Florida Perinatal Quality Collaborative Potentially Better Practice Guidelines in Golden Hour Part I: Delivery Room management

Potentially Better Practices	Supporting Evidence
TEAM WORK & ANTENATAL MANAGEMENT **FPQC goal:** *Develop and utilize a specific delivery room (DR) management plan in infants with GA ≤30 6/7 wks or anticipated BW ≤1500 g who are admitted to the NICU to facilitate: 1. Pre-defined DR team roles assigned in ≥50% of deliveries, 2. DR team debriefings within 4 hours of delivery in ≥50% of infants.*	
Organize DR care as you would NICU care[1] Determine your hospital's process for DR management. Useful quality improvement methodologies include: • Scripting • Process mapping (e.g., fishbone diagrams, value stream mapping) • Lean thinking approach (i.e., increase efficiency, reduce waste in time/materials) • Evaluation of process parameters	Premature and very low birth weight (VLBW; ≤1500 g) infants have unique requirements for effective transition from fetal to extra-uterine life. They are at increased risk for severe hypothermia and respiratory failure, which significantly increases the risk of morbidities and mortality. Creation of a DR environment that closely mimics the NICU, appropriate preparation, and effective interventions decreases these risks.[1]
Utilize a standardized, scripted, multi-disciplinary approach to enhance coordination and guidance of initial management for all newborn infants.[2]	The resuscitation and initial stabilization of newborn infants is a transition consisting of several discrete processes that require coordination of personnel and equipment. Events occurring during this transition can affect immediate survival and long-term morbidity. A coordinated team effort improves outcomes.[2]

Understand the hospital's delivery team process. Suggestions include:[2] • Develop a hospital policy for DR team composition (e.g., based on infant demographics, singleton and multiple gestation deliveries, multiple simultaneous deliveries) • Provide clearly defined DR team roles • Allow DR team members to have appropriate training (e.g., scripting, simulation) and experience in resuscitation practices and communication techniques. • Ensure labor and delivery staff is capable of providing basic NRP care in the event of delayed DR team arrival.	A skilled and capable DR team that can provide the most appropriate resuscitation, support, and evaluation should attend all deliveries. Newborn resuscitations generally include a well-defined, analyzable series of processes that routinely occur in specific locations, and a well-defined team of individuals using appropriate equipment usually conducts them. A DR team's composition is unique to each hospital and varies depending on clinical resources and individual patient needs.[2] FPQC recommends a minimum of 3 health care providers be available and committed solely for evaluation and care of newborns with GA ≤30 wks or BW≤1500 g (i.e. roles of Team leader, Respiratory, and Circulation). A concerted team effort to coordinate and communicate is vital given the range of tasks, space and equipment limitations, and variable team composition. Process analyses and scripting resuscitations facilitates standardization and improvement of team function.[2]
Anticipate and prepare for potential admissions and deliveries. Suggestions include: [2] • Develop a communication process between obstetric and neonatology services to notify the DR team of potential admissions (e.g., huddles) and to ensure the team is immediately available for delivery (e.g., m phone, beeper, overhead page). • Pre-brief DR team and assign tentative roles. • Develop a pre-delivery preparation checklist of DR and admission tasks. • Provide a prenatal neonatology consult if possible.	Pre-admission activities are a series of multiple tasks, which may happen simultaneously or in a sequence. Ideally, some of these tasks are completed before the DR team arrives at a delivery. Providers who are responsible for resuscitation and admission of infants should receive education, training, and evaluation of necessary tasks.[2]

