

Timing of Interventions in the Delivery Room: Does Reality Compare with Neonatal Resuscitation Guidelines?

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Objective To determine the proportion of infants who had the tasks recommended in the neonatal resuscitation guidelines performed within 30 and 60 seconds of birth, and the time taken to perform each task.

Study design From video recordings in delivery rooms, we determined the time from birth and arrival on a resuscitation table to warm, assess heart rate (HR), attach an oximeter, and provide respiratory support for each infant. We determined the proportion of infants who had these tasks completed by 30 and 60 seconds, and the median time taken to perform each task.

Results We reviewed and analyzed data from 189 infants (median gestational age, 29 weeks [IQR, 27-34 weeks]; median birth weight, 1220 g [IQR, 930-2197 g]). Twelve infants (6%) were not on the resuscitation table within 30 seconds of birth. Less than 10% of infants were placed in polyethylene bags or had their HR determined by 30 seconds. By 60 seconds, 48% were in polyethylene bags, 33% had their HR determined, 38% received respiratory support, and 60% had an oximeter attached. The median time taken to perform all tasks was greater than that recommended in the guidelines.

Conclusion Most newborns were not managed within the time frame recommended in resuscitation guidelines. The recommended 30- and 60-second intervals may be too short. (*J Pediatr* 2013;163:1553-7).

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The International Liaison Committee on Resuscitation (ILCOR) makes recommendations for the care of newborn infants in the delivery room (DR).¹ Based on these recommendations, the American Academy of Pediatrics, European Resuscitation Council, and UK Resuscitation Council have formulated neonatal resuscitation guidelines.²⁻⁵ ILCOR recommends that newborn resuscitation be approached in a stepwise manner, and that clinicians proceed to the next step of resuscitation only after successful completion of the preceding step.

The ILCOR guidelines allocate 30 seconds to successfully complete each of the first 2 steps of the resuscitation algorithm (Figure; available at www.jpeds.com). The guidelines recommend that infants be warmed within 30 seconds of birth. Infants who require assistance after birth are usually transferred to a resuscitation table, where they are placed under radiant heat. Term and near-term infants are dried with warm towels, and very preterm infants are wrapped in polyethylene. Within 30 seconds, infants should be stimulated to breathe, have the airway positioned, and have breathing and heart rate (HR) assessed. By 60 seconds, respiratory support should be provided if necessary and pulse oximetry considered for infants requiring ongoing resuscitation. The guidelines specify the 30-second intervals allotted for the initial stages of stabilization are from birth rather than from when the infant is received by the neonatal team or placed on the resuscitation table. A single-center study of 34 newborns suggested that in many infants, these tasks are not performed within these time frames.⁶

We investigated the proportion of infants who have the interventions recommended by ILCOR completed within 30 and 60 seconds, and determined the time taken to perform the individual tasks recommended in the ILCOR guidelines.

Methods

We performed this study at 2 hospitals, the Royal Women's Hospital (RWH) in Melbourne, Australia and the National Maternity Hospital (NMH) in Dublin, Ireland. Medical and nursing staff received training in neonatal resuscitation

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bpm	Beats per minute
DR	Delivery room
HR	Heart rate
ILCOR	International Liaison Committee on Resuscitation
NMH	National Maternity Hospital
PPV	Positive-pressure ventilation
RWH	Royal Women's Hospital

in accordance with ILCOR recommendations. High-risk deliveries in both hospitals were attended by a resuscitation team led by a consultant neonatologist or neonatal fellow accompanied by trainee doctors and neonatal nurses.

We defined high-risk deliveries as those in which the possible need for infant resuscitation was anticipated. Infants at high risk included preterm infants and infants with a known congenital anomaly. Delayed cord clamping was not performed at either hospital during the study period.

High-risk infants were video recorded in the RWH and NMH DRs for audit and research purposes with approval from the hospitals' Research Ethics Committees. Infants were recorded when a member of the research team was available, when the researchers judged that the infant was at sufficiently high (but undefined) risk of requiring resuscitation, and when parental permission was obtained. Written permission was sought from parents to video record their infant in the DR and to use the recordings for audit, research, and educational purposes.⁷ When time permitted, permission was sought from parents antenatally. When this was not feasible, the infant was recorded in the DR and permission was sought from the parents to use the recording afterward. If the parents declined, then the recording was erased without review.

