Antenatal Periviability Counseling and Decision-Making: A Retrospective Examination by the
Investigating Neonatal Decisions for Extremely Early Deliveries (INDEED) Study Group

Running header: Antenatal Periviability Counseling and Decision-Making

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ABSTRACT

Objective: To describe periviability counseling practices and decision-making

Study design: Retrospective review of mothers and newborns delivering between 22 and 24 completed weeks from 2011-2015 at six U.S. centers. Maternal and fetal/neonatal clinical and maternal sociodemographic data from medical records and geocoded sociodemographic information were collected. Separate analyses examined characteristics surrounding: receiving neonatology consultation; planning neonatal resuscitation; centers' planned resuscitation rates.

Results: Neonatology consultations were documented for 40%, 63%, and 72% of 498 mothers delivering at 22, 23, and 24 weeks, respectively. Consult vs. no-consult mothers had longer median admission-to-delivery intervals (58.7 vs. 8.7h, $p<0.001$). Consultations were seen more frequently when parental decision-making was evident. 76% of mothers had neonatal resuscitation planned. Resuscitation vs. no-resuscitation newborns had higher mean gestational ages (24.0 vs. 22.9 weeks, $p<0.001$) and birthweights (618 vs. 469g, $p<0.001$). Planned resuscitation rates differed at higher (HR) vs. lower (LR) rate centers at 22 (43% vs. 7%, $p<0.001$) and 23 (85% vs. 58%, $p<0.001$) weeks. HR vs. LR centers' populations had more socioeconomic hardship markers but fewer social work consultations (OR 0.31, CI:0.15-0.59, $p<0.001$).

Conclusion: Areas requiring improvement included: delivery/content of neonatology consultations, social work support, consideration of centers' patient populations, and opportunities for shared decisions.

SELECTED KEYWORDS: neonatology, perinatology, ethics, palliative care, race and health, decision-making, policy-making

INTRODUCTION

The American Academy of Pediatrics (AAP) released 2015 guidelines for antenatal counseling for deliveries between 22 and 25 weeks gestation, often termed “periviable” due to increased risks of death and neurologic impairment.¹ Previous guidelines from 2009 had reviewed approaches of selective resuscitation (after discussion with parents) at these gestational ages, but stressed the importance of discussing possible outcomes and treatments with parents if resuscitation was an option per physicians’ judgment.² The 2009 recommendations suggested most parents would need more than one consultation. Both guidelines explained counseling by obstetric and neonatology services together was preferable, and in that vein, a pediatric and obstetric Joint Workshop affirmed shared decision-making for physicians and parents deciding between neonatal resuscitation and comfort care.³

A 2018 survey of U.S. neonatologists revealed that most desired some level of consensus for guidelines, but lacked consensus for standardization level (institutional, regional, national).⁴ Varying institutional practices impact survival differences,⁵ but institutional policies are seldom documented.⁶⁻⁷ Relationships between sociodemographic parental characteristics⁸⁻¹⁰ and medical decisions have been studied, but not in relation to centers’ practices. Despite these challenges, the AAP urges institutions to develop antenatal counseling policies.¹ As institutions hone periviability counseling approaches, we sought to describe documented practices in counseling and decision-making documentation to identify areas of interest to future research and quality improvement initiatives.

METHODS

Mother/baby identification and data collection

Mothers delivering at the 6 INDEED (Investigating Neonatal Decisions for Extremely Early Deliveries) study centers from 1/1/2011-12/31/2015 were identified as a retrospective cohort. The INDEED centers include: Indiana University (Indianapolis), Medical College of Wisconsin (Milwaukee), University of Chicago (Chicago), University of Michigan (Ann Arbor), University of Mississippi Medical Center (Jackson), NorthShore University HealthSystem Evanston Hospital (Evanston, IL). These academic centers provided tertiary neonatology and obstetric care for 2100-4600 annual deliveries including high-risk regional maternal transports.

Co-investigators at each site (1-3 per center) identified mothers and newborns and collected data from their medical records. The lead author/INDEED coordinator conducted a teleconference with each site's co-investigators when a site had acquired permissions to join the study to review inclusion criteria, process of sharing deidentified information in common REDCap database, and reviewed data collection techniques and characterizations. All co-investigators also shared process questions via a common online document and lead author answered questions on classification by email.