While FPQC does not define a standard set of initial stabilization steps, individual centers can track this over time as a quality metric. Examples of some of these measures might include:[2] • Respiratory support on transport to the NICU • Time required to administer surfactant and dextrose, and to obtain IV access • Time required to complete an established stage of stabilization (i.e., IV access obtained, IV fluids administered, X-rays completed, respiratory support in place, oximeter functioning, vital signs, time laboratory specimens sent recorded)	Because determinants of long-term outcomes of VLBW infants are multifactorial, it is unlikely that institutions can verify that changes in resuscitation procedures improve outcomes. Measurements of short-term care process and clinical outcomes can be used to indicate quality of resuscitative efforts. Use of these measurements is supported by findings that several, such as admission temperature, are associated with long-term outcomes of VLBW infants. Other measurements reflect the preparedness of the team and the consistency of the resuscitative efforts, both of which should be associated with improved clinical outcomes.[2]
Script and rehearse resuscitations using defined roles and common goals. Stress the importance of teamwork through cooperation and communication when learning resuscitation strategy. Benefits of this approach for neonatology resuscitation include the potential to:[2] • Clearly outline tasks • Facilitate awareness and communication between team members • Establish a timeline • Facilitate uniformity and allow for rehearsals • Educate staff on rationale behind interventions • Facilitate review and revision of protocols and scripts • Allow for amendment of timelines and role assignments • Allow for continuous, safe, real time feedback	Scripting and rehearsing resuscitations improves uniformity of practices and improves process measures. Improvements associated with consistency in practice are reported for non-medical fields, including those with high-risk activities such as commercial aviation, nuclear energy and the military [3]. Benefits of planned, scripted approaches in health care are reported for cardio-vascular surgery management [4], emergencies, and trauma.[5] Uniformity of practice improves consistency in performing resuscitation tasks by facilitating: training of new participants; identification of outlying practices and process-associated outcomes; evaluation and comparisons of alternative practices.[2] The delivery room is a highly technical, complex, dynamic environment where potentially life-threatening emergencies are common. A coordinated team response with members having cognitive (content knowledge), technical (hands-on procedures), and behavioral (teamwork) skills is critical to a successful resuscitation.[6,7]

Implement an effective process for teaching, developing, and assessing individual and team-related delivery room care processes.[7]
• Support the practice of constructive pre-briefings and debriefings of individual and team performance during real neonatal resuscitations
• Participate in simulation-based perinatal team training in training (classroom) and/or real (hospital) environments with goals of:
  • Conducting and debriefing simulated high-risk events, difficult deliveries, and neonatal resuscitations.
  • Simulating new delivery room processes/systems before they are implemented to determine weaknesses and institute corrective actions before use in actual patient care.
	Simulation-based perinatal team training provides multiple, realistic visual, auditory and tactile cues, which facilitates deep learning and lasting memory[8-10]. Constructive debriefings after simulations facilitate reflective discussion, reinforce important educational objectives, and build learners' confidence. Individuals are able to analyze interventions, synthesize performance, and identify areas for improvement.[7]
	
	Simulations enable individuals and the team to demonstrate appropriate cognitive, technical, and behavioral skills that are necessary for optimizing patient care. Simulation experiences can be individualized, be directed towards particular strengths and weaknesses, and be adapted to level of experience.[7]
	
	The International Liaison Committee on Resuscitation, American Academy of Pediatrics, American Heart Association, and Joint Commission for Accreditation of Healthcare Organizations support training through simulation, briefing, and debriefing techniques.

Implementation strategies[1,2,7]
Address the following critical tasks to implement the standardized, scripted approach. • Obtain consensus on policies/procedures used for high-risk deliveries. • Identify specific, identifiable patient populations that require a different team composition. • Develop policy/procedure for special deliveries and determine process to communicate these actions in deliveries. • Determine how your standardized approach can be adopted and applied in non-standard delivery locations (e.g., emergency department, in elevator during maternal transport, antenatal floor). • Ensure systems in place to enable all providers to know the pre-defined DR team role for which they are responsible. • Ensure that team members are readily available and easy to contact. • Identify equipment that should be readily available and accessible for all deliveries including high risk deliveries, where equipment can be stored, person responsible for quickly transporting equipment to resuscitation site, and person responsible for periodic checking of equipment and restocking supplies after use. • Ensure there is an evaluation process and feedback to evaluate effectiveness of actions taken during a specific delivery. • Ensure there are process/outcome measures to assess, monitor, and evaluate task performance. • Simulation based training requires human, financial, and technological resources. Clearly define patient safety aspects of training and work closely with Quality Improvement and Risk Management departments to improve patient care.

