ACoRN : Acute Care of at-Risk Newborns

دکتر بهناز بصیری- فوق تخصص نوزادان

دانشیار دانشگاه علوم پزشکی همدان

ACoRN: Acute Care of at-Risk Newborns

A Resource and Learning Tool for Health Care Professionals

SECOND EDITION

Edited by Jill E. Boulton, MD, FRCPC Kevin Coughlin, MD, FRCPC, MHSc Debra O'Flaherty, RN, BScN, MSN Alfonso Solimano, MD, FRCPC

Key Concepts

- 1. ACoRN is a post-resuscitation stabilization program.
- 2. Infants who are unwell, at-risk, or post-resuscitation require close observation for early detection, intervention, treatment, and (ideally) prevention of problems.
- 3. The Primary Survey is a rapid, thorough, systematic, and sequential assessment of eight areas of potential concern that is completed with minimal disturbance to the infant
- 4. The Consolidated Core Steps are a rapid series of supportive actions performed at the same time as the Primary Survey.

- . 5. Alerting Signs are used to identify infants with system-specific risks or problems who will benefit from the ACoRN Process.
- 6. The Problem List, which is generated after completing the Primary Survey, ensures that all the appropriate sequences are addressed in a standardized and prioritized order.
- 7. ACoRN Sequences are algorithms that systematically guide care in each area of concern identified in the Problem List.
- 8. Level of Risk is designated based on an infant's presentation, anticipated clinical course, and the site's capacity to deliver the care required

- 9. Support, an integral component of the ACoRN Process, begins at the time of the first contact with the infant and family, and is an important determinant of neonatal outcomes.
- 10. The ACoRN Process helps the provider to complete necessary assessments and tasks within one hour of the initial encounter—the 'Golden Hour'.
- 11. Consultation and preparation for transport are essential elements of stabilization and should be considered early in the infant's course.

Golden Hour

- In ACoRN, the 'Golden Hour' refers to the first, crucial care window following initial patient contact, when a health care team must ensure that an infant is properly monitored, and that all organ systems have been evaluated and appropriately stabilized using a prioritized, systematic, evidence-based approach.

- Resuscitation and stabilization are critical processes that require effective team dynamics and timed outputs. During the first hour of patient contact, the neonatal team focuses on initial stabilization, orders diagnostic tests (e.g., radiographs and blood gases) to support decision-making, and identifies the need for consultation or transport

- The Golden Hour ends when all individualized ACoRN assessments and tasks are completed, including an evaluation of the infant's Level of Risk. The clinical course is anticipated, interventions to prevent deterioration have been implemented, and the decisions whether to consult with a specialist or arrange for transport have been reached.

ACoRNs mnemonic

- A . . . Alerting Signs Specific indicators of a problem within each system
- C . . . Core Steps Essential tasks to assist decision-making and organize care
- O . . . Organization of Care A prioritized approach to meeting the infant's stabilization requirements
  R . . . Response Immediate, necessary steps to stabilize the infant
- N . . . Next Steps Tasks (including a focused history and physical exam) that provide information to formulate a specific diagnosis and management plan
  S . . . Specific Diagnosis and Management Identifying cause, treatment, and the need for specialized consultation and management

*

- Any ACoRN Alerting Sign marked with an asterisk (*) in the Primary Survey suggests that infection may also be present.

Problem List

- The Problem List prioritizes the eight areas of concern the Primary Survey
- Glucose and Fluid
- Jaundice
- Thermoregulation
- Infection
- Respiratory
- Cardiovascular
- Neurology
- Surgical Conditions

The ACoRN Process Level of Risk:

- In the ACoRN Primary Survey, level of risk is based on the highest level of risk assigned in any of the ACoRN sequences.

Level of Risk: The ACoRN Process

In the ACoRN Primary Survey, level of risk is based on the highest level of risk assigned in any of the ACoRN sequences.

Green:

- Infant is 35 weeks gestation or greater, clinically stable, and needs a low level of intervention and ongoing monitoring, **AND**
- Ongoing requirements do not exceed site capability

Yellow:

- Infant is clinically stable but needs a higher level of observation or intervention, **OR**
- Infant is clinically stable but a worsening clinical course is anticipated, **AND**
- Site can provide appropriate management, investigations, and monitoring for the infant's condition

Infants at a Yellow Level of Risk require increased levels of attention and may require consultation. Transfer is required if needs exceed site capabilities.

Red:

- Infant is unstable or unwell, needs a high level of observation or intervention, **OR**
- Infant is anticipated to become unstable or unwell, **OR**
- Infant requires care that is beyond the site's capacity to manage or monitor safely

Infants at a Red Level of Risk are considered unstable, and require level 3 care. Transfer is required if infant or care team needs exceed site capabilities.

Green:

- • Infant is 35 weeks gestation or greater,
- clinically stable,
- and needs a low level of intervention and ongoing monitoring,
- AND • Ongoing requirements do not exceed site capability

Yellow:

- • Infant is clinically stable but needs a higher level of observation or intervention,
- OR • Infant is clinically stable but a worsening clinical course is anticipated,
- AND • Site can provide appropriate management, investigations, and monitoring for the infant's condition Infants at a Yellow Level of Risk require increased levels of attention and may require consultation. Transfer is required if needs exceed site capabilities.

Red:

- • Infant is unstable or unwell
- needs , a high level of observation or intervention,
- OR • Infant is anticipated to become unstable or unwell, OR • Infant requires care that is beyond the site's capacity to manage or monitor safely Infants at a Red Level of Risk are is required if infant or care team needs exceed site capabilities. considered unstable, and require level 3 care. Transfer is required if infant or care team needs exceed site capabilities.

Identifying the infant at risk

- The ACoRN Process begins with distinguishing the infant who seems well from the infant who does not. The well infant has normal vital signs, colour, activity, feeding patterns, and has passed meconium and urine within the first 24 h post-birth.

