

THE PRETERM INFANT

Any infant born prior to completing 37 weeks' gestation is identified as premature. Thus, the level of development and maturity, and often the degree of complications, varies within this group, dependent on the length of gestation.

NEONATAL ASSESSMENT DATA BASE

Circulation

Apical pulse may be rapid and/or irregular within a normal range (120–160 bpm).
Audible heart murmur may indicate PDA.

Food/Fluid

Weight less than 2500 g (5 lb 8 oz).
Body long, thin, limp with a slight potbelly.
Suck/swallow reflex may be absent/uncoordinated (impacts feeding choices).

Neurosensory

Head size large in relation to body; sutures may be easily movable; fontanelles may be large or wide open.
May demonstrate twitching or eye rolling.
Edema of eyelids common; eyes may be fused shut (depends on gestational age).
Reflexes depend on gestational age; rooting well established by 32 weeks' gestation; coordinated reflexes for sucking, swallowing, and breathing usually established by 32 wk; first component of Moro's reflex (lateral extension of upper extremities with opening of hands) appears at 28 wk; second two components (anterior flexion and audible cry) appear at 32 wk.
Dubowitz examination indicates gestational age between 24 and 37 wk.

Respiration

Apgar scores may be low.
Respirations may be shallow, irregular; diaphragmatic with intermittent or periodic breathing (40–60/min).
Grunting, nasal flaring, suprasternal or substernal retractions, or varying degrees of cyanosis may be present.
Auscultatory presence of "sandpaper" sound indicates RDS.

Safety

Temperature fluctuates easily.
Cry may be weak.
Face may be bruised; caput succedaneum may be present; labor or delivery may have been precipitous.
Skin reddened or translucent; color may be pink/ruddy, acrocyanotic, or cyanotic/pale.
Lanugo widely distributed over entire body.
Extremities may appear edematous.
Sole creases may or may not be present on all or part of the foot.
Nails may be short.

Sexuality

Female labia minora may be larger than labia majora, with prominent clitoris.
Male testes may not be descended; rugae may be scant or absent on scrotum.

Teaching/Learning

Maternal history may reveal factors that contributed to preterm labor, such as young age; low socioeconomic background; closely spaced pregnancies; multiple gestation; poor nutrition; previous preterm birth; obstetric

complication such as abruptio placentae, premature rupture of membranes (PROM), premature dilation of cervix, presence of infection; blood incompatibility associated with erythroblastosis fetalis; or use of prescription, over-the-counter, or street drugs.

DIAGNOSTIC STUDIES

Choice of tests and the expected results depend on presenting problems and secondary complications.

Amniotic Fluid Studies: For lecithin-to-sphingomyelin (L/S) ratio, fetal lung profile, and phosphatidyl glycerol/phosphatidyl inositol may have been performed during pregnancy to assess fetal maturity.

CBC: Decreases in Hb/Hct may be associated with anemia or blood loss. WBC count may be $<10,000/\text{mm}^3$ with a shift to the left (excess early neutrophils and bands), which is usually associated with severe bacterial disease.

Dextrostix: Reveals hypoglycemia. Serum glucose test may be required if Dextrostix result is 45 mg/ml.

Serum Calcium: May be low.

Electrolytes (Na^+ , K^+ , Cl^-): Usually within normal limits initially, but susceptible to critical fluctuations.

Blood Type: May reveal potential for ABO incompatibility.

Rh and Direct Coombs' Determination (if mother is Rh-negative and father is Rh-positive): Determines incompatibilities.

ABGs: Po_2 may be low; Pco_2 may be elevated and reflect mild/moderate acidosis, sepsis, or prolonged respiratory difficulties.

Erythrocyte Sedimentation Rate (ESR): Elevation indicates an acute inflammatory response. Diminishing ESR indicates resolution of inflammation.

C-reactive Protein (a beta globulin): Present in serum in proportion to severity of infectious or noninfectious inflammatory process.

Platelet Count: Thrombocytopenia may accompany sepsis.

Fibrinogen Levels: May decrease during disseminated intravascular coagulation (DIC) or become elevated during injury or inflammation.

Fibrin Split Products: Present with DIC.

Blood Cultures: Identify causative organisms associated with sepsis.

Urinalysis (on second voided specimen): Detects abnormalities, renal injury.

Urine-Specific Gravity: Ranges between 1.006 and 1.013; elevated with dehydration.

Clinitest/Clinistix: Identifies presence of sugar in urine.

Hematest: Examines stools for blood; positive results suggest necrotizing enterocolitis.

Shake Test on Gastric Aspirate: Determines presence or absence of surfactant. (Intermediate results if blood or meconium is present.)

Chest X-Ray (posteroanterior [PA] and lateral) with Air Bronchogram: May have ground-glass appearance (RDS).

Serial Cranial Ultrasonography: Detects presence and severity of intraventricular hemorrhage (IVH).

Lumbar Puncture: May be performed to rule out meningitis.

Maternal GBS Status: Determines potential for meningitis/infections.

NURSING PRIORITIES

1. Promote optimal respiratory functioning.
2. Maintain neutral thermal environment.
3. Prevent or reduce risk of potential complications.
4. Maintain homeostasis.
5. Foster development of healthy family unit.

DISCHARGE GOALS

1. Maintaining physiological and behavioral homeostasis with minimal external support.
2. Weight $4\frac{1}{2}$ lb or greater appropriate to age/condition.
3. Complications prevented/resolving or independently managed.
4. Family identifying and using resources appropriately.
5. Family demonstrates ability to manage infant care.
6. Plan in place to meet needs after discharge.

NURSING DIAGNOSIS:**May Be Related To:****Possibly Evidenced By:****DESIRED OUTCOMES/EVALUATION
CRITERIA—NEONATE WILL:****GAS EXCHANGE, impaired**

Ventilation perfusion imbalances, inadequate surfactant levels, immaturity of pulmonary arteriole musculature, immaturity of CNS and neuromuscular system, airway congestion, anemia, and cold stress

Hypercapnia, hypoxia, tachypnea, cyanosis

Maintain PO_2/PCO_2 levels WNL.

Suffer minimal RDS, with reduced work of breathing and no morbidity.

Be free of bronchopulmonary dysplasia.

ACTIONS/INTERVENTIONS

RATIONALE**Independent**

Review information related to infant's condition, such as length of labor, type of delivery, Apgar score, need for resuscitative measures at delivery, and maternal medications taken during pregnancy or delivery, including betamethasone.

Prolonged labor increases risk of hypoxia, and respiratory depression may follow maternal drug administration or usage. In addition, infants who required resuscitative measures at birth, or those with low Apgar scores, may require more intense interventions to stabilize blood gases and may have suffered CNS injury with damage to the hypothalamus, which controls respiratory functioning. Note: Administration of corticosteroids to mother within 1 wk of delivery fosters the infant's lung maturity and surfactant production.

Note gestational age, weight, and sex.

Neonates born before 30 weeks' gestation and/or weighing less than 1500 g are at higher risk for developing RDS. In addition, males are twice as susceptible as females. Note: The majority of deaths related to RDS occur in infants weighing less than 1500 g.

Assess respiratory status, noting signs of respiratory distress (e.g., tachypnea, nasal flaring, grunting, retractions, rhonchi, or crackles).

Tachypnea indicates respiratory distress, especially when respirations are >75 /min after the first 5 hr of life. Expiratory grunting represents an attempt to maintain alveolar expansion; nasal flaring is a compensatory mechanism to increase diameter of nares and increase oxygen intake. Crackles/rhonchi may indicate pulmonary vasocongestion associated with PDA, hypoxemia, acidemia, or immaturity of muscles in arterioles, which fail to constrict in response to increased oxygen levels.

Apply transcutaneous oxygen monitor or pulse oximeter. Record levels hourly. Change site of probe every 3–4 hr.

Provides constant noninvasive monitoring of oxygen levels. Note: Pulmonary insufficiency usually worsens during the first 24–48 hr, then reaches a plateau.

Suction nares and oropharynx carefully, as needed. Limit time of airway obstruction by catheter to 5–10 sec. Observe transcutaneous oxygen monitor or pulse oximeter before and during suctioning. Provide “bag” ventilation following suctioning.

