# Neo-Perinatal Care Delivery: Epi-HSR – What’s Trending

**Thursday, June 11  4:30-6:00 pm EDT**

**Moderators**  
Mandy Belfort  
Heather Brumberg

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Note: Schedule subject to change based on presenter availability.
CONTROL ID: 3339541

TITLE: Differences in Quality of Care by Race and Ethnicity in U.S. NICUs

PRESENTER: Erika M Edwards

AUTHORS (LAST NAME, FIRST NAME): Edwards, Erika M 1; Greenberg, Lucy T. 1; Profit, Jochen 2; Draper, David 3; Helkey, Daniel 2; Horbar, Jeffrey D. 1

AUTHORS/INSTITUTIONS: E.M. Edwards, L.T. Greenberg, J.D. Horbar, Vermont Oxford Network, Burlington, Vermont, UNITED STATES; J. Profit, D. Helkey, Pediatrics, Stanford University, Stanford, California, UNITED STATES; D. Draper, University of California at Santa Cruz, Santa Cruz, California, UNITED STATES;

CURRENT CATEGORY: Neonatology

CURRENT SUBCATEGORY: Neonatal-Perinatal Health Care Delivery: Quality Improvement

KEYWORDS: Baby-MONITOR, quality of care, disparities.

SESSION TITLE: Neo-Perinatal Care Delivery: Epi-HSR - What's Trending?

SESSION TYPE: Webinar

ABSTRACT BODY:

Background: A previous study in California identified differences in neonatal intensive care unit (NICU) quality of care by race and ethnicity using Baby-MONITOR, a NICU-level composite measure. In that study, black non-Hispanic and Hispanic infants scored lower on process measures and higher on outcome measures than white infants.

Objective: To measure racial/ethnic differences in quality of care at the national level using Baby-MONITOR

Design/Methods: Vermont Oxford Network member NICUs in the U.S. contributed data from 2014 to 2018 on all infants 22-29 weeks’ gestation or 401-1500 grams birth weight who were inborn or transferred to the reporting hospital within 28 days of birth. Baby-MONITOR is a NICU-level score calculated using infant-level process (antenatal steroid exposure, admission hypothermia, timely retinal exam, discharge on human milk) and outcome (pneumothorax, health care-associated infection, chronic lung disease, mortality, growth velocity) measures. Measures were individually risk-adjusted, standardized relative to other hospitals in the dataset, equally weighted, and averaged to derive a score for the process measures, a score for the outcome measures, and an overall composite score. To receive scores, hospitals needed to have data on at least one infant for each measure. Other or unknown races, serious congenital anomalies, deaths in the delivery room or within 12 hours of birth, and infants that transferred more than once were excluded.

Results: The analysis included 195,556 infants (86,513 non-Hispanic white, 60,939 non-Hispanic black, 36,552 Hispanic, 9,977 non-Hispanic Asian, 1,575 non-Hispanic Native American) at 780 hospitals. Compared to white infants in the same NICU, Black, Hispanic, and Asian infants had significantly higher mean Baby-MONITOR composite scores, while Native American infants’ scores were not significantly different (Figure 1). Black, Hispanic, Asian, and Native American infants had significantly lower mean process scores and significantly higher mean outcome scores compared to white infants in the same NICU (Figure 1). Differences by race/ethnicity from white infants varied by individual measure (Figure 2).

Conclusion(s): Using a national dataset, non-Hispanic black, Hispanic, