Published in final edited form as:

Clin Perinatol. 2017 September ; 44(3): 663–681. doi:10.1016/j.clp.2017.05.003.

Tackling Quality Improvement in the Delivery Room

Wannasiri Lapcharoensap, MD¹ and Henry C. Lee, MD, MS^{2,3}

¹Department of Pediatrics, Oregon Health & Science University, Portland, OR 97239

²Department of Pediatrics, Stanford University, Stanford, CA 94305

³California Perinatal Quality Care Collaborative, Stanford, CA 94305

Synopsis

Implementation of standardized practices in the delivery room fosters a safe environment to ensure that newborn infants are cared for optimally, whether or not they require extensive resuscitation. Quality improvement (QI) is an excellent methodology for implementation of standardized practices due to the multidisciplinary nature of the delivery room, the complexity of the tasks involved, and opportunities to track measurable processes and outcomes. In this article, we discuss the various ways that the delivery room is a unique environment and present specific examples on how to approach delivery room QI. Key areas of potential focus for teams pursuing delivery QI include thermal regulation, optimizing respiratory support, and facilitating team communication.

Keywords

Quality improvement; neonatal resuscitation; very low birth weight infant; delivery room; labor & delivery

Introduction

The initial cry of a newborn baby is part of a sequence of events marking a successful transition from intrauterine to neonatal life. With that first cry, the infant pushes fetal lung fluid out and fills the alveoli with air to oxygenate. The pulmonary vasculature relaxes, pulmonary blood flow increases, and oxygenated blood returns to the heart allowing the infant to achieve independence from placental blood supply. While this process occurs smoothly in most deliveries, an estimated 5-10% of all newborn deliveries require active assistance at birth (such as stimulation, suction, etc.) and 1% of births require intensive resuscitation measures.¹ The incidence of intensive measures, such as cardiopulmonary resuscitation (CPR), is inversely correlated with gestational age and independently associated with increased morbidity and mortality.²⁻⁵ Furthermore, in each delivery room,

Corresponding author: Henry C. Lee, MD, MS 1265 Welch Road, Stanford, CA 94305 hcllee@stanford.edu; Wannasiri Lapcharoensap, MD, Oregon Health & Science University, 707 SW Gaines Street, CDRCP, Portland, OR 97239, lapcharo@ohsu.edu. Conflicts of interest: None.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

the safety of both the mother and infant are paramount and the sheer number of equipment and personnel required can contribute to a seemingly chaotic environment. Given the unpredictable nature of the delivery room, there is a need to establish standardized practices and optimize workflow among labor and delivery units to ensure effective care in a timely manner.

The International Liaison Committee on Resuscitation (ILCOR) and the Neonatal Resuscitation Program (NRP) guidelines help provide a framework for the workflow of a delivery room.⁶⁻⁸ Skilled personnel present at the delivery must possess the technical and behavioral skills for resuscitation, while also ensuring that equipment is readily available. Implementation of these guidelines and training of personnel are often carried out and improved upon by institutional quality improvement (QI) projects. Delivery room QI is aimed at identifying and improving quantifiable processes to ensure that teams are prepared for all resuscitations. In this article, we will discuss what makes the delivery room a unique environment for QI, the various facets of delivery room QI, and specific examples on how to approach delivery room QI.

The Context of the Delivery Room for Quality Improvement

The conceptual frameworks for quality of care in the healthcare setting share a common theme of developing a work *environment* in which providers work as a *team* to reliably execute *processes* of care that are known to work and to avoid care that may be harmful.⁹ When we consider the environment, team and processes that are relevant to delivery room care, we note several distinguishing features that may differ from other healthcare settings (Box 1).

Unique Physical Environment—First, the environment of the delivery room can be challenging due to the sheer number of people involved. For example, in the operating room before an infant is born by emergency cesarean section, there can be more than 10 people encompassing 3 different medical teams (obstetrics, pediatrics, and anesthesia) who must work together to ensure safety of both the mother and the fetus / newborn in a discrete amount of time and often in a small amount of space. Each medical specialty plays an important role to improve neonatal outcomes.

One Point in a Continuum of Care—Delivering optimal care in the delivery room requires specific preparation and the team's actions in the delivery room can have immediate consequences. However, although it may be obvious, it is worth noting that the delivery and birth of the infant is but part of the overall care of the mother and fetus / neonate. When we consider QI to improve processes and outcomes for neonatal resuscitation, we can also closely examine care of the mother and fetus / neonate preand postnatally. The goal to improve neonatal outcomes through QI in the delivery room may be hindered by sub-optimal care that happens prior to or after delivery. For example, administration of antenatal steroids prior to preterm birth is an evidence-based practice; therefore, QI to facilitate consistent practice may complement ongoing delivery room QI for respiratory management.¹⁰ Similarly, a lack of standardization in the NICU for post-extubation management could negate gains made in the delivery room.

Unpredictable Nature of Deliveries—While perinatal risk factors may assist with risk stratification and subsequent preparation for deliveries, a newborn infant may require emergency resuscitation without the presence of any warning signs. Thus any delivery room QI should also consider the unpredictable nature of the delivery room in order to consistently apply processes to infants most at-risk and in need of delivery room assistance. Providers and staff caring for mothers and infants should be familiar with their own institutional processes on how to call for assistance initially and for further help when there is a need to escalate care.

Quality Data Acquisition—A crucial component of QI is standardized data collection in order to track performance. In considering Donabedian's framework of contextual, process, and outcome measures (including balancing measures), delivery room QI will include those outcomes that are measured immediately, but also may include longer-term outcomes.¹¹ Data collection in the delivery room can be more challenging than other healthcare settings. During and after a neonatal resuscitation, the clinicians involved may not have time to document in real-time or even immediately following the resuscitation, as they may be busy with post-resuscitation care in the neonatal intensive care unit (NICU). Therefore, working on data quality may be an important aspect of a delivery room QI project.

Strategies for Implementation

The unique context of the delivery room translates to aspects of implementation that might also be different from traditional quality improvement strategies (Box 2).

Data collection: Standardized forms—Acquiring appropriate data from the delivery room for review and QI activities may be challenging. Data may be present in the mother's, infant's, or both medical records, and there may be inconsistencies across multiple data sources. The activities surrounding the delivery and resuscitation may not be recorded immediately, and subject to errors in recall. Often, there is a circulating nurse assigned to the obstetric team to record times and other actions that are called out as they occur. However, such record-keeping for neonatal resuscitation is often less consistent.