Maintain thermal neutrality with body temperature at 97.7°F (± 0.5°F). (Refer to ND: Thermoregulation, ineffective.)

Monitor fluid intake and output; weigh infant as indicated by protocol.

Promote rest; minimize stimulation and energy expenditure.

Position infant on abdomen if possible. Provide “rocker” mattress, as indicated.

Observe for evidence and location of cyanosis.

Investigate sudden deterioration in condition associated with cyanosis, diminished or absent breath sounds, shift of point of maximal impact (PMI), bulging of chest wall, hypotension, or cardiac dysrhythmias.

Monitor for signs of necrotizing enterocolitis. (Refer to ND: Constipation/Diarrhea, risk for.)

Collaborative

Monitor laboratory/diagnostic studies, as appropriate:

Graph serial ABGs;

May be necessary to maintain airway patency, especially in infant receiving controlled ventilation. Preterm infant does not develop the coordinated reflex for sucking, swallowing, and breathing until 32–34 weeks' gestation. Cilia may not be fully developed or may be damaged from use of endotracheal tube. Exudate phase associated with RDS at about 48 hr postpartum may contribute to infant's difficulty in handling secretions. Suctioning may stimulate vagus nerve, causing bradycardia, hypoxemia, or bronchospasm. Bag ventilation promotes rapid restoration of oxygen levels.

Cold stress increases infant's oxygen consumption, may promote acidosis, and may further impair surfactant production.

Dehydration impairs ability to clear airways because mucus becomes thickened. Overhydration may contribute to alveolar infiltrates/pulmonary edema. Weight loss and increased urine output may indicate diuretic phase of RDS, usually beginning at 72–96 hr and preceding resolution of condition.

Reduces metabolic rate and oxygen consumption.

Prone position compensates for weak chest and abdominal muscles, decreasing the amount of respiratory effort required to expand chest, thus allowing optimal chest expansion and enhancing inhalation of air. Stimulates respirations and ventricular growth. Positioning infant on abdomen or side reduces risk of aspiration of mucus/regurgitated formula.

Cyanosis is a late sign of low P_{aO_2} and does not appear until there are slightly more than 3 g/dl of reduced Hb in central arterial blood, or 4–6 g/dl in capillary blood, or until oxygen saturation is only 75%–85%, with PO_2 levels of 32–41 mm Hg. Therefore, prompt intervention is crucial.

Sudden or unexplained deterioration of respiratory function may indicate onset of pneumothorax.

Hypoxia may cause shunting of blood to brain, thereby reducing circulation to the intestines, with resultant intestinal cell damage and invasion by gas-forming bacteria.

Hypoxemia, hypercapnia, and acidosis reduce surfactant production. P_{aO_2} levels should be 50–70

Hb/Hct;	mm Hg or higher, P_{aCO_2} levels should be 35–45 mm Hg, and oxygen saturation should be 92%–94%. Decreased iron stores at birth, repeated blood sampling, rapid growth, and hemorrhagic episodes increase the likelihood that preterm infant will be anemic, thereby reducing the oxygen-carrying capacity of the blood. Note: Administration of packed cells may be necessary to replace blood drawn for laboratory studies.
Serial chest x-rays.	Atelectasis, congestion, or air bronchogram suggests developing RDS.
Administer supplemental oxygen, as needed, by mask, hood, endotracheal tube, or mechanical ventilation using constant positive airway pressure (CPAP) and intermittent mandatory ventilation (IMV), or intermittent positive-pressure breathing (IPPB) and positive end-expiratory pressure (PEEP).	Hypoxemia and acidemia may further decrease surfactant production, increase pulmonary vascular resistance and vasoconstriction, and cause ductus arteriosus to remain open. Immaturity of the hypothalamus may necessitate ventilatory assistance to maintain respirations. Use of PEEP may reduce airway collapse, enhancing gas exchange and reducing the need for high levels of oxygen.
Monitor oxygen therapy closely. Record fraction of oxygen in inspired air (F_{IO_2}) every hour. Adjust level and/or limit duration of administration as appropriate.	Amount of oxygen administered, expressed as F_{IO_2} , is determined individually, based on transcutaneous monitoring or capillary blood samples. Prolonged high levels of serum oxygen combined with prolonged high pressures resulting from IPPB and PEEP (barotrauma) may predispose infant to bronchopulmonary dysplasia and retinal damage. Note: The retina has an immature vascular system that is susceptible to damage, leading to vaso-obliteration. New vessels that are developing may rupture, creating retinal and vitreous hemorrhage, leading to formation of scar tissue.
Initiate postural drainage, chest physiotherapy, or lobe vibration every 2 hr, as indicated, noting infant's tolerance of procedure.	Facilitates removal of secretions. Length of time allotted to each lobe is related to infant's tolerance. (Infant usually cannot tolerate a full treatment regimen each time.)
Aspirate gastric contents for shake test.	Provides immediate information about presence of surfactant. Surfactant, which is necessary to promote normal expansion and elasticity of alveoli, is usually not present in sufficient quantities until 32–33 weeks' gestation.
Provide feedings by nasogastric or orogastric tube instead of nipple feedings, as appropriate.	Reduces oxygen needs, promotes rest, conserves energy, and reduces risk of aspiration caused by poorly developed gag reflex.
Administer medications as indicated:	
Sodium bicarbonate;	If measures to increase respiratory rate or improve ventilation are not sufficient to correct acidosis, cautious use of sodium bicarbonate may help return pH to normal range. Note: Adequate circulation (HR >100) must be established.

<p>Surfactant (artificial or exogenous).</p> <p>Assist with procedures as needed:</p> <p>Needle aspiration, thoracentesis, or chest tube insertion;</p> <p>Indirect ophthalmoscopic fundal exam;</p> <p>Laser therapy or cryotherapy.</p>	<p>May be given at birth or after diagnosis of RDS to decrease severity of condition and associated complications. Effect may last up to 72 hr.</p> <p>Reinflates lung enough through removal of trapped air or fluid, reestablishing negative pressure and enhancing gas exchange.</p> <p>Recommended for all infants less than 36 weeks' gestation or under 2000 g and receiving oxygen therapy. Usually done between 4 and 8 wk of age and repeated as indicated to diagnose/monitor progression of retinopathy of prematurity and determine therapy needs.</p> <p>May be useful in limiting adverse effects associated with acute stages of retinopathy of prematurity by obliterating newly forming vessels, reducing traction on the retina and subsequent detachment, and limiting creation of new vessels.</p>
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NURSING DIAGNOSIS:

BREATHING PATTERN, ineffective

May Be Related To:

Immaturity of the respiratory center, limited muscular development, decreased energy/fatigue, drug-related depression, and metabolic imbalances

Possibly Evidenced By:

Dyspnea, tachypnea, periods of apnea, nasal flaring, use of accessory muscles, cyanosis, abnormal ABGs, tachycardia

DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:

Maintain periodic breathing pattern (apneic periods last 5–10 sec, followed by short periods of rapid ventilation), with mucous membranes pink, and heart rate 110–160/respiratory rate 24–60.

ACTIONS/INTERVENTIONS

RATIONALE

Independent

Assess respiratory rate and breathing pattern. Note presence of apnea and changes in heart rate, muscle tone, and skin color associated with procedures or care. Institute continuous respiratory and cardiac monitoring.

Helps in distinguishing normal cyclic periodic breathing pattern from true apneic spells, which are particularly common prior to 30 weeks' gestation.

Suction airway as needed.

Removes mucus obstructing the airway to maximize respiratory effort.

Review maternal history for drugs that might contribute to respiratory depression in the infant.

Magnesium sulfate and narcotics depress respiratory center and CNS activity.

Position infant on abdomen or in supine position with rolled diaper beneath shoulders to produce slight hyperextension.

Such positioning may facilitate respiration and reduce apneic episodes, especially in the presence of hypoxia, metabolic acidosis, or hypercapnia.

Maintain optimal body temperature. (Refer to ND: Thermoregulation, risk for ineffective.)

