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Determination of antepartum and intrapartum risk factors associated with neonatal intensive care unit admission

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Abstract

Objective—To determine antepartum and intrapartum factors that are associated with admission to neonatal intensive care unit (NICU) among infants delivered between 36.0 and 42.0 weeks at our institution.

Methods—The retrospective cohort study included 73 consecutive NICU admissions and 375 consecutive non-NICU admissions. Data on demographic, antepartum, intrapartum and neonatal factors were collected. The primary endpoint defined was admission to NICU. Univariate analyses using the Student's *t*-test, Mann-Whitney *U*-test, χ^2 Fisher's exact test was performed along with multivariate analysis of significant non-redundant variables.

Results—Those with a significantly higher risk of NICU admission underwent induction of labor with prostaglandin analogs (12.5% vs. 24.7%, $P = 0.007$). Length of first stage 720 min (33.5% vs. 51.9%, $P = 0.011$), length of second stage of labor 240 min (10.6% vs. 31.6%, $P < 0.001$) and prolonged rupture of membranes 120 min (54.0% vs. 80.0%, $P = 0.001$) were all associated

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with an increased chance of NICU admission. Intrapartum factors predictive of NICU admission included administration of meperidine (11.7% vs. 27.4%, $P < 0.001$), presence of preeclampsia (5.5% vs. 0.8%, $P = 0.015$), use of intrapartum IV antihypertensives (1.1% vs. 13.7%, $P < 0.001$), maternal fever (5.3% vs. 31.5%, $P < 0.001$), fetal tachycardia (1.9% vs. 12.3%, $P < 0.001$), and presence of meconium (30% vs. 8%, $P < 0.001$).

Conclusion—Identification of modifiable risk factors may reduce neonatal morbidity and mortality. Results from this study can be used to develop and validate a risk model based on combined antepartum and intrapartum risk factors.

Keywords

Antenatal; intrapartum NICU; risk factors

Introduction

Neonatal intensive care unit (NICU) admissions in the United States have risen to 6.7% in 2008 [1]. The mean length of hospital stay for a neonate admitted to the NICU is 13.2 days with an average hospital cost of \$76,164 dollars [2]. While a number of NICU admissions are due to prematurity, maternal infection, respiratory failure, jaundice, neonatal infection, and congenital malformation, there is still a large percentage of term admissions that are unanticipated at the time of delivery [3, 4].

Therefore, the primary objective of this study was to determine antepartum and intrapartum factors that are associated with NICU admissions among infants delivered between 36 weeks and 0 days and 42 weeks and 0 days at our institution. The secondary objective of this study is to highlight non-modifiable and modifiable risk factors in an attempt to decrease future NICU admissions. Early identification of risk factors may help prevent adverse maternal and neonatal outcomes and recognize deliveries that may need the presence of a pediatrician.

Methods and materials

This study was conducted at Richmond University Medical Center, Staten Island, New York, which is a high-risk tertiary care center for obstetrical patients and neonates. For this study 686 consecutive medical records from November 2014 to February 2015 were retrospectively reviewed. All singleton deliveries between 36.0 and 42.0 gestational weeks were included, with the exception of patients with incomplete medical records, stillbirths, and congenital fetal anomalies. Of the 686 charts reviewed, 153 were excluded due to incomplete medical records, 12 due to multiple gestations, and 73 due to preterm births prior to 36 weeks and 0 days' gestation. Of the remaining 448 records, 375 patients and their neonates were included in the non-NICU cohort, and 73 patients and their neonates were included in the NICU cohort. NICU admission was at the discretion of the admitting pediatrician. NICU admission criteria at our institution includes maternal temperature above 100.6°F at the time of delivery, neonatal respiratory distress, Apgar score < 7 at 5 min of life, clinical signs of chorioamnionitis, neonatal hypotonia, neonatal hypoglycemia, and neonatal seizures. Data on demographics, antepartum, intra-partum and neonatal factors were collected. Demographic data collected included maternal age, BMI, race, and insurance