To ensure identification of all periviable deliveries, inborn newborns delivered at 22 0/7 to 24 6/7 weeks were identified from sites' neonatology databases; mothers admitted with living fetuses delivering between 22 0/7 to 24 6/7 weeks were identified from sites' obstetric databases. Admissions for planned pregnancy termination were not included. Mothers whose fetuses had known major congenital or chromosomal anomalies were excluded. Because decision-making rather than neonatal outcomes or treatments was of interest, a mother meeting inclusion criteria with a subsequently documented plan for resuscitation or no resuscitation remained included if she progressed to intra-uterine fetal demise (IUFD). In cases

of multiple fetuses, only fetuses meeting inclusion criteria were studied. Plans were analyzed by each mother to avoid duplication of maternal characteristics for statistical analyses, but singleton vs. multiple gestations were noted. A mother delivering fetuses more than 24 hours apart but within the periviable period was analyzed as two separate mothers to note different delivery characteristics.

Mothers' and newborns' records were examined for medical characteristics, clinical interventions, and maternal sociodemographics. Neonatology consultation notes were analyzed for provider type and documented content. Delivery room interventions were recorded as *resuscitation* (including "resuscitation intended, IUFD") or *no resuscitation* (after delivery with expectant management or labor induction). Fields in infants' database records provided internal validation of resuscitation plans which were examined by lead author and periodically checked with centers' co-investigators to clarify discrepancies. A mother with notes affirming neonatal resuscitation (positive pressure ventilation at minimum) would be pursued was noted to have resuscitation planned. None of the six centers routinely offered partial resuscitation such as positive pressure but no intubation; in the rare event such a delivery room course occurred, the lead author discussed with the co-investigator the context in which this was done, and the plans that had been documented up to the delivery room. For example, a mother who precipitously delivered with no plan documented whose newborn received a few breaths of positive ventilation and then comfort care would be placed in the planned no-resuscitation group. Because sometimes the delivery room plan changed over the admission course, separate database fields noted ultimate resuscitation plan (the actual course at the time of baby's birth) and the initial decision/plan if made by parent that was noted in the

neonatal consultation. The ultimate resuscitation plan (and including resuscitation intended, but IUFD) formed the basis of resuscitation vs. no-resuscitation and planned resuscitation rate groups. Evidence of mothers having a choice between resuscitation and no resuscitation was affirmed if there was notation of both options from the provider's offer or the parents' deliberations and was sought in obstetric, neonatology, nursing and/or social work notes. Provider recommendations were affirmed if there was evidence of choice for both resuscitation and no resuscitation, but one was endorsed by the neonatology consultant. The possibility of moving to comfort care pending baby's NICU course was noted in the neonatology consultation affirmed "care redirection." Regular prenatal care was assumed unless *late/no/poor* were documented. Delivery indications were classified for decision-group analyses as maternal health only (*preeclampsia or other maternal health reasons*); fetal health only (*poor fetal growth, abnormal umbilical cord Dopplers, or non-reassuring fetal heart tracing*); gestational/combined (*cervical insufficiency, preterm labor, placenta previa, abruption, premature rupture of membranes*, or combined maternal/fetal). For missing birthweights, estimated fetal weights noted within a week of birth were substituted.

Sociodemographic "geocoding" data were noted for each mother based on her residential zip code recorded at the time of her admission for delivery. One co-investigator was given deidentified lists of zip codes and extracted information from a federally-provided online resource, 5-year American Community Survey estimates.¹¹ Sociodemographic information related to each zip code were extracted and sent to each participating site and re-linked to study mothers. Information included rates of unemployment, rates of highest level of education

in adults, rates of single female heads of households and rates of disability in children <18 years of age.

Data were managed securely through coordinating center's REDCap¹² online database. Each site's team worked under its Institutional Review Board's approval for waived consent.

Data analysis

Analyses focused on three areas: antenatal neonatology consultations, comparisons of mothers grouped by resuscitation plan, and center trends for planned resuscitation. Neonatology consultations were examined for each mother meeting the aforementioned inclusion criteria, but analyses of resuscitation vs. no resuscitation decisions and centers with higher and lower resuscitation rates excluded the 2 women who differing plans for their multiple fetuses and two women with no documented plan whose children were stillborn. Mothers with and without consultations were compared using 2-tailed Student's t-test and Mann Whitney u-test for continuous and Chi- or Fisher's exact tests for categorical variables; descriptive statistics characterized consultation mechanics and content. Characteristics (clinical, sociodemographic, and geocoded) of mothers/infants with planned neonatal resuscitation vs. no resuscitation were analyzed by Chi-squared or student t tests; only those factors differing significantly were included in a subsequent multivariable logistic regression analysis. Center trends were examined by grouping them as three "higher" (HR) and "lower" (LR) planned resuscitation rate centers. The aforementioned 2-step analysis (individual variables differing significantly entering into subsequent multivariable logistic regression analysis) compared characteristics of mothers/infants at HR vs. LR centers. Chi-testing analyzed intervals between

mothers' admission and delivery (singleton or "Baby A") to investigate group differences in quickly-progressing delivery rates. Statistical analyses were performed using SAS v.9.3 (SAS Institute, Cary, NC). P-values <0.05 were considered significant.