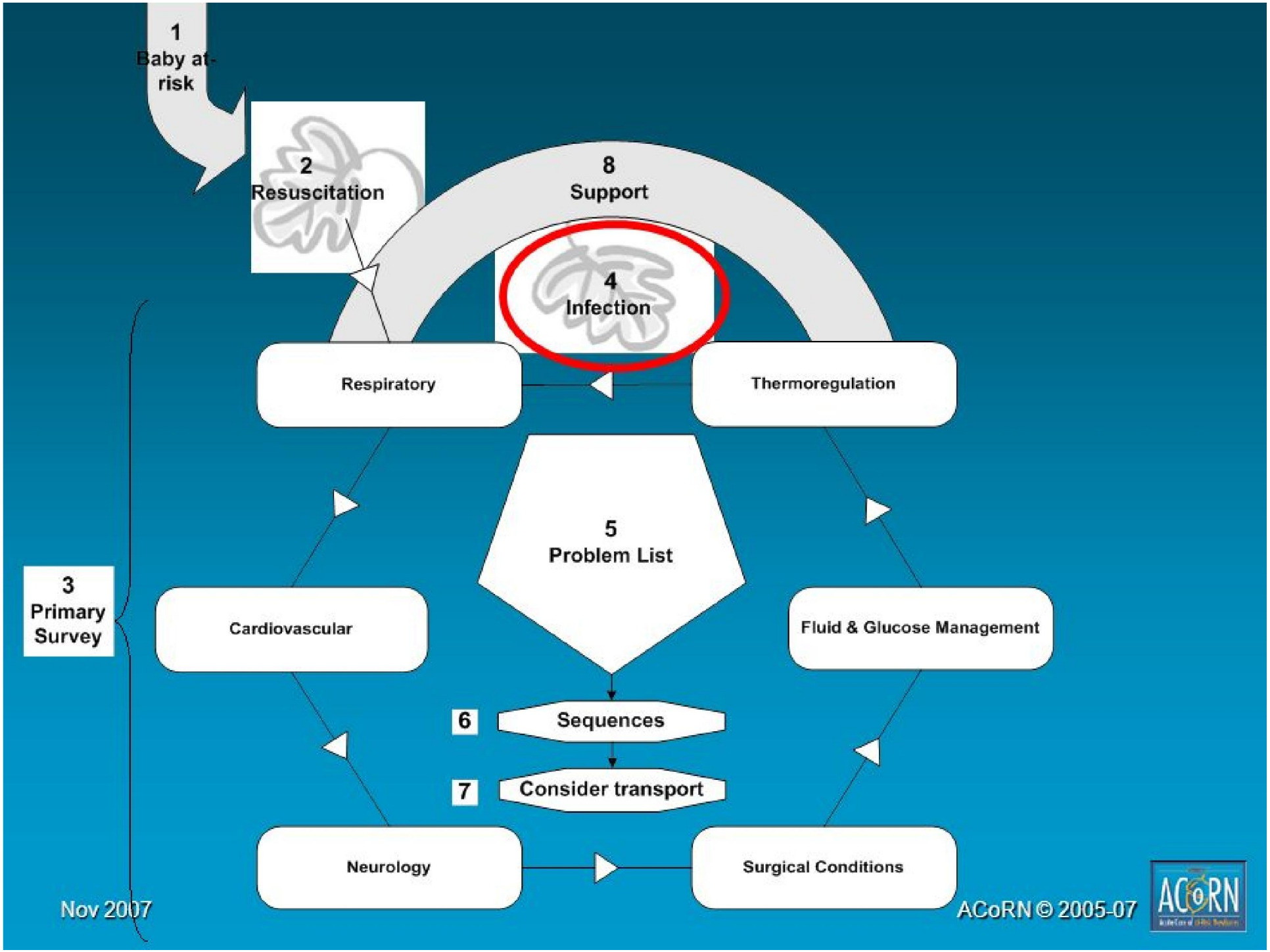
The unwell infant

Indications that an infant is unwell may be as subtle as a weak sucking reflex or as obvious as cyanosis unresponsive to oxygen. Close observation and a timely review of maternal and birth histories and findings on physical examination are warranted. An intuitive sense that something is 'just not right' with an infant is as valid as more overt signs. Both should trigger the provider to start the ACoRN Process.

The at-risk infant

Of the infants who appear well initially, some are at greater risk of becoming unwell than the general newborn population. These 'at-risk' infants are broadly identified on the basis of their gestational age, weight, and the presence of risk factors in the antepartum, intrapartum, and/or neonatal histories. Examples include:

- Infants who are preterm, including late preterm (34 to 36 weeks) or small for gestational age
- Infants of diabetic mothers
- Infants born exposed to licit or illicit drugs
- Infants born following prolonged rupture of membranes
- Infants who have been exposed to abnormally warm or cold environments


1
Baby at-risk
2
Resuscitation
8
Support
4
Infection
Respiratory
Thermoregulation
5
Problem List
3
Primary Survey
Cardiovascular
Fluid & Glucose Management
6
Sequences
7
Consider transport
Neurology
Surgical Conditions
Nov 2007
ACoRN © 2005-07
ACoRN

Resuscitation

The first priority in caring for an unwell or at-risk infant is to determine whether immediate resuscitation is needed to establish adequate cardiorespiratory function. That is why, in the ACoRN Process, the Resuscitation Sequence is positioned before entry into the Primary Survey. The need for immediate resuscitation takes precedence over all other concerns

Important

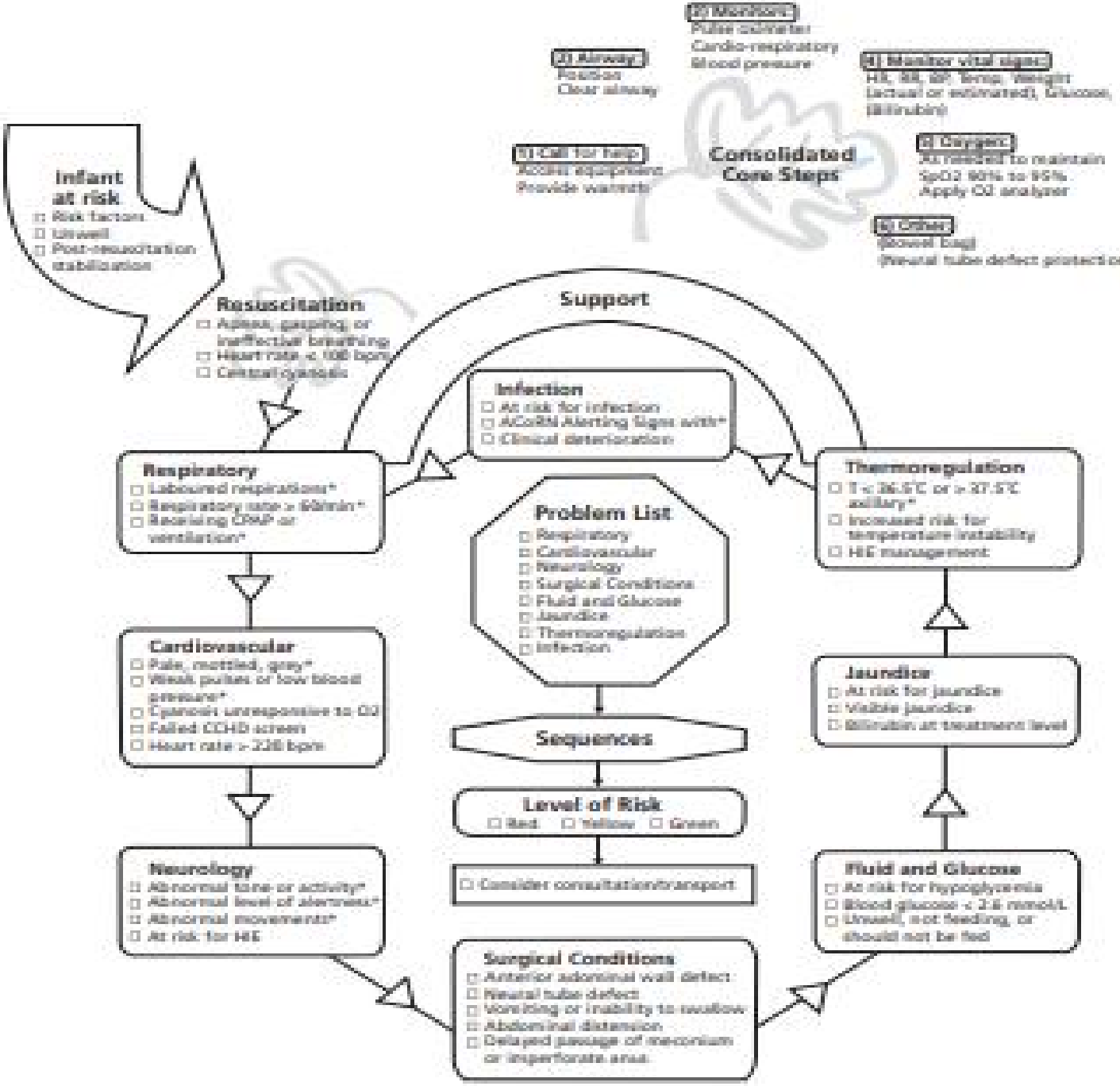
- . The most common cause of cardiorespiratory instability in the newborn is hypoxemia (decreased oxygen content in the blood), and the most common cause of poor response to resuscitation is failure to correct this condition. Therefore, interventions in the Resuscitation Sequence aim to establish effective ventilation, improve oxygenation, and stabilize cardiac output.