Provide prompt tactile stimulation (e.g., rub infant's back) if apnea occurs. Note presence of cyanosis, bradycardia, or hypotonia. Encourage parental contact.

Place infant on neowave mattress.

Collaborative

Monitor laboratory studies (e.g., ABGs, serum glucose, electrolytes, cultures, and drug levels) as indicated.

Administer supplemental oxygen, as indicated. (Refer to ND: Gas Exchange, impaired.)

Administer medications, as indicated:

Sodium bicarbonate;

Antibiotics;
Calcium gluconate;
Aminophylline;

Pancuronium bromide (Pavulon);

Glucose solutions.

Even a slight increase or decrease in environmental temperature can lead to apnea.

Stimulates CNS to promote body movement and spontaneous return of respirations. Sometimes, infants experience fewer or no episodes of apnea or bradycardia if parents touch and talk to them.

Movement provides stimulation, which may reduce apneic episodes.

Hypoxia, metabolic acidosis, hypercapnia, hypoglycemia, hypocalcemia, and sepsis may contribute to apneic spells. Drug toxicity, which depresses respiratory function, may occur because of limited excretion and prolonged drug half-life.

Correction of oxygen and carbon dioxide levels may improve respiratory function.

Judicious use may be required to help correct acidosis, especially after hypoxic episodes, because bicarbonate is excreted at lower serum levels and immature kidneys are slower to excrete lactic acid. Treat respiratory infection or sepsis. Hypocalcemia predisposes infant to apnea. May increase activity of respiratory center and lower sensitivity to carbon dioxide, reducing frequency of apnea. Induces skeletal muscle relaxation, which may be necessary if infant is to be mechanically ventilated. Prevent hypoglycemia. (Refer to ND: Nutrition: altered, risk for less than body requirements.)

NURSING DIAGNOSIS:

May Be Related To:

Possibly Evidenced By:

DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:

THERMOREGULATION, ineffective

Immature CNS development (temperature regulation center), decreased ratio of body mass to surface area, decreased subcutaneous fat, limited brown fat stores, an inability to shiver or sweat, limited/inability to flex extremities, poor metabolic reserves (limited glycogen stores), thinner skin, muted response to hypothermia, and frequent medical/nursing manipulations and interventions

Fluctuation of body temperature below/above normal range

Tachypnea/apnea, generalized cyanosis, bradycardia, lethargy (cold stress)

Tachycardia, flushed color, lethargy, apnea (hyperthermia)

Maintain skin/axillary temperature within 97.7°F–99.1°F (36.5°C–37.3°C).

Be free of signs of cold stress.

ACTIONS/INTERVENTIONS

RATIONALE

Independent

Assess temperature frequently. Check rectal temperature initially; thereafter, check axillary temperature or use thermostat probe with open bed and radiant warmer. Repeat every 15 min during rewarming.

Ascertain medications mother received during prenatal and intrapartal periods. Note presence of fetal distress or hypoxia.

Place infant in warmer, Isolette, incubator, open bed with radiant warmer, or open crib with appropriate clothing for larger or older infants. Use heating pad under infant as necessary, in conjunction with Isolette or open bed.

Use heat lamps during procedures. Warm objects coming in contact with infant's body, such as stethoscopes, linens, and clothing. Use blanket/diaper to pad cold surfaces such as scale, examination table, x-ray plate, and hands. Surround infant with warmed receiving blankets. Cover radiant warmers with plastic wrap, if appropriate. Warm blood products, if administered.

Reduce exposure to drafts; avoid unnecessary opening of portholes in Isolette.

Change clothing or bed linens when wet. Keep infant's head covered.

Note environmental temperature/monitor temperature-regulating system, radiant warmers, or incubators. (Maintain upper limit at 98.6°F [37°C], depending on infant's size or age.)

Maintain relative humidity of 50%–80%. Warm humidified oxygen to 88°F–93°F (31°C–34°C).

Hypothermia predisposes infant to cold stress, utilization of nonrenewable brown fat stores if present, and reduced sensitivity to increased levels of carbon dioxide (hypercapnia) or decreased oxygen levels (hypoxia). Note: Too rapid rewarming is associated with apneic states. This causes further respiratory depression instead of increased respiratory rate, leading to apnea and reduced oxygen uptake.

Fetal hypoxia or maternal use of meperidine (Demerol) alters fetal metabolism of brown fat, often causing significant drop in neonate's temperature. Magnesium sulfate can cause vasodilation and interfere with infant's ability to retain heat.

Maintains thermoneutral environment, helps prevent cold stress.

Decreases loss of heat to the cooler environment of the room/treatment surfaces, or by infusion of chilled blood.

Reduces heat losses due to convection/conduction. Limits heat losses from radiation.

Decreases evaporative losses.

Hyperthermia with resultant increases in metabolic rate, oxygen and glucose needs, and insensible water losses can occur when controlled environmental temperatures are too high. Conversely, a decrease in the environmental temperature of 3.6°F (2°C) also results in significant increase of oxygen consumption and glucose needs.

Prevents excessive evaporation, reducing insensible fluid losses.

Note presence of tachypnea or apnea; generalized cyanosis, acrocyanosis, or mottled skin; bradycardia, poor cry, or lethargy. Evaluate degree and location of jaundice. (Refer to CP: Newborn: Hyperbilirubinemia.)

Provide gradual warming for infant with cold stress.

Measure urine output and specific gravity.

Monitor serial weight gain. If weight gain is inadequate, increase environmental temperature as indicated.

Note frequency and amount of food intake. Monitor Dextrostix. Assess infant for vomiting, abdominal distension, or apathy.

Assess infant's progressive ability to adapt to lowered temperatures in incubator or Isolette, or to room temperature, while demonstrating appropriate weight gains.

Monitor infant's temperature when out of warmed environment. Provide parents with information about thermoregulation.

Note development of tachycardia, flushed color, diaphoresis, lethargy, apnea, coma, or seizure activity.

Evaluate external sources of heat (e.g., phototherapy, heat lamp, or sunlight), limit clothing, and provide tepid sponge bath, as appropriate. Verify proper positioning of temperature probe, if used.

These signs indicate cold stress, which increases oxygen and caloric consumption and predisposes infant to acidosis associated with anaerobic metabolism. Hypothermia increases risk of kernicterus, as fatty acids released with brown fat metabolism compete with bilirubin for binding sites on albumin. Note: Skin color may be bright red peripherally, with cyanosis noted centrally as a result of failure of dissociation of oxyhemoglobin.

Rapid increase in body temperature may cause excessive oxygen consumption and apnea.

Reduced urine output and increased specific gravity of urine are related to reduced kidney perfusion during periods of cold stress. Note: Use of radiant heat for warming, for longer than a few hours, potentiates water loss decreasing circulating volume and renal perfusion.

Inadequate weight gain despite sufficient caloric intake may indicate that calories are being used to maintain body temperature, necessitating increased environmental temperature. Note: Excessive warming also increases metabolic demands as infant attempts to cool down.

Poor feeding is common in infants with thermal instability; in addition, cold stress increases consumption of metabolic reserves. Dextrostix levels <45 mg/dl indicate hypoglycemia, necessitating prompt intervention.

Bassinet may be used when infant can maintain stable body temperature of 97.7°F (36.5°C) in room air and still gain weight.

Out-of-bed contact, especially with parents, may need to be brief, if allowed at all, to prevent cold stress. Note: Hyperthermia can also occur when infant is held by parents.

These signs of hyperthermia (body temperature 99°F [37.2°C]) can progress to brain damage, if untreated.

These measures are generally successful in correcting hyperthermia. Note: If hyperthermia persists after assuring proper position and functioning of temperature probe, the possibility of a hypermetabolic state such as sepsis or narcotic withdrawal should be considered.

Collaborative

Monitor pulse oximetry, laboratory studies, as indicated (e.g., ABGs, serum glucose, electrolytes, and bilirubin levels). (Refer to ND: Gas Exchange, impaired.)

Administer D₁₀W and volume expanders IV, as needed.

Provide supplemental oxygen as indicated.

Administer medications, as indicated:

Phenobarbital;

Sodium bicarbonate.