	TeamSTEPPS briefing checklist[11]
	Who is on core DR team?
	All members understand & agree upon goals?
	Roles & responsibilities understood?
	Plan of care identified?
	Staff availability assessed?
	Workload assessed?
	Available resources assessed?

	TeamSTEPPS debriefing checklist[11]
	Communication clear?
	Roles & responsibilities understood?
	Situation awareness maintained?
	Workload distribution?
	Did we ask for or offer assistance?
	Were errors made or avoided?
	What went well, what should change, what can improve?

THERMOREGULATION **FPQC goal:** *Develop and utilize a specific DR management plan to achieve target NICU admission temperatures of 36.5°C-37.5°C in ≥ 75% infants with GA ≤30 6/7 wks or anticipated BW ≤1500 g (without regard to DR ambient temperature).*	
Maintain a normal core body temperature (i.e., 36.5-37.5°C) by considering and utilizing a variety of techniques:[12]	Despite the use of standard DR thermoregulatory measures, infants lose heat quickly after delivery when transported from the warm intrauterine environment to the cooler DR environment. Preterm infants are at particular risk for hypothermia during this time because of immature thermoregulatory mechanisms (i.e., underdeveloped epidermis, decreased brown fat stores, increased surface area-to-body weight ratio). Hypothermia (<36.5°C) is associated with respiratory compromise, increased oxygen consumption, hypoglycemia, metabolic acidosis, cardiovascular changes, intraventricular hemorrhage (IVH), necrotizing enterocolitis, and mortality.[13] [12,14] Hyperthermia (>37.5°C) is associated with cardio-respiratory compromise and lethargy. Neonates are prone to excessive heat loss after delivery via convection (i.e., ambient room temperature, humidity), conduction (i.e., cold blankets or mattress), evaporation (i.e., immature epidermal barrier), and radiation. Temperature regulation is a recognized problem in the VON network. FPQC 2011 data revealed that approximately 50% of VLBW infants had an admission temperature <36.5°C.
Assign a dedicated individual the task of monitoring the infant's temperature[12] • Ensure timely placement of the temperature sensor • Note the infant's temperature every 5 minutes while in the DR-resuscitation area • Transport infant to NICU in a warmed transport incubator	The temperature probe must be placed as part of the routine resuscitation by an assigned team member and should be placed according to the manufacturer's instructions. Lightly drying the skin in the area where the probe will be placed may improve adherence to the skin. Remember that the temperature probe is monitoring the infant's skin temperature – not their core temperature. Birth to NICU admission takes approximately 23 minutes for the typical ELBW infant. Temperature should be measured every 5 minutes while in the delivery and resuscitation areas. [15] Maintain temperature control during transport from the delivery room to NICU using a warmed transport incubator.[12]