status. Antepartum factors included parity, history of preterm births, history of cesarean deliveries, maternal comorbidities, and use of medications during pregnancy. Intra-partum factors assessed included gestational age at delivery, induction of labor, augmentation of labor with oxytocin or artificial rupture of membranes, scheduled cesarean delivery, admitting diagnoses, pain management (meperidine, epidural), length of stages of labor, length of membrane rupture, and mode of delivery. The presence of maternal fever, nuchal chord and/or meconium and fetal heart tracing characteristics were also evaluated. Neonatal characteristics assessed included fetal weight, sex, and Apgar scores. The primary endpoint defined was admission to the NICU. Statistical analysis was carried out using IBM SPSS 22.0. Univariate analyses for continuous variables were compared using the Student's *t*-test or Mann-Whitney *U*-test. Categorical data was compared using χ^2 -test or Fisher's exact tests. A *P* value of < 0.05 was considered statistically significant. Variables that were statistically significant on univariate analysis were tested for interaction of terms. Non-redundant variables were entered into multivariable logistic regression model to test for adjusted associations. Variables that retained statistical significance are reported as adjusted odds ratios (aOR) with 95% confidence intervals.

Results

Of the 448 women who were included in this study, 73 (16.3%) neonates were admitted to the NICU and 375 (83.7%) were admitted to the newborn nursery. The maternal demographic characteristics of both groups are summarized in Table 1 and were similar between groups, as was gestational age at delivery (Table 2).

Factors related to maternal obstetrical history were assessed, and were all shown to be non-significant factors for NICU admission (Table 3).

Antepartum factors

Induction of labor with the use prostaglandin was a significant predictor of NICU admission (OR 2.28, 95% CI 1.24–4.22, *P* = 0.007), with 18/75 (24.7%) of the NICU patients and only 47/375 (12.5%) of the non-NICU patients undergoing prostaglandin induction (Table 3). Table 4 lists reasons for induction of labor, mode of delivery, and NICU admission status. Scheduled cesarean delivery was non-predictive of NICU admission. The most common reason for cesarean delivery was scheduled repeat cesarean delivery in women that declined a trial of labor after cesarean (Table 5).

Eighteen patients in our study had a current hypertensive disorder, of which six infants (33%) were admitted to NICU. Mothers with gestational hypertension or chronic hypertension not being treated with antenatal hypertension medications were not at increased risk of having their infant admitted to NICU (*P* = 0.972), in contrast to those being treated with an anti-hypertensive medication (OR 10.81, 95% CI 1.94–60.80, *P* = 0.008). Other antepartum factors that did not reach statistical significance included obesity (BMI > 30 kg/m²), pre-gestational diabetes, and gestational diabetes types I and II.

Intrapartum factors

All factors are listed in Table 3. Admitting diagnosis of active labor was documented in 19/73 (26.0%) of NICU patients and 149/375 (39.7%) of non-NICU patients and was shown to be a protective factor for NICU admission (OR 0.53 95% CI 0.30–0.94, $P = 0.027$).

While the length of the first stage of labor was not significant between the two groups (Table 6), prolonged 1st stage of labor ≥ 720 min was significantly associated with NICU admission (Table 3).

Variables associated with rupture of membranes, including length of membrane rupture (Table 6) and amniotomy (Table 3) were not found to be significant. However, prolonged rupture of membranes ≥ 240 min was found to be significant (OR 3.41, 95% CI 1.58–7.37, $P = 0.001$) (Table 3). The presence of meconium on membrane rupture was documented in 17/73 (23.3%) of NICU patients and 28/375 (7.5%) of non-NICU patients (OR 3.76, 95% CI 1.93–7.32, $P < 0.001$). Maternal group B strep positive culture or bacteriuria was a non-significant factor.

All cases of Category II fetal heart tracing, Category III fetal heart tracings, and the presence of late decelerations were not significant predictors of NICU admission (Table 3). However, when the presence fetal tachycardia was isolated, it was significantly associated with NICU admission (OR 7.39, 95% CI 2.66–20.56, $P < 0.001$). Maternal fever was observed in 23/73 (31.5%) of NICU patients and 20/375 (5.3%) of non-NICU patients (OR 8.17, 95% CI 4.19–15.93, $P < 0.001$) and found to be a predictive factor. Of the 43 patients with intrapartum fever, 3 patients had the diagnosis of clinical chorioamnionitis, and their infants were admitted to the NICU.

