nursery at work. Street clothes are worn to and from work. Visitors wear yellow cover gowns before entering the nursery. Community property, such as blood pressure machines and scales, are cleaned after use and are not touched while holding a baby. Each infant has its own stethoscope and care is taken to prevent "dangling" of other stethoscopes that may be around the neck of staff examining the infant. Infants should remain at their own bedside and should not be carried around the nursery while being fed, etc. Trash should be dropped into wastecans and not "tossed" from a distance. ANYTHING dropped on the floor should be disposed of. The cost to replace the item is minimal compared to the cost of extra days in the nursery for antibiotic treatment, not to mention the risk put to the infant. Lastly, handwashing with antimicrobial soap should proceed every procedure that involves touching anything in the nursery (359).
Drug Withdrawal in the Newborn

Drug use in the pregnant mother is rising in incidence over the past few years. In 1987, it is estimated that 8 to 14 percent of pregnant mothers were addicted to either mood altering drugs or alcohol (360). In 1982, 1.2 percent of live births experienced some form of drug withdrawal while in 1987, 10 percent of live births were subjected to maternal drug use during the fetal period (361). The most commonly used drugs are cocaine, marijuana, heroin, methadone, and alcohol (362).

Cocaine is a central nervous system stimulant and a mood altering drug. Its effects do cross the placenta to the developing infant. Effects, which are similar to the adult and the fetus, include vasoconstriction, elevated heart rate and hypertension. These newborns have increased incidences of SIDS (Sudden Infant Death Syndrome) and distress during birth. They also exhibit intrauterine growth retardation (IUGR), low birth weights, smaller head sizes and an irregular heart rate. These newborns are easily stressed due to the immaturity and increased instability of the CNS. They often exhibit a low tolerance for more than one sensory stimuli at a time. Maternal use of cocaine is only detectable by urine sampling 24 hours following use. However, if cocaine use occurs within 2 to 3 days prepartum, the drug use can be detected in the infant for 4 to 6 days after birth (363,364,365,366).

The mood altering component of marijuana is THC
(tetrahydrocannabinol) The effects of the drug to the fetus and the mother are directly proportional to the dose taken. The dose is also ten times more powerful when inhaled vs. when ingested orally. THC is absorbed in the brain, gonads and fatty tissues and damages the cellular process. Irreversible brain damage due to atrophy is a probable outcome, in addition to bronchitis, pharyngitis and damaged lung tissue equivalent to conditions observed after 10 to 20 years of cigarette smoking (367). Genetic damage in the forms of mutations and chromosomal aberrations are possible, as are physical and mental developmental abnormalities. Chronic marijuana users may expect abnormal sperm production due to decreased testosterone levels. Irregular ovulation patterns and a high incidence of spontaneous abortions may also occur. Because of THC's affect on the function of the placenta, a higher incidence of infant mortality, as well as the incidence if prematurity, low birth weight, low maternal weight gain, more complicated pregnancies (i.e. bleeding, abruptions), IUGR, meconium staining, resuscitations at birth, stillbirths, and delay in psychological and physiological development have been observed. These outcomes are not only due to the harmful effects of the drug, but the lack of prenatal care that occurs due to the mother's use of the drug (368, 369, 370, 371).

Heroin and methadone are opiates that also cross the placenta. They cause vasoconstriction and therefore reduce the placenta blood flow. While chronic opiate users almost always see a cease of ovulation and menstruation, a time
period when the drug is inaccessible is usually when pregnancy results (372). Surprisingly, infants of addicted opiate users have a decreased incidence of respiratory distress syndrome because the drug enhances surfactant production and oxygenation of the red blood cells. However, the infants of opiate user have an increased incidence of meconium aspiration or aspiration pneumonia, low birth weight, and severe intrauterine withdrawal (373). Protocol calls for allowing the expecting mother to continue her drug abuse under supervision until the delivery of the infant so withdrawal in the fetus and its effects are avoided (374).

Alcohol use by expecting mothers is viewed often more as a syndrome than a withdrawal situation for the newborn (375). Fetal Alcohol Syndrome (FAS) infants typically present small head size with irregular facial, joint, and limb formation. CNS and cardiac damage are also common. Withdrawal doesn't normally occur with FAS, just mental and physical anomalies (376).

