Predicting the need for significant neonatal resuscitation following the delivery of late preterm neonates

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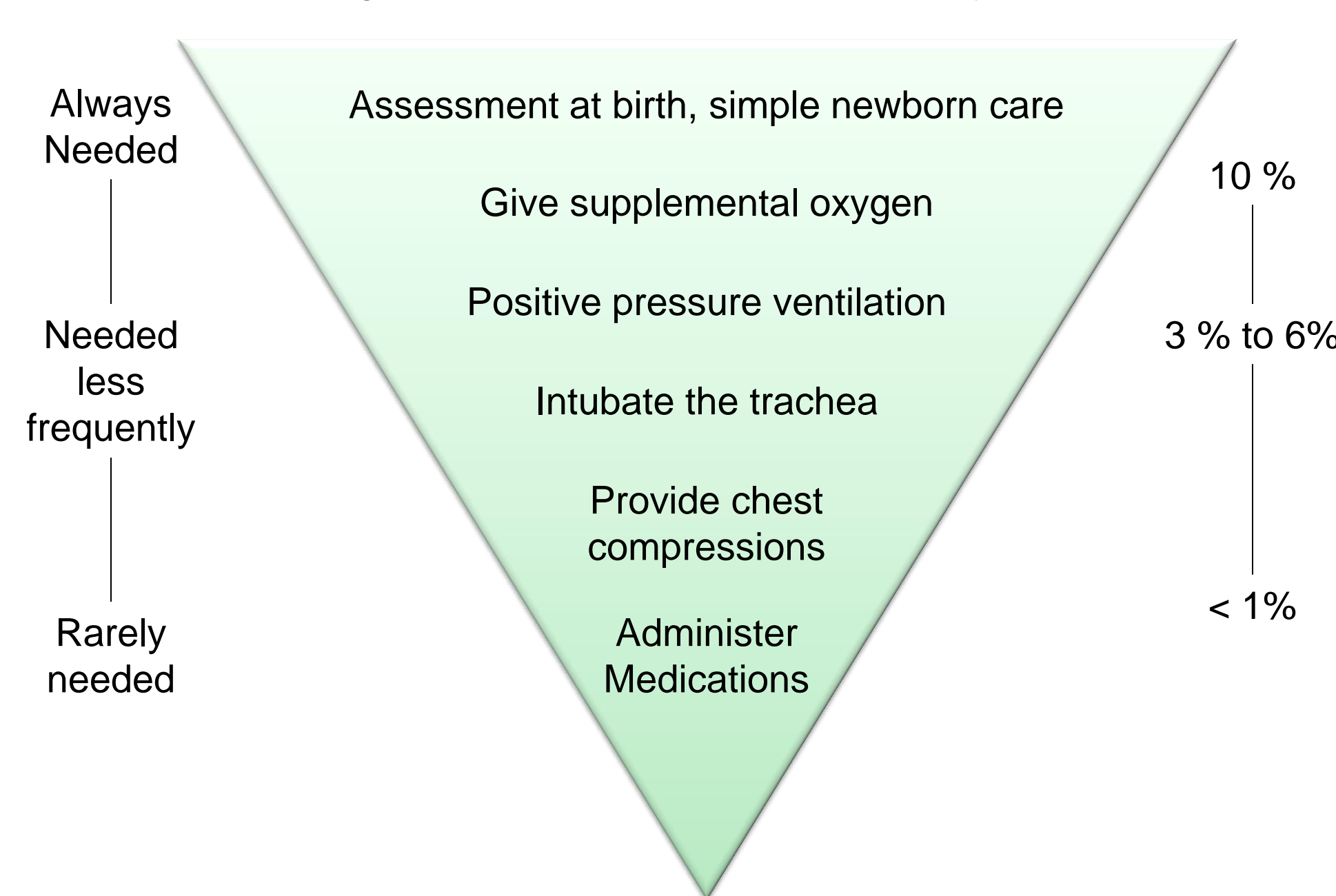[3]Parkland Health and Hospital System, Dallas, TX

Background

- Anticipation, adequate preparation and prompt support are critical for successful resuscitation in the delivery room (DR).
- Infants needing significant neonatal resuscitation (SNR) in the DR require a team to adequately carry out all steps.
- Delay in initiating ventilation may lead to adverse outcomes such as cerebral palsy, learning difficulties and other disabilities.
- Limited information is available about the need for delivery room resuscitation and late preterm birth.