Ensure proper use of the radiant warmer[12] • Use the servo control mode • Set the appropriate "target" temperature (often starting the skin temperature at 37°C).	A pre-warmed servo-controlled radiant warmer promotes normothermia in VLBW infants. Radiant warmers used at manual mode decrease power after 15 minutes of use and must be reset to continue providing adequate heat. Use the servo-control mode to avoid this problem and help prevent hyperthermia.[12]
Additional tasks for infants with GA ≤30 wks or BW≤1500 g may include:[12] • Ensure that the DR or resuscitation ambient temperature is at minimum 26°C (79°F).	NRP 6th edition, AAP, and WHO have made recommendations for DR ambient temperatures, with minimum ranges of 24-26°C (75-79°F). A *post hoc* analysis of the Knobel 2004 trial demonstrated the significant effect of DR temperatures on infant temperature. VLBW infants delivered in rooms with a temperature >26°C (79°F) and wrapped in polyurethane bags were the only subgroup with an average admission temperature >36.4°C.[16]
• *Without drying* the infant, wrap in a polyethylene occlusive dressing or place infant in a standard one-gallon food quality polyethylene bag. Ensure plastic wrap covers as much of the infant as possible.	Several trials have demonstrated improved admission temperatures in infants GA<28-29 wks with use of plastic wrap (as a sheet of polyethylene wrap or a polyurethane bag) immediately after birth without first drying the skin.[16-18] Plastic wrap should have similar levels of sterility similar to other neonatal resuscitation devices. [16] NRP 6th edition recommends use of a re-closable polyethylene bag which can be a "standard 1-gallon, food-quality polyethylene bag purchased in a grocery store".[19,20]
• Dry infant's head and place a cap on the infant's head.	Because an infant's head has a large surface area, it is a significant source of heat loss when wet. The infant's head should be dried and cap placed, despite the use of plastic wrap around the body. The wrap is not applied to the head. [12]
• For VLBW infant: place on exothermic mattress below pre-warmed blankets on which the infant is placed.	One small, randomized trial evaluating prevention of hypothermia in VLBW infants using a TransWarmer Infant Transport Mattress™ found those treated with the mattress had a lower incidence of hypothermia.[21] This type of single use exothermic gel mattress is chemically activated and heats to an average of 38°C for 2 hours without an electrically powered source.[22]

Implementation strategies[12]	
Strategies	• Assign a dedicated individual the task of monitoring the infant's temperature. • Have equipment and thermoregulation supplies prepared prior to infant's delivery. • Turn radiant warmer on full power in *manual* mode while awaiting delivery. • Ensure appropriate ambient temperature of delivery/resuscitation room. • Gently dry skin where temperature probe will be placed. • Ensure that warmer is *switched to "Servo"* mode after placing probe. • Measure infants' admission temperatures every 5 minutes in the delivery/resuscitation room.
Barrier	• Perception that infant will be more difficult to access when wrapped. • Coordination with other resuscitation tasks. • Conflicts with other occupants of delivery room regarding ideal temperature.
Measures	Observe resuscitation team performance: • Is the team able to coordinate function to accomplish all tasks? Clinical drills may be required to establish confidence in completing additional tasks. • Do the resuscitation team members and obstetricians understand the importance of avoiding hypothermia? • How frequently are the desired actions implemented?

<table>
<tr><th colspan="2">MONITORING SUPPLEMENTAL OXYGEN USE[1,12]
FPQC goal: *Develop and utilize a specific DR management plan to achieve compliance with NRP oxygen targets (85-95%) at 10 minutes of life in ≥50% infants with GA ≤30 6/7 wks or anticipated BW ≤1500 g who are admitted to the NICU.*</th></tr>
<tr><td>**Pulse oximeter use is important** to continuously monitor oxygen saturations and heart rate. The audio function of the oximeter can facilitate resuscitation by automatically communicating these parameters to team members.[12]</td><td>Cyanosis can be difficult to detect visually and may not be apparent until oxygen saturations are <70%.[23] Use of a pulse oximeter is required for more precise measurement of oxygen saturation and to guide titration of supplemental oxygen administration. NRP 6th edition recommends use of oximeters and a targeted oxygen strategy to gradually increase the neonatal SpO_2 approximating intrauterine values over the first 10 minutes of life. This strategy requires the use of air and an oxygen blender in the DR.[12,19,21]</td></tr>
<tr><td>**Assign a dedicated individual to place the pulse oximeter probe**:[12]
• Notify team of actual heart rate (in bpm).
• Individuals designated for this task should perform this role for all deliveries to ensure consistent task performance and to achieve dexterity with probe placement.
• To avoid delays in obtaining useful signal display on oximeter:
o Turn the oximeter on while preparing for infant's delivery
o Attach probe to pre-ductal site (i.e., right hand or wrist) *before* connecting to oximeter
• Keep oximeter audio turned on for heart rate and saturation tone to be audible to all team members.</td><td>NRP 6th edition recommends intermittent monitoring of heart rate by auscultation.[19] Pulse oximetry devices usually are functional after 60-90 seconds. We recommend monitoring heart rate continuously until the oximeter monitor is functional. Techniques to monitor heart rate include: continuous palpation, auscultation, or electronic heart rate monitors.[12]