If there was sufficient time before delivery and if a researcher was available to attend the delivery of a high-risk infant, a digital video camera (Sony, Tokyo, Japan) was brought to the DR and fixed above the resuscitation table using a mobile tripod arm (Manfrotto Magic Arm, Manfrotto, Italy). The camera was positioned to record the infant, the hands of the resuscitators, and the pulse oximeter screen. Recording commenced just before birth and continued until the infant left the DR. Sound was recorded, and communication between resuscitation team members and the Apgar alarms was audible. After parental permission was obtained, the video footage was transferred to a password-protected computer for review.

A single investigator (L.M.) reviewed all video recordings (from 2004-2006 for RWH and 2010-2012 for NMH) using Windows Live Movie Maker software (Microsoft, Redmond, Washington). The time of birth was defined as the time announced by the attending team or when the Apgar clock was started. The time taken for each task was determined from birth as described below.

Very preterm infants were placed without drying in food-grade polyethylene bags.^{8,9} Before delivery, a hole was cut in the polyethylene bag for the infant's head to fit through. When the infant was transferred to the table, the head was placed through the hole, and the bag was then pulled over the body and sealed below the feet. This was defined as the time at which the infant was placed in the bag.

Staff were taught to count the HR in beats per minute (bpm) by listening to the precordium with a stethoscope or feeling umbilical cord pulsations, counting over 6 seconds and multiplying by 10.³ Pulse oximetry is recommended for infants who are likely to need respiratory support in the DR.¹ The Masimo Radical oximeter (Masimo, Irvine, Cali-

fornia) was the only pulse oximeter used at RWH and was the principal device used at NMH. Nellcor OxiMax NPB-40 and N-595 oximeters (Covidien, Mansfield, Massachusetts) were used occasionally at NMH. The sensor was placed around the infants' right wrist before being connected to the oximeter.^{10,11} The time at which a stethoscope was placed on the chest or the cord was palpated was considered the time of clinical HR assessment. The time at which the sensor was connected to the oximeter was considered the time of oximeter application. The time at which the HR was first available was the time at which an HR was verbalized by the team member auscultating or palpating the HR or the time at which the HR value appeared on the pulse oximeter screen, whichever occurred first.

Staff were taught to provide respiratory support to infants with apnea, signs of respiratory distress, or HR <100 bpm with a T-piece device (Neopuff Infant Resuscitator; Fisher & Paykel Healthcare, Auckland, New Zealand) through a round silicone face mask (Laerdal, Stavanger, Norway or Fisher & Paykel Healthcare) or a short tube (endotracheal tube shortened to 5 cm) inserted into the nasopharynx. Extremely preterm infants were not routinely intubated or given surfactant in the DR. The time at which respiratory support was given was defined as the time when the mask was applied to the face or the T-piece was attached to a short nasal tube.

Chest compressions are recommended for infants with a persistent HR <60 bpm despite adequate positive-pressure ventilation (PPV). We recorded the time at which compressions were started. Epinephrine via the intravenous or endotracheal route is recommended for infants with persistent bradycardia despite chest compressions. We considered the time at which the syringe plunger was pressed to be the time of administration.

We determined whether these tasks were performed within 30 seconds and 60 seconds of birth for each infant, as well as the median time taken to perform these tasks. Because the time taken for an infant to be transferred to the resuscitation table after birth might not be within the resuscitation team's control, we also determined whether tasks were performed within 30 seconds and 60 seconds of arrival on the resuscitation table. Data were analyzed using SPSS version 18.0 (IBM, Armonk, New York). Results are presented as number (%) or median (IQR).

Results

At RWH, a total of 12 833 infants were born between January 2004 and May 2006, 584 of whom had a birth weight <1500 g. At NMH, 16 630 infants were born between August 2010 and May 2012, 221 of whom weighed <1500 g. Videos from 194 resuscitations were reviewed. Five infants in whom the exact time of birth could not be determined from recordings were excluded from the analysis; thus, a total of 189 videos (137 from RWH and 52 from NMH) were analyzed. The infants had a median gestational age 29 weeks (IQR, 27-34 weeks) and a median birth weight of 1220 g

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