



Clinical Paper

NASCAR pit-stop model improves delivery room and admission efficiency and outcomes for infants <27 weeks' gestation[☆]



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ABSTRACT

Aim: To evaluate a new process based on teamwork in a manner similar to the race car pit stop on organization and efficiency during the “Golden Hours” for extremely preterm infants.

Methods: A team designed an improved process focused on checklists, preparation, assigning roles, and best practices, for the care of infants <27 weeks' gestation in the delivery room (DR) through admission to the neonatal intensive care unit (NICU). Clinical outcomes 2 years before and after implementation were analyzed. A survey was administered to NICU staff prior to and 14 months after implementation. The survey assessed organization and efficiency in the DR and during the admission process of the target population.

Results: There were 62 inborn infants prior to and 90 infants after implementation with overall survival of 90.3% and 86.6%, respectively ($p = 0.61$). Infants were more stable on admission with a mean arterial blood pressure equal to or greater than their gestational age in the post intervention group compared to the pre-cohort (76% vs 57%, $p = 0.02$) and discharged home at a lower mean postmenstrual age (39.0 ± 2.2 vs 40.1 ± 3.5 weeks, $p = 0.04$). The survey demonstrated improvement in assessment of roles being clearly defined in the DR and in the organization and the efficiency both in the DR and during the NICU admission ($p < 0.05$).

Conclusions: A systematic approach to the care of the <27 weeks' gestation neonate increased staff perception of improved organization and efficiency in the DR through admission processes and improved outcomes.

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1. Introduction

Teamwork and communication have been shown to be important in neonatal resuscitation in reducing errors and improving performance.¹ Morbidity and mortality continue to be significant problems for the most extremely preterm infants despite advances in perinatal care. Making improvement in these outcomes is highly desirable.^{2–4} Many short and long-term outcomes have their origins tied to events that occur in the delivery room with the stabilization and resuscitation of these infants.⁵

The NASCAR pit stop model uses checklists and well-orchestrated procedures along with team huddles prior to and debriefings after the race to improve efficiency and reduce errors. This is similar to the care provided in the delivery room in that multiple tasks are being done simultaneously by multiple individuals. Systematic approaches using the motorcar racing pit stop model have recently been applied to the field of medicine especially with regard to hand-off of care.^{6,7}

The “Golden Hour” is a term known in the adult trauma population. It refers to the fact that trauma patients have improved outcomes if they receive the necessary interventions, often including lifesaving surgery, within 60 min of the trauma.⁸ Recently, this term has been applied to other fields of medicine including neonatology, especially focused on the extremely low gestational age neonate.^{4,9} For preterm infants, “Golden Hours” refers to the time period that begins with birth and continues in the delivery room, transport and admission to the neonatal intensive care unit (NICU).

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For extremely preterm infants, evidence is emerging that while some infants truly need resuscitation, a well-orchestrated delivery, following the neonatal resuscitation program (NRP) guidelines,¹⁰ would be a stabilization rather than a resuscitation process. A gentle stabilization for this fragile population may help contribute to improved outcomes.

Using a combination of principles from the NASCAR pit stop and the Golden Hour of trauma, our objective was to develop our own “Golden Hours” for the <27 weeks’ gestational age neonate from pre-delivery preparation through admission to the NICU. We hypothesized that with the use of checklists and the assignment of specific roles, responsibilities, and positions, would improve team communication, organization, and efficiency from birth through NICU admission. This paper describes our systematic approach to the “Golden Hours” for extremely preterm infants <27 weeks in the delivery room and on admission to the NICU and evaluates its effect on organization, efficiency and clinical outcomes during their hospitalization.

2. Methods

In September 2009, a multidisciplinary team was assembled to design and implement a systematic approach to improve the resuscitation, stabilization and admission of infants <27 weeks’ gestation born at the University of Virginia (UVa) Children’s Hospital. The team included physicians, nurse practitioners, nurses, respiratory therapists, a quality improvement project coordinator and analyst, a bioengineer specializing in human factors, and other ancillary staff essential for the care of this population. Approximately 550 infants are admitted to the UVa NICU each year of which about 60% (350) are inborn. About 8% (50) of the total admissions are <27 weeks’ gestation.