Resuscitation

- Apnea,
- gasping, or ineffective breathing
- Heart rate < 100 bpm
- Central cyanosis

Respiratory

- Key concept
- Skills
- Neonatal respiratory problems
- ACoRN respiratory sequence
- Alerting signs
- Core steps
- Organization of care
- Response
- Next steps


Consolidated Core Steps
Infant at risk
Risk factors
Unwell
Post-resuscitation stabilization
Resuscitation
Apnea, gasping, or ineffectual breathing
Heart rate < 100 bpm
Central cyanosis
Support
Infection
At risk for infection
ACoRN Alerting Signs with*
Clinical deterioration
Respiratory
Laboured respirations*
Respiratory rate > 60/min*
Receiving CPAP or ventilation*
Problem List
Respiratory
Cardiovascular
Neurology
Surgical Conditions
Fluid and Glucose
Jaundice
Thermoregulation
Infection
Thermoregulation
T < 36.5°C or > 37.5°C axillary*
Increased risk for temperature instability
HIE management
Cardiovascular
Pale, mottled, grey*
Weak pulses or low blood pressure*
Cyanosis unresponsive to O2
Failed CCHD screen
Heart rate > 220 bpm
Sequences
Jaundice
At risk for jaundice
Visible jaundice
Bilirubin at treatment level
Level of Risk
Red
Yellow
Green
Consider consultation/transport
Neurology
Abnormal tone or activity*
Abnormal level of alertness*
Abnormal movements*
At risk for HIE
Fluid and Glucose
At risk for hypoglycemia
Blood glucose < 2.6 mmol/L
Unwell, not feeding, or should not be fed
Surgical Conditions
Anterior abdominal wall defect
Neural tube defect
Vomiting or inability to swallow
Abdominal distension
Delayed passage of meconium or imperforate anus
1) Monitors
Pulse oximeter
Cardio-respiratory
Blood pressure
2) Airway
Position
Clear airway
3) Monitor vital signs
HR, RR, BP, Temp, Weight (actual or estimated), Glucose, Bilirubin
4) Call for help
Access equipment
Provide warmth
5) Oxygen
As needed to maintain SpO2 90% to 95%
Apply O2 analyzer
6) Other
Bowel bag
Neural tube defect protection

Educational objectives

Upon completion of this chapter, you will be able to:

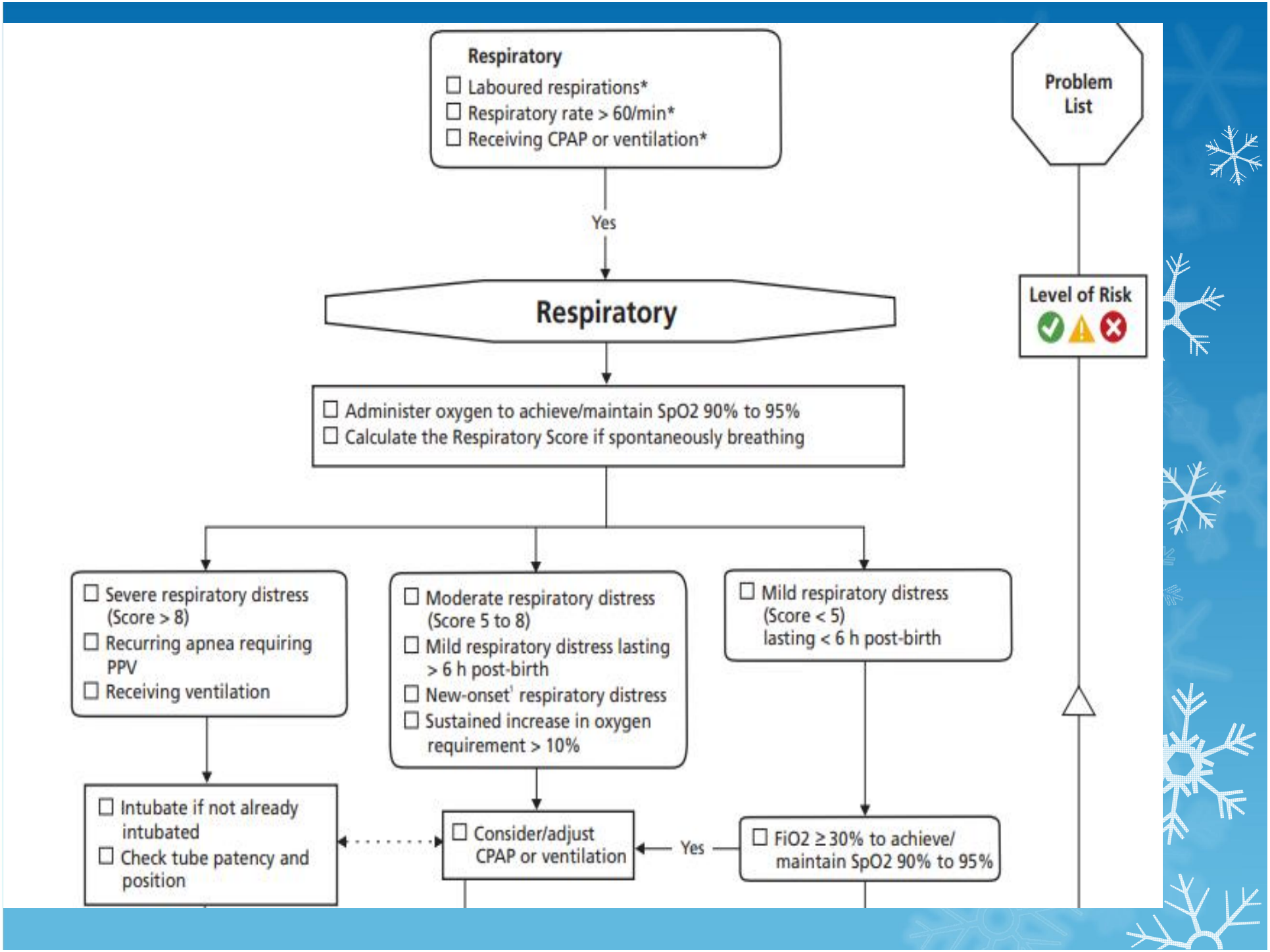
- Identify infants who require respiratory support or interventions.
- Apply the Acute Care of at-Risk Newborns (ACoRN) Respiratory Sequence.
- Determine oxygen requirements and select an appropriate oxygen delivery method.
- Use the Respiratory Score to organize care and monitor status on the basis of severity of respiratory distress.
- Recognize the need for, and how to initiate, respiratory support.
- Perform basic interpretation of chest radiographs and blood gas results.
- Recognize and manage the common causes of respiratory distress.
- Recognize when to exit the Respiratory Sequence to other ACoRN sequences