RESULTS

498 mothers delivering 570 babies were included in neonatology consultation analyses; 4 mothers (6 babies) were excluded from decision-group analyses. Figure 1 details inclusion flow.

Quickly-progressing deliveries

Nearly half of all deliveries (of singleton or "Baby A") occurred within 24 hours of maternal admission: <2h: 11%; <4h 19%; <6h 24%; <12h 32%; <24 h 45%. Delivery rates occurring within 2 hours of admission differed by weeks: 17% of 23-, 13% of 22-, and 6% of 24-week deliveries ($p<0.005$). Forty-percent of 22- and 35% of 23-week deliveries occurred within 12 hours of mother's admission, and most (63% and 53% respectively) occurred within 24 hours, compared to only 25% within 12 and 31% within 24 hours for 24 week deliveries ($p=0.014$ within 12h, $p<0.001$ within 24h). In logistic regression analysis of delivery before or after 24 hours from mother's admission, resuscitation likelihood was not different, but those delivering before 24 hours had a lower likelihood of having documented neonatology consultation (OR 0.20, CI:0.13-0.31, $p<0.001$) and receiving steroids (OR 0.18, CI:0.099-0.32, $p<0.001$) when adjusting for these factors and gestational age.

Characteristics of Neonatology Consultations

Maternal characteristics based on neonatal consult documentation and consult details are reported in Table 1. Documented consultations increased with gestational age at delivery,

occurring for 43 (40%) mothers delivering at 22, 100 (64%) at 23, and 168 (72%) at 24 weeks. For consult vs. no-consult mothers, regular prenatal care was noted more often (91% vs. 84%, $p=0.001$) and rates of some delivery indications differed. Median admission-to-delivery intervals were longer for consult vs. no-consult mothers (58.7h vs. 8.7h, $p<0.001$), ranging up to 63 and 80 days, respectively. Neonatology consultation occurred a median 5.2h (0.1h-26.2d range) after admission. Short admission-to-delivery intervals occurred less frequently for consult vs. no-consult mothers <2h: 3% vs. 25%; <4h: 7% vs. 37%; <6h: 11% vs. 44%; <12h: 17% vs. 56% ($p<0.001$). Of the 311 mothers receiving neonatology consultation, 42 (13.5%) had one additional consultation documented, and 4 (1.3%) had 2 additional consultations documented.

Documented clinical decision-making is described in Figure 2. Evidence anywhere (including neonatology, obstetric, nursing, social work notes) in mothers' records of being given a choice between resuscitation and no resuscitation was more frequent for consult vs. no consult group mothers at each delivery week: 65% vs. 11% at 22; 85% vs. 44% at 23; 63% vs. 21% at 24 weeks ($p<0.001$). There was no documented evidence of choice in records of 68% mothers delivering at 22 weeks; 78% of these had no-resuscitation plans, whereas for most 23 and 24 week deliveries without documented evidence of choice, resuscitation was planned.

Documented content differed by gestational age (Table 1b). Documented content and provider recommendations (when present) differed between weeks, favoring comfort care at 22 and resuscitation at 24 weeks. Parents' expressed decisions were documented in about half (45-67%) of all consultations, with 35% of mothers delivering at 22 and 24 weeks apparently given no choice. Providers documented citing outcome statistics in approximately half of all

consults. Neonatology fellows documented participation in about half of the consults, often independently. Co-counseling with obstetricians/perinatologists was rarely (<10%) evident.

Clinical and sociodemographic characteristics by resuscitation plan

Table 2 compares characteristics of 374 (76%) mothers with neonatal plans for resuscitation (R) vs. 120 (24%) mothers with no resuscitation (NR) planned. R group newborns averaged higher gestational weeks (24.0 vs. 22.9, $p<0.001$) and weights (618 vs. 469g, $p<0.001$) at birth. R vs. NR mothers were younger (26.8 vs. 29.0, $p<0.001$) and had higher odds of speaking English as their primary language (OR 3.6, CI: 1.2-11, $p=0.03$). Short admission-to-delivery intervals did not differ by plan.

Center trends for resuscitation plans

Center rates of planned resuscitation differed significantly except at 24 weeks. The higher (HR) vs. lower (LR) resuscitation centers' mean rates of planned resuscitation differed significantly at 22 (43% vs. 7%, $p<0.001$) and 23 weeks (85% vs. 58%, $p<0.001$). Planned resuscitations per site are shown in Table 3. Deliveries at 22 weeks accounted for a higher proportion of all periviable deliveries at HR vs. LR sites (25% vs. 15%, $p=0.007$). Short admission-to-delivery intervals did not differ by center grouping.