Figure 1: Neonatal Resuscitation Pyramid

Assessment at birth, simple newborn care — Always Needed
Give supplemental oxygen — 10 %
Positive pressure ventilation — Needed less frequently
Intubate the trachea — 3 % to 6%
Provide chest compressions — Rarely needed
Administer Medications — < 1%

Objectives

- Describe baseline rate of need for SNR in the DR in late preterm neonates
- Identify ante-partum and intra-partum factors associated with SNR
- Create a risk prediction model of SNR in late preterm neonates

Materials & Methods

- Retrospective case control study at Parkland Health and Hospital System from 1/2011 to 8/2012
- Identified neonates from electronic medical records, resuscitation database and neonatal intensive care database
- Inclusion criteria: All late preterm neonates between 34[0/7] weeks and 36[6/7] weeks estimated gestational age (GA)
- Exclusion criteria: Infants deemed nonviable (ie lethal congenital anomalies)
- Identified ante-partum and intra-partum factors
- SNR definition: Prolonged positive pressure ventilation > 1 minute, CPAP or intubation in the DR
- Cohort divided into two groups:
  - Group 1: Need for significant neonatal resuscitation (SNR)
  - Group 2: No need for significant neonatal resuscitation (No SNR)
- Statistical Analysis:
  - Categorical variables: Chi square Test
  - Continuous variables: Student T-test or Mann Whitney Rank Sum Test
  - Stepwise forward logistic regression to create the final predictive model
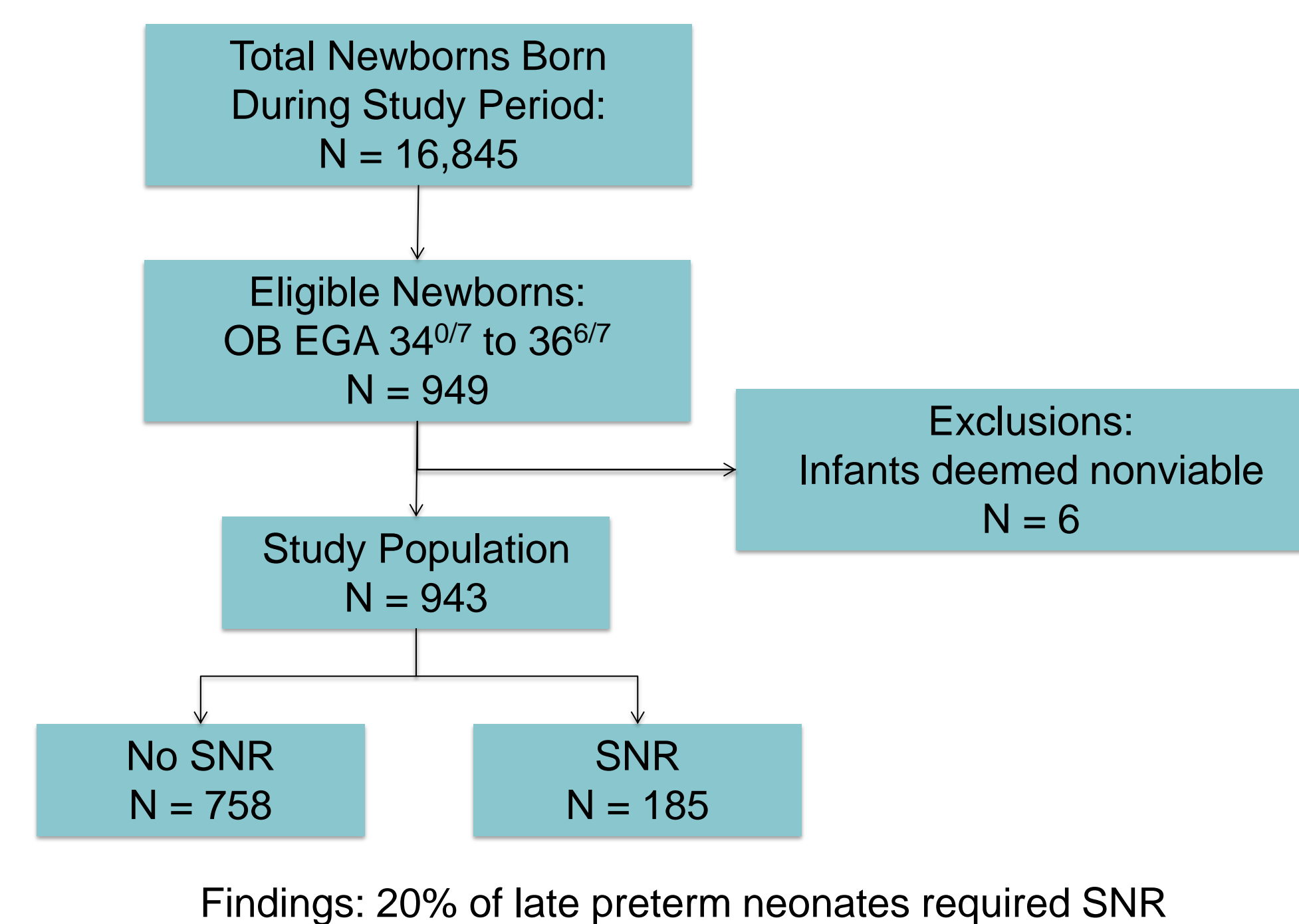
Results