Reporting actual heart rate (bpm) has been shown to improve accuracy, as opposed to reporting heart rate below targets of <100 bpm or <60 bpm.[24]

A saturation probe placed pre-ductally displays slightly higher values than if placed post-ductally.[12]</td></tr>
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Optimize oxygen administration by administering oxygen using techniques similar to those used in the NICU:[1]

- Provide supplemental oxygen appropriate to the oxygen needs of the infant by utilizing a blender to mix oxygen and compressed air (if your DR has that capability).
- Initiate resuscitation with FiO_2 21% to 40%.[19]

Hyperoxia may induce oxidative stress injuries in ELBW infants. Because the anti-oxidative system of premature infants is not fully developed, they are at increased risk of developing diseases associated with oxygen radical damage (e.g. ROP, BPD, NEC, IVH).[12,25]

Meta-analysis of trials including term and preterm infants evaluating use of room air vs. oxygen demonstrate decreased overall mortality in those resuscitated with room air.[26-28] The use of 100% oxygen in previous trials was not associated with a more rapid rise in SpO_2 in near term infants.[1,29]

- Adjust the administered supplemental oxygen according to the infant's condition and NRP guideline target ranges.[19]

Minutes of life	NRP target SPO2
1	60-65%
2	65-70%
3	70-75%
4	75-80%
5	80-85%
10	85-95%

Prior to a normal delivery, in utero SpO_2 measures are approximately 50-55%. By 5 minutes, SpO_2 measures in term infants not requiring resuscitation are approximately 85% to 90%. These measures are thought to be lower in preterm infants.[30-33] Until more evidence becomes available about the optimum oxygen saturation as measured by pulse oximetry for a preterm baby, it is recommended to try to keep the infant in the same saturation range as recommended for a term infant.[1,19]

Pulse oximeter use allows targeting of SpO_2 values. These devices are usually functional after 60-90 seconds. Thus, reasonable targets are a SpO_2 of 70-75% by 3 minutes, 85-90% by 5 minutes, and 85-95% by 10 minutes.[1]

Implementation strategies[1,12]	
Strategies	• Use a pulse oximeter with audio turned on in neonatal resuscitations. • Assign a dedicated individual to place the pulse oximeter probe on a pre-ductal site. • Have equipment prepared prior to infant's delivery. • Set oxygen blender setting to 21-40% prior to infant's delivery. • Turn on oximeter when preparing for infant's delivery. • Attach probe to pre-ductal site *before* connecting to oximeter. • Continuously monitor heart rate until oximeter is functional. • Adjust FiO_2 based on infant SpO_2 values using NRP guideline targets, and monitor every 1-minute once oximeter is functional until NICU admission.
Barriers	• Perception that it will be more difficult to place pre-ductal pulse oximeter probe when infant is wrapped. • Coordination with other tasks of resuscitation. • Duration from time of pulse oximeter probe placement to functional reading on oximeter.
Measures	Observe resuscitation team performance: • Is the team able to coordinate function to accomplish all tasks? Clinical drills may be required to develop comfort with additional tasks. • Do the resuscitation team members understand the importance of avoiding hypoxia and hyperoxia? • How frequently are the desired actions implemented?