An aid in data collection for neonatal resuscitation activities can be a standardized form that contains all of the pertinent variables that may be considered important for the medical record and for assessment of quality. In the current environment of electronic medical records, most systems will facilitate a customized form that contains both standard items required at every delivery (time of birth, Apgar scores), additional variables if resuscitation is required, as well as free text. An electronic medical record system that can automatically fill pre-selected fields with data from the maternal record can also reduce errors in manual transfer of data. In the process of pursuing a QI project, there may be additional variables that can be standardized for data collection. For example, in 2015, the California Perinatal Quality Care Collaborative implemented an optional data collection for delayed cord clamping (DCC) in order to facilitate QI in this area.¹² For this purpose, participating centers have collected data on the following 4 questions:

1. Was delayed umbilical cord clamping performed?

2. (If yes to 1) How long was delayed cord clamping?
3. Was umbilical cord milking performed?
4. Did breathing begin before umbilical cord clamping?

By standardizing the data collection for delayed cord clamping, the electronic medical record can be used to keep track of process measures that are relevant to the QI project.

Video review for data collection and QI—Video recording and review in the delivery room can be one solution to improving data collection, and also facilitate QI activities.^{13,14} Investigators at the University of California San Diego (UCSD) have had extensive experience in the implementation of video recording of neonatal resuscitations in order to facilitate QI.¹⁵ Video review can be used to evaluate the performance of teams in providing neonatal resuscitation in regard to following the NRP guidelines, which can be used to develop specific QI goals in order to address deficiencies.¹⁶ Performance in following NRP guidelines may include excessive action, or errors of commission, such as giving oxygen unnecessarily, as well as errors of omission, such as missing corrective steps to address ineffective positive pressure ventilation.^{16,17}

The UCSD team has used audio and video recordings of neonatal resuscitations since 1999 for the purpose of quality assurance.¹⁵ Their experience has shown that the medical record is not always consistent with actual practice, and can facilitate areas for improvement in communication, systems issues, and team performance. In addition to video recordings, the team at UCSD can also use simultaneous physiologic recordings in order to align team actions with clinical data.¹⁵

When considering the start of a video recording program, each center will need to research local regulations and resources available to support the program. A recording system and procedures that can ensure confidentiality for both patients' families and personnel will be crucial. In the UCSD program, video recordings are erased at most 14 days after the event.¹⁵ Centers like UCSD have determined that video recording in the delivery room for the purpose of quality improvement does not require family consent, as it is for the purpose of quality improvement and adequate protections for privacy have been established. If videos are saved for teaching purposes, an explicit consent can then be obtained. Similar to UCSD, a center in German video records resuscitations as a part of routine patient care and approved to do so without consent.¹⁸ However, other centers may determine that consent is required and then may be obtained as either part of a general consent form completed on admission, a specific consent for recording in the delivery room, or signs posted noting the potential recording.

For particularly salient video and audio recordings that could inform future educational efforts, there may be procedures to save recordings for that purpose with consent obtained from patients' families and any personnel that may have been involved in the resuscitation. State regulations may protect recordings that are for the purpose of quality assurance from medico-legal use. Such regulations should be reviewed by local risk management and quality assurance teams prior to program implementation.

Incorporation of the Checklist—The delivery of a newborn and potential neonatal resuscitation that follows is a relatively quick process. Resuscitation equipment and supplies should be readily available for every delivery. Therefore, preparation prior to delivery is a crucial element to consider in QI. Utilization of checklists can help ensure consistent and accurate set-up of equipment and supplies for each delivery room. Checklists in healthcare improve safety, reduce human error, and ensure that safety standards are met.^{19,20} In a survey of the most optimal elements in a delivery room checklist, participants of a year-long collaborative QI project noted the broad category of checking and preparing all equipment as the most important content of a checklist.¹⁹ For those clinicians that attended more than 20 deliveries annually, introducing the team and assigning roles was also considered important. The NRP textbook provides a quick equipment checklist and encourages users to tailor the list to their own institution (Figure 1).⁷ Checklists may be categorized either according to the specific NRP step or task, and often a supplemental checklist is required for very premature infants. Incorporation of the checklist is consistent across multiple successful QI initiatives in different areas of the delivery room, including equipment checks, preand post-delivery briefings, communication techniques, and specialized care for the extremely premature infant.^{19,21-26} In addition to facilitating resuscitations, checklists are also a tool for identifying areas for improvement in future QI projects.

Enhancing Skills with Simulation-based Learning—Institutions have different requirements on who is required to attend deliveries, often depending on known risk factors.²⁷ Ensuring that these are standardized to best care for the mother and infant is important. The skills of any person attending a delivery can be divided into content knowledge, technical skills and behavioral skills. These skills are often acquired via NRP course completion, which is renewed once every two years. Studies have demonstrated waning knowledge retention by 6 months following completion of the NRP course,^{28,29} thus supporting the argument that more frequent skill sessions are required. Simulation is a powerful methodology of adult learning with the benefit of allowing for mistakes to occur without harm to a real patient.^{30,31} For technical skills, such as proper mask positioning or intubation, performing short, brief skill sessions may be beneficial. This allows the provider to familiarize themselves with the delivery room environment and equipment. Behavioral skills can be enhanced with a more multidisciplinary approach, complex simulation sessions, and debriefing of the session to provide real-time feedback. In particular, simulation training is a unique opportunity to improve communication skills across multidisciplinary teams.^{32,33} Moreover, simulation-based training can be incorporated into quality improvement initiatives – such as improving time to CPAP application, utilizing new equipment to reduce hypothermia, or implementing new communication techniques – allowing delivery room attendants to practice new skills, familiarize themselves with new equipment, and identify system errors in a safe environment.

Multidisciplinary Team Approach: Crew Resource Management—The multidisciplinary nature of the delivery room lends itself to QI methodology while also necessitating a multidisciplinary approach to QI. Labor and delivery room staff are often required to be trained to resuscitate infants and may be called upon to assist in the event of a neonatal emergency. Furthermore, in the rare event that both the mother and infant are in

duress, the teams need to be prepared to work in close quarters to resuscitate two individual patients. Formal interdisciplinary simulation training of maternal emergencies with both obstetric and pediatric teams present has the potential to improve neonatal outcomes.³⁴⁻³⁶

The development of teamwork across disciplines may be enhanced by crew resource management (CRM) – a concept developed by the aviation industry. In particular, communication failures heavily contribute to medical errors and can be improved upon by CRM training.³⁷ QI projects may incorporate CRM training as a tool to improve communication in specific arenas, such as ensuring closed loop communication during assessment of an infant's heart rate during delivery room resuscitation. Simulation is the optimal environment in order to assess and teach components of CRM.