Figure 1: Study Population

Total Newborns Born During Study Period: N = 16,845
→ Eligible Newborns: OB EGA 34[0/7] to 36[6/7] N = 949
→ Exclusions: Infants deemed nonviable N = 6
→ Study Population N = 943
→ No SNR N = 758 / SNR N = 185

Findings: 20% of late preterm neonates required SNR

Table 1: Maternal factors and need for SNR

	No SNR n=758	SNR n=185	p-value	Adjusted p-value*
Maternal Age (years) #	28 (22, 34)	27 (22, 33)	NS	NS
Black Race	295 (39%)	118 (64%)	<0.01	NS
Hispanic	603 (80%)	126 (68%)	<0.01	<0.01
Gravida #	3 (2, 4)	3 (2, 4)	NS	NS
Parity #	2 (1, 3)	1 (0, 3)	<0.01	NS
Maternal Obesity (BMI > 25)	492/658 (75%)	148/158 (94%)	<0.01	0.01
Diabetes Mellitus	110 (15%)	21 (11%)	NS	NS
Maternal Infection	190 (25%)	31 (17%)	0.02	NS
Chorioamnionitis	18 (2%)	3 (2%)	NS	NS
Prolonged Rupture of Membranes	102 (14%)	31 (17%)	NS	NS
Antibiotic Administration	583 (77%)	118 (64%)	<0.01	<0.01
Maternal Substance Use	49 (7%)	15 (8%)	NS	NS
Severe Preeclampsia	206 (27%)	69 (37%)	<0.01	NS
Magnesium Administration	201 (35%)	67 (77%)	<0.01	<0.01
Placenta Previa	14 (2%)	9 (5%)	0.02	NS
Abruption	7 (1%)	10 (6%)	<0.01	<0.01
Oligohydramnios	45 (6%)	10 (5%)	NS	NS

*Adjusted for gestational age. # median (interquartile)

Findings: Need for SNR is associated with black race, maternal obesity, infection during pregnancy, severe preeclampsia, magnesium administration, placenta previa and placental abruption.