Table 4 displays characteristics of populations of mothers delivering at HR (n=314) vs. LR (n=180) centers. HR mothers' odds of being African American were 2.7 (CI: 1.4-5.4, $p=0.02$) times higher compared to other races; odds of being Hispanic were 78% lower (CI: 0.07-0.71, $p=0.01$) than non-Hispanic. HR vs. LR centers' mothers were more likely to live in zip codes with lower rates of bachelor's degrees as the highest educational achievement, lower median

household incomes, and higher rates of unemployment. HR vs. LR mothers received 70% fewer antenatal social work consultations (CI: 0.15-0.59, $p < 0.001$).

DISCUSSION

This is the first multi-center study describing characteristics of periviability counseling and neonatal resuscitation plans for all women admitted for unanticipated perivable deliveries. While professional organizations recommend policies and ethicists outline steps to achieve shared decisions,¹³⁻¹⁴ our study adds empiric baseline data on how six academic centers cared for 498 mothers and their perivable newborns. Mechanisms and content of consultation and shared decision-making are examined with respect to ideal practices. While we recognize our findings are limited by reliance on medical documentation, we encourage centers to consider the following questions.

Are mothers receiving neonatology consultation?

Documented rates of neonatology consultations were low, ranging from 40% for 22 week deliveries to 72% for 24 week deliveries. Short admission-to-delivery rates do not fully explain consultation gaps. On average, mothers waited one day for neonatology consultation after admission, but some waited weeks, and some mothers never had consultation documented despite long inpatient stays. Repeat consultations were rare despite these long stays. Neonatology consultation rates did not differ between HR and LR centers. Neonatology consultations were documented most frequently when there was evidence of a parental decision to be made, perhaps reflecting attitudes that neonatology consultation is less necessary when options are not considered available or plans are clear. Obstetric triggers for consultation were not captured in this review, but likely influenced consultation occurrence.

Neonatology involvement in a timely manner is therefore our foremost recommendation. The Joint Workshop and AAP guidance suggest that a reasonable benchmark for neonatal consultation could be 22 0/7 weeks gestation.¹ Neonatology consultations can facilitate either some level of resuscitation or comfort care planning and establish relationships for decision-making if pregnancies are sustained until resuscitation is offered. Timeliness is essential and should be attainable given neonatology services are available continuously at academic centers. Despite the frequency of deliveries soon after admission, the median time from admission to delivery in the no consult group was >8 hours and the median time for neonatology consultation was 5.2 hours. Perhaps a reasonable goal would be within 4 hours of admission, given consultations after 4 hours of admission would have still missed one-fifth of study mothers.

Who counsels?

Interdepartmental collaboration must go beyond initiating neonatology consultations. While mothers with resuscitation planned had higher rates of consultations, this did not remain significant in the multivariable analysis. About half of mothers had delivery room preferences documented in neonatology consultation notes, perhaps reflecting influence of obstetric counseling prior to consultation. Co-consultation by obstetric and neonatology teams was documented in <10% of neonatology consultations across delivery weeks. Centers can strive to coordinate efforts to improve co-consultation rates, but often this will not be possible. Recognizing that reality, centers can promote communication to develop cohesive approaches to care across specialties to allow patients cohesive care plans.

Studies demonstrate willingness to share decisions for periviable newborns increases with experience⁶ and that fellows lack opportunities for observing experienced counselors.⁷ Co-consultation by neonatology attending physicians and fellows, while documented infrequently, could improve clinical and educational experiences.

Are decisions shared?

A rich body of literature examines ideal elements of how physicians and parents/patients can work together to make decisions about clinical care in the “shared decision-making” process. While the retrospective nature of our study design and reliance on medical documentation could not fully capture the complexity of shared decision-making, we sought to report the most basic foundation of “shared decisions,” reporting if there was evidence that the parent was actually choosing between more than one delivery room care option. In regard to opportunities for parents to make decisions between resuscitation and no resuscitation, all six centers demonstrated gestational-age effects similar to other reported cohorts.^{5,15} Study mothers delivering at 23 weeks appeared to best represent the prerequisites of shared decision-making—frequent evidence of parental choice and documented neonatology recommendations varying between comfort care and resuscitation. . Care plans when choice was not evident favored no resuscitation at 22 weeks and resuscitation at 24 weeks. Comfort care descriptions were noted infrequently for 23- and 24-week deliveries. Possible redirection of care after NICU admission was documented in fewer than half of consultations.