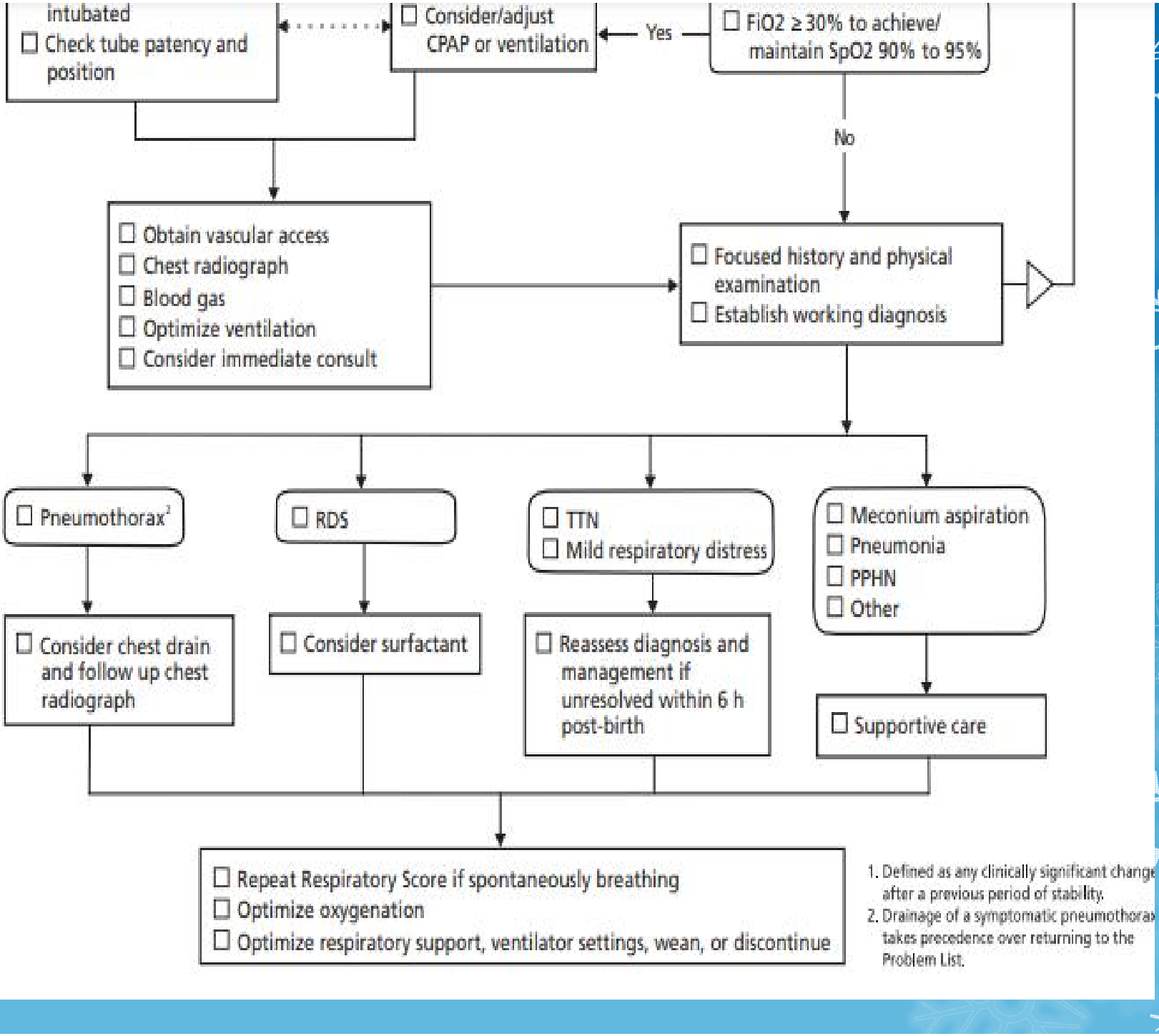
Key concepts

1. Establishment of ventilation and prevention of hypoxia are required for successful transition from fetal to neonatal circulation.
2. Oxygenation is critical for cellular, tissue, and organ function.
3. Infants with increasing oxygen requirements require close observation and may require additional interventions.
4. Hyperoxia (SpO2 > 95% in infants receiving supplemental oxygen) is associated with oxygen toxicity.
5. The most common cause of cardiorespiratory failure in the newborn is hypoxemia, which is corrected with adequate oxygenation and ventilation.
6. Processes that interfere with the inflation and subsequent ventilation of a newborn's lungs cause respiratory distress.
7. The goal of early detection and intervention for respiratory distress is to optimize oxygenation and ventilation.
8. Severe respiratory distress is a precursor to respiratory failure.
9. A low, irregular respiratory rate with respiratory distress can be an early indication of respiratory failure.
10. Infants with severe respiratory distress, apnea, or gasping require immediate intubation and ventilation.
11. Preterm infants have poor respiratory reserve and may require earlier intervention.
12. Respiratory distress may be a sign of infection requiring immediate treatment

Skills

- • Blood gas interpretation
- • Chest radiograph interpretation
- • Assessment and delivery of oxygen needs
- • Provision of respiratory support (i.e., continuous positive airway pressure [CPAP], intubation, mechanical ventilation)
- • Management of pneumothorax


Respiratory
☐ Laboured respirations*
☐ Respiratory rate > 60/min*
☐ Receiving CPAP or ventilation*
Yes
Respiratory
☐ Administer oxygen to achieve/maintain SpO2 90% to 95%
☐ Calculate the Respiratory Score if spontaneously breathing
☐ Severe respiratory distress (Score > 8)
☐ Recurring apnea requiring PPV
☐ Receiving ventilation
☐ Moderate respiratory distress (Score 5 to 8)
☐ Mild respiratory distress lasting > 6 h post-birth
☐ New-onset[1] respiratory distress
☐ Sustained increase in oxygen requirement > 10%
☐ Mild respiratory distress (Score < 5) lasting < 6 h post-birth
☐ Intubate if not already intubated
☐ Check tube patency and position
☐ Consider/adjust CPAP or ventilation
Yes
☐ FiO2 ≥ 30% to achieve/ maintain SpO2 90% to 95%
Problem List
Level of Risk


intubated
☐ Check tube patency and position
☐ Consider/adjust CPAP or ventilation
Yes
☐ FiO2 ≥ 30% to achieve/ maintain SpO2 90% to 95%
No
☐ Obtain vascular access
☐ Chest radiograph
☐ Blood gas
☐ Optimize ventilation
☐ Consider immediate consult
☐ Focused history and physical examination
☐ Establish working diagnosis
☐ Pneumothorax[2]
☐ RDS
☐ TTN
☐ Mild respiratory distress
☐ Meconium aspiration
☐ Pneumonia
☐ PPHN
☐ Other
☐ Consider chest drain and follow up chest radiograph
☐ Consider surfactant
☐ Reassess diagnosis and management if unresolved within 6 h post-birth
☐ Supportive care
☐ Repeat Respiratory Score if spontaneously breathing
☐ Optimize oxygenation
☐ Optimize respiratory support, ventilator settings, wean, or discontinue
1. Defined as any clinically significant change after a previous period of stability.
2. Drainage of a symptomatic pneumothorax takes precedence over returning to the Problem List.

Neonatal respiratory problems

- A delay or inability to complete the normal pulmonary transition to extrauterine life results in neonatal respiratory problems. Common examples include:
- • Transient tachypnea of the newborn (TTN), when reabsorption of alveolar fluid is delayed.
- • Respiratory distress syndrome (RDS), when surfactant is deficient and alveoli do not stay inflated after alveolar fluid is reabsorbed.
- • Aspiration syndromes, when small airways and alveoli become obstructed by meconium, blood, or amniotic fluid.
- • Pneumonia, when lungs become infected.
- • Persistent pulmonary hypertension of the newborn (PPHN), when smooth muscle in the pulmonary vasculature does not relax and pulmonary pressures remain high, causing cyanosis from right to left or bidirectional shunting at the patent ductus arteriosus (PDA) and patent foramen ovale (PFO). •
- Pneumothorax, when lungs suffer external compression from air trapped between the lung and chest wall.
- • Pulmonary hypoplasia, when lungs are small and underdeveloped due to a space-occupying lesion in the chest (e.g., congenital diaphragmatic hernia [CDH]) or prolonged, severe oligohydramnios.

Alerting Signs

- An infant who shows one or more of the following
- Alerting Signs enters the ACoRN Respiratory Sequence:

- Laboured respirations*
- Respiratory rate > 60/min*
- Receiving CPAP or ventilation*

laboured respirations

- An infant with laboured respirations is also described as having respiratory distress, difficulty breathing, or increased work of breathing. The signs of laboured respirations are:
- • Nasal flaring—Outward flaring movements of the nostrils on inspiration in an attempt to move more air into the lungs.
- • Grunting—Audible sounds produced as the infant exhales against a partially closed glottis in an effort to maintain end-expiratory pressure and increase functional residual capacity.
- • Intercostal and subcostal retractions—Retractions of the intercostal and subcostal spaces due to increased negative pressure within the chest. Mild retractions involve the intercostal spaces only; moderate retractions involve the intercostal and subcostal spaces.
- • Sternal retractions—Paradoxical backward movements of the sternum on inspiration caused by increased negative pressure within the chest. Involvement of the intercostal, subcostal, and sternal spaces is considered severe.