A pre-survey was anonymously administered to all NICU staff 3 months prior to piloting the systematic approach. The staff included physicians (residents, neonatal fellows, and attending neonatologists), nurses, neonatal nurse practitioners, and respiratory therapists. The survey consisted of six questions. The first four questions focused on years of experience and role in the NICU. The fifth question focused on delivery room management, with five statements on a Likert scale, focusing on comfort level, role and responsibility awareness of the individual and the team, organization, and efficiency. The sixth question evaluated the NICU admission process using the same five statements on the Likert scale as in question five. The same survey, except with two additional questions assessing the number of <27 weeks’ gestation deliveries and admissions the individual participated in, was re-administered 14 months following implementation of the new process.

2.1. Preparation for the delivery

2.1.1. Checklists

A pre-delivery checklist, prompting a “check and verify” process, was designed and posted at the head of the neonatal resuscitation table in the delivery room (Fig. 1). The newly created delivery record included checklist confirmation boxes for preparation for the airway, breathing, circulation, and thermoregulation and team introduction and role assignments (Fig. 2).

2.1.2. Role assignment and position in the delivery room

One of the most important aspects of this improvement process was the assignment of team roles and responsibilities, including where the team was positioned around the neonate’s bed (Fig. 1). Prior to each delivery, a team leader was identified who introduced all team members. Team members were assigned to specific tasks

per the NRP guidelines (Fig. 1).¹⁰ In conjunction with NRP guidelines, we aimed for the delivery to be stabilization, and determined goals to include gentle ventilation and oxygenation, thermoregulation, decreasing insensible water loss, prophylactic surfactant administration, and providing hydration and dextrose nutrition. This role assignment could be tailored based on the number of providers attending a specific delivery.

2.1.3. Equipment accessibility

A <27 weeks’ gestation supply cart was created that was easily accessible in the delivery room and contained the necessary equipment for this population. The cart included an airway box, supplies for peripheral intravenous (IV) placement, normal saline and dextrose 10% water solution, IV syringe pump, emergency drugs (e.g., epinephrine), and thermoregulation supplies including chemical warming mattresses and thermal plastic wraps. The cart was also designed with an expandable surface area for use in setting up for any procedures in the delivery room.

2.1.4. Real-time documentation

We created a neonatal delivery record (Fig. 2) with a pre- and post-delivery checklist. Historically the interventions that occurred in the delivery room were not documented in real time, and therefore relied on the memory of the team members involved in the resuscitation. To improve documentation, an additional RN with the sole responsibility of documentation of delivery room events was assigned.

2.2. Admission to the NICU

2.2.1. Preparation for admission

When the NICU was alerted to a potential admission, the bedside nurses in the NICU prepared for the admission by setting up the humidified incubator, IV pumps, and IV fluids. The medical team sterilely prepared umbilical lines for placement upon admission prior to delivery (or a second team not attending the delivery if delivery was emergent), and respiratory therapy set up the ventilator at the bedside.

2.2.2. Efficiency during the admission of the infant

Similar to the methods used in the delivery room, we established specific roles for the different members of the admission team. These roles were displayed on a large poster sized chart placed at the bedside of the infant being admitted. The chart guided the admission process and established the goals focused on obtaining admission vital signs quickly followed by establishing umbilical access as a priority while maintaining thermoregulation and preventing insensible water loss, aiming to have the infant stabilized in a closed humidified incubator with vascular access (the NICU’s simulation of the in utero environment) within 30–60 min after arrival to the NICU signaling the completion of the delivery and admission process.

We standardized care by creating a specific order set for our target population. Included in the standardization were guidelines for oxygen saturations, laboratory sampling, parenteral nutrition initiation, arterial line fluids, administration of prophylactic indomethacin in first 6 h (if cortisol level ≤ 15 and not contraindications), commonly used medications including antibiotics and prophylactic fluconazole, and radiographs.

2.3. Education of staff

In April 2010, there was a presentation given to all staff members explaining the changes in care practice. Simulations of the delivery of infants <27 weeks’ gestation occurred. In May 2010 during the yearly NICU nursing skills fair in which all nurses were required

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