Cold stress increases the needs for glucose and oxygen and may result in acid-base problems if infant resorts to anaerobic metabolism when sufficient oxygen levels are not available. Elevated indirect bilirubin levels may occur because of the release of fatty acids from brown fat metabolism, with fatty acids competing with bilirubin for binding sites on albumin. Metabolic acidosis may also occur with hyperthermia.

Administration of dextrose may be necessary to correct hypoglycemia. Hypotension caused by peripheral vasodilation may require treatment in heat-stressed infant. Hyperthermia may cause a threefold to fourfold increase in dehydration.

If oxygen is not readily available to meet increased metabolic needs associated with efforts to increase body temperature, the infant will use anaerobic metabolism, resulting in acidosis caused by lactic acid buildup. Hypothermia reduces the preterm infant's response to hypoxia and hypercapnia, which causes further respiratory depression instead of increased respiratory rate, leading to apnea and reduced oxygen uptake. Hyperthermia caused by too rapid/excessive warming is associated with apneic states, increased insensible water losses, and increased metabolic rates with increased demands for oxygen and glucose.

Helps prevent seizures associated with CNS irritation caused by hyperthermia.

Corrects acidosis, which may occur with both hypothermia and hyperthermia.

NURSING DIAGNOSIS:

Risk Factors May Include:

Possibly Evidenced By:

DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:

FLUID VOLUME, risk for deficit

Extremes of age and weight (premature, under 2500 g), excessive fluid losses (thin skin, lack of insulating fat, increased environmental temperature, immature kidney/failure to concentrate urine)

[Not applicable; presence of signs/symptoms establishes an *actual* diagnosis]

Be free of signs of dehydration or glycosuria with fluid intake approximating output and pH, Hct, and urine specific gravity WNL.

Display weight gain of 20–30 g/day.

ACTIONS/INTERVENTIONS

RATIONALE

Independent

Obtain daily serial weights using same scale at same time of day.

Weight is the most sensitive indicator of fluid balance. Weight loss should not exceed 15% of total body weight or 1%–2% of total body weight per day. Inadequate weight gain may be related to water imbalance or inadequate caloric intake.

Calculate fluid balance (total intake minus total output) each shift and cumulative balance each 24-hr period. Maintain hourly records of infusing IV fluids/feedings. Determine output through measuring urine from collecting bag or through weighing/counting diapers. Also record amount of blood taken for laboratory testing.

Output should be 1–3 ml/kg/hr, while fluid therapy needs are approximately 80–100 ml/kg/day on the 1st day of life, increasing to 120–140 ml/kg/day by the 3rd day after delivery. Lower gestational age has a negative impact on the glomerular filtration rate (GFR) and is further limited by conditions that impair renal blood flow or oxygen content (e.g., dehydration, respiratory distress), often resulting in oliguria/anuria. Positive fluid balance and corresponding weight gain in excess of 20–30 g/day suggest fluid excess.

Measure urine specific gravity after each voiding, or every 2–4 hr, by aspirating urine from diaper if infant cannot tolerate adhesive or urine collecting bag.

Although renal immaturity and inability to concentrate urine usually result in low specific gravity in the preterm infant (normal range is 1.006–1.013), urine specific gravity may vary, providing an indication of the level of hydration. Low levels indicate excessive fluid volume; levels >1.013 indicate insufficient fluid intake and dehydration.

Test urine with Dextrostix per protocol.

Even in cases of hypoglycemia, glycosuria occurs as immature kidneys begin excreting glucose, which may lead to osmotic diuresis, increasing risk of dehydration.

Minimize insensible fluid losses through use of clothing, thermoneutral temperatures, and warm or humidified oxygen.

Preterm infant loses large amounts of water through skin, because blood vessels are close to surface and insulating fat levels are decreased or absent. Phototherapy or use of radiant warmer may increase insensible losses by 50%, necessitating increased intake to as much as 200 ml/kg/day. Note: Infants weighing <1500 g (3 lb 5 oz) are most susceptible to insensible fluid losses.

Monitor BP, pulse, and mean arterial pressure (MAP).

A loss of 25% of blood volume results in shock, with MAP of less than 25 mm Hg indicating hypotension. Note: BP is related to weight, that is, the smaller the baby, the lower the MAP.

Evaluate skin turgor, mucous membranes, and status of anterior fontanel.

Fluid reserves are limited in the preterm infant. Minimal fluid losses/shifts can quickly lead to dehydration, as noted by poor skin turgor, dry mucous membranes, and depressed (sunken) fontanels.

Note lethargy, high-pitched cry, abdominal distension, increased apnea, twitching, hypotonia, or seizure activity.

These signs reflect hypocalcemia, which is most likely to occur during the first 10 days of life.

Assess IV site every hour. Note edema or failure of fluid infusion. Do not check needle position by lowering fluid below needle level.

Monitor infusion rate closely and use pumps to administer fluids.

Institute measures to prevent infection. (Refer to ND: Infection, risk for.)

Collaborative

Monitor laboratory studies as indicated:

Hct;

Serum calcium and serum magnesium;

Serum potassium;

Blood urea nitrogen (BUN), creatinine, and uric acid levels.

Administer parenteral infusions in amounts 180 ml/kg, especially in PDA, bronchopulmonary dysplasia (BPD), or necrotizing enterocolitis (NEC).

Administer potassium chloride, 10% calcium gluconate, and 50% magnesium sulfate, as indicated. Monitor infant for potential bradycardia via cardiac monitor; observe infusion site for signs of irritation or edema.

Administer blood transfusions.

Administer dopamine hydrochloride, as indicated.

Swelling may indicate that infiltration of fluid is occurring or that tape is too tight. Back-up of blood caused by lowering fluid may clog needle.

Verifies accuracy of infusion rate to meet individual needs of infant and to prevent excess intake. Note: Limited ability of kidneys to excrete excess fluid increases risks of overhydration with cardiac or respiratory involvement as noted by presence of crackles, rhonchi, dyspnea, tachypnea, and/or peripheral edema.

Infection places increased demands on an already-compromised renal system.

Dehydration increases Hct level beyond the normal reading of 45%–53%. Removal of blood for testing causes reduction in Hb/Hct levels.

Preterm infant is susceptible to hypocalcemia (calcium level <7 mg/dl) because of low stores, depressed parathyroid stimulation, and stress caused by hypoxia, sepsis, or hypoglycemia.

Hypomagnesemia often accompanies hypocalcemia. Hypokalemia may occur because of losses through nasogastric tube, diarrhea, or vomiting. Excessive levels of potassium (hyperkalemia) can result from replacement errors, potassium shifts from intracellular to extracellular compartments, acidosis, or renal failure.

Assesses adequacy of kidney function.

Fluid replacement expands blood volume; helps reverse vasoconstriction associated with hypoxia, acidosis, and right-to-left shunting through PDA; and has been helpful in reducing complications of NEC and BPD.

Correction of electrolyte imbalances is necessary to maintain or achieve homeostasis. Calcium administered through umbilical venous catheter may cause liver necrosis; if administered through umbilical artery, it may contribute to NEC. Early recognition and prompt intervention may limit untoward effects of infiltration of medication, such as sloughing, calcification, and necrosis. Note: Calcium replacement is ineffective in presence of magnesium deficit.

May be necessary to maintain optimal Hb/Hct levels and replace blood losses.

May be used to counteract drops in blood pressure, especially when related to administration of pancuronium (Pavulon).

NURSING DIAGNOSIS:**Risk Factors May Include:****Possibly Evidenced By:****DESIRED OUTCOMES/EVALUATION
CRITERIA—NEONATE WILL:****NUTRITION: altered, risk for less than body requirements**

Immaturity of enzymatic production; reduced production of hydrochloric acid (reduces absorption of fat and fat-soluble vitamins); immaturity of the cardiac sphincter; lax abdominal muscles; small stomach capacity; weak, absent, or unsynchronized reflexes associated with feeding; inadequate levels of stored nutrients

[Not applicable; presence of signs/symptoms establishes an *actual* diagnosis]

Maintain growth and weight gain in a normal curve, with steady weight gain of at least 20–30 g/day.

Maintain serum glucose WNL and positive nitrogen balance.