Briefings and Debriefings—While ILCOR and NRP guidelines continue to suggest performing briefings and debriefings whenever possible,³⁸ briefings and debriefings are an important component of the delivery room that is often neglected. In a study of 84 NICUs, pre-briefs occurred 66% of the time and debriefings occurred only 19% of the time for very low birth weight (VLBW) infants.³⁹ Regular use of briefs and debriefings has been demonstrated to improve overall team communication during resuscitations.²⁴ The brief prior to delivery creates a shared mental model for the resuscitation team and ensures team readiness, similar to a team pause prior to procedures and surgical cases. Following a delivery, debriefing can be challenging as team members often disperse to continue care for the infant. Nonetheless, implementation of debriefing is crucial for identifying what went well, what did not go well, and what might be improved. Taking the time to debrief is a powerful tool for revealing systematic, technical or behavioral errors.

Utilizing Technology for Resuscitation—Since a neonatal emergency may occur in any location, hospital staff should be aware of what resources are available at their own hospital. Many community hospitals now have the capability to use communication technology, such as telemedicine, to assist with resuscitation and care of the neonate.⁴⁰ The use of telemedicine in adult trauma and burn patients has been shown to improve adherence to guidelines, overall management of patients, and increase provider confidence in taking care of patients in a remote location.⁴¹⁻⁴⁴ In neonates, telemedicine is a proven health information technology used to screen for retinopathy of prematurity due to scarce availability of qualified ophthalmologists.^{45,46} Though research in the neonatal resuscitation setting is limited, a high fidelity simulation study concluded that video assisted resuscitation significantly improved provider time to effective ventilation, and adherence to the NRP guidelines.⁴⁷ If live video-assisted telemedicine is unavailable, another recent high fidelity simulation study demonstrated that a tablet application turned on at the beginning of a resuscitation also allows staff to deliver resuscitation measures (PPV, intubation, chest compressions) in a timely manner and improve performance.⁴⁸ The incorporation of new technology into the workflow requires appropriate training and familiarization but may positively impact delivery room management of infants.

Specific QI opportunities / approaches

Although neonatal resuscitation occurs in a relatively short window of time, there are many unique aspects of neonatal care that can be used as focus points for improvement (Box 3). As QI efforts are undertaken, the various components that will lead to successful implementation may include equipment, training in technical and behavioral skills as noted above, and consideration of what outcome and balancing measures will be available or feasible for collection during the project (Table 1). While we have listed several areas of potential improvement in Box 3, we describe a few of those in more detail in this section. In particular, we highlight key components of delivery room QI in which there are examples for which QI has successfully led to improved processes and outcomes.

Optimizing the Resuscitation Cart—Delivering effective and timely resuscitation also depends on the ability to readily access effective code carts (resuscitation cart, code cart). Standardization of the code cart is shown to affect patient safety in the adult literature by improving nursing familiarity, confidence and performance.^{49,50} Using the LEAN methodology to improve resuscitation and emergency carts is a proven approach in not only neonatal emergencies, but also in pediatrics and adult care.⁵¹⁻⁵⁴ Human factors engineering principles to increase usability, while reducing human error and wasteful actions can be employed for QI projects to optimize the resuscitation cart. Further training to familiarize staff to the contents and location of the code cart is also paramount. Within each unit, establishing a culture of safety allows for appropriate use of the neonatal code cart during urgent and emergent situations.

Temperature Management—Admission hypothermia and hyperthermia of a newborn is associated with adverse effects, including increased risk of respiratory distress, intraventricular hemorrhage, and death.⁵⁵⁻⁵⁷ Several published QI initiatives have successfully reduced admission hypothermia by using published recommendations by NRP and the World Health Organization (WHO), such as ensuring correct use of blankets, hats, radiant warmers, and chemical mattresses and polyethylene wraps when indicated.^{25,58-61} Working to increase the ambient temperature of the delivery room or operating room is an effective method to prevent both maternal and neonatal hypothermia.⁶² Many of the studies on delivery room QI focused on improving admission temperatures among very low birth weight (VLBW) infants while utilizing checklists and a multidisciplinary approach to ensure adherence to guidelines. In one such study, rates of moderate hypothermia (admission temperature < 36°C) was reduced from 55% to approximately 6% without any increase in rates of admission hyperthermia (>37.5°C).⁵⁹ Given the known risks of hypothermia, QI focus on admission temperature has the potential to impact clinical outcomes.

Respiratory Support in the Delivery Room—The most recent recommendations from the Committee on Fetus and Newborn supports the use of continuous positive airway pressure (CPAP) immediately after birth in the preterm infant.⁶³ The rationale for this approach is the recognition that early CPAP applied optimally is associated with less intubation, may reduce the potential for long-term respiratory morbidity in the form of bronchopulmonary dysplasia, which may translate into lower healthcare utilization and improved childhood respiratory function.⁶⁴⁻⁶⁷ The efficient and optimal application of CPAP

in the delivery room will benefit from applying many of the principles noted above, including appropriate equipment set-up, briefing including assignment of roles, and communication skills.

Optimal respiratory management in the delivery room has multiple facets and steps (Table 2). As the NRP algorithm relies on accurate measurements of heart rate and oxygen saturation, role assignment and equipment set-up are key factors for effective QI. Further team training in communication and technical skills for ongoing assessment and providing effective positive pressure ventilation are needed to delivery optimal respiratory care.