Respiratory rate > 60 breaths/ min

- * The normal newborn respiratory rate is 40 to 60 breaths/min. Tachypnea, a respiratory rate greater than 60 breaths/min, usually indicates an intrathoracic process causing respiratory difficulty or distress. Tachypnea is often the first and most subtle sign of respiratory distress in infants with mildly decreased respiratory function

Receiving CPAP or ventilation*

- This Alerting Sign identifies infants who are receiving ongoing respiratory support via either CPAP or ventilation. Any infant receiving positive inspiratory pressure (PIP) and positive end-expiratory pressure (PEEP) qualifies as receiving ventilation, irrespective of whether it is being delivered manually or by ventilator, through an endotracheal tube (ETT; invasively) or via nasal prongs or mask (noninvasively)

*

- Infection commonly presents with respiratory signs in the newborn.
- All three Alerting Signs in the Respiratory Sequence have an asterisk (*) to remind ACoRN providers to check (✓) Infection in the Problem List.

Core Steps

- Infants entering the Respiratory Sequence will have had monitoring established and some interventions performed as part of the Consolidated Core Steps. ACoRN providers should continually reassess airway patency and adequacy of respiratory drive in infants with respiratory Alerting Signs.

- The Core Steps in the Respiratory Sequence are to:

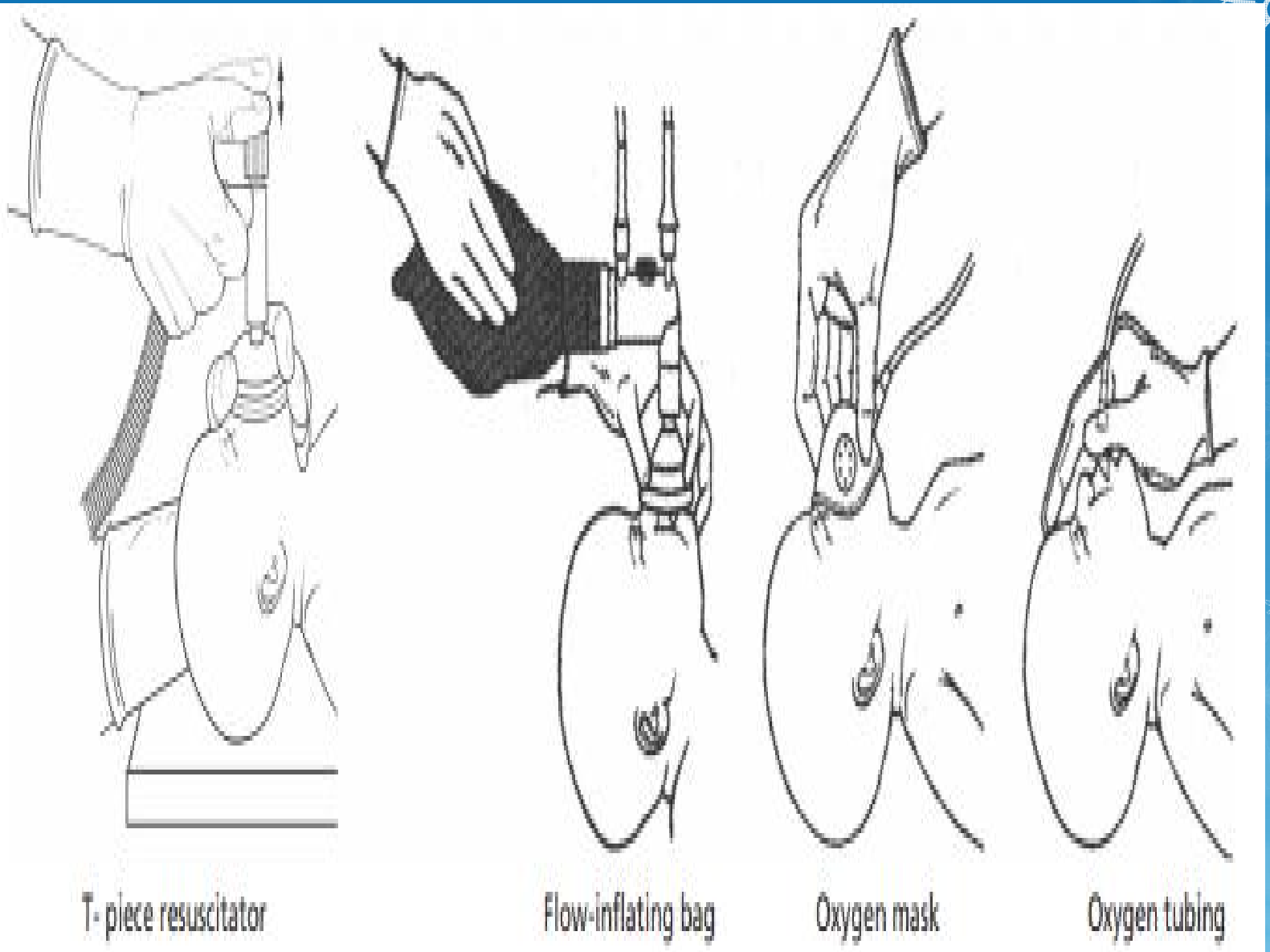
- • Administer oxygen as needed to achieve and maintain a SpO2 of 90% to 95%, based on pulse oximetry,and
- • Calculate the Respiratory Score for all spontaneously breathing infants

Oxygen administration during resuscitation

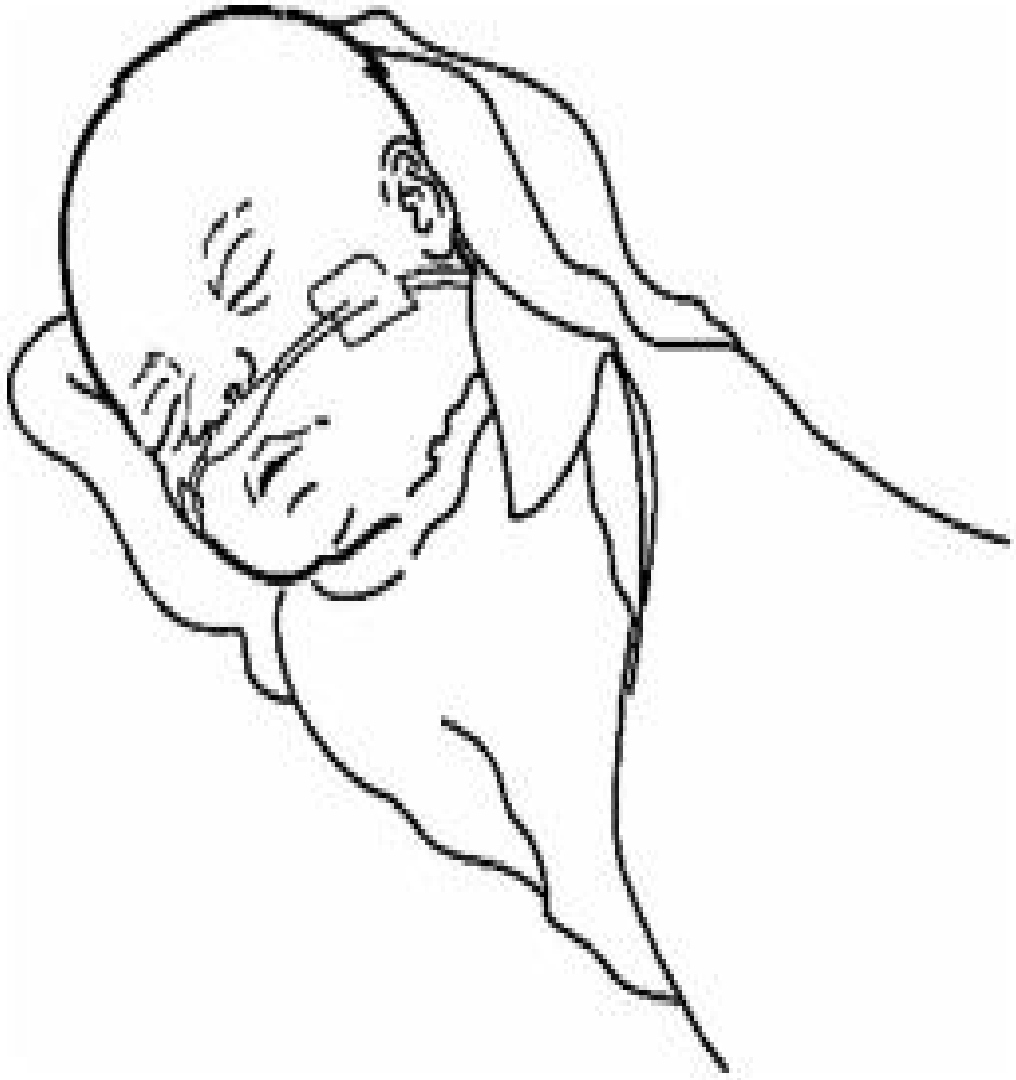
- • Apply the T-piece resuscitator, flow-inflating bag, oxygen mask, or oxygen tubing/prongs to the infant's face.
- • Use a flow rate of 10 L/
- • A T-piece resuscitator or flow-inflating bag delivers the oxygen concentration set on the blender if there is a seal between the infant's face and the mask. When there is a seal, either device may also deliver CPAP, depending on the set flow rate.
- • A T-piece resuscitator or flow-inflating bag held close to the infant's face but without a seal functions like an oxygen mask or oxygen tubing by diluting flow with room air and cannot deliver the oxygen concentration set on the blender.