Table 2: Infant characteristics and need for SNR

	No SNR n=758	SNR n=185	p-value	Adjusted p-value*
Gestational Age (weeks) #	36 (35,36)	35 (34,36)	<0.01	-
Birth weight (grams) #	2638 (2270,2990)	2344 (2058,2580)	<0.01	NS
Female	363 (48%)	84 (45%)	NS	NS
Multiple Gestation	89 (12%)	27 (15%)	NS	NS
Intrauterine Growth Restriction	31 (4%)	15 (8%)	0.02	<0.01
Non-Reassuring Fetal Heart Rate	76 (10%)	37 (20%)	<0.01	<0.01
Fetal Malpresentation Breech	53 (7%)	29 (16%)	<0.01	<0.01
Transverse	4 (1%)	5 (3%)	<0.01	NS

*Adjusted for gestational age. # median (interquartile)

Findings: Need for SNR is associated with lower GA, lower birth weight, intrauterine growth restriction, non-reassuring fetal heart rate and fetal malpresentation.

Table 3: Delivery characteristics and need for SNR

	No SNR n=758	SNR n=185	p-value	Adjusted p-value*
Delivery Type				
Vaginal	455 (60%)	60 (32%)	<0.01	<0.01
Routine C/S	163 (22%)	55 (30%)	<0.01	<0.01
Emergency C/S	139 (18%)	70 (38%)	<0.01	<0.01
Delivery Anesthesia				
Spinal	256 (34%)	81 (44%)	<0.01	<0.01
General	17 (2%)	28 (15%)	<0.01	<0.01
Precipitous Delivery	27 (4%)	12 (1%)	NS	NS
Failure to Progress	35 (5%)	11 (6%)	NS	NS
Nuchal Cord	120 (16%)	27 (15%)	NS	NS
Cord Gas pH #	7.26 (7.21, 7.31)	7.23 (7.17, 7.28)	<0.01	NS
Apgar score (1 minute) #	8 (8, 9)	6 (3, 8)	<0.01	NS
Apgar score (5 minute) #	9 (9, 9)	8 (7, 9)	<0.01	NS

*Adjusted for gestational age. # median (interquartile)

Findings: Need for SNR is associated with cesarean delivery, spinal and general anesthesia, lower cord blood gas pH and lower Apgar scores.