Delayed Cord Clamping—Recent evidence for delayed cord clamping (DCC) has changed the practice of immediate cord clamping over the past decade. DCC has been shown to decrease incidence of intraventricular hemorrhage, lower need for transfusion, and lower rates of necrotizing enterocolitis in premature infants and iron deficiency anemia in term infants.^{68,69} Current recommendations from the American College of Obstetricians and Gynecologists, ILCOR, and NRP support delayed cord clamping for 30–60 seconds in infants not requiring resuscitation at birth.⁷⁰ Incorporation of DCC in the delivery room requires close coordination and clear communication between the neonatal and obstetrics team in order to keep time as well as determine safety of the mother and infant during DCC. The briefing prior to delivery can serve as a reminder on whether the mother and infant are appropriate candidates for DCC. Policies and procedures can be developed by the obstetrics and neonatal team to determine a list of patients (mother or infant) to be excluded from DCC in addition to logistics of who will be the responsible team member for the infant while attached to the umbilical cord. The latter can assist with any confusion that may potentially arise during DCC, such as who is holding the infant, who is assessing tone, and who is providing gentle stimulation. The California Perinatal Quality Care Collaborative (CPQCC) has developed a webpage with resources for improving quality of data collection and education surrounding DCC.¹²

Collaborative Quality Improvement

Aside from utilizing local resources, institutions may elect to participate in collaborative QI groups. These groups may be national, such as the Vermont Oxford Network (VON), or statewide, such as the CPQCC, or institution-network specific. Collaboration allows for sharing of potentially better practices and creates a culture of information sharing. For example, a specific toolkit for delivery QI was published by CPQCC and is freely available online.⁷¹ Furthermore, collaborative QI has been demonstrated to be effective in improving outcomes. In a CPQCC study on delivery room QI, those who participated in a collaborative QI had superior outcomes with decreased hypothermia and increased CPAP use compared to those hospitals that participated in stand-alone QI projects.²⁵ Furthermore, the collaborative QI group also had significantly reduced odds of developing bronchopulmonary dysplasia.⁷²

In an analysis of focus groups of participants in collaborative QI for delivery room management, several factors were noted as key drivers for positive change: tracking of individual and comparative performance measurement, visible positive impacts key components of the project, and initial and ongoing education on the evidence behind

practices.⁷³ In regard to tracking data, both an institution's quality data over time and comparisons to similar institutions can be facilitated by belonging to a QI network. For example, if an institution noted that their rates of chest compression or epinephrine use for extremely preterm infants was significantly higher than other network hospitals, there may be benefit to evaluating the reasons for the higher rates.⁵

Golden Hour

The term “golden hour” has come to represent different concepts and protocols in various medical fields, and in neonatology refers to the key procedures and tasks that should be performed in the first hour after delivery for very preterm infants.⁷⁴ Protocols should be tailored to each institution as there are differing personnel availability, policies, and procedures. The plan starts in the delivery room prior to the delivery, as providers are assigned specific tasks (Table 3). This may involve administrative tasks such as entering orders, communication with the obstetric team and parents, and preparing umbilical lines. After the infant is born, the initial steps of clinical management of temperature and respiration are performed in the delivery room per NRP. The “golden hour” protocol then often continues into the NICU with timed goals for vascular access, dextrose infusion, antibiotic and surfactant administration (as appropriate), and closure of the incubator. Team member tasks may include entering orders, securing vascular access, obtaining laboratory specimens, setting up the ventilator and giving surfactant, and providing a family update.⁷⁵ An example of a detailed plan for respiratory management is shown in Figure 2.

Conclusion

The unique nature and complexity of the delivery room makes QI an excellent methodology for implementing positive changes in the delivery room. This article has given a broad overview of some of the unique aspects of QI in the delivery room and points to multiple resources that QI teams can use for this purpose. Ultimately, QI teams will need to assess their own institutions' data, the context of their hospital and corresponding networks in order to design the best approach for their local projects. Ongoing research on optimal methods to pursue delivery room QI and the short- and long-term impacts of such activities will continue to inform best practices.

Acknowledgments

Funding source for this article: This project was supported by grant number P30HS023506 from the Agency for Healthcare Research and Quality. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality.

References

1. Finer N, Rich W. Neonatal resuscitation for the preterm infant: evidence versus practice. *Journal of perinatology: official journal of the California Perinatal Association*. 2010; 30(1):S57–66. [PubMed: 20877409]
2. Soraisham AS, Lodha AK, Singhal N, et al. Neonatal outcomes following extensive cardiopulmonary resuscitation in the delivery room for infants born at less than 33 weeks gestational age. *Resuscitation*. 2014; 85(2):238–243. [PubMed: 24513125]