The use of intravenous anti-hypertensive medication (Labetalol or Hydralazine) for an intrapartum diastolic blood pressure > 110 mm Hg was found to be significant predictor of NICU admission. A diagnosis of pre-eclampsia was also found to be a significant predictor (OR 7.19, 95% CI 1.57–32.83, $P < 0.001$) while the requirement of magnesium sulfate for its management approached significance ($P = 0.07$).

Second stage of labor was longer in the NICU admission group (102 vs. 61 min, $P = 0.052$), and this difference approached statistical significance. (Table 6). Mode of delivery was also predictive, with cesarean delivery incurring increased risk and vaginal delivery being a protective factor.

Neonatal factors and outcomes

Admitted diagnosis of NICU infants are listed in Table 7. Non-mutually exclusive admitting diagnoses for NICU infants included suspected sepsis 51/73 (69.9%), respiratory distress 36/73 (49.3%), hypoglycemia 2/73 (2.7%) and hypotonia 1/73 (1.4%) (Table 7). Suspected sepsis was the most common factor among term infants admitted to NICU, and accounted for the longest hospital stay averaging 4.8 days with a range of 2–31 days.

After multiple regression analysis, two factors retained their statistical significance. Both use of antenatal anti-hypertensives (aOR 32.21, 95% CI 2.87–361.58, $P = 0.005$) and presence of maternal fever (aOR 7.78, 95% CI 2.71–22.37, $P < 0.001$) were shown to be independent predictors of NICU admission.

Discussion

About 5–18% of term infants are admitted to neonatal intensive care units annually, with a majority of these admissions being unanticipated [5]. Intervention for modifiable factors may decrease neonatal morbidity and may have the potential to lessen the financial burden of higher-level nurseries admissions on hospitals.

Although the mean gestational age at delivery was similar between both groups (Table 2), analysis of the extremes of gestational age in our cohort revealed interesting results. Infants that delivered in the 36th gestational week were more likely to be admitted to NICU (11% vs. 3.5%), however infants delivered after 41 weeks were not at increased risk for admission (5.5% vs. 7.5%) (Table 2). Other studies have showed varied results. Cheng et al. retrospectively analyzed a cohort of 2,527,766 low risk women with term singleton deliveries that showed neonates delivered at 40–41 weeks had higher risks of birth-weight > 4500 g, neonatal injury, meconium aspiration and febrile morbidity [6]. However, as in our study, a prospective analysis of 5000 non-anomalous term infants by Spain et al. failed to demonstrate an increase in neonatal morbidity after 41 gestational weeks [5].

We have shown an increased risk of NICU admission with use of prostaglandins for induction of labor in our patient population. Reasons for induction varied in our study group (Table 4). Studies have shown that risks associated with elective versus medically indicated inductions of labor are similar [7]. Baud et. al retrospectively reviewed medical records of 5090 patients that underwent induction labor for either medical or elective indications [7]. The results showed nulliparous women in the elective induction labor group had the same risk of cesarean section, instrumental delivery, as those who were induced for medical/obstetrical reasons. Additionally, their neonates also had similar risks including admission in NICU, prolonged hospitalization, low Apgar score, umbilical cord arterial pH < 7.1, as those whose mothers were induced for medical reasons [7]. Given our findings and that of the other studies described above, it is our recommendation that as the risk versus benefit ratio is similar between both medically and socially indicated inductions at term, that it may be beneficial to monitor these patients and allow them to present in active labor.

Our study showed that admission in active labor and delivery by vaginal route were protective factors for NICU admission. Data merged from two prospective studies that compared 216 low-risk nulliparous women that were admitted in either active labor vs. pre-active labor found an increased risk of cesarean delivery among the patient admitted in pre-active labor [8]. As in other studies that have demonstrated increased neonatal morbidity and respiratory complications, cesarean delivery was associated with an increased risk of NICU admission in our study [5]. Delaying admission until patients enter the active phase of labor may improve both neonatal and maternal outcomes and reduce NICU admissions.