In the “periviable” age range, mortality curves are steep, but weekly differences in rates of neurologically-impaired survivors are less pronounced.¹⁶ Providing information and

supporting parents' goals for their children is appropriate throughout this period.¹⁶⁻¹⁷ Especially in light of uncertain gestational dating and other factors known to affect neonatal outcomes, we urge centers to reconsider the rationale of treating these weeks as different from each other when approaching options offered to parents, and suggest the balanced approach of offering resuscitation with reevaluation and limits and no resuscitation with comfort care reported most often in our mothers delivering at 23 weeks is an appropriate model. Importantly, introducing options to reassess response and prognostic outcomes in relation to parental goals in cases of NICU complications may avoid a family's perception of an "all-or-none" decision.¹⁸

Guidelines advocate supporting emotional and spiritual needs of parents facing periviable delivery.¹ Providing this support has been a weakness identified by neonatology program directors.⁷ Centers with higher resuscitation plan rates had higher likelihood of socioeconomic hardship markers, but lower likelihood of antenatal social work consultations. This may reflect fewer resources, but these populations may be most in need. Formalized processes for funding and routinely involving social workers may bolster psychosocial support.

Do maternal factors affect decisions?

Over three-fourths of mothers had neonatal resuscitation planned; few maternal medical or sociodemographic factors impacted decisions. In a study of state records, newborns born to black and Hispanic women had higher resuscitation rates, but this effect disappeared for Hispanic women after adjusting for birth hospital clustering.¹⁹ Our mothers with plans for resuscitation vs. no resuscitation did not differ by race. However, there was a nearly three-fold higher likelihood of African American mothers delivering at HR vs. LR sites compared to other

rates. Race as significant only in the context of centers with higher resuscitation rates and in conjunction with markers of socioeconomic hardship illustrates complex sociodemographic relationships.²⁰

Do centers influence plans?

Depending on delivery center, neonatal resuscitation was planned for none to half of mothers delivering at 22 weeks and half to nearly all delivering at 23 weeks. During the years being studied, our 6 centers did not have written approaches to options, though agreed-upon approaches likely impacted resuscitation decisions. Tendencies of favoring approaches at some centers raise questions of “ethical cultures”²¹ that may reflect the cultural influences of certain populations or medical biases. Interactions of patient and medical cultures influencing center approaches require elucidation. Perhaps higher volumes of periviable newborns at some centers reflect socioeconomic hardship and worse overall health, but other cultural factors in this same community foster greater comfort with resuscitation.²² We encourage centers making policies and researchers to examine how practitioners’ preferences and their own patient populations are best served by their periviability practices. Given the unpredictable nature of preterm delivery, it is impractical to believe each individual patient coming to a center will have congruent delivery room preferences. In the absence of uniform guidelines, the just approach may be to treat each of these gestational ages equivalently regarding choice.

Limitations

Our biggest study limitations come from its retrospective nature. Reliance on medical record documentation, reporting patient care from an earlier period (2011-2015), and potential inter-researcher variability in characterizing consultations constrain findings. Electronic

template notes for neonatology consultations were routinely used at any only one center. The template prompted the provider to record points discussed, including treatment options, parental values, and chances of survival and neurodevelopmental outcomes; redirection of care was not part of the template and therefore could have affected that site's data. Planned resuscitations were studied for decision-making; IUFDs and stillbirths minimally lowered actual resuscitation rates.

CONCLUSIONS

This multi-center exploration of practices in relation to recommendations surrounding decisions for periviable newborns reveals several areas for consideration by institutions improving care approaches and for future research. Widespread consultations modeled by experienced neonatologists, cohesive approaches to options offered in the delivery room across gestational ages with the possibility of redirecting intensive care, and processes to ensure equitable medical experiences are worthy goals for centers improving care for these families.

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FIGURE CAPTIONS

Figure 1. Study Inclusion Flow

Figure 2. Decision-Making by Gestational Age and Receipt of Neonatology Consultation

Table 1a. Characteristics of Mothers with Documented Neonatology Consultations

	Documented consultation (n=311)	No documented consultation (n=187)
Maternal age years, mean +SD (range)	27.3 $\pm$ 6 (16-43)	27.4 $\pm$ 6 (13-44)
Race		
African American	173 (56%)	115 (61%)
Caucasian	104 (33%)	51 (28%)
Asian	4 (1%)	4 (2%)
Native American	2 (0.6%)	2 (1%)
Other/unknown	19 (6%)	15 (8%)
Ethnicity		
Hispanic	22 (7%)	20 (11%)
Non-Hispanic	278 (89%)	162 (87%)
Unknown	11 (4%)	5 (3%)
Primary language		
English	296 (95%)	172 (92%)
Spanish	12 (4%)	14 (7%)
Other	3 (1%)	1 (1%)
Insurance		
Public	173 (56%)	121 (65%)