3. Chamnanvanakij S, Perlman JM. Outcome following cardiopulmonary resuscitation in the neonate requiring ventilatory assistance. *Resuscitation*. 2000; 45(3):173–180. [PubMed: 10959016]
4. Finer NN, Horbar JD, Carpenter JH. Cardiopulmonary resuscitation in the very low birth weight infant: the Vermont Oxford Network experience. *Pediatrics*. 1999; 104(3 Pt 1):428–434. [PubMed: 10469765]
5. Handley SC, Sun Y, Wyckoff MH, Lee HC. Outcomes of extremely preterm infants after delivery room cardiopulmonary resuscitation in a population-based cohort. *J Perinatol*. 2015; 35(5):379–383. [PubMed: 25521563]
6. Perlman JM, Wyllie J, Kattwinkel J, et al. Part 7: Neonatal Resuscitation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations (Reprint). *Pediatrics*. 2015; 136(2):S120–166. [PubMed: 26471381]
7. Weiner, GM. Textbook of Neonatal Resuscitation. 7th. American Academy of Pediatrics and American Heart Association; 2016.
8. Wyckoff MH, Aziz K, Escobedo MB, et al. Part 13: Neonatal Resuscitation: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (Reprint). *Pediatrics*. 2015; 136(2):S196–218. [PubMed: 26471383]
9. Profit, J., Lee, HC., Gould, JB., Horbar, JD. Evaluating and Improving the Safety and Quality of Neonatal Intensive Care. In: Martin, R.Fanaroff, A., Walsh, M., editors. Fanaroff and Martin's Neonatal-Perinatal Medicine. Elsevier; 2014. p. 59-88.
10. Lee HC, Lyndon A, Blumenfeld YJ, Dudley RA, Gould JB. Antenatal steroid administration for premature neonates in California. *Obstetrics and gynecology*. 2011; 117(3):603–609. [PubMed: 21446208]
11. Donabedian A. Evaluating the quality of medical care. *The Milbank Memorial Fund quarterly*. 1966; 44 1(3):166–206.
12. California Perinatal Quality Care Collaborative. <https://www.cpqcc.org/perinatal-programs/cpqcc-data-center/2016-delayed-cord-clamping-pilot-project-dccpp>
13. Finer NN, Rich W. Neonatal resuscitation: toward improved performance. *Resuscitation*. 2002; 53(1):47–51. [PubMed: 11947979]
14. Gelbart B, Hiscock R, Barfield C. Assessment of neonatal resuscitation performance using video recording in a perinatal centre. *Journal of paediatrics and child health*. 2010; 46(7-8):378–383. [PubMed: 20546105]
15. Rich WD, Leone T, Finer NN. Delivery room intervention: improving the outcome. *Clinics in perinatology*. 2010; 37(1):189–202. [PubMed: 20363455]
16. Carbine DN, Finer NN, Knodel E, Rich W. Video recording as a means of evaluating neonatal resuscitation performance. *Pediatrics*. 2000; 106(4):654–658. [PubMed: 11015505]
17. Chitkara R, Rajani AK, Oehlert JW, Lee HC, Epi MS, Halamek LP. The accuracy of human senses in the detection of neonatal heart rate during standardized simulated resuscitation: implications for delivery of care, training and technology design. *Resuscitation*. 2013; 84(3):369–372. [PubMed: 22925993]
18. Konstantelos D, Gurth H, Bergert R, Ifflaender S, Rudiger M. Positioning of term infants during delivery room routine handling - analysis of videos. *BMC pediatrics*. 2014; 14:33. [PubMed: 24495525]
19. Brown T, Tu J, Profit J, Gupta A, Lee HC. Optimal Criteria Survey for Preresuscitation Delivery Room Checklists. *American journal of perinatology*. 2016; 33(2):203–207. [PubMed: 26368913]
20. Hales BM, Pronovost PJ. The checklist--a tool for error management and performance improvement. *Journal of critical care*. 2006; 21(3):231–235. [PubMed: 16990087]
21. Bennett SC, Finer N, Halamek LP, et al. Implementing Delivery Room Checklists and Communication Standards in a Multi-Neonatal ICU Quality Improvement Collaborative. *Jt Comm J Qual Patient Saf*. 2016; 42(8):369–376. [PubMed: 27456419]
22. Castrodale V, Rinehart S. The golden hour: improving the stabilization of the very low birth-weight infant. *Advances in neonatal care: official journal of the National Association of Neonatal Nurses*. 2014; 14(1):9–14. quiz 15-16. [PubMed: 24472882]
23. DeMauro SB, Douglas E, Karp K, et al. Improving delivery room management for very preterm infants. *Pediatrics*. 2013; 132(4):e1018–1025. [PubMed: 24043285]

24. Katheria A, Rich W, Finer N. Development of a strategic process using checklists to facilitate team preparation and improve communication during neonatal resuscitation. *Resuscitation*. 2013; 84(11):1552–1557. [PubMed: 23810750]
25. Lee HC, Powers RJ, Bennett MV, et al. Implementation methods for delivery room management: a quality improvement comparison study. *Pediatrics*. 2014; 134(5):e1378–1386. [PubMed: 25332503]
26. Vergales BD, Dwyer EJ, Wilson SM, et al. NASCAR pit-stop model improves delivery room and admission efficiency and outcomes for infants <27 weeks' gestation. *Resuscitation*. 2015; 92:7–13. [PubMed: 25891960]
27. Aziz K, Chadwick M, Baker M, Andrews W. Ante- and intra-partum factors that predict increased need for neonatal resuscitation. *Resuscitation*. 2008; 79(3):444–452. [PubMed: 18952348]
28. Patel J, Posencheg M, Ades A. Proficiency and retention of neonatal resuscitation skills by pediatric residents. *Pediatrics*. 2012; 130(3):515–521. [PubMed: 22926169]
29. Kaczorowski J, Levitt C, Hammond M, et al. Retention of neonatal resuscitation skills and knowledge: a randomized controlled trial. *Fam Med*. 1998; 30(10):705–711. [PubMed: 9827341]
30. Halamek LP. Simulation as a methodology for assessing the performance of healthcare professionals working in the delivery room. *Seminars in fetal & neonatal medicine*. 2013; 18(6): 369–372. [PubMed: 24051303]
31. Ades A, Lee HC. Update on simulation for the Neonatal Resuscitation Program. *Seminars in perinatology*. 2016; 40(7):447–454. [PubMed: 27823817]
32. Dadiz R, Weinschreider J, Schrieffer J, et al. Interdisciplinary simulation-based training to improve delivery room communication. *Simul Healthc*. 2013; 8(5):279–291. [PubMed: 23842120]
33. Yamada NK, Fuerch JH, Halamek LP. Impact of Standardized Communication Techniques on Errors during Simulated Neonatal Resuscitation. *American journal of perinatology*. 2016; 33(4): 385–392. [PubMed: 26485251]
34. Lipman SS, Daniels KI, Arafeh J, Halamek LP. The case for OBLS: a simulation-based obstetric life support program. *Seminars in perinatology*. 2011; 35(2):74–79. [PubMed: 21440814]
35. Draycott T, Sibanda T, Owen L, et al. Does training in obstetric emergencies improve neonatal outcome? *BJOG*. 2006; 113(2):177–182. [PubMed: 16411995]
36. Zabari M, Suresh G, Tomlinson M, et al. Implementation and case-study results of potentially better practices for collaboration between obstetrics and neonatology to achieve improved perinatal outcomes. *Pediatrics*. 2006; 118(2):S153–158. [PubMed: 17079618]
37. Grogan EL, Stiles RA, France DJ, et al. The impact of aviation-based teamwork training on the attitudes of health-care professionals. *J Am Coll Surg*. 2004; 199(6):843–848. [PubMed: 15555963]
38. Wyckoff MH, Aziz K, Escobedo MB, et al. Part 13: Neonatal Resuscitation: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2015; 132(18 Suppl 2):S543–560. [PubMed: 26473001]
39. Edwards EM, Soll RF, Ferrelli K, et al. Identifying improvements for delivery room resuscitation management: results from a multicenter safety audit. *Matern Health Neonatol Perinatol*. 2015; 1:2. [PubMed: 27057320]
40. Fang JL, Collura CA, Johnson RV, et al. Emergency Video Telemedicine Consultation for Newborn Resuscitations: The Mayo Clinic Experience. *Mayo Clinic proceedings*. 2016; 91(12):1735–1743. [PubMed: 27887680]
41. Duchesne JC, Kyle A, Simmons J, et al. Impact of telemedicine upon rural trauma care. *J Trauma*. 2008; 64(1):92–97. discussion 97–98. [PubMed: 18188104]
42. Wibbenmeyer L, Kluesner K, Wu H, et al. Video-Enhanced Telemedicine Improves the Care of Acutely Injured Burn Patients in a Rural State. *J Burn Care Res*. 2015
43. Agarwal AK, Gaieski DF, Perman SM, et al. Telemedicine RESuscitation and Arrest Trial (TREAT): A feasibility study of real-time provider-to-provider telemedicine for the care of critically ill patients. *Heliyon*. 2016; 2(4):e00099. [PubMed: 27441272]
44. Ajami S, Arzani-Birgani A. Fast resuscitation and care of the burn patients by telemedicine: A review. *J Res Med Sci*. 2014; 19(6):562–566. [PubMed: 25197300]

45. Fierson WM, Capone A Jr. American Academy of Pediatrics Section on Ophthalmology, American Academy of Ophthalmology, American Association of Certified Orthoptists. Telemedicine for evaluation of retinopathy of prematurity. *Pediatrics*. 2015; 135(1):e238–254. [PubMed: 25548330]
46. Quinn GE, Ying GS, Repka MX, et al. Timely implementation of a retinopathy of prematurity telemedicine system. *J AAPOS*. 2016; 20(5):425–430 e421. [PubMed: 27651231]
47. Fang JL, Carey WA, Lang TR, Lohse CM, Colby CE. Real-time video communication improves provider performance in a simulated neonatal resuscitation. *Resuscitation*. 2014; 85(11):1518–1522. [PubMed: 25132477]
48. Fuerch JH, Yamada NK, Coelho PR, Lee HC, Halamek LP. Impact of a novel decision support tool on adherence to Neonatal Resuscitation Program algorithm. *Resuscitation*. 2015; 88:52–56. [PubMed: 25555358]
49. Rousek JB, Hallbeck MS. Improving medication management through the redesign of the hospital code cart medication drawer. *Hum Factors*. 2011; 53(6):626–636. [PubMed: 22235525]
50. Shultz J, Davies JM, Caird J, Chisholm S, Ruggles K, Puls R. Standardizing anesthesia medication drawers using human factors and quality assurance methods. *Can J Anaesth*. 2010; 57(5):490–499. [PubMed: 20143279]
51. Agarwal S, Swanson S, Murphy A, Yaeger K, Sharek P, Halamek LP. Comparing the utility of a standard pediatric resuscitation cart with a pediatric resuscitation cart based on the Broselow tape: a randomized, controlled, crossover trial involving simulated resuscitation scenarios. *Pediatrics*. 2005; 116(3):e326–333. [PubMed: 16061568]
52. Chan J, Chan B, Ho HL, Chan KM, Kan PG, Lam HS. The neonatal resuscitation algorithm organized cart is more efficient than the airway-breathing-circulation organized drawer: a crossover randomized control trial. *Eur J Emerg Med*. 2016; 23(4):258–262. [PubMed: 25710083]
53. Chitkara R, Rajani AK, Lee HC, Snyder Hansen SF, Halamek LP. Comparing the utility of a novel neonatal resuscitation cart with a generic code cart using simulation: a randomised, controlled, crossover trial. *BMJ Qual Saf*. 2013; 22(2):124–129.
54. Weigel WA. Redesigning an airway cart using lean methodology. *J Clin Anesth*. 2016; 33:273–282. [PubMed: 27555177]
55. Lapcharoensap W, Lee HC. Temperature Management in the Delivery Room and During Neonatal Resuscitation. *NeoReviews*. 2016; 17(8):e454–e462.
56. Laptok AR, Watkinson M. Temperature management in the delivery room. *Seminars in fetal & neonatal medicine*. 2008; 13(6):383–391. [PubMed: 18501693]
57. Miller SS, Lee HC, Gould JB. Hypothermia in very low birth weight infants: distribution, risk factors and outcomes. *J Perinatol*. 2011; 31(1):S49–56. [PubMed: 21448204]
58. Lee HC, Ho QT, Rhine WD. A quality improvement project to improve admission temperatures in very low birth weight infants. *J Perinatol*. 2008; 28(11):754–758. [PubMed: 18580878]
59. Russo A, McCready M, Torres L, et al. Reducing hypothermia in preterm infants following delivery. *Pediatrics*. 2014; 133(4):e1055–1062. [PubMed: 24685958]
60. Manani M, Jegatheesan P, DeSandre G, Song D, Showalter L, Govindaswami B. Elimination of admission hypothermia in preterm very low-birth-weight infants by standardization of delivery room management. *Perm J*. 2013; 17(3):8–13. [PubMed: 24355884]
61. Billimoria Z, Chawla S, Bajaj M, Natarajan G. Improving admission temperature in extremely low birth weight infants: a hospital-based multi-intervention quality improvement project. *J Perinat Med*. 2013; 41(4):455–460. [PubMed: 23334053]
62. Duryea EL, Nelson DB, Wyckoff MH, et al. The impact of ambient operating room temperature on neonatal and maternal hypothermia and associated morbidities: a randomized controlled trial. *American journal of obstetrics and gynecology*. 2016; 214(4):505 e501–507. [PubMed: 26874298]
63. Committee on Fetus and Newborn, American Academy of Pediatrics. Respiratory support in preterm infants at birth. *Pediatrics*. 2014; 133(1):171–174. [PubMed: 24379228]
64. Finer NN, Carlo WA, Walsh MC, et al. Early CPAP versus surfactant in extremely preterm infants. *N Engl J Med*. 2010; 362(21):1970–1979. [PubMed: 20472939]
65. Stevens TP, Finer NN, Carlo WA, et al. Respiratory outcomes of the surfactant positive pressure and oximetry randomized trial (SUPPORT). *The Journal of pediatrics*. 2014; 165(2):240–249 e244. [PubMed: 24725582]