The duration of the first stage of labor is also an important factor affecting NICU admission. In our study, a first stage of labor exceeding 720 min was associated with an increased risk of NICU admission. Others studies have also found an increased risk of neonatal morbidity with increasing length of first stage of labor [9, 10].

Therefore, strategies for shortening the duration of the first stage of labor may decrease neonatal morbidity and NICU admission. One method to possibly shorten the length of the first stage of labor is early use of oxytocin [11]. Hinshaw and colleagues showed in a randomized trial that early use of oxytocin led to a reduction in time to delivery without affecting the number of cesarean deliveries nor maternal/neonatal morbidity. A Cochran review in 2013 supported these results [12]. Amniotomy is another technique that has been suggested to shorten duration of labor, however there is little evidence to support its routine use. Although amniotomy was not predictive of NICU admission in our study, membrane rupture exceeding 120 min carried a significantly increased risk. Therefore, the use of amniotomy for the purpose of shortening the first stage of labor to decrease NICU admission is not supported by the current evidence.

A second stage of labor longer than 240 min, irrespective of the mode of delivery, was predictive of NICU admission within our group of patients. Other studies have shown similar morbidity associated with prolonged second stage of labor [13–15]. A retrospective study by Cheng et al. showed that multiparous women with a second stage of labor longer than 3 h had a higher risk NICU admission as well as other neonatal and maternal morbidities [16].

Instrumental delivery is an alternative to shorten the second stage of labor, however it also carries inherent risk of neonatal morbidity [17, 18]. Randomized studies assessing the risk of instrumental versus cesarean delivery for a prolonged second stage of labor on NICU admission are yet to be done.

The presence of maternal fever $> 100.6^{\circ}\text{F}$ at the time of delivery warrants admission to the NICU for evaluation of neonatal sepsis in our institution. This accounted for the largest group on NICU admission, of which only two infants had culture positive sepsis. The rate of clinical chorioamnionitis was 7%. Therefore many causes of elevated intrapartum maternal temperature may have been from non-infectious etiologies such as epidural use and oxidative stress [19]. Both infectious and non-infectious etiologies of maternal fever have been linked to adverse neonatal complications such as low Apgar scores, respiratory distress, and neonatal seizures [19]. Fetal tachycardia was strongly correlated with maternal fever in our study. Other studies have demonstrated a similar correlation [19]. Fetal tachycardia, secondary to the presence of maternal fever, may necessitate a cesarean delivery due to a persistent non-reassuring fetal heart status. Therefore, regardless of the etiology of the fever, there should be more of a focus on quicker reduction of intrapartum fever during labor to reduce the advent of adverse neonatal outcomes.

Of interest, our study did not show significant differences in NICU versus neonatal nursery admission based on category II nor category III tracings. The reasons for this could be due to the small number of patients that we had in our study that had electronic fetal heart rate

tracings that were concerning. Also, a number of category II tracings within our study were secondary to fetal tachycardia, with results described as above.

There was also a small number of patients with medical co-morbidities in our study. Although, obese patients are at an increased risk for complications related to cesarean delivery and post-operative complications, studies including ours have shown there are no differences in neonatal outcomes [20]. Similar to our results, a recent study by Vinturache et al. reported infants of overweight and obese women were more likely to have increased birth weight compared to infants of normal weight women, but there were no differences in Apgar scores, admission to the NICU, or length of postnatal hospital stay among groups [20].

The presence of pre-gestational diabetes, gestational diabetes, and hypertensive disorders not requiring treatment with anti-hypertensive medication did not incur an increased risk for NICU admission. It is well known that uncontrolled diabetes mellitus has multiple long-term adverse effects on both mother and neonate [21, 22]. Within our study, we evaluated term neonates without any anomalies. As patients with poorly controlled pre-gestational and gestational diabetes, and/or gestation and chronic hypertensive disorders are more likely to deliver before 36 weeks, [23] it is possible that many patients who fall into one or both categories were also excluded from the study due to prematurity. Therefore, the patients meeting inclusion criteria were possibly a lower risk group.

