During the transition from fetus to neonate some babies will need active intervention and resuscitation. Neonatal resuscitation and follow up care provided by knowledgeable and skilled health care professionals is critical to a healthy outcome for these babies. Early intervention and prevention of complications is the basic principle in neonatal resuscitation and stabilization.

In Saskatchewan there are approximately 12,000 births each year and it is estimated 1300 babies might require intensive care.

The ideal way to transport a potentially sick infant is in utero. This involves a consultation with a Perinatal/Neonatal Center to arrange for transfer of the mother. Unfortunately, not all neonatal problems can be recognized to allow transport before birth.

The Neonatal Resuscitation Program (NRP) presented in the "Textbook of Neonatal Resuscitation" 4th edition, is recommended as the standard for neonatal resuscitation. NRP Instructors throughout Saskatchewan are available to provide this educational program to health care providers caring for newborns. The Post Resuscitation Care of the Sick Newborn (STABLE) and Acute Care of the At-Risk Newborn (ACoRN) education programs are offered to provide additional information on care of the ill newborn. For more information about these programs contact the Perinatal Education Program, Division of Continuing Professional Learning and Continuing Nursing Education, University of Saskatchewan or the Perinatal Outreach Program, Regina General Hospital.

Some babies require special observation after resuscitation or in the first days of life, while others may require immediate management and transfer depending on their needs and the facilities available at the centre of birth.

Consultation with neonatologists at the Neonatal Intensive Care Units is available 24 hours per day, 7 days per week. Consultation may be sought for advice regarding management of care or for arrangement of transport.

Infants must be resuscitated and stabilized prior to transport. The neonatal transport team is usually dispatched after a baby is born and is identified as requiring transport, particularly in situations where viability is questionable. Upon arrival, the team will assess the infant and determine further management.

Good communication is essential between care providers and hospitals. Parents and their families need to be involved in the discussions and exchange of information regarding their ill newborn. Give the family as much information as possible about the infant’s condition and arrange for contact with the baby before transport. If possible, a picture of the baby should be given to the parents before the baby is transferred. Parents should be encouraged to visit & telephone the NICU and referral centres are encouraged to inquire about the clinical progress of the infant.

Consider transferring the mother to the tertiary center if the baby will be admitted to the NICU. To make arrangements for admission to the obstetrical unit, it is necessary to contact an Obstetrician or Family Physician at the receiving center.
Neonatal Intensive Care Units

Regina General Hospital
Regina SK
NICU Telephone: 766-4226
FAX: 766-4557

Royal University Hospital
Saskatoon SK
NICU Telephone: 655-1910
FAX: 655-6726

Contact the neonatologist on call for the NICU. The following information is needed when making the call:

- gestational age
- weight of infant
- current status/condition
- maternal history

- antepartum problems
- intrapartum problems
- delivery history
- management since birth

PROBLEMS THAT OFTEN REQUIRE REFERRAL TO A PEDIATRICIAN OR NEONATOLOGIST

- Apgar score of < 7 at 5 minutes
- sepsis suspected
- meconium present at birth and a non-vigorous infant (defined by NRP as HR < 100 bpm, poor respiratory effort and poor muscle tone)
- infant of substance using mother
- difficult labour and/or delivery
- infant of diabetic mother
- maternal illness and/or fever
- abnormal transitional period (tachypnea, chest retractions)
- rupture of membranes > 24 hours prior to delivery
- congenital anomalies
- near term infants (35 to 37 weeks gestation)
- low birth weight, between 2000-2500 grams
- cardiac murmur
- unequal breath sounds

NOTE: If Apgar score is < 7, continue to assign scores every 5 minutes up to 20 minutes of age.

CONDITIONS THAT REQUIRE TRANSPORT TO AN NICU

- Prematurity ≤ 34 wks
- Birth weight <2000 gms
- Respiratory distress
- Seizure disorders
- Congenital anomalies or chromosomal anomalies which require specialized diagnostic procedures or treatment
- G.I. problems, including abdominal distention and vomiting
- Bleeding disorders
- Genitourinary disorders, including oliguria or anuria
- Cardiac abnormalities
- Severe hemolysis and jaundice
- Surgical conditions
- Central cyanosis
- Perinatal asphyxia
- Severe birth trauma
- Evidence of infection
- Flaccid infant/poor tone
- Suspected metabolic disorders
- Generalized pallor
- Symptomatic withdrawal in infant of substance using mother
- Pneumothorax
Observe continuously and do not leave the infant unattended. Handle gently. Complete the “Transport of Newborn Record” and ensure that the infant has proper identification.