Oxygen administration during stabilization

- Administering oxygen to a spontaneously breathing infant during stabilization requires a less user dependent system and, because these infants require oxygen for longer periods, it should, ideally, be humidified. Options include:
- • Low-flow nasal prongs
- • An oxygen hood or incubator
- • Heated, humidified high-flow nasal cannula therapy (H3FNC)


T- piece resuscitator
Flow-inflating bag
Oxygen mask
Oxygen tubing

- Low-flow nasal prongs are not the preferred method of oxygen delivery during stabilization because oxygen is easily diluted by room air as the infant breathes or cries. The rate and depth of respiration, and the precise amount of oxygen the infant is receiving, cannot be reliably determined.

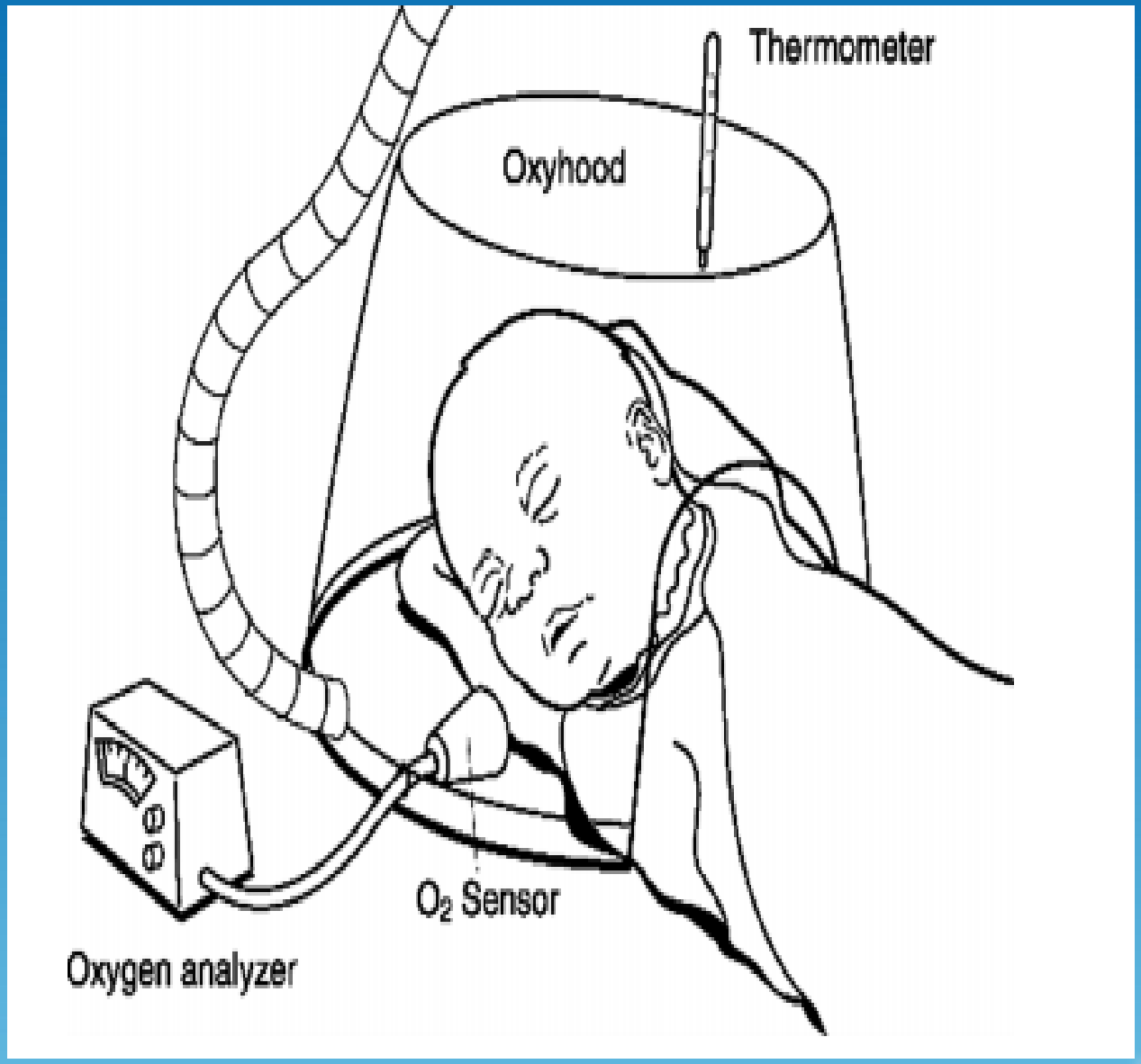


2. Infant with nasal prongs.

- • 100% oxygen is administered at a flow rate of up to 1 L/min. As it is not humidified, higher flows can irritate and dry the nasal mucosa.
- • Oxygen flow is adjusted up or down to achieve SpO2 between 90% and 95%.

oxygen hood

- An oxygen hood, placed over the infant's head, contains the breathing environment (Figure 3.3).
- • Blended humidified oxygen/air is administered at the concentration set on the blender.
- • A gas flow greater than 7 L/min prevents CO2 accumulation.
- • An exact amount of delivered oxygen can be determined using an oxygen analyzer placed close to the infant's mouth and adjusted via the oxygen blender to achieve the desired SpO2 between 90% and 95%.
- • Gas entering the hood should be warmed to 32°C to 34°C and humidified.