Although it only included a small group of patients, hypertensive disorders requiring anti-hypertensive medication was found to be a potential risk factor for NICU management. The results of several randomized trials reveal that control of maternal blood pressure with anti-hypertensive drugs does not improve pregnancy outcome in women with gestational hypertension [24]. In fact, some studies have indicated increase harm [25–29]. Therefore careful selection of patients requiring anti-hypertensive medications may have an impact on NICU admissions.

The limitations of our study include those inherent to any retrospective study, including the possibility of some maternal and fetal indications were not well documented by the managing physicians or reporting nurses. Decisions for admission to NICU and management of neonatal complications were at the discretion of neonatologists and pediatricians that could have varied within the time period. Strengths of our study include development of a comprehensive picture of NICU risk factors from pre-pregnancy demographical factors, antepartum factors, and intrapartum factors.

Conclusion

This study brings to light the value in further assessment of modifiable factors (Table 8), highlighting the need for early identification of risk factors, and communicating potential adverse risk factors to pediatricians early within the labor process. Results from this study can be used to develop and validate a risk model based on combined antepartum and intrapartum risk factors.

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Table 1

Patient demographic continuous variables for NICU admission.

Factor	NICU (n = 73)	Newborn nursery (n = 375)	P-value
Maternal age, mean (range)	29.85 (18–41)	30.16 (13–44)	0.659
Parity, median (range)	2 (1–6)	2 (1–15)	0.092
Number of previous vaginal deliveries, mean (range)	0.36 (0–3)	0.67 (0–10)	0.029
Number of previous cesarean deliveries, mean (range)	0.36 (0–5)	0.30 (0–5)	0.494
Gestational age by weeks, mean (range)	39.02 (36–41)	39.04 (36–42)	0.908
BMI kg/m ² , mean (range)	28.44 (17–43)	30.19 (18.4–53.2)	0.043

P < 0.05 significant.

Table 2

Gestational age by weeks.

Weeks gestation	NICU (n = 73); n (%)	Non-NICU (n = 375); n (%)	P-value
36	8 (11.0)	13 (3.5)	0.041 ^a
37	7 (9.6)	44 (11.7)	
38	9 (12.3)	87 (23.2)	
39	24 (32.9)	125 (33.3)	
40	21 (28.8)	78 (28.8)	
41	4 (5.5)	27 (7.2)	
42	0 (0.0)	1 (0.3)	

P < 0.05 significant.

^a χ^2 contingency.

Table 3

Categorical risk factors for NICU admission.