Any infant who is unwell or shows signs of compromise should NOT BE GIVEN ORAL FEEDS. IV access should be established.

**Vital Signs**
Record every 30 minutes, depending on the infant’s condition.

- **Heart rate** - Normal 110 - 160 bpm
- **Respiratory rate** - Normal 40 - 60 per minute. An open airway can be maintained with the neck slightly extended & suction as necessary.
- **Temperature** - Maintain axillary temperature of 36.5-37.2°C
- **Blood pressure** is assessed in newborns with a neonatal cuff and B.P. monitor. In general, Mean Blood Pressure correlates well with the gestational age (term infant 38 to 42 mm Hg). The signs of adequate perfusion include good capillary refill, color, brachial and femoral pulses, adequate urinary output and alertness. Determine capillary refill time to assess perfusion by blanching the areas over the sternum and upper thigh using digital pressure. Normal refill is 2-4 seconds in a normothermic infant.
- **Oximetry**: Adjust oxygen flow rate to keep oxygen saturation at 88-95%. Some newborns such as those with cardiac or respiratory problems require oxygen saturation levels that are less than or higher than this range. Consultation should be sought for these newborns to identify an appropriate range.

**Thermoregulation**
Provide warmth to maintain a normal body temperature. The environmental temperature in which an infant uses the least energy to maintain body temperature (neutral thermal zone) depends on the infant’s weight, gestation, and postnatal age. Prolonged cold stress results in increased oxygen consumption and abnormal glucose utilization leading to hypoglycemia, hypoxemia, and acidosis.

Heat is lost by:
- **Evaporation** - Minimize by drying the baby, removing wet linen and keeping the environment warm and humid.
- **Radiation** - Minimize by maintaining a warm room temperature, keeping the infant away from cold windows, and using double-walled incubators or radiant heaters
- **Convection** - Minimize with draft-free environment.
- **Conduction** - Minimize by warming linen in contact with the baby.

Control environment by using:
- **Incubator** - Regulate by air-mode, or by servo-control using a skin probe (baby-mode), suggested setting for skin probe is 36.5°C. Suggested starting temperature for incubator:
  - <1000 gms. 35-36°C
  - 1000-1500 gms. 34-35°C
  - 1500-2000 gms. 33-34°C
  - >2000 gms. 32-33°C
- **Radiant warmer** - Radiant heat is delivered to infant and regulated by servo-control using a skin probe. Suggested starting temperature is 36.5 °C. When using a servo-control mode do not cover the baby. If a skin probe is not used, do not leave the baby unattended as there is a danger of overheating.
- **Continue to take the axillary temperature every 30 minutes.**
Maintenance of Oxygenation and Ventilation

Observe for signs of respiratory distress:
- apnea, gasping or periodic breathing (rapid shallow breaths followed by breathholding of 5-15 sec.)
- tachypnea (respiratory rate > 70 / minute)
- chest wall retractions (intercostal, sternal)
- grunting, nasal flaring

The most common causes of respiratory distress in newborns are: respiratory distress syndrome, aspiration syndrome, pneumonia, and pulmonary air leak.

In babies with respiratory distress it is difficult to differentiate an infectious etiology from other causes. For this reason, blood cultures and intravenous antibiotic therapy are essential until infection is ruled out.

Respiratory Failure and Mechanical Ventilation

Respiratory failure refers to progressively increasing oxygen demands and respiratory distress. If the infant shows evidence of respiratory failure, immediate steps should be taken to provide positive pressure ventilation. Oxygen saturation should be maintained in the 88-95 % range by pulse oximetry measurement. In the presence of respiratory distress syndrome, surfactant may be administered by the transport team upon arrival.

Initiate PPV with infant resuscitation bag at the rate of 40-60 respirations per minute. Recommended peak inspiratory pressure (PIP) is 15-20 cm H₂O + positive end expiratory pressure (PEEP) is 4-5 cm H₂O. If available, pressure can be measured with a manometer. Effectiveness of ventilation is judged by observation of the infant’s clinical response, symmetrical chest movement and auscultation of breath sounds in both lungs.

Major cardiopulmonary failure may be prevented by early intervention with oxygen and PPV.

Maintenance of Circulation

Adequate cardiac output is essential to maintain circulation. The best way to maintain circulation is adequate provision of fluids and electrolytes. Babies with unstable conditions are usually kept NPO and an intravenous infusion started.