66. Morley CJ, Davis PG, Doyle LW, et al. Nasal CPAP or intubation at birth for very preterm infants. *N Engl J Med*. 2008; 358(7):700–708. [PubMed: 18272893]
67. Dunn MS, Kaempf J, de Klerk A, et al. Randomized trial comparing 3 approaches to the initial respiratory management of preterm neonates. *Pediatrics*. 2011; 128(5):e1069–1076. [PubMed: 22025591]
68. Perlman JM, Wyllie J, Kattwinkel J, et al. Part 7: Neonatal Resuscitation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation*. 2015; 132(16 Suppl 1):S204–241. [PubMed: 26472855]
69. Raju TN. Timing of umbilical cord clamping after birth for optimizing placental transfusion. *Current opinion in pediatrics*. 2013; 25(2):180–187. [PubMed: 23407180]
70. Committee on Obstetric Practice, American College of Obstetricians & Gynecologists. Committee Opinion No.543: Timing of umbilical cord clamping after birth. *Obstetrics and gynecology*. 2012; 120(6):1522–1526. [PubMed: 23168790]
71. Bell, R., Finer, N., Halamek, L., et al. on behalf of the Perinatal Quality Improvement Panel, California Perinatal Quality Care Collaborative. [Accessed July 2, 2012] Delivery Room Management Quality Improvement Toolkit. California Perinatal Quality Care Collaborative. 2011. http://cpqcc.org/quality_improvement/qi_toolkits/delivery_room_management_toolkit_revised_july_2011
72. Lapcharoensap W, Bennett MV, Powers RJ, et al. Effects of delivery room quality improvement on premature infant outcomes. *J Perinatol*. 2016
73. Lee HC, Arora V, Brown T, Lyndon A. Thematic analysis of barriers and facilitators to implementation of neonatal resuscitation guideline changes. *J Perinatol*. 2016
74. Wyckoff MH. Initial resuscitation and stabilization of the periviable neonate: the Golden-Hour approach. *Seminars in perinatology*. 2014; 38(1):12–16. [PubMed: 24468564]
75. Doyle KJ, Bradshaw WT. Sixty golden minutes. *Neonatal network: NN*. 2012; 31(5):289–294. [PubMed: 22908049]

Box 1**Unique Considerations for Delivery Room QI****Unique Physical Environment**

- Two patients simultaneously receiving care
- Multidisciplinary personnel and equipment
- Can be chaotic and noisy
- Inadequate space

Unpredictable Nature

- Emergency preparedness for every delivery
- Equipment readily available at all times
- Varying personnel

Quality Data Acquisition

- Efficient and accurate delivery room documentation
- Data collection and reporting for mother and neonate

Box 2**Strategies for Implementation**

Standardized forms for data collection
Video recording and review
Development and utilization of checklists
Simulation training
Crew Resource Management
Briefings and Debriefings
Utilizing technology / telemedicine

Box 3**Examples of QI opportunities in the Delivery Room**

Delivery room layout
Optimizing the neonatal code cart
Appropriate delivery room attendance
Activation of code / back-up team
Temperature management
Respiratory management
Communication among team members
Communication with family
Time to hold in the delivery room
Delayed cord clamping
Care of the very low birth weight infant (“golden hour”)

Key Points

- Quality improvement (QI) in the delivery room requires a multidisciplinary approach and careful consideration of the unique aspects of the delivery room setting
- Delivery room attendants may refine their technical and behavioral skills through simulation sessions and utilize those skills to meet delivery room QI objectives
- QI projects may be further enhanced by participation in collaborative projects with other neonatal intensive care units to promote a culture of information sharing and improvement
- Improvements in discrete areas of delivery room management of the neonate has the potential to impact neonatal outcomes

Neonatal Resuscitation Program® Quick Equipment Checklist

This checklist includes only the most essential supplies and equipment needed at the radiant warmer for most neonatal resuscitations. Tailor this list to meet your unit-specific needs. Ensure that an equipment check has been done prior to every birth.

• Preheated warmer
• Warm towels or blankets
• Temperature sensor and sensor cover for prolonged resuscitation
• Hat
• Plastic bag or plastic wrap (<32 weeks' gestation)
• Thermal mattress (<32 weeks' gestation)
• Bulb syringe
• 10F or 12F suction catheter attached to wall suction, set at 80 to 100 mm Hg
• Meconium aspirator
• Stethoscope
• Flowmeter set to 10 L/min
• Oxygen blender set to 21% (21%-30% if <35 weeks' gestation)
• Positive-pressure ventilation (PPV) device
• Term- and preterm-sized masks
• 8F feeding tube and 20-mL syringe
• Equipment to give free-flow oxygen
• Pulse oximeter with sensor and cover
• Target oxygen saturation table
• Laryngoscope with size-0 and size-1 straight blades (size 00, optional)
• Stylet (optional)
• Endotracheal tubes (sizes 2.5, 3.0, 3.5)
• Carbon dioxide (CO ₂) detector
• Measuring tape and/or endotracheal tube insertion depth table
• Waterproof tape or tube-securing device
• Scissors
• Laryngeal mask (size 1) and 5-mL syringe
Access to
• 1:10,000 (0.1 mg/mL) epinephrine
• Normal saline
• Supplies for placing emergency umbilical venous catheter and administering medications
• Electronic cardiac (ECG) monitor leads and ECG monitor

Figure 1.
Neonatal Resuscitation Program Quick Equipment Checklist.
Reprinted with permission from the Textbook of Neonatal Resuscitation (2015) American Academy of Pediatrics and American Heart Association.

Figure 2.
Platinum Hour: Delivery Room & Initial NICU Respiratory Management.
Reprinted with permission from the NICU Guide, Lucile Packard Children's Hospital
Stanford (Christine Johnson, MD, Ronald Cohen, MD, Kari McCallie, MD).

Table 1
Examples of various aspects of specific delivery room QI opportunities and what to measure