Factor	NICU (n = 73)		Non-NICU (n = 375)		Univariate analysis	
	Exposed, n (%)	Non-exposed, n (%)	Exposed, n (%)	Non-exposed, n (%)	OR (95% CI)	P-value
Maternal history						
Nulligravida	39 (53.4)	34 (46.6)	157 (41.9)	218 (58.1)		0.069
Previous cesarean section	18 (24.7)	55 (75.3)	78 (20.8)	297 (79.2)		0.462
Maternal history of preterm birth	7 (9.6)	66 (90.4)	16 (4.3)	359 (95.7)		0.059
Maternal history of hypertension/preeclampsia	3 (4.1)	70 (95.9)	13 (3.5)	362 (96.5)		0.787
Maternal history of thrombophilia/pulmonary embolism/deep vein thrombosis	2 (2.7)	71 (97.3)	7 (1.9)	368 (98.1)		0.446 ^a
Maternal history of diabetes/gestational diabetes	5 (6.8)	68 (93.2)	12 (3.2)	363 (96.8)		0.135
Antenatal						
BMI ≥ 30 kg/m ² at delivery	32 (43.8)	41 (56.2)	178 (47.5)	197 (52.5)		0.324
Current maternal hypertensive disorder	2 (2.7)	71 (97.3)	10 (2.7)	365 (97.3)		0.972
Antenatal anti-hypertensive medications	4 (5.5)	69 (94.5)	2 (0.5)	373 (99.5)	10.81 (1.94–60.80)	0.008 ^a
Diabetes mellitus	2 (2.7)	71 (97.3)	1 (0.3)	374 (99.7)		0.07 ^a
Gestational diabetes, type I	5 (6.8)	68 (93.2)	12 (3.2)	363 (96.8)		0.126
Gestational diabetes, type II	1 (1.4)	72 (98.6)	4 (1.1)	371 (98.9)		0.591 ^a
Scheduled cesarean delivery	19 (26.0)	54 (74.0)	79 (21.2)	296 (78.9)		0.348
Prostaglandin induction	18 (24.7)	55 (75.3)	47 (12.5)	328 (87.5)	2.28 (1.24–4.22)	0.007
Factors associated with 1 st stage of labor						
Admitting diagnosis active labor	19 (26.0)	54 (74.0)	149 (39.7)	226 (60.3)	0.53 (0.30–0.94)	0.027
Prolonged first stage of labor ≥ 720 min (n = 330)	27/52 (51.9)	25/52 (48.1)	93/278 (33.5)	185/278 (66.5)	2.15 (1.18–3.91)	0.011
Group B strep positive	15 (20.5)	58 (79.5)	82 (21.9)	293 (78.1)		0.794
Oxytocin augmentation	35 (47.9)	38 (52.1)	139 (37.1)	236 (62.9)		0.081
Meperidine	20 (27.4)	53 (72.6)	44 (11.7)	331 (88.3)	2.84 (1.55–5.19)	<0.001
Epidural	46 (63.0)	27 (37.0)	243 (64.8)	132 (35.2)		0.77
Preeclampsia	4 (5.5)	69 (94.5)	3 (0.8)	372 (99.2)	7.19 (1.57–32.83)	0.015 ^a
Intrapartum IV antihypertensives	10 (13.7)	63 (86.3)	4 (1.1)	371 (98.9)	14.72 (4.48–48.39)	<0.001

Factor	NICU (n = 73)			Non-NICU (n = 375)			Univariate analysis	
	Exposed, n (%)	Non-exposed, n (%)	Exposed, n (%)	Non-exposed, n (%)	OR (95% CI)	P-value		
Magnesium sulfate	2 (2.7)	71 (97.3)	1 (0.3)	374 (99.7)		0.07 ^a		
Maternal fever	23 (31.5)	50 (68.5)	20 (5.3)	355 (94.7)	8.17 (4.19–15.93)	< 0.001		
Fever > 2 h	21 (28.8)	52 (71.2)	14 (3.7)	361 (96.3)	10.41 (4.99–21.74)	< 0.001		
Fetal tachycardia	9 (12.3)	64 (87.7)	7 (1.9)	368 (98.1)	7.39 (2.66–20.56)	< 0.001		
Electronic fetal monitoring: category II	25 (34.2)	48 (65.8)	112 (29.9)	263 (70.1)		0.457		
Electronic fetal monitoring: category III	3 (4.1)	70 (95.9)	4 (1.1)	371 (98.9)		0.089 ^a		
Late decelerations	16 (21.9)	57 (78.1)	55 (14.7)	320 (35.3)		0.121		
Factors associated with rupture of membranes								
Prolonged rupture of membranes 240 min (n = 310)	36/45 (80.0)	9/45 (20.0)	143/265 (54.0)	122/265 (46.0)	3.41 (1.58–7.37)	0.001		
Amniotomy	24 (32.0)	49 (67.1)	124 (32.1)	251 (66.9)		0.975		
Factors associated with 2 nd stage of labor								
Prolonged second stage of labor 120 min ^b (n = 273)	12/38 (31.6)	26/38 (68.4)	25/235 (10.6)	210/235 (89.4)	3.88 (1.74–8.63)	< 0.001		
Vaginal delivery	32 (43.8)	41 (56.2)	231 (61.6)	144 (38.4)	0.487 (0.293–0.808)	0.005		
Cesarean section	41 (56.2)	32 (43.8)	144 (38.4)	231 (61.6)	2.06 (1.24–3.41)	0.005		
Meconium	17 (23.3)	56 (76.7)	28 (7.5)	347 (92.5)	3.76 (1.93–7.32)	< 0.001		
Neonatal factors								
Male sex	38 (52.1)	35 (47.9)	187 (49.9)	183 (50.1)		0.717		
Nuchal cord	23 (32.9)	47 (67.1)	94 (25.1)	281 (74.9)		0.174		
1 min Apgar < 7	13 (17.8)	60 (82.2)	3 (0.8)	372 (99.2)	26.87 (7.43–97.08)	< 0.001		
5 min Apgar < 7	4 (5.5)	69 (94.5)	0 (0)	375 (100)	1.06 (1.00–1.19)	0.001 ^a		