DELAYED CORD CLAMPING[34] **FPQC goal:** *Develop and utilize a specific DR management plan to implement delayed cord clamping for 30-60 seconds in ≥50% of infants with GA ≤30 6/7 wks or anticipated BW ≤1500 g.*	
Collaborate with Obstetricians to develop a delayed cord clamping (DCC) protocol for infants with GA≤30 wks and BW≤1500 g.	Delayed clamping of the umbilical cord for 30-60 seconds after birth in preterm infants increases hemoglobin concentration, reduces the need for blood transfusions, increases systemic blood pressure, and decreases the incidence of any intraventricular hemorrhage. Reported benefits in term infants include higher hemoglobin, serum ferritin, and iron stores at 1 year of age. The WHO, ACOG, Society of Obstetricians and Gynecologists of Canada, European Association of Perinatal Medicine, and the International Liaison Committee on Resuscitation recommend delayed cord clamping as standard of care**.** Transfusion benefit of increased blood volume in DCC approximates 5-15 cc/kg in operative (CS) delivery and 10-30 cc/kg in vaginal births.[34]
Determine the method for cord clamping (i.e., milking vs. delayed clamping)	Utilizing a delayed cord clamping practice vs. milking the umbilical cord results in similar benefits.[35]
Determine your hospital's process for delayed cord clamping and consider:[34] • Maternal relative or absolute contraindications (e.g. maternal hypotension, uterine contraction and drugs affecting uterine contraction) • Relative or absolute contraindications (e.g., infants at high risk for polycythemia or hyperbilirubinemia) • Infant positioning during delayed cord clamping • Infant precautions during delayed cord clamping (e.g. dry and stimulate infant, use of warm towels)	The ideal position of the infant in relation to the placenta at delivery is within the range of 10 cm above or below the placenta.[35]
Determine the timing for delayed cord clamping.[34]	Studies demonstrate that functional closure of umbilical arteries begins at 45 seconds of life and there is significant closure of the umbilical vein by 2 minutes of life. A number of studies have evaluated the efficacy and safety of delayed cord clamping for 30-60 seconds in preterm infants.[35]

Educate team members and mother/infant providers about delayed cord clamping and address concerns, [34] which may include: • Perception that resuscitation may be delayed • Obtaining cord blood for banking purposes • Potential effects on infant outcomes (e.g., thermoregulation, polycythemia, hyperbilirubinemia)	Concerns regarding urgency of resuscitation after birth, infant temperature on NICU admission, cord blood banking, and degree of placental transfusion previously promoted immediate cord clamping (usually within 15 seconds of birth). Recent evidence suggests delayed cord clamping may particularly benefit infants who demonstrate fetal distress through the following proposed mechanisms: increasing oxygenated blood flow to the infant, providing ideal cardiac output, and aiding in transition to neonatal circulation. Studies comparing delayed versus immediate clamping for deliveries of preterm infant report no significant differences in Apgar scores, umbilical cord pH, NICU admission temperatures, degree of respiratory distress, or need for exchange transfusion (for hyperbilirubinemia or polycythemia). Elective cord blood banking is not considered an appropriate reason for immediate cord clamping. Studies show inconsistent results regarding incidence of polycythemia, hyperbilirubinemia, and need for phototherapy in term infants. Concerns of increased risk of postpartum hemorrhage have not been substantiated.[35]
Educate parents about delayed cord clamping and address concerns.[34]	A verbal informed consent approach (risks, benefits and alternatives) may prove to be the Family Centered way to achieve universal implementation.[34]

Implementation strategies[34]	
Strategies	Collaborate with obstetricians to develop a delayed cord clamping protocol, which addresses the method, process, and timing for cord clamping.
Barriers	• Address provider concerns for infant and mother affected by delayed cord clamping through education. • Address parental concerns for infant and mother affected by delayed cord clamping through education.
Measures	Observe delayed cord clamping process: • How frequently is delayed cord clamping implemented according to developed protocol? Clinical drills may be required to develop confidence with delayed cord clamping process. • Are there perceived infant or maternal concerns associated with delayed cord clamping? • Do the resuscitation team members and obstetricians understand the importance of delayed cord clamping?

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