ACTIONS/INTERVENTIONS

RATIONALE**Independent**

Assess maturity of reflexes associated with feeding (ie., sucking, swallowing, gag, and coughing).

Auscultate for presence of bowel sounds. Assess physical state and respiratory status.

Initiate intermittent or tube feedings, as indicated.

Assess infant for proper placement of feeding tube; use appropriate clamping procedures to prevent entry of air into stomach.

Instill breast milk/formula slowly over 20 min at a rate of 1 ml/min.

Assess energy level and expenditure, degree of fatigability, respiratory rate, and length of time needed for feedings.

Determines appropriate feeding method for infant.

The first feeding in a stable infant with peristalsis can begin 3–6 hr following birth. If respiratory distress is present, parenteral fluids are indicated, and oral fluids should be withheld.

Gavage feedings may be necessary to provide adequate nutrition in infant who has a poorly coordinated suck-and-swallow reflex or who becomes fatigued during oral feedings. Note: Transition to oral feeding is significantly delayed if apneic episodes are experienced.

Improper placement of tube in trachea can compromise respiratory function. When 1 ml or less is aspirated from the stomach, this sum should be subtracted from the feeding and reinstalled in tube. When more than 2 ml is aspirated, feeding schedule may need to be altered.

Too-rapid entry of feeding into stomach may cause rapid rebound response with regurgitation, increased risk of aspiration, and abdominal distension, all of which compromise respiratory status.

Excessive expenditure of energy during feedings reduces calories available for normal growth and development. Total or intermittent use of tube feedings may be necessary to reduce fatigue. Oral feedings are not appropriate if respiratory rate is >70/min.

Minimize social interaction stimuli other than those directly related to feeding if infant displays signs of sensory overload. Reduce stimuli prior to feedings.

Provide pacifier during tube feedings. (If baby is going to be breastfed eventually, mother may rub pacifier on breast, moistening it with a dab of breast milk to scent it. She may also hold the baby during feedings.)

Position infant on right side or prone, with head of mattress elevated 30 degrees.

Postpone postural drainage for at least 1 hr after feeding.

Note presence of diarrhea, vomiting, regurgitation, excessive gastric residual, or positive result of guaiac test. (Refer to ND: Constipation/Diarrhea, risk for.)

Monitor Dextrostix levels and urine Clinitest per protocol.

Maintain thermoneutral environment and appropriate oxygenation of tissues. Disturb infant as little as possible.

Monitor infant for local or systemic reactions to parenteral feeding (e.g., increased temperature, dyspnea, vomiting, cyanosis, or blood vessel thrombosis).

Record growth by plotting daily weight and weekly measurements of body length and head circumference.

Encourage/support mother's efforts to pump and collect own breast milk. Identify additional resources.

Excessive stimulation may interfere with feeding, so that the necessary stimuli must be provided between feedings. Overstimulation prior to feedings may negatively affect sucking and GI motility and may cause vomiting or regurgitation.

Accommodates infant's need for sucking. Provides oral satisfaction so that infant associates self-gratification in sucking with comfort of filling stomach.

Facilitates gastric emptying and prevents reflux.

Allows optimal ingestion and absorption of feeding; helps prevent regurgitation associated with increased handling.

Indicates impaired gastric function. Gastric residual greater than 2 ml (aspirated via gavage tube before feedings) suggests a need to reduce amount of feedings and may indicate poor absorption or NEC.

Because the immature liver does not store or release glycogen well, risk of hypoglycemia is increased. Hypoglycemia can be diagnosed by a Dextrostix level <45 mg/dl. Note: Infant may be asymptomatic, even when Dextrostix results are as low as 20 mg/dl.

Cold stress, hypoxia, and excessive handling increase infant's metabolic rate and caloric needs, possibly sacrificing growth and weight gains.

About 50% of complications associated with total parenteral nutrition (TPN) are caused by sepsis, usually *Candida* septicemia. Other complications include fluid overload and obstruction or dislodgement of catheter.

Growth and weight gain are criteria for establishing caloric requirements, for adjusting formula, and for determining frequency of feedings. Growth spurts increase caloric requirements and protein needs.

Breast milk is easy to digest (reduces potential for NEC), and research suggests it boosts infant immunities and is associated with reduced occurrence of allergic food reactions, fewer ear infections, lower rate of childhood cancer. Note: There are seven breast-milk banks that can be contacted through the Human Milk Banking Association of North America (Fax 1-860-232-0113) to obtain supplements for infant, educational material, or to refer mother as potential donor if infant is not able to use breast milk presently and mother wishes to maintain lactation.

Collaborative

Start feedings of sterile water, glucose, and breast milk or formula, as appropriate.

Feed as frequently as indicated based on infant's weight and estimated stomach capacity.

Use concentrated formula to provide 120–150 cal/kg/day or more, with 3–4 g/kg/day of protein. Add human milk fortifiers (HMF) to breast milk for gavage feeding, as needed.

Administer supplemental vitamins and minerals, especially vitamins A, C, D, and E, and iron, as indicated.

Maintain patency; assist with change of indwelling feeding tube (transpyloric, nasojunal, nasoduodenal tubes).

Administer TPN feedings via infusion pump using indwelling catheter into vena cava or peripheral line. Infuse fat emulsions (Intralipid) through peripheral line.

Monitor laboratory studies, e.g., serum glucose, electrolytes, total protein, prealbumin.

Early feedings prevent depletion of reserves.

Infants <1250 g (2 lb 12 oz) are usually fed every 2 hr; infants between 1500 and 1800 g (3 lb 8 oz to 4 lb) are fed every 3 hr.

Calorie intake must be sufficient to prevent catabolism. Concentrated formulas/fortified breast milk supply more calories in less volume, which is necessary because of reduced gastric capacity and emptying, and the danger of stressing immature kidneys. Note: Sick infants may require half-strength formula initially with volume/concentration advanced over 1–10 days, as infant tolerates.

Replaces low nutrient stores to promote adequate nutrition and reduce risk of infection. Vitamin C may reduce susceptibility to hemolytic anemia and alleviate BPD and retrolental fibroplasia. Vitamin D facilitates retention of calcium and increased bone density. Vitamin E helps prevent RBC hemolysis and corrects deficiencies associated with use of iron-fortified formulas and diet high in polyunsaturated fats.

Provides continuous infusion of formula in very small preterm infants who meet specific criteria; e.g., tachypnea, chronic lung disease, respirator dependence, recurrent aspiration, or repeated elevated gastric residuals with other feeding approaches. Note: Potential risks accompanying use of these indwelling tubes (e.g., gastric/intestinal perforation) must be weighed against benefits.

TPN infusion of protein hydrolysate, glucose, electrolytes, minerals, and vitamins may be necessary for infant with chronic diarrhea; malabsorption syndrome; surgical repair of GI anomalies, obstruction, or NEC; or extreme prematurity. Intralipid infusion provides essential fatty acids to infant receiving TPN. Note: Benefits of using Intralipid must be weighed against possible risk of fat accumulation in the lungs.

Measures necessity for and effectiveness of TPN administration.

NURSING DIAGNOSIS:

Risk Factors May Include:

INFANT BEHAVIOR, risk for disorganized

Prematurity (immaturity of CNS system, hypoxia), environmental overstimulation, invasive/painful procedures and therapies, separation from parent(s)

Possibly Evidenced By:

[Not applicable; presence of signs/symptoms establishes an *actual* diagnosis]

DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:

Exhibit organized behaviors that allow the achievement of optimal potential for growth and development as evidenced by modulation of physiological, motor, state, and attentional-interactive functioning.

ACTIONS/INTERVENTIONS

RATIONALE

Independent

Determine infant's chronological and developmental age; note length of gestation. Assess individual behaviors using appropriate tool (e.g., assessment of Preterm Infant Behavior Scale).

Useful in choosing interventions to meet specific needs of infant and reduce detrimental environmental stimuli. The APIB scale measures five areas of developmental behaviors, autonomic, motor control, state differentiation, attention maintenance and social interaction, self-regulation.

Provide a primary nurse for each shift. (Assign one primary nurse per baby to provide information to parents.)