Private	117 (38%)	47 (25%)
Unknown	2 (0.6%)	4 (2%)
None	19 (6%)	15 (8%)
Admission gestational age, mean $\pm$ SD (range)	23w2d $\pm$ 5.5d (20w2d-24w6d)	23w2d $\pm$ 6.5d (20w1d-24w6d)
First pregnancy	93 (30%)	63 (34%)
Singleton	250 (80%)	158 (84%)
Regular prenatal care¹	282 (91%)	157 (84%)
Reasons for delivery²		
Cervical insufficiency	81 (26%)	36 (19%)
Preterm labor	159 (51%)	113 (60%)
(P)/PROM	139 (45%)	73 (39%)
Pre-e/HELLP	48 (15%)	24 (13%)
Other maternal	34 (11%)	35 (19%)
Fetal indication	30 (10%)	23 (12%)
Chorioamnionitis	81 (26%)	31 (17%)
Admit to birth, median (range)	58.7 h (0.4-1519)	8.7 h (0-1920)
mean $\pm$SD³	95.2 $\pm$ 133	34.4 $\pm$ 144
Admit to consult, median (range)	5.2 h (0-628)	
mean $\pm$ SD⁴	24.8 $\pm$ 64	

¹significant differences (p<0.05 in bivariate analyses) in bold

²total>100% due to multiple options available; ³data for 310 mothers; missing 1 delivery time;

⁴data for 291 mothers; missing 20 neonatology consultation times (e.g., note timed after delivery)

Table 1b. Neonatology Consultation Providers and Content by Week of Gestation at Delivery

	22 0/7-22 6/7 Weeks n=43	23 0/7- 23 6/7 Weeks n=100	24 0/7-24 6/7 Weeks n=168
Gestational age at consultation mean $\pm$ SD (range)	22w3d $\pm$ 2d (21w0d-22w6d)	23w1d $\pm$ 3d (21w3d-23w6d)	23w6d $\pm$ 4d (21w3d-24w6d)
Neonatology consultant			
Fellow	15 (35%)	34 (34%)	61 (36%)
Attending	15 (35%)	28 (28%)	38 (23%)
Fellow & Attending	4 (9%)	20 (20%)	23 (15%)
NNP	0 (0%)	3 (3%)	4 (2%)
NNP & Fellow	0 (0%)	0 (0%)	1 (1%)
NICU RN	6 (14%)	16 (16%)	37 (22%)
Obstetric & neonatology co-consultation	3 (7%)	9 (9%)	5 (3%)
Topics discussed^{1,2}			
Survival	34 (79%)	83 (83%)	132 (79%)
Neurodevelopment	24 (56%)	68 (68%)	101 (60%)

DR Comfort care	19 (44%)	46 (46%)	35 (21%)
DR Interventions	24 (56%)	80 (80%)	141(84%)
Care redirection	7 (16%)	39 (39%)	76 (45%)
Statistics cited and documented	24 (56%)	47 (47%)	74 (44%)
Care plan approaches as documented in neonatology consultation³			
Resuscitation is the only option	1 (2%)	15 (15%)	69 (41%)
Resuscitation recommended	4 (9%)	0 (0%)	6 (4%)
No recommendation; either accepted	15 (35%)	57 (57%)	73 (43%)
No resuscitation is recommended	8 (19%)	19 (19%)	4 (2%)
No resuscitation is the only option	8 (19%)	3 (3%)	3 (2%)
Not noted	7 (16%)	6 (6%)	14 (8%)
Parental decision expressed and documented in consult note?			
Yes	21 (49%)	66 (66%)	75 (45%)
Unclear	2 (5%)	9 (9%)	9 (5%)
None to be made	5 (12%)	12 (12%)	23 (14%)
No	15 (35%)	13 (13%)	61 (36%)

¹total>100% due to multiple options available;²all but survival and neurodevelopmental

outcomes differed significantly between topics discussed at one gestational week vs. the other

two;³all but “resuscitation recommended” differed significantly between each care plan

approach at one gestational week vs. the other two

Table 2: Mothers and Plans for Newborns: No Resuscitation (NR) vs. Resuscitation (R)