- **Vascular Access**
  If a peripheral vein cannot be cannulated, a catheter can be inserted into the umbilical vein (see Appendix 2 )

- **Infants requiring intravenous infusions for transport include:**
  - any infant who is unwell or compromised
  - very low birthweight infants (VLBW)
  - gastro-intestinal anomalies
    - ie: gastroschisis
  - cardiac anomalies
  - respiratory distress syndrome
  - dehydration
  - infants in shock
  - suspected sepsis
  - seizures

- **Fluid administration guidelines with D10W for newborn infants in the first 24 hours of life.**
  - term  60 - 70 cc/kg/24 hours
  - preterm 70 - 80 cc/kg/24 hours

By the 5th day of life, infants should receive 150 cc/kg/24 hours. In certain circumstances after consultation with a neonatologist, a lower volume might be necessary.
Maintenance of Hemostasis

Hypoglycemia

Glucose screening is indicated within 30 minutes of life in newborns who are unwell (respiratory distress, sepsis, unable to feed). Continue to assess blood glucose levels hourly. The infant with risk factors who is able to feed and is asymptomatic should have a glucose screen at 2 hours of age.

Risk factors for hypoglycemia include:
- Premature infants
- Low birthweight infants / Small for Gestational Age (SGA) / Intrauterine Growth Restriction
- Infants Large for Gestational Age (LGA)
- Infant of a diabetic mother (IDM)
- Infants of mothers treated with propanolol, oral hypoglycemic agents, or who received IV infusions with glucose in labour
- Infants unable to maintain a normal temperature

Signs of hypoglycemia include: Jitteriness, tremors, hypothermia, lethargy, limpness, hypotonia, apathy, intermittent apnea or tachypnea, sudden pallor, episodes of cyanosis, weak suck or refusal to eat, vomiting, high-pitched or weak cry, eye-rolling, seizures, cardiac arrest.

Management of hypoglycemia:
Blood glucose levels of < 2.6 mmol/L in the symptomatic baby should be treated. Administration of a 10% Dextrose solution at approximately 3-4 ml/kg/hr is usually adequate to correct transient hypoglycemia. Persistent hypoglycemia should be treated with a mini bolus of D10W 2 mls/kg IV over several minutes, but may result in a rebound hypoglycemia. Recheck blood glucose every 30 minutes until blood glucose is ≥ 2.6 mmol/L.

Acid-Base Status

Abnormalities of acid-base status are very common with many neonatal conditions requiring stabilization and neonatal transport. It is essential to monitor blood gases. Metabolic acidosis requiring correction includes: pH <7.28, Bicarbonate <18 and base excess of < -8. Do lactic acid levels if available with blood gas analysis in your facility.

Dosage of Sodium Bicarbonate:
2.0 mEq/kg IV push over 2 to 3 min.

Recommended concentration
is 0.5 mEq/ml = 4.2% solution.

Consultation is strongly recommended before administration of Sodium Bicarbonate.

Biochemical Status

Monitoring of electrolytes is recommended in infants having seizures or who are greater than 24 hrs of age and are unwell or compromised. Monitor sodium, calcium, magnesium and potassium levels.

Assess for Infection

Clinical signs of sepsis include: respiratory distress, abnormal skin perfusion, temperature instability, feeding intolerance, abnormal heart rate and BP and abnormal neurological status.

If sepsis is suspected based on clinical signs or maternal history, obtain blood for culture if possible and CBC with differential. Intravenous antibiotic administration should not be delayed if unable to obtain a blood culture. First doses should be given before transport.

Antibiotic dosages:

- **Ampicillin** 50 mg/kg every 12 hours, slow IV push over 5 minutes
  AND EITHER
- **Cefotaxime** 50 mg/kg/every 8-12 hours, slow IV push over 5 minutes
  OR
- **Gentamicin**: slow IV infusion over 30 minutes.

For dosing guidelines see table for protocol

<table>
<thead>
<tr>
<th>Post Conception Age (PCA)</th>
<th>Dose (mg/kg/dose)</th>
<th>Dosing Interval (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 29 weeks</td>
<td>3 mg/kg/dose</td>
<td>q24</td>
</tr>
<tr>
<td>30-34 weeks</td>
<td>3.5 mg/kg/dose</td>
<td>q24</td>
</tr>
<tr>
<td>≥ 35 weeks</td>
<td>4.0 mg/kg/dose</td>
<td>q24</td>
</tr>
</tbody>
</table>

Consultation is recommended

Management of Seizures

Seizures in the newborn may be subtle (staring, chewing, poor suck and swallow, bicycling, posturing) or overt (rhythmic or jerking movements). History (eg. maternal drug use), alertness, muscle tone (hyper or hypotonia), reflexes and breathing should also be evaluated. Jitteriness (symmetrical rapid movements of limbs) may be confused with seizures. Tremors associated with jitteriness stop when the limb is held and are sensitive to stimuli.