Promotes continuity of care and follow-through with developmental program. Enhances recognition of subtle changes in infant's behavior and condition. Consistent and predictable care enables infant to develop trust in caregiver, environment, and self and facilitates coping. Multiple caretakers confuse the infant, increase distress during feeding, cause irritability, and upset usual attention. Note: Having one nurse responsible for giving information helps to reduce instances of parents' being uninformed or misunderstanding.

Create womblike atmosphere whenever possible by covering Isolette for extended periods, playing recorded placental or maternal heart sounds, and surrounding infant with rolled blankets or manufactured "nesting" device.

Providing dark, quiet environment reduces stress, promotes adaptation, and has been found to correlate positively with weight gain, early weaning from oxygen or ventilators, and earlier discharge. Recorded maternal heart sounds tend to reduce or eliminate infant's perception of noise from the Isolette. Nesting position facilitates hand-to-mouth behavior for self-consoling.

Cover top of radiant warmer with plastic wrap, if appropriate.

Reduces environmental stress from air currents, which startle the infant as personnel move past the warmer.

Reposition infant using rolled diapers placed at the back and front, if infant is in lateral position, or at sides, if infant can tolerate a prone position.

Neuromuscular immaturity can impair infant's ability to seek a position of comfort or to relieve stress through repositioning. Rolled diapers surrounding baby provide a sense of security and have a calming effect. Prone position promotes sleep and optimal relaxation.

Change infant's position periodically (especially if infant has nasal CPAP or endotracheal tube).

Provides kinesthetic stimulation. Neuromuscularly immature infant is unable to reposition self or move about in the Isolette.

Use containment measures when handling/moving infant and avoid sudden postural changes.

Provide gentle stroking and caressing, especially at feeding time, introducing textures (tongue blade, washcloth), as appropriate.

Provide pacifier/enable hand-to-mouth activity after feedings.

Talk or quietly sing to infant, call infant by name, play soft music in nursery, or play a tape of parent(s) voice.

Interact with infant at face level (en face interaction), allowing eye contact. Provide colorful linens and changing designs or pictures on side of incubator, and encourage parents to make mobiles of construction paper and string once infant reaches postconception age of 40 wk.

Hold infant in ventral position (e.g., baby held to shoulder to burp) when possible, uncover eyes periodically if infant is receiving phototherapy.

Encourage periodic skin-to-skin contact, as appropriate (i.e., mother holds diaper-clad infant upright between her bare breasts).

Assess infant for physiological signs/behavioral cues indicating stress (e.g., apnea, color change, bradycardia, sneezing, yawning), irritability or apathy, change in muscle tension, disorganized motor activity and sleep-wake cycles, measured change in sensory acuity), noting causative factors and eliminating or reducing stressors when possible.

Plan activities to allow periods of sleep. Prevent loud noises, limit conversation near bedside, respond to alarms quickly; and reduce light intermittently by covering incubator with towel, shielding infant's eyes, or lowering room lighting.

Weigh infant daily. Note feeding frequency and intake and frequency of stools.

Using hands to hold infant's arms and legs in flexed position close to midline of body helps stabilize infant's motor and physiological subsystems.

Provides tactile stimulation, which is associated with weight gains and is especially critical when infant is 40 weeks after conception or more. Note: Slow, sure movements provide stimulation while reducing motor disorganization.

Nonnutritive sucking provides calming effect, decreases body movement, enhances sleep, and increases weight gain.

Provides auditory stimulation. Playing tape of parents' voices may enhance infant's recognition of them.

Visual stimulation is best provided by objects placed 7–9 in from face. Black and white faces and a checkerboard design promote visual attention. Infant may become habituated to stimuli that do not change. Involving parents in creating stimuli for infant helps ensure that the process continues after discharge.

Enhances visual stimulation/orientation.

Research suggest kangaroo-care technique not only provides closeness, strengthening mother-infant attachment, but also reduces periodic breathing and promotes deep sleep.

Disorganization of the autonomic system is often associated with prematurity, resulting in some infants lacking the developmental capability of dealing with more than one sensory input at a time. Familiarity with the infant's usual behavioral responses and personality traits is necessary for identifying subtle changes that indicate stress and the need for intervention to modify causative factors.

Helps protect infant from overstimulation, which can negatively affect growth and physiological status; promotes infant's sense of the day-night cycle. Note: Research reveals cycled lighting lowers infant's heart rate and motor activity, promoting longer periods of quiet inactivity resembling quiet sleep, and conserving energy.

Vagal stimulation produced by appropriate tactile and kinesthetic stimulation promotes weight gain, increases peristalsis and expulsion of waste products, reduces gastric retention, and increases feeding activity.

Note risk factors of birth weight, coexisting conditions, and associated therapies.

Provide parents with information about infant's behavioral cues and responses to stressors. (Refer to CP: The Parents of a Child With Special Needs; ND: Parent/Infant Attachment, risk for altered.)

Collaborative

Provide rocking or water beds, if indicated.

Retinopathy of prematurity is no longer believed to be exclusively the result of prolonged/high levels of oxygen therapy. Immaturity, presence of some congenital anomalies, and various therapies place the infant at risk. Note: Infants with birth weight <1000 g have an 88% incidence of retinopathy.

Parents must gain skill in recognizing subtle infant cues indicating stress so that they can effectively intervene to minimize stress and facilitate the infant's positive adaptation to extrauterine life. Awareness that visually impaired infant may not show recognition or feelings by changes in facial expression encourages parent(s) to observe body language/other cues reflecting self-expression, thereby strengthening the attachment bond.

Kinesthetic stimulation in preterm infants of 34 weeks' gestation has been shown to improve sleep, decrease heart rate, reduce frequency of state changes, and increase head size and biparietal diameter.

NURSING DIAGNOSIS:

Risk Factors May Include:

Possibly Evidenced By:

DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:

INJURY, risk for CNS damage

Tissue hypoxia, altered clotting factors, metabolic imbalances (hypoglycemia, electrolyte shifts, elevated bilirubin)

[Not applicable; presence of signs/symptoms establishes an *actual* diagnosis]

Be free of seizures and signs of CNS impairment.

Maintain homeostasis, as evidenced by ABGs; serum glucose, electrolytes, and bilirubin levels WNL.

ACTIONS/INTERVENTIONS

RATIONALE

Independent

Assess respiratory effort. Note presence of pallor or cyanosis.

Respiratory distress and hypoxia affect cerebral function and may damage or weaken walls of cerebral blood vessels, increasing risk of rupture. If untreated, hypoxia may result in permanent damage. (Refer to ND: Gas Exchange, impaired.)

Monitor Dextrostix levels, and observe infant for behaviors indicating hypocalcemia or hypoglycemia (such as convulsions, twitching, myoclonic jerks, or eye rolling.) (Refer to ND: Nutrition: altered, risk for less than body requirements.)

Observe infant for alterations in CNS function, as manifested by behavior changes, lethargy, hypotonia, bulging or tense fontanel, eye rolling, or seizure activity. Investigate deteriorating status indicated by high-pitched cry, labored respirations, and cyanosis, followed by apnea, flaccid quadriparesis, unresponsiveness, hypotension, tonic posturing, and areflexia.

Measure head circumference, as indicated.

Assess skin color, noting evidence of increasing jaundice associated with behavior changes such as lethargy, hyperreflexia, convulsions, and opisthotonos. (Refer to CP: Newborn: Hyperbilirubinemia.)

Collaborative

Monitor laboratory studies, as indicated:

Hb/Hct; ABGs;

Bilirubin levels.

Provide supplemental oxygen.

Assist with diagnostic or therapeutic procedures, as indicated:

Computerized tomography (CT) scanning, cranial ultrasonography;

Lumbar puncture;

Because of its demands for glucose, the brain may suffer irreparable damage when serum glucose levels are lower than 30–40 mg/dl. Hypocalcemia (serum calcium levels < 7 mg/dl) often accompanies hypoglycemia and may result in apnea and seizures.