	Equipment	Systems Issues	Technical and Behavioral skills	Measurable Outcomes	Balancing Measures
<i>Optimizing the Resuscitation Cart</i>	<ul style="list-style-type: none"> Correct size and number of carts Appropriate emergency supplies 	<ul style="list-style-type: none"> Space for placement of resuscitation carts in optimal locations 	<ul style="list-style-type: none"> Training staff to increase familiarity with resuscitation cart Culture of safety to utilize cart as appropriate 	<ul style="list-style-type: none"> % times cart used during code situations 	<ul style="list-style-type: none"> Number of times equipment cannot be located
<i>Appropriate delivery room attendance</i>	<ul style="list-style-type: none"> Communication devices Institution specific communication system during emergencies (button, phone, pager, overhead) 	<ul style="list-style-type: none"> Policies & procedures for calling appropriate team (standard / complex / back-up) 	<ul style="list-style-type: none"> Familiarity with policies and procedures Communication between obstetrics and pediatrics team 	<ul style="list-style-type: none"> % appropriate delivery room notifications % appropriate delivery room attendance 	<ul style="list-style-type: none"> Number of codes called per month that were false alarms
<i>Temperature Management</i>	<ul style="list-style-type: none"> Hat Blankets Plastic wrap Temperature sensor Warming mattress Radiant warmer 	<ul style="list-style-type: none"> Appropriate operating / delivery room temperature 	<ul style="list-style-type: none"> Team member assigned to monitor temperature and apply equipment 	<ul style="list-style-type: none"> NICU admission temperature % infants with hypothermia 	<ul style="list-style-type: none"> % infants with hyperthermia
<i>Respiratory Management</i>	<ul style="list-style-type: none"> T-piece resuscitator Appropriate sized mask Oxygen blender Monitors (O₂, ECG) CO₂ detector 	<ul style="list-style-type: none"> Air, oxygen, and suction capabilities in all delivery rooms 	<ul style="list-style-type: none"> Familiarity with NRP algorithm including ventilation corrective steps (MR SOPA) Accurately recognize whether ventilation is effective or ineffective 	<ul style="list-style-type: none"> % delivery room CPAP use % delivery room intubation time to nasal CPAP 	<ul style="list-style-type: none"> % infants with air leak / pneumothorax

	Equipment	Systems Issues	Technical and Behavioral skills	Measurable Outcomes	Balancing Measures
<i>Time to Hold in Delivery Room (for NICU admissions)</i>	<ul style="list-style-type: none"> • Warm blankets • Hat • Stethoscope 	<ul style="list-style-type: none"> • Team member availability to monitor infant during hold time • Policies for appropriate patient population and length of time 	<ul style="list-style-type: none"> • Communication between obstetrics and pediatrics team for appropriateness • Ability to wrap infant and/or place skin to skin on mother • Ability to monitor infant during hold 	<ul style="list-style-type: none"> • % appropriate infants held by mother in the delivery room prior to NICU admission • Time until delivery room hold 	<ul style="list-style-type: none"> • Number of cases requiring early interruption of hold time
<i>Delayed Cord Clamping (DCC)</i>	<ul style="list-style-type: none"> • Sterile blankets, towels, or medical-grade plastic wrap 	<ul style="list-style-type: none"> • Policies & procedures for DCC (who, how long) as determined by pediatric and obstetric team 	<ul style="list-style-type: none"> • Team member to monitor time until cord clamping • Identified team member to provide infant stimulation during DCC 	<ul style="list-style-type: none"> • % appropriate infants receiving DCC • Length of DCC time 	<ul style="list-style-type: none"> • % infants with hyperbilirubinemia requiring phototherapy • % mothers with hemorrhage complications • Number of times there is a break in sterile field

Table 2
Step-wise QI goals and activities related to delivery room respiratory management

Progression	QI Goals	Activities
Time	Initial and continual evaluation of infant need for respiratory support	<ul style="list-style-type: none"> • Role assignment • Teamwork and communication • ECG placement and assessment • Pulse oximetry with appropriate FiO2 titration
	Early and effective application of CPAP	<ul style="list-style-type: none"> • Equipment preparation and familiarization on how to deliver PEEP • Technical skills for appropriate equipment use (e.g. mask size, OG placement) • Time to nasal CPAP, if indicated / available
	Safe, effective positive pressure ventilation (PPV)	<ul style="list-style-type: none"> • Training in t-piece resuscitator / anesthesia bag / respiratory delivery systems • Assessment of effective PPV using CO2 detectors and team communication • Technical skills on ventilation corrective steps (MR SOPA) • Equipment preparation for intubation
	Volume targeted ventilation	<ul style="list-style-type: none"> • Timely surfactant administration, if indicated • Obtaining physiologic measurements via respiratory monitors or ventilators • Ongoing feedback and reactive behavior

Table 3
Golden Hour NRP algorithm delineated by role

Time (seconds)	Provider Action	RT Action	RN Action
0 s	<ul style="list-style-type: none"> - Wrap infant (already done) - Place hat on head - Position head - Hold mask (both hands) 	<ul style="list-style-type: none"> -Set APGAR timer -Open mouth -Place mask -Begin mCPAP 5cmH₂O, FiO₂ 0.3 with colorimeter detector 	<ul style="list-style-type: none"> - Flatten wrap against skin - Place pulse oximetry probe on right wrist - Place temperature probe - Use stethoscope to listen for HR and tap HR out -Listen for breath sounds
30 s	<ul style="list-style-type: none"> - State HR out loud (< 60, < 100, or >100) 	<ul style="list-style-type: none"> - Start PPV at 20/5, FiO₂ 0.3 with NeoPuff* 	<ul style="list-style-type: none"> - Listen and tap heart rate - Listen for breath sounds - Look for chest rise
45 s	<ul style="list-style-type: none"> - State HR out loud - Reposition head* - May assist with MR SOPA measures 	<ul style="list-style-type: none"> -Reapply mask * -Open mouth * -Increase PIP -Consider need for prolonged iTime 	<ul style="list-style-type: none"> - Listen and tap heart rate - Suction mouth, if needed - Listen for breath sounds - Look for chest rise
60 s	<ul style="list-style-type: none"> - State HR out loud - Intubate within 30 seconds*,** 	<ul style="list-style-type: none"> -Tape the ETT 	<ul style="list-style-type: none"> - Listen for bilateral breath sounds - Look for chest rise - Listen and tap heart rate
90 s	<ul style="list-style-type: none"> - Start Chest Compressions** - 2nd provider to place emergent UVC** 	<ul style="list-style-type: none"> - Provide breaths via ETT at 3:1 ratio - Ensure adequate chest rise with each breath 	<ul style="list-style-type: none"> - Place ECG leads - Call Neonatal Code Blue - Listen and tap heart rate (until monitoring is accurate)

* HR < 100 bpm and not rising

** HR < 60 bpm

Reprinted with permission from Very Low Birth Weight (< 32 weeks GA) Stabilization after Delivery: The Golden Hour (Doernbecher Children's Hospital) by Wannasiri Lapcharoensap MD, Trang Huynh MD, John Evered MD, Megan Tinling BSN RN, Anita Khut BSN RN CCRN, Nikki Wiggins BSN RN CCRN, Brian Scottoline MD PhD.