While symptoms of drug withdrawal in the newborn may not be observed for two weeks after birth, they can last for 4 to 6 months. Signs and symptoms include wakefulness, irritability, tremors, temperature instability (especially hyperthermia due to excessive crying) (377), tachypnea, hyperactivity, respiratory distress, apnea, failure to gain weight due to vomiting, diarrhea, increased activity and decreased sleep, metabolic alkalosis (result of loss of acid due to excessive vomiting), and respiratory alkalosis (result of hyperventilation and crying) (378). Nursing care includes
swaddling (tight bundling) the infant, providing a quiet, dark atmosphere, rocking, frequent vital sign checks, especially temperature and respiratory rate, accurate input and output records, specific gravity records, frequent diaper changes, good skin care, maintaining electrolyte balance, assessing for nasal congestion with suctioning if needed, daily weights, and small, frequent feedings with accurate monitoring of caloric intake (379,380,381,382,383).

Long term outcome for infants exposed to drugs in utero can include smaller physical size and impaired behavioral, perceptual and organizational abilities (384,385).
The Special Care Nursery is a bright, noisy, busy place, 24 hours a day. While this is necessary to provide acute care to sick newborns, it is not conducive to the healing and normal growth and development of a chronically ill infant. The philosophies of "minimal stress" and "cluster caregiving" can be practiced on all patients in the SCN, but are especially important when dealing with the older infants. When the patients the caregiver is dealing with are too small to object, often their comfort and less obvious, or "important", needs (i.e. quiet environment to sleep, pain, fear, etc.) are neglected in the name of providing intense care for the physical aspects of the infant.

The goal of this philosophy is to accomplish the following as consistently as possible in the SCN:

1) To move the chronic infant from the loud environment of the intensive care setting into an area that will be more conducive to the healing and normal growth and development.

2) Patient care is to include developmental needs.

3) Improve nutrition.

4) Organize normal sleep and awake patterns.

5) Establish separate area (in the "chronic area") for sleep and play. (i.e. cribs vs. playmats)

6) Limitation and strict timing of procedures such as labs, weights, diaper changes, baths, treatments, doctor exams, etc.
7) "Cluster" care giving.
8) Educate staff on developmental care.
9) Increase family involvement and education on care for a chronically ill infant (386,387).

A goal for the SCN is to facilitate the staff and space requirements to open a "BPD" unit. (Bronchopulmonary dysplasia, or chronic lung disease, is usually the only reason for prolonged hospitalization in the SCN) Admission requirements would ideally be infants at least one month of age with oxygen or ventilation requirements, and a diagnosis of BPD with no more acute interventions expected (388). Each BPD infant will have an individualized daily schedule that will be followed by all persons involved in the care of that infant. Care should be planned in a schedule that is as close to "home-like" as possible. Each plan will include what the care givers have learned to be that infants "signals of stress", or signs that the infant will give to show agitation, possibly followed by distress. Included also will be "calming techniques" that work with the infant to avoid distress (389).

Specific care guidelines include the following:

1) Do not wake a sleeping infant unless for a scheduled feeding. An infant should not be waken up for the following procedures: weights, labs, respiratory therapy treatments (RT), occupational or physical therapy treatments (OT, PT), physical assessments, vital signs, baths, diaper changes, or suctioning (unless indicated by a sign of distress on the monitor). Daily weights are usually not necessary for these
infants and when a weight is needed, it can be done at bath time or when clothes are being changed for bedtime.

2) Babies should not be awakened early in the morning for lab draws. Care should be taken by the doctors in ordering routine labs that are not always necessary. In the BPD area, the infant should be moved out of their crib for lab draws so that pain is not associated with their normal environment.

3) RT treatments should be incorporated into the daily schedule. Night treatment should be avoided or done on a PRN (as needed) basis only. When night treatments are necessary, they should be done with the least amount of handling possible. (i.e. the infant should not be picked up, hand ventilation with the ambu bag should only be done is necessary, etc.)

4) OT and PT treatments should be initiated as soon as possible in the infant's plan of care. Again, the infant should not be awakened for these treatments.

5) Doctors (nurse practitioners, medical students, etc.) should incorporated exams in with the infant's plan of care and, again, should not wake the infant for an exam. The importance of being respectful of the baby's environment (i.e. not leaning on the crib or speaking in a loud voice during rounds) should be stressed by all personnel.

6) Vital signs and assessments do not need to be done at a specific time (4-8-12, etc.), but can be done with feedings when the infant is awake. Monitors need to be used to do a visible vital sign check of heart rate, oxygen
saturation, etc. Infants also can be assessed as to color, respiratory effort, environment and equipment at bedside, "biox", activity, and monitors without disturbing the infant. Doctors can change orders to "vital signs with feedings" when requested to do so.