Figure 2: SNR in the DR based on gestational age

Gestational Age	SNR	Intubation
34 weeks	32	6
35 weeks	40	6
36 weeks	9	1
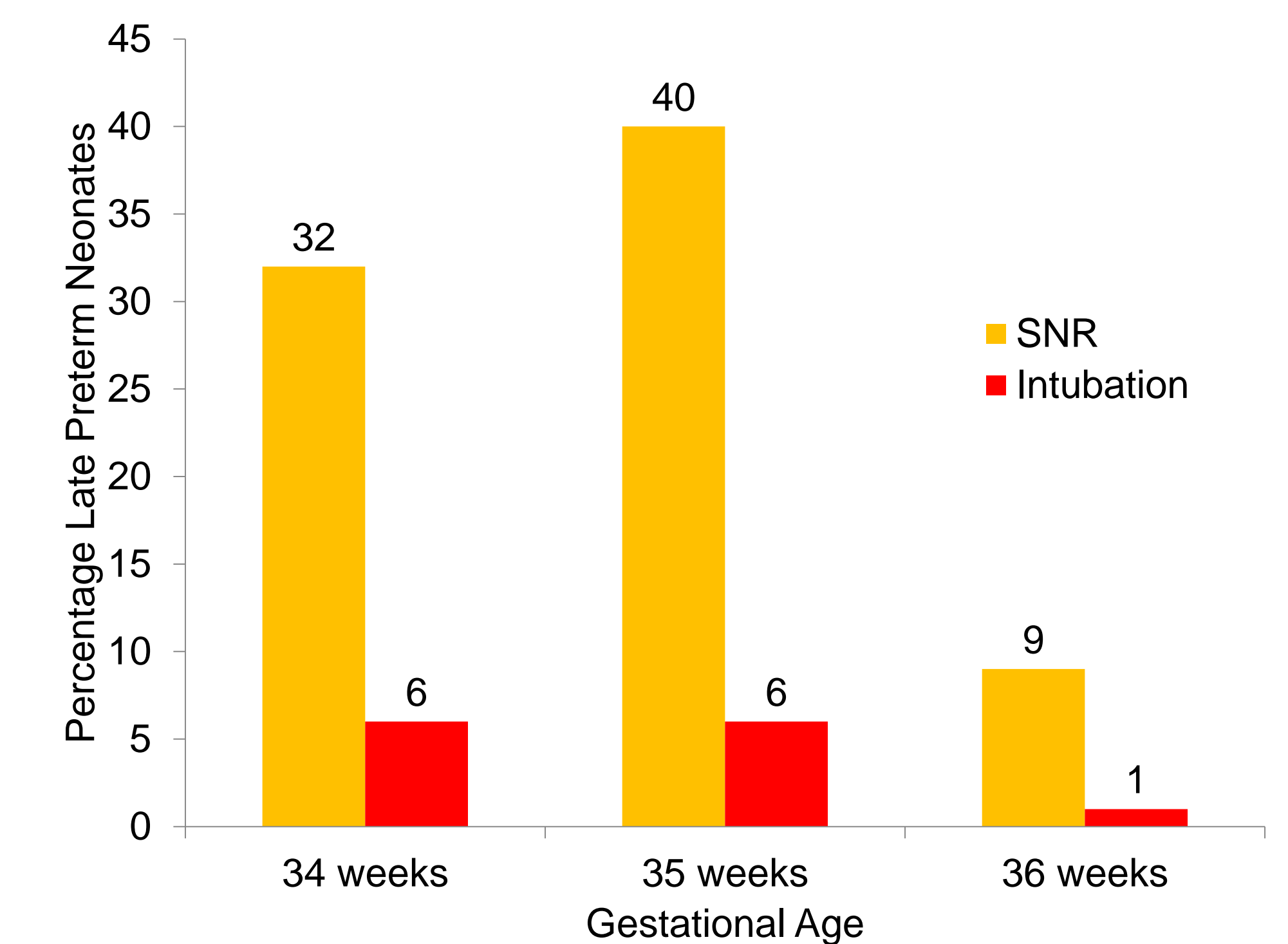
Findings: Need for SNR increases with lower gestational age.

Table 4: Logistic regression model for SNR in the DR

	Odds Ratio (95% CI)	p-value
Gestational Age (34-36 wks)	0.51 (0.40, 0.64)	<0.01
Maternal Obesity (BMI > 25)	2.31 (1.10, 4.85)	0.03
Intrauterine Growth Restriction	2.12 (0.98, 4.59)	0.056
Severe Preeclampsia	1.57 (1.06, 2.33)	0.03
Abruption	5.09 (1.50, 17.31)	<0.01
Fetal Malpresentation Breech	2.47 (1.52, 4.01)	<0.01
Transverse	5.23 (1.39, 19.67)	0.01
General Anesthesia	5.45 (2.54, 11.72)	<0.01

Findings: All risk factors with p-value <0.1 were included in stepwise forward logistic regression model. Seven factors were selected in the final model, as described above. Predictive model for need for SNR shows 0.82 area under the curve.

Conclusions

- One in five late preterm neonates needs SNR in the DR.
- In our study population, maternal obesity was independently associated with need for SNR in the late preterm population, which has not been previously described.
- It is possible to predict need for SNR in late preterm neonates using ante-partum and intra-partum variables.
- Such a risk-stratification model, if prospectively validated, can be used for better anticipation and preparation for high risk deliveries.