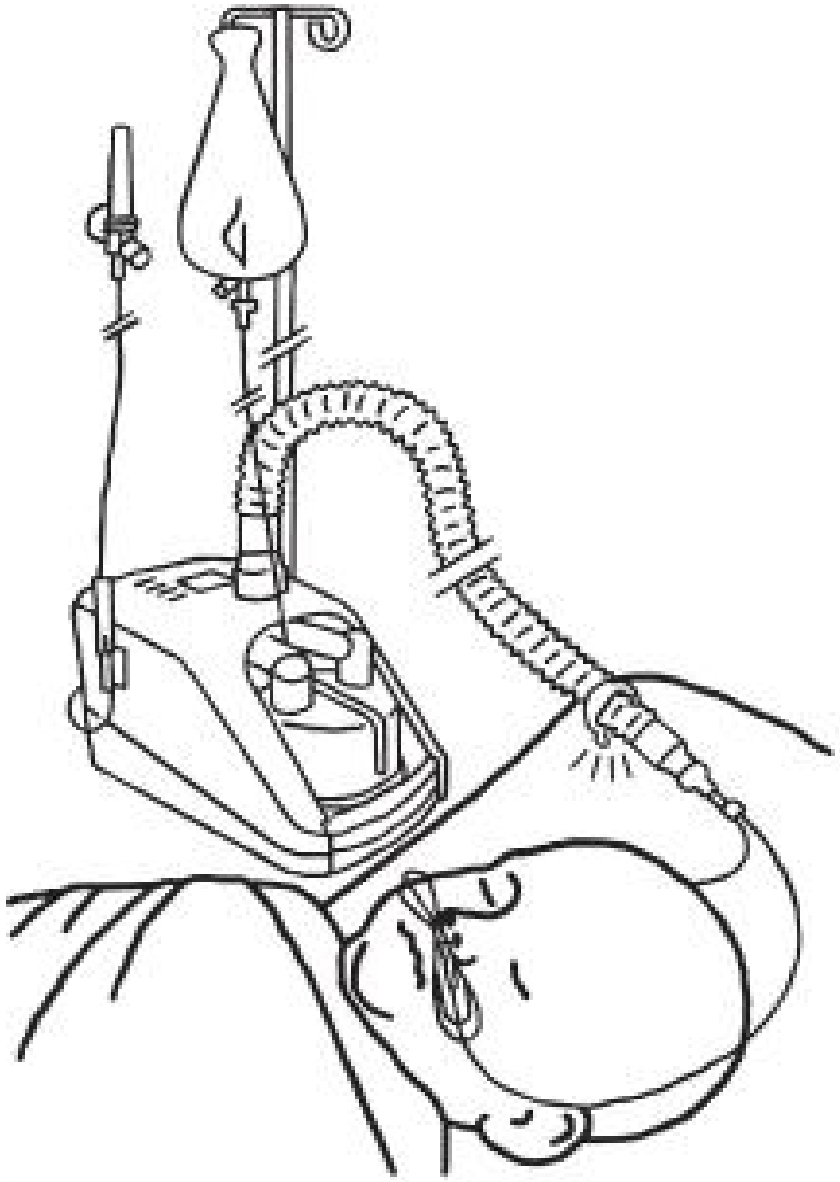

Thermometer
Oxyhood
O_2 Sensor
Oxygen analyzer

Incubators

- Incubators manufactured after 1990 can administer high oxygen concentrations, humidity, and warmth and have built-in oxygen analyzers that continuously adjust the oxygen flow to maintain a preset concentration. Older incubators or incubators with the port-hole doors opened frequently are not able to maintain set oxygen concentrations.

H3FNC

- H3FNC administers blended oxygen at flows of 1 L/min to 8 L/min via special prongs.
- • Gas is humidified to prevent irritation and drying of the nasal mucosa.
- • Oxygen can be titrated up or down to maintain a SpO2 of 90% to 95%.
- • Higher flow rates can wash out dead space in the infant's upper airway, which allows accurate assessment of the oxygen content being delivered to the alveoli.
- • Theoretical concerns exist about the pressure generated by high flow rates, with current systems being unable to measure pressures delivered. High pressures may increase the risk of air leaks and become more likely when exhalation is impaired, such as when cannulae are greater than half the diameter of an infant's nares or migrate too far into the nares and when an infant's mouth is closed.



3.4. Infant with heated, humidified high-flow nasal cannula.

Pulse oximetry

- Pulse oximetry is frequently used to monitor an infant's oxygenation because it is noninvasive, easy to use, and provides immediate readings in a continuous display. SpO2 closely reflects SaO2.
- Applying the probe to an infant's right hand or wrist measures pre-ductal oxygen saturation, which reflects the oxygen content of blood coming from the lungs and going to the brain.

Safe oxygen saturation levels for infants

- While the ideal oxygen saturation range for infants, particularly preterm infants, is unclear, levels of 90% to 95% are generally recommended for newborns receiving supplemental oxygen. Oxygen saturation Respiratory
- values greater than 95% are associated with oxygen toxicity, which can cause tissue and organ damage.
- The lower an infant's gestational age (GA), the greater the risk for oxygen toxicity. Term infants with hypoxic ischemic injury are also at high risk.

Respiratory Score

- Score 0 1 2 Respiratory rate 40 to 60/min 60 to 80/min > 80/min
- Retractions None Intercostal or subcostal retractions (or both) Intercostal, subcostal, and sternal retractions Grunting None With stimulation Continuous at rest
- Oxygen requirement* None ≤ 30% > 30%
- Breath sounds on auscultation Easily heard throughout Decreased Barely heard Prematurity > 34 weeks 30 to 34 weeks < 30 weeks
- Respiratory Score __/12

The Respiratory Score

Score	0	1	2
Respiratory rate	40 to 60/min	60 to 80/min	> 80/min
Retractions	None	Intercostal or subcostal retractions (or both)	Intercostal, subcostal, and sternal retractions
Grunting	None	With stimulation	Continuous at rest
Oxygen requirement*	None	≤ 30%	> 30%
Breath sounds on auscultation	Easily heard throughout	Decreased	Barely heard
Prematurity	> 34 weeks	30 to 34 weeks	< 30 weeks
		Respiratory Score	**__/12**

Response

- Mild respiratory distress
- Infants with mild respiratory distress lasting less than 6 h post-birth require close observation and regular monitoring using the Respiratory Score.
- They may require supplemental oxygen to maintain blood oxygen levels within the target SpO2 range of 90% to 95%

Response

- Any of the following signs suggest that an infant is no longer meeting criteria for mild respiratory distress and should prompt the ACoRN provider to reassess and increase respiratory support:
- • Persistence of respiratory signs beyond 6 h of age
- • A worsening Respiratory Score
- • A sustained increase in oxygen requirement of greater than 10% from baseline for 10 min or more
- • An oxygen requirement of 30% or greater to maintain saturations within the target range. In an infant who is not receiving respiratory support, this indicates atelectasis (loss of lung volume) and inability to sustain adequate oxygenation

Response

- Moderate respiratory distress
- Infants who are breathing spontaneously but experiencing moderate respiratory distress will benefit from support with CPAP, which prevents atelectasis by stabilizing the small airways and chest wall at end-expiration. CPAP can delay or prevent the progression to severe respiratory distress and eventual respiratory failure.

Continuous positive airway pressure

- CPAP decreases the need for endotracheal intubation and mechanical ventilation in infants with moderate respiratory distress and good respiratory drive. CPAP must be administered and monitored by on-site, trained personnel, in settings resourced to provide additional respiratory support, especially if escalation in care is anticipated.

. Infant on CPAP.

The purpose of CPAP

- is to:
- • Improve arterial PO2 to reduce inspired oxygen concentration in infants with respiratory distress who do not require mechanical ventilation
- • Stabilize respiratory function on extubation from mechanical ventilation,and
- • Treat obstructive apnea in some preterm infants. ◦ CPAP reduces mixed and obstructive apnea. It has no effect on central apnea.

Contraindications of CPAP

- CPAP is contraindicated in infants with:
- • Inadequate respiratory drive (i.e., irregular breathing or apnea),
- • Impaired spontaneous breathing (e.g., as in central nervous system disorders),
- • Significant agitation or who cannot tolerate CPAP,and • Conditions where air swallowing is undesirable (e.g., gastrointestinal obstruction, necrotizing enterocolitis, congenital diaphragmatic hernia [CDH])

Response

- Severe respiratory distress
- Infants with severe respiratory distress, recurrent apnea, or gasping require immediate intubation and ventilation to prevent respiratory failure.
- If a care provider with intubation skills is not present, use of a laryngeal mask airway should be considered.