Birth trauma, fragile capillaries, and impaired coagulation processes place preterm infant at risk for IVH, especially those infants weighing 1500 g or under 34 weeks' gestation. Tense or bulging anterior fontanel may be first sign of IVH, hemorrhagic shock, or increased intracranial pressure (IICP), which can easily lead to death from circulatory collapse. Infant of 32 weeks' gestation may become lethargic or hypotonic and may manifest uncontrolled "roving-eye" movements and lack of visual tracking. Note: Clinical signs of developing IVH may be absent, very subtle, or sudden and life-threatening.

Helps detect possible IICP or hydrocephalus, which may be a sequela of subdural hemorrhage. Only 35%–50% of infants with hydrocephalus develop normally.

Preterm infant is more susceptible to kernicterus at lower serum bilirubin levels than full-term infant because of increased levels of unconjugated circulating bilirubin crossing the blood-brain barrier.

Lowered Hb levels or anemia reduce oxygen-carrying capacity, increasing risk of permanent CNS damage associated with hypoxemia. Abrupt fall in Hct may be first indicator of IVH. Note: Pulse oximetry may be used to monitor O₂ level routinely with periodic ABGs to monitor other parameters of acid/base balance.

Rapidly rising levels may result in kernicterus if not treated promptly.

Hypoxemia increases the risk of impairment or permanent CNS damage.

Identifies presence/extent of hemorrhage, which is useful in predicting likelihood of long-term complications and in choice of treatment. A bloody CSF specimen confirms IVH. Some hospitals carry out serial daily lumbar punctures to reduce ICP and prevent deleterious effects of hydrocephalus.

Exchange transfusion;	Elevated or rapidly rising bilirubin levels indicate the need for a double-volume exchange transfusion with O-negative blood to remove bilirubin and to prevent further hemolysis of RBCs.
Ventriculopuncture or taps;	May be used to remove excess blood from the ventricles, although studies have not indicated any corresponding improvement in outcome.
Placement of ventriculoperitoneal shunt.	Progressive ventricular dilation unresponsive to other measures may require surgical intervention to correct or prevent hydrocephalus.
Administer medications, as indicated:	
Calcium, magnesium, sodium bicarbonate, and/or glucose;	Correction of imbalances helps prevent neonatal seizure activity, which may occur in response to transient metabolic imbalances.
Phenobarbital;	Helps to control acute convulsions and status epilepticus in newborn.
Phenytoin or diazepam (Valium);	May be used if other antiepileptic drugs are not successful in controlling seizure activity. Note: Dosage should be based on blood levels.
Furosemide (Lasix), acetazolamide (Diamox), or steroids;	Helps reduce intracranial pressure and treats secondary effects of bleeding.
Vitamin E;	Antioxidant property protects RBC membranes against hemolysis.
Indomethacin (Indacin).	IV administration may correct hemodynamic imbalances through closure of PDA.
Assist with fluid replacement or maintain restrictions, as appropriate.	Cerebral perfusion depends on adequate circulatory volume. Note: Fluids may need to be restricted in cases of hypertonicity, CNS damage with bleeding, or cerebral palsy.
Perform/obtain results of car-seat test prior to discharge.	Car-seat test is performed by nursing staff or occupational therapist (OT) on infant <2500 g or 37 weeks' gestation. Infant is placed in car seat for 2 hr. During that time, infant is monitored for possible apnea, bradycardia, or oxygen desaturation. Infant is surrounded by precut foam forms or rolled receiving blankets to keep the head in a neutral, upright position.

NURSING DIAGNOSIS:

Risk Factors May Include:

Possibly Evidenced By:

DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:

INFECTION, risk for

Immature immune response, fragile skin, trauma-tized tissues, invasive procedures, environmental exposure (PROM, transplacental exposure)

[Not applicable; presence of signs/symptoms establishes an *actual* diagnosis]

Be free of signs of infection, for example, temperature instability, lethargy, respiratory distress, purulent drainage/secretions.

Maintain negative serum, CSF, urine, and nasopharyngeal cultures with CBC, platelets, and pH level WNL.

ACTIONS/INTERVENTIONS

RATIONALE

Independent

Review record of delivery to determine whether resuscitative measures were required, length of rupture of membranes, and presence of chorioamnionitis. Note maternal GBS status and/or other sexually transmitted diseases (STDs) present.

Determine gestational age of fetus, using Dubowitz criteria.

Promote meticulous hand washing by staff, parents, and ancillary workers per protocol. Use antiseptic before assisting with surgical or invasive procedure.

Monitor staff and visitors for presence of skin lesions, draining wounds, acute respiratory infections, fever, gastroenteritis, active herpes simplex (oral, genital, or paronychia), and herpes zoster.

Provide adequate space between infants or between Isolettes or individual units. Use separate isolation rooms and isolation technique, as indicated.

Assess infant for signs of infection, such as temperature instability (hypothermia or hyperthermia), lethargy or behavior changes, respiratory distress (apnea, cyanosis, or tachypnea), jaundice, petechiae, nasal congestion, or drainage from eyes or umbilicus.

Establish a cohort of infants, when possible, and ensure that same nurse cares for the infants grouped together.

Infant who has been resuscitated and has required invasive interventions is especially prone to introduction of pathogens and infection. Maternal factors such as PROM with preterm labor and delivery possibly caused by an infectious process predispose the preterm infant to ascending infection. Early-onset sepsis (occurring within the first 2 days of life) is affected by host defenses and duration of antepartal rupture of membranes. Transplacentally acquired infections (which affect two-thirds of all infected infants) are also a threat.

Delivery prior to 28–30 weeks' gestation increases infant's susceptibility to infection, because of reduced ability of WBCs to destroy bacteria, reduced transfer of IgG (IgG is transported across the placenta primarily in the third trimester), lack of IgA if infant does not receive breast milk, and poorly keratinized skin with ineffective barrier qualities. Note: Infant who suffers from intrauterine growth retardation/restriction is at greater risk for infection.

Hand washing is the most important practice for preventing cross-contamination and controlling infection in the nursery.

Transmission of disease to neonate by employees or visitors can occur directly or indirectly.

Providing 4–6 ft of space between infants helps prevent spread of droplet or airborne infections.

Useful in the diagnosis of infection; body temperature alone is an unreliable means of assessing infection in the preterm infant with impaired inflammatory response and WBC mobilization.

Infants who are born within the same time frame (usually 24–48 hr), or who are colonized/infected with the same pathogen, may be grouped together until discharge. Such grouping is an important measure in infection control in that it limits the amount of contact of one infant with other susceptible infants or personnel.

Perform care of umbilical cord according to hospital protocol.

Prepare site(s) of invasive procedures with alcohol (70%), tincture of iodine, or iodophor. Monitor IV infusion site(s) and sites of invasive monitoring lines per protocol.

Use aseptic technique during suctioning. Date the opened solution for humidification, irrigation, or nebulization, and discard after 24 hr. Ensure routine cleaning or replacement of respiratory equipment.

Treat arterial line, stopcocks, and catheter as sterile fields; draw all blood specimens at the same time, when possible.

Monitor infant for signs of late-onset disease or infection.

Observe for signs of shock or DIC, such as bradycardia, decreasing BP, temperature instability, listlessness, edema, or erythema of abdominal wall.

Provide breast milk for feeding, if available.

Collaborative

Obtain specimens as indicated (e.g., urine through suprapubic aspiration, blood, CSF, visible skin lesions, nasopharynx, or sputum, if infant is intubated).

Monitor laboratory studies, as indicated:

Serial WBC count and differential;

Platelet count;

Serum glucose and pH levels.

Administer antibiotics IV based on results of culture and sensitivity.

Local application of alcohol, triple dye, or various antimicrobials helps prevent colonization.

Reduces incidence of possible phlebitis or bacteremia.

Reduces opportunity for introduction of bacteria that could result in respiratory infection.

Helps prevent bacteremia associated with arterial line and its direct access to blood and deep tissues.

Late-onset disease may occur as early as the 5th day, but usually occurs after the 1st wk of life. Signs of late-onset infection are likely to be caused by bacteria acquired from the maternal genital tract, or from human contact or contaminated equipment/supplies after birth.

DIC may occur with gram-negative septicemia.

Breast milk contains IgA, macrophages, lymphocytes, and neutrophils, which provide some protection from infection.