7) Most babies do not need a daily bath. Baths can be done on any shift. Most likely, "accidents" will present a need for a bath at any time! Bath time should be a soothing, gentle tub bath instead of a sponge bath. Sponge baths leave the infant cold and agitated.

8) Suctioning should only be done PRN.

9) Diaper changes should only be done when the infant is awake. (there is some room for improvisation on this guideline, obviously!) If an infant is gavage fed every two hours, it does not need to be awaken at every feeding for a diaper change.

10) When possible, X-rays should be taken by placing the film under the mattress of a warmer bed (390,391).

The BPD area should have a homelike environment. Quiet voices should be used, alarm volumes should be lowered, and "biox" pulse sounds should be off. Tape players can be used to play music during "awake" times. Lights should be on during the day and off during sleep times. Again, monitors need to be trusted! When the lights are off, most infants tend to calm down (392).

"Containment" or "nesting" are good calming techniques. Placing blanket rolls around an infant will give it something to bump up against, offering a feeling of security. It also
keeps premature infants from rolling on to the cold, hard plastic of the isolette. Sheepskin and bubble blankets also provide a soft bed to lie on. Swaddling an infant or placing the infant on its side with rolls between its knees, hands and behind its back also may provide comfort. Once it is discovered what works for the infant, it should be passed on to all care takers and placed in the care plan (393,394).

Developmental milestone charts should be referred to for corrected age (gestational age considered) appropriate behavior and these tasks should be encouraged. Toys, especially pictures, should be provided for focusing and development. High chairs, walkers, and pumpkin seats should be used as soon as the infant is old enough and as tolerated (395).

Family involvement should be encourage early in the hospitalization period. Parents can help in many tasks and should receive a list of tasks they can do and a copy of the baby's schedule so they can participate also. This will also encourage bonding when the parent can't be in the nursery, because he/she will know what their child is doing. Its important to point out the baby's normal features and to try to paint the baby as a "baby" vs. a "patient" (396). Often, parents visualize their child as being sick forever and do not realize that their child has special and normal needs. The role of spouses, grandparents, and siblings needs to be acknowledged and incorporated into the care plan also, when appropriate (397).

Discharge will be a much smoother process if a homeli...
environment has been established in the nursery. There are several tasks, including "well baby" care issues, that may need to be taught to parents. Financial concerns should be discussed and referrals should be made. Community supports, such as home monitor systems, public health nurses, and parent support groups can assists in the transition (398). "Rooming in", having the mother and primary care takers spend a few nights in the hospital, taking care of the baby with available help if necessary, is provided for any parent that requests it and required for infants who have spent long periods of time in the SCN. Home monitoring, CPR training, and other skills such as administering medications can be taught in this time period (399,400).
Drugs Used in the Special Care Nursery

1) Acyclovir- I.V. drug used in the treatment of Herpes I and II, inhibits viral replication.

2) Amikacin- I.V. antibiotic used in treatment of serious infection caused by staphylococcus or E. coli.

3) Aminophylline- I.V. or oral spasmocytic used in treatment of apnea, relaxes smooth muscle in the lungs.

4) Ampicillin- I.V. or I.M. antibiotic used in treatment of systemic infection, broad spectrum treatment of rule-out sepsis patients.

5) Apresoline- oral drug used to lower blood pressure caused by congestive heart failure.

6) Ativan- I.V. antiepileptic used in treatment of seizures.

7) Atropine- I.V. or I.M. emergency drug used in treatment of bradycardia (low heart rate) by blocking cardiac vagal reflex.

8) Caffeine Citrate- Oral methylxanthines used in the Theophylline- treatment of apnea due to prematurity by stimulating the central nervous system and smooth muscle relaxers.
9) Calcium Gluconate- added to dextrose solution to prepare I.V. fluids used to replace and maintain major electrolyte balances.

10) Cefotaxime- I.V. or I.M. antibiotic used in the treatment of serious infection of lower respiratory tract and urinary tract infections caused by streptococci, staphylococcus aureus and E. coli.

11) Chloral Hydrate- oral drug given as a sedation agent.

12) Diazoxide- oral agent used in the treatment of acute hypertension by directly relaxing the arteriole smooth muscle.

13) Dilantin- I.V. or oral anticonvulsant used in the treatment of seizures.

14) Dobutamine- I.V. adrenergic agent used to stimulate heart to raise cardiac output.

15) Dopamine- I.V. adrenergic agent used in the treatment of shock, hypotension, low cardiac output, and low perfusion to vital organs by stimulating the sympathetic nervous system.

16) Drisdol- I.M. or oral vitamin D agent used to promote