DOPE

- D . . . Displaced ETT? Has the infant accidentally extubated or is the ETT in the right main stem bronchus? Ensuring that the ETT is not displaced from its proper position involves: • Making certain that it is at the same measurement mark at the lip or nares as when inserted, • Using an exhaled CO2 detector to determine whether the tube is inserted in the airway, not the esophagus, • Auscultating for presence and symmetry of breath sounds in the chest but not over the stomach area (this may not be a reliable sign in small infants),and • Inspecting the tube position using a laryngoscope. Figure 3.6. Infant on CPAP.

O . . . Obstructed airway or ETT? Kinked or blocked by secretions?

- P . . . Pneumothorax or other critical diagnosis? Other possible causes include pulmonary interstitial emphysema, or atelectasis.
- E . . . Equipment working and ventilation optimized?

Next steps

- Focused history
- Important information to gather for a focused respiratory history includes:
- Antepartum
- Intrapartum
- Neonatal

Diagnostic tests

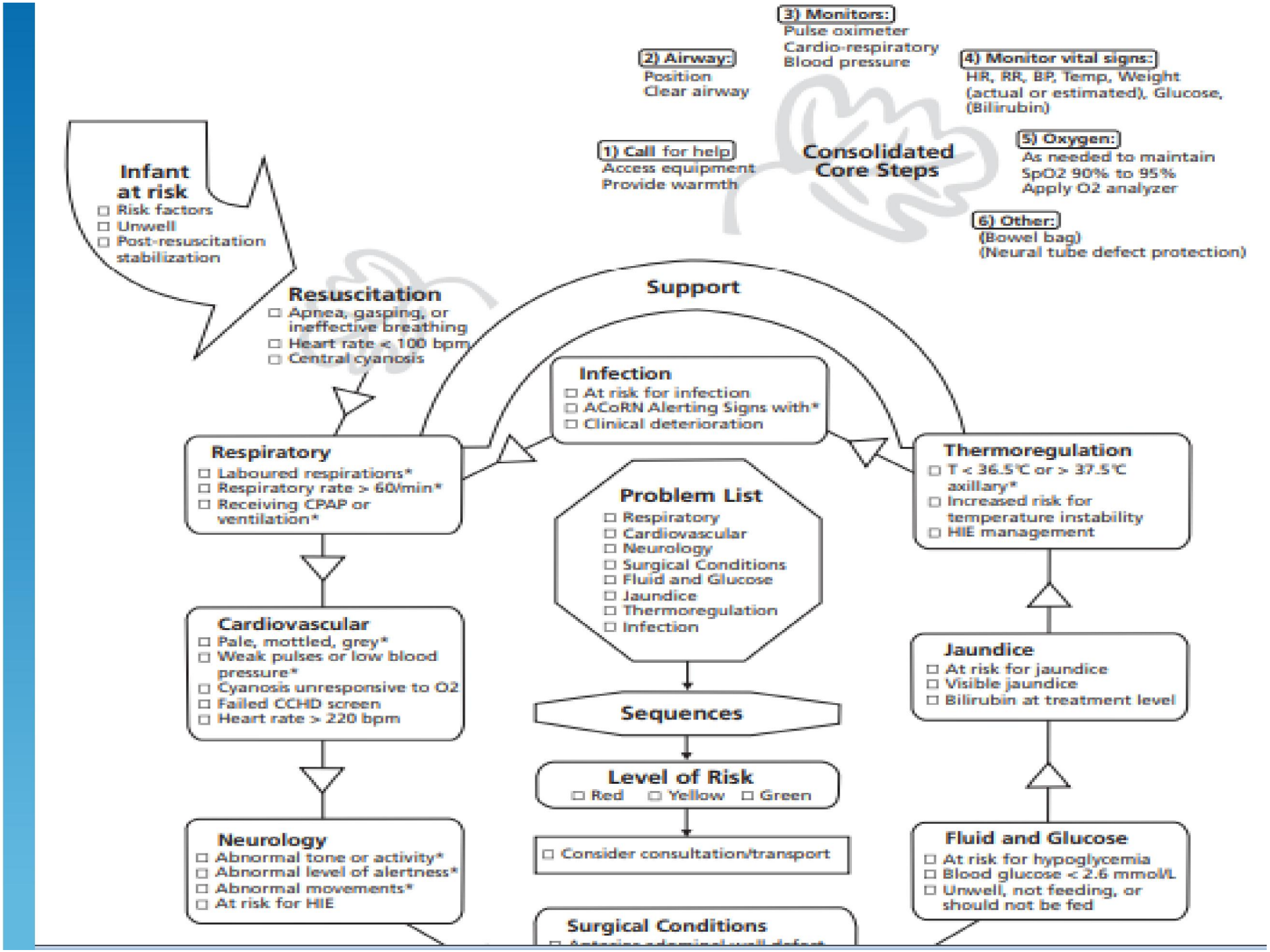
- are conducted for all infants entering the Respiratory Sequence except term infants with mild respiratory distress lasting less than 6 h.
- Vascular access
- Chest radiograph
- Blood gas

Optimize ventilation

- Optimizing ventilation involves ensuring that:
- • The infant is connected to the ventilator,
- • The ventilator or manual ventilation equipment is delivering the settings indicated and is not malfunctioning,
- • Chest expansion can be observed, and breath sounds are equal and symmetrical,
- • The infant breathes in synchrony with the ventilator and work of breathing has decreased , and
- • Pulse oximetry and blood gases are within the target range

Consider immediate consult

- Consideration should be given to obtaining immediate consultation for guidance depending on expertise with managing neonatal respiratory disease and the resources available on site. When an infant's needs exceed or are anticipated to exceed site capabilities, early recognition and planning for transport can be lifesaving. While waiting for diagnostic test results, the ACoRN provider should establish a working diagnosis based on the presentation of mild, moderate, or severe respiratory distress and a Level of Risk category for this infant.


Consolidated Core Steps
1) Call for help
Access equipment
Provide warmth
2) Airway:
Position
Clear airway
3) Monitors:
Pulse oximeter
Cardio-respiratory
Blood pressure
4) Monitor vital signs:
HR, RR, BP, Temp, Weight (actual or estimated), Glucose, (Bilirubin)
5) Oxygen:
As needed to maintain SpO2 90% to 95%
Apply O2 analyzer
6) Other:
(Bowel bag)
(Neural tube defect protection)
Infant at risk
Risk factors
Unwell
Post-resuscitation stabilization
Resuscitation
Apnea, gasping, or ineffective breathing
Heart rate < 100 bpm
Central cyanosis
Support
Infection
At risk for infection
ACoRN Alerting Signs with*
Clinical deterioration
Respiratory
Laboured respirations*
Respiratory rate > 60/min*
Receiving CPAP or ventilation*
Problem List
Respiratory
Cardiovascular
Neurology
Surgical Conditions
Fluid and Glucose
Jaundice
Thermoregulation
Infection
Thermoregulation
T < 36.5°C or > 37.5°C axillary*
Increased risk for temperature instability
HIE management
Cardiovascular
Pale, mottled, grey*
Weak pulses or low blood pressure*
Cyanosis unresponsive to O2
Failed CCHD screen
Heart rate > 220 bpm
Sequences
Jaundice
At risk for jaundice
Visible jaundice
Bilirubin at treatment level
Level of Risk
Red
Yellow
Green
Neurology
Abnormal tone or activity*
Abnormal level of alertness*
Abnormal movements*
At risk for HIE
Consider consultation/transport
Fluid and Glucose
At risk for hypoglycemia
Blood glucose < 2.6 mmol/L
Unwell, not feeding, or should not be fed
Surgical Conditions