Cultures/sensitivity tests are necessary to diagnose pathogens and identify appropriate therapy.

Prematurity reduces the immune response to infection. WBC count in preterm infant varies from 6000 to 225,000/mm³ and may change from day to day, limiting diagnostic reliability. A marked and sudden increase or decrease in WBCs or band cells may suggest infection.

Sepsis causes platelet count to drop, but in the preterm infant, the normal platelet range may be 60,000 (in the first 3 days) to 100,000/mm³.

Hypoglycemia, hyperglycemia, or metabolic acidosis (with bicarbonate levels <21 mEq/L) suggests infection.

Broad-spectrum antibiotic coverage with ampicillin and an aminoglycoside is usually initiated, pending results of culture and sensitivity tests. Indiscriminate or inappropriate use of systemic antibiotics may cause undesirable side effects, foster emergence of resistant bacterial strains, and alter the newborn's normal flora.

Monitor drug levels, especially if infant is receiving gentamicin or nafcillin.

Assure proper amount and concentration of supplemental formula.

Assist with lumbar puncture, as needed.

Assist with treatment for possible conditions associated with infection, for example, hypoxemia, thermal abnormalities, electrolyte and acid-base imbalances, anemia, or shock.

Administer IV Ig as appropriate.

Kidney immaturity inhibits or retards drug excretion, so that in the preterm infant, toxicity can occur more quickly and at lower levels than in the full-term infant.

Human milk contains less renal solute than does cow's milk. Kidney may be unable to handle formula with excess concentration of solute.

Helps identify organism and site of infection when meningitis is suspected.

Associated physiological events and sequelae may be as life-threatening to the infant as the infection itself.

Research suggests IV administration of Ig may increase survival rates in septic infants. In addition, prophylactic therapy for infants weighing <1500 g may reduce incidence of late-onset nosocomial infections.

NURSING DIAGNOSIS:**Risk Factors May Include:****Possibly Evidenced By:****DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:**

CONSTIPATION/DIARRHEA, risk for

Dietary/fluid intake, physical inactivity, weak abdominal musculature, altered gastric motility

[Not applicable; presence of signs/symptoms establishes an *actual* diagnosis]

Establish customary bowel habits, dependent on type of feeding, with abdomen soft and nondistended.

Be free of signs of NEC and *Clostridium difficile* organism.

ACTIONS/INTERVENTIONS

RATIONALE**Independent**

Consider frequency and characteristics of stool in relation to infant's age and type of feeding. Auscultate bowel sounds. Measure abdominal girth, reporting any increase of 1 cm or more from previous measurement.

Note presence of risk factors, such as hypoxia, sepsis, or circulatory problems associated with PDA. (Refer to NDs: Gas Exchange, impaired; Infection, risk for.)

Decreased bowel functioning and GI motility result in infrequent stools and abdominal distension.

These conditions can contribute to development of NEC. Recent findings suggest that the development of NEC is related to developmental and gestational age.

Assess hydration status and fluid intake and output. (Refer to NDs: Fluid Volume risk for deficit; Nutrition: altered, risk for less than body requirements.)

Monitor for signs of NEC, such as abdominal distension, rigidity, or tenderness; shiny or taut abdominal skin; visible bowel loops; excessive spitting up, bile-stained emesis; failure of gavage feedings to be absorbed or excessive gastric residual; and absence of bowel sounds. Test stools (unless bloody diarrhea is present) using Hematest or guaiac. Test gastric residual.

Minimize handling of infant; provide stroking of face, hands, and feet. Talk to infant.

Monitor for signs of *C. difficile*. Initiate/maintain contact precautions if detected by culture (use of gloves/gown).

Avoid use of diapers and rectal thermometers.

Monitor infant for signs of sepsis, shock, or DIC (e.g., bradycardia, decreasing BP, temperature instability, listlessness, and edema or erythema of abdominal wall).

Maintain strict policy of hand washing before/after handling each infant.

Collaborative

Use breast milk for feedings whenever possible.

Increase dilution of supplemental formula as indicated.

Monitor laboratory studies, as indicated, e.g., WBC count and differential, platelet count, PT, and PTT.

Review abdominal x-rays.

Send initial bloody or positive Hematest stool to the laboratory.

Discontinue oral or gavage feedings for 7–10 days, as indicated. Provide TPN feedings.

Insert orogastric or NG tube, and connect to continuous, low suction, as needed.

Inadequate hydration may contribute to dry or constipated stool.

NEC is a potentially life threatening complication that affects 3%–8% of preterm infants, usually presenting within the first 2 wk of life.

Avoids further abdominal trauma. Emotional and stroking needs can be met through touching extremities and head and through quiet conversation.

Increased foul-smelling stools, thick green to tan color and texture suggest the presence of *C. difficile* organism. Associated cramping is manifested by infant's bringing knees to abdomen and crying. Discomfort may be noted by scowl on face and mild, continuous, moaning cry.

Diapers increase lower abdominal pressure and prevent or restrict observation of abdomen. Rectal thermometers may cause trauma to rectal mucosa.

NEC can progress to bowel perforation with peritonitis, resulting in sepsis, shock, and DIC.

Helps prevent an epidemic of NEC from occurring in the nursery.

Breast milk is more easily digested, produces softer stool, and may reduce risk of enteric infections or development of NEC.

Diarrhea may indicate intolerance to formula concentration.

Increased or decreased WBC count or a shift to the left suggests sepsis. Thrombocytopenia or prolonged clotting times may indicate developing DIC.

Presence of distended loops of bowel, thickened walls, and ascites reflects NEC.

Alum-precipitated toxoid test is required to differentiate infant from maternal blood.

Allows the bowel to rest, promoting tissue healing while meeting fluid and nutritional needs.

May be necessary for gastric decompression in cases of suspected NEC or following surgical intervention.

Administer antibiotics, such as vancomycin, as indicated.

Prepare for surgery, as appropriate.

May be given IV or PO to combat enteric infection. May promote healing of bowel.

Operative procedure may be necessary to remove segments of inflamed bowel.

NURSING DIAGNOSIS:**Risk Factors May Include:****Possibly Evidenced By:****DESIRED OUTCOMES/EVALUATION CRITERIA—NEONATE WILL:****SKIN INTEGRITY, risk for impaired**

Thin skin, fragile capillaries near the skin surface, absence of subcutaneous fat over bony prominences, inability to change positions to relieve pressure points, use of restraints (protecting invasive lines/tubes), alterations in nutritional state

[Not applicable; presence of signs/symptoms establishes an *actual* diagnosis]

Maintain intact skin.

Be free of dermal injury.

ACTIONS/INTERVENTIONS**RATIONALE**

Independent

Inspect skin, noting areas of redness or pressure.

Identifies areas of potential dermal breakdown, which can result in sepsis. (Refer to ND: Infection, risk for.)

Provide mouth care using saline or glycerin swabs. Apply petroleum jelly to lips.

Helps prevent drying and cracking of lips associated with absence of oral intake or the drying effects of oxygen therapy.

Avoid application of harsh topical agents; carefully wash off povidone-iodine solutions after procedures.

Helps prevent skin breakdown and loss of protective epidermal barrier.

Provide range-of-motion exercises, routine position changes, and fleece or flotation pad.

Helps prevent possible necrosis related to edema of dermis or lack of subcutaneous fat over bony prominences.

Minimize use of tape to secure tubes, electrodes, urine bags, IV lines, and so forth.

Removal of tape may accidentally remove epidermal layer, because cohesion is stronger between tape and stratum corneum than between dermis and epidermis.

Bathe infant using sterile water and mild soap. Wash only grossly soiled body parts. Minimize manipulation of infant's skin.

After 4 days, skin develops some bactericidal properties because of acid pH. Frequent bathing using alkaline soaps or moisturizers may raise skin pH, compromising normal flora and natural defense mechanisms that protect against invading pathogens.

Change electrodes only when necessary.

Frequent changing may contribute to skin irritation/dermal injury.

Collaborative

Apply antibiotic ointment to nares, mouth, and lips if they are cracked or irritated.

Promotes healing of lesions associated with administration of oxygen; reduces risk of infection.