^aP-value calculated with Fischer's exact test.

P < 0.05 significant.

Table 4

Prostaglandin induction; indication, resulting mode of delivery and NICU admission (total prostaglandin induction n = 53).

	Indication for induction	n	Mode of delivery	NICU admission
Medically indicated	History of previous fetal demise	1	Vaginal: 100%	100%
	Gestational diabetes mellitus	1	Vaginal: 100%	0%
	Cholestasis	1	Vaginal: 100%	0%
	Polyhydramnios	3	Vaginal: 3/3	0%
	Intrauterine growth restriction	4	Vaginal: 50%	0%
			Cesarean: 50%	100%
	Oligohydramnios	5	Vaginal: 60%	33%
			Cesarean: 40%	0%
	Gestational hypertension/preeclampsia/eclampsia	6	Vaginal: 67%	25%
			Cesarean: 33%	0%
Non-medically indicated	Other/unspecified	9	Vaginal: 89%	13%
			Cesarean: 11%	0%
	< 40 weeks	3	Vaginal: 100%	0%
	40 weeks (40–40 weeks and 6 days)	8	Vaginal: 38%	33%
			Cesarean: 52%	20%
	41 weeks (41–41 weeks and 6 days)	12	Vaginal: 50%	33%
			Cesarean: 50%	0%

Table 5

Indications for scheduled cesarean deliveries (total n = 95).

Diagnosis	n	Percent (%)
Repeat	75	76.5%
Primary elective	7	7.1%
Macrosomia	4	4.1%
Breech	3	3.1%
Oligohydramnios	1	1.0%
Maternal history of myomectomy	1	1.0%
Placenta previa	1	1.0%
Active genital herpes	1	1.0%
Other	2	2.0%

Table 6

Continuous temporal variables for NICU admission (min).

Factor	NICU, mean (range)	Newborn nursery, mean (range)	P-value
Length of first stage of labor	793 (51–2792)	690 (45–5492)	0.194
Length of second stage of labor	102 (1–386)	61 (1–1450)	0.052
Length of membrane rupture	623 (16–2089)	448 (1–9976)	0.12

Table 7

NICU admission diagnosis (n = 73).

Diagnosis	n	Percent (%)	Gestational age (weeks), Mean (range)	Days in NICU (days), Mean (range)
Suspected sepsis	51	69.9%	38.0 (36–39.5)	4.8 (2–31)
Respiratory distress	36	49.3%	36.7 (36–41)	3.6 (2–37)
Other	16	21.9%	38.4 (36.0–40.3)	8.8 (2–37)
Hypoglycemia	2	2.7%	40.4 (36.1–40.4)	3.0
Hypotonia	1	1.4%	40.3	3.0

Table 8

Modifiable risk factors for NICU admission and recommendations.

Association/risk factor	Recommendation
Antenatal anti-hypertensive medications	Further research needed on fetal effects of anti-hypertensive medications
Prostaglandin induction	Reduce non medically indicated inductions
1 st stage of labor > 720 min	Early use of oxytocin
Maternal fever	Further investigations needed into non-infectious causes
Rupture of membranes > 240 min	Oxytocin, limit use of amniotomy
2 nd stage of labor > 120 min	Consider operative vaginal delivery when appropriate