	Clinical Characteristics			Multivariable Regression
	No Resuscitation n=120 mothers	Resuscitation n=374 mothers	P-value	OR (CI)
Study site:				
A	27 (22.5%)	84 (22.5%)	0.06	
B	22 (18.3%)	110 (29.4%)		
C	15 (12.5%)	56 (15.0%)		
D	13 (10.8%)	39 (10.4%)		
E	25 (20.8%)	48 (12.8%)		
F	18 (15.0%)	37 (9.9%)		
Evidence of parent having choice of resuscitation v. no resuscitation	44 (36.7%)	216 (57.8%)	<0.001	1.8 (0.92, 3.6) p=0.09
Neonatology consultation occurred	49 (40.9%)	259 (69.3%)	<0.001	1.6 (0.79, 3.1) p=0.20
Social work visited before delivery	19 (15.8%)	83 (22.2%)	0.13	

Chaplain visited before delivery	9 (7.5%)	34 (9.1%)	0.59	
Maternal transport from outside hospital	53 (44.2%)	181 (48.5%)	0.39	
Assisted reproduction	12 (10.0%)	21 (5.6%)	0.09	
Regular prenatal care [Unknown: 6 (5%) NR, 8 (2%)R]	105 (92.1%)	332 (88.8%)	0.54	
Reasons for delivery Maternal only Fetal only Combined/Gestational	11 (9.2%) 2 (1.7%) 107 (89.2%)	37 (9.9%) 2 (0.5%) 335 (89.6%)	0.47	
Chorioamnionitis noted before or at delivery [Unknown: 13 (11%) NR, 25 (7%) R]	24 (20.0%)	88 (23.5%)	0.56	
Mother's age at admission mean (SD)	29.0 (6.1)	26.8 (6.1)	0.01	0.91 (0.86, 0.95) p<0.001
Admission weeks gestation mean (SD)	22.7 (0.7)	23.5 (0.8)	<0.001	0.89 (0.46, 1.7) p=0.73
Singleton gestation	93 (77.5%)	313 (83.7%)	0.12	
Sex(es) of fetus(es):				

Male only	55 (47.4%)	190 (50.9%)	0.81	
Female only	55 (47.4%)	167 (44.5%)		
Combination	6 (5.2%)	17 (4.5%)		
Gestational weeks at birth: Mean (SD)	22.9 (0.6)	24.0 (0.7)	<0.001	4.8 (2.3, 9.9) p<0.001
Birthweight: Mean (SD)	469 (103)	618 (116)	<0.001	1.01 (1.01, 1.01) p<0.001
English as primary language	107 (89.2%)	358 (95.7%)	0.008	3.6 (1.2, 11) p=0.03
Private medical insurance	39 (33.6%)	124 (33.3%)	0.95	
Mother's Race				
Caucasian	38 (31.7%)	115 (30.8%)	0.07	
African American	62 (51.7%)	224 (59.9%)		
Other or unknown	20 (16.7%)	35 (9.4%)		
Mother's ethnicity				
Hispanic	12 (10.4%)	30 (8.2%)	0.47	
Non-Hispanic	103 (89.6%)	334 (91.8%)		
Substance abuse in pregnancy	16 (13.3%)	62 (16.6%)	0.40	

Religion identified	57 (47.9%)	171 (46.0%)	0.71	
Christian religion identified	53 (44.5%)	160 (43.0%)	0.77	
Maternal Zip Code-Related Census Information: No significant differences noted. [Data missing for 7 of 119 (6%) NR mothers and 24 of 376 (6%) R mothers]				

Table 3: Resuscitation Rate Plans by Site and Week of Gestation

Mothers with planned resuscitation by delivery site, n (%)							
Gestational Week at Delivery	Higher Resuscitation Rate Sites (HR)			Lower Resuscitation Rate Sites (LR)			P-value
	Site A	Site B	Site C	Site D	Site E	Site F	
Week 22 (n=107)	14 of 39 (36%)	13 of 26 (50%)	7 of 15 (47%)	1 of 6 (17%)	1 of 14 (7%)	0 of 7 (0%)	0.017
Week 23 (n = 155)	26 of 28 (93%)	32 of 39 (82%)	19 of 24 (79%)	15 of 22 (68%)	11 of 21 (52%)	11 of 21 (52%)	0.004
Week 24 (n = 232)	44 of 44 (100%)	65 of 67 (97%)	30 of 32 (94%)	23 of 24 (96%)	36 of 38 (95%)	26 of 27 (96%)	0.59

Table 4: Mothers Delivering at Lower Resuscitation (LR) vs. Higher Resuscitation (HR) Rate Centers