Anticonvulsant management for seizures:

Consultation is recommended.

Initial management includes Phenobarbital 10-20 mg/kg slow IV over 20 mins.(minimum duration). Consultant/tertiary centre can provide further direction if seizure activity continues or repeat dosing required. Note: Severe skin sloughing may occur if IV is interstitial. Respiratory depression post-dosing may occur. Provide positive pressure ventilation as needed.
CONSIDERATION OF SPECIAL CONDITIONS

- **Meconium Aspiration** - If the infant is not vigorous (depressed respirations, depressed muscle tone and heart rate less than 100 bpm) use an endotracheal tube to suction meconium from the airway as soon as possible after delivery. If it is necessary to make two or more attempts to clear the meconium, leave the endotracheal tube in place. After initial stabilization, an orogastric tube should be inserted and stomach contents aspirated.

- **Gastro-intestinal Obstruction** (such as duodenal atresia, ileal atresia and anal atresia) - Infant should be kept NPO. Insert a large bore orogastric tube (#10 or #12) with a vented port to remove gastric contents and prevent abdominal distention. Establish IV of D10W, add 3 mEq NaCl/100 ml.

- **Neonatal Abstinence Syndrome** - Drug withdrawal appears as the newborn’s body attempts to remove addictive substances from circulation. NAS can occur with exposure to prescription drugs such as narcotics and anti-depressants as well as through exposure to alcohol, nicotine and illegal drugs. Monitor infant for restlessness, hypertonicity/hypotonicity, tremors, poor feeding, vomiting, repetitive sneezing, sweating and stuffy nose. Document age of the infant at the onset of symptoms. Assess for severity of symptoms every two hours until transfer. Provide supportive care (dim lighting, reducing noise and stimulation, swaddling). Establish IV and do not feed. Consult with Neonatologist at referral center re: pharmacologic intervention.

- **Perinatal Asphyxia** (Hypoxic-Ischemic Encephalopathy)
  - **Definition:**
    - Apgar score 0-3 at ≥5mins
    - Neonatal neurologic sequelae
    - Evidence of multi-organ system dysfunction
    - Umbilical cord arterial pH <7.0 and base deficit/excess > 16 mmol/L
  - **Signs:**
    - altered gaze, slack face
    - increasing irritability
    - seizures
    - decreased muscle tone
    - decreased suck, swallow and/or gag reflex
    - breathing irregularities
    - stupor or coma
    - signs of increased intracranial pressure (bulging fontanel, frequent emesis, blunted reflexes, “sunset” eyes).

If a baby presents with respiratory depression at birth and maternal substance use is known or suspected do not give Naloxone as it can precipitate immediate withdrawal and onset of seizures.

- **Pneumothorax** - Breath sounds will be diminished on the side of the pneumothorax. Diagnosis can be made with an x-ray or transillumination. If the infant has respiratory compromise, the air may need to be aspirated from the chest and supplemental oxygen administered. (see Appendix 3)

- **Shock** - If suspected, volume expansion is indicated (eg, 10 ml/kg. normal saline or Ringer’s lactate).

- **Diaphragmatic Hernia** - A large bore orogastric tube (#10 or #12) with a vented port should be inserted to prevent gastric distention that could impede respiration. If ventilatory assistance is required, endotracheal intubation is recommended rather than bag and mask. Keep baby NPO. Establish IV of D10W.

- **Tracheo-esophageal fistula or Esophageal atresia** - Elevate infant’s head to prevent aspiration of gastric contents. The upper esophageal pouch should be gently suctioned at frequent intervals. An orogastric tube can be gently inserted until resistance is met and connected to low intermittent suction. Keep baby NPO. Establish IV of D10W.

- **Exposed Abdominal or Neural Contents** - Handle exposed organs using sterile technique. Wrap defect in warm, sterile saline dressing and cover with plastic wrap to prevent drying. Position so no pressure is applied to the defect.

- **Choanal Atresia** - If infant has respiratory distress an oropharyngeal airway or endotracheal tube may be necessary.

- **Pierre-Robin Syndrome (mandibular hypoplasia)** - Position infant prone to maintain open airway. Note if cleft palate is present.
**APPENDIX 1**

**Equipment and Supplies for Resuscitation & Stabilization**

- Incubator
- Radiant heating unit (servo-controlled overhead warmer)
- Infant stethoscope
- Infant self-inflating resuscitation bag and mask set (00, 0/1, 1)
- Suction catheters (#6, 8, 10)
- Oxygen, Air, Suction outlets and tubing
- Intubation equipment (laryngoscope with 0 and 1 straight blades, 2.5 - 4.0 endotracheal tubes, stylets).
- Orogastric tube (#5 & #8)
- Oral airway (00, 01)
- Intravenous equipment (infusion set, cathlons, tubing, infusion pump)
- Intravenous solutions - D5W, D10W.
- Volume expanders - Normal Saline, Ringer’s Lactate
- Umbilical vessel catheterization equipment
- Cardiorespiratory & Blood Pressure Monitor

- Chest drainage equipment (20 cc syringe, stopcock, #16 gauge cathlon or #23 gauge butterfly)
- Medications:
  - Sodium bicarbonate 4.2%
  - Epinephrine 1:10,000
  - Naloxone
  - Penicillin
  - Ampicillin
  - Gentamicin
  - Cefotaxime
  - Phenobar or Phenytoin
  - Lorazepam

- Blood glucose monitor
- Syringes, tape, scissors
- Gloves, masks, sterile gowns
- Antiseptic solution
- Oxygen saturation/pulse oximeter monitor

**APPENDIX 2**

**Umbilical Vein Catheterization**

**Equipment for Umbilical Catheterization**

Should be readily available in a preset tray.

To ensure sterility:
- Gown, mask, and gloves
- Sterile towels (surgical field)
- Two medicine cups, antiseptic solution, saline, 2x2 gauze

To insert line:
- One straight mosquito hemostat
- One curved mosquito hemostat
- One straight non-toothed forceps
- One curved non-toothed forceps
- One lacrimal forceps (smooth deep curved Iris forceps)
- Scalpel blade and handle
- Scissors
- Needle driver & 3-0 silk with curved needle
- Umbilical catheters: 3.5 or 5 Fr., Argyle, or #5 or #8 Orogastric tube
- 10” umbilical tape
- One stopcock
- Syringes
- Normal saline
- IV Solution: D5W or D10W

**Method:**
- Use sterile technique.
- Attach catheter to syringe via stopcock, and flush with Normal Saline
- Use antiseptic solution to clean the cord and the abdomen around the cord.
- Tie an umbilical tape around the base of the cord for hemostasis.
- Cut the cord horizontally with a scalpel blade, 1 - 2 cm above skin level.
- Identify the umbilical vein.
- Insert the catheter so that the tip is just below skin level (3 to 4 cm)
- Check for free flow of blood to indicate adequate position of catheter.
- Secure with purse-string sutures and tape
- Never leave catheter open to the atmosphere
- Tubing connections should be secured eg. use of leur-locks
- Check placement using X-ray.
APPENDIX 3
Aspiration of Pneumothorax

Equipment for Pneumothorax Aspiration
Should be readily available.
- Gown, mask, and gloves
- Skin cleansing agent
- 1% lidocaine without epinephrine
- #18, 20 or 22 over needle cathlon
- 3-way stopcock
- 20 cc syringe
- IV extension tubing
- small container of sterile water

Method:
- Connect IV tubing to stopcock and syringe
- Position baby supine
- Identify second intercostal space in midclavicular line on the side of the chest where pneumothorax is suspected and swab area with antiseptic
- Insert cathlon perpendicular to chest, just over the top of the rib
- Attach tubing with stopcock and syringe
- Turn stopcock to open cathlon to syringe and aspirate air in chest
- When syringe is full, turn stopcock off to cathlon and empty syringe. Repeat steps until baby improves or you no longer aspirate air.
- While awaiting chest tube placement, cathlon can be secured and attached to under water seal by placing free end of extension tubing in water bottle.

REFERENCES
- ACoRN, Acute Care of the At-Risk Newborn. 2005. The ACoRN Editorial Board, Vancouver, B.C.

ACKNOWLEDGEMENTS
Thank you to the following nurses and physicians for their assistance in revising this educational resource:

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This document, along with the Transport of Newborn Form and Maternal-Fetal Transport Guidelines can be accessed and downloaded from the Perinatal Education Program website: www.usask.ca/nursing/cne/perinatal/guidelines.htm