	Lower Resuscitation (n = 180)	Higher Resuscitation (n = 314)	Bivariate P-value	Multivariable Regression OR (CI, p-value)
Clinical experiences: n (%)				
Evidence of parent having choice of resuscitation v. no resuscitation	121 (67.2%)	139 (44.3%)	<.001	0.67 (0.38, 1.17, p=0.16)
Antenatal steroids (any doses) received	115 (63.9%)	193 (61.5%)	0.59	
Cesarean delivery	71 (39.7%)	111 (35.3%)	0.34	
Neonatology consultation occurred	115 (63.9%)	193 (61.5%)	0.59	
Social work visited before delivery	65 (36.1%)	37 (11.8%)	<0.001	0.31 (0.15, 0.59, p<.001)
Maternal Medical Characteristics: n (%)				
Maternal transport from outside hospital	67 (37.2%)	168 (53.5%)	<0.001	1.74 (0.98, 3.11, p=0.06)
Assisted reproduction noted	24 (13.3%)	9 (2.9%)	<0.001	0.70 (0.19, 2.62, p=0.59)
Regular prenatal care	164 (91.6%)	271 (90.0%)	0.56	

[Unknown: 1 (<1%) LR, 13 (4%)HR]				
Mother's age at admission: Mean (SD)	26.2 (5.8)	29.3 (6.3)	<0.001	0.97 (0.93, 1.02, p=0.18)
Neonatal Medical Characteristics: n (%)				
Singleton gestation	134 (74.4%)	272 (86.6%)	<0.001	1.45 (0.69, 3.04, p=0.33)
Sex(es) of fetus(es)				
Male only	81 (45.2%)	164 (52.7%)	0.26	
Female only	88 (49.2%)	134 (43.1%)		
Combination	10 (5.6%)	13 (4.2%)		
Gestational weeks at birth Mean (SD)	23.65 (0.83)	23.79 (0.80)	0.07	
Birthweight: Mean (SD)	578 (129)	595 (129)	0.15	
Maternal Sociodemographic Characteristics: n (%)				
English as primary language	164 (91.1%)	301 (95.9%)	0.03	0.36 (0.08, 1.55, p=0.17)
Private medical insurance	85 (47.5%)	78 (25.2%)	<0.001	0.78 (0.41, 1.50, p=0.45)
Mother's Race				
Caucasian	91 (50.6%)	62 (19.8%)	<0.001	Reference
African American	58 (32.2%)	228 (72.6%)		

Other or Unknown	31 (17.2%)	24 (7.6%)		2.70 (1.35, 5.40) 1.10 (0.37, 3.25) p=0.02
Mother's ethnicity				
Hispanic	27 (15.1%)	15 (5.0%)	<0.001	0.22 (0.07, 0.71, p=0.01)
Non-Hispanic	152 (84.9%)	285 (95.0%)		Reference
Religion identified	101 (56.4%)	127 (40.6%)	<0.001	0.64 (0.14, 3.00, p=0.57)
Christian religion identified	93 (52.0%)	120 (38.5%)	0.004	1.03 (0.22, 4.83, p=0.97)
Maternal Zip Code-Related Census Information: Mean (SD)				
[Data missing for 5 of 180 LR mothers (3%), 26 of 315 (8%) HR mothers]				
Highest educational attainment in those ≥25 years old in area				
9th-12th grade, no diploma	7.4% (4.5%)	12.0% (4.7%)	<0.001	1.12 (0.97, 1.29, p=0.12)
High school graduate/equivalent	26.7% (9.1%)	30.2% (7.1%)	<0.001	0.94 (0.87, 1.02, p=0.11)

Bachelor's Degree	19.2% (8.8%)	12.1% (5.5%)	<0.001	0.87 (0.79, 0.96, p=<0.001)
Graduate Degree	12.3% (10.1%)	7.8% (5.7%)	<0.001	1.00 (0.93, 1.07, p=0.95)
Economic markers				
Median household income Mean (SD)	56569.33 (23272.93)	40285.48 (30082.61)	<0.001	1.00 (1.00, 1.00, p<0.001)
Unemployment rate civilian labor force	9.4% (4.7%)	14.84 (6.48)	<0.001	1.15 (1.05, 1.25, p<0.001)
Public assistance	3.1% (2.2%)	4.1% (2.6%)	<0.001	0.62 (0.51, 0.74, p<0.001)
Individuals below poverty level	16.8% (10.5%)	28.0% (10.8%)	<0.001	1.03 (0.97, 1.09, p=0.34)
Family characteristics				
Family, female head, no husband	14.5% (8.7%)	24.2% (11.3%)	<0.001	1.01 (0.97, 1.05, p=0.58)

Disability in children <18 years old	6.2% (3.1%)	6.8% (3.6%)	0.04	0.88 (0.80, 0.97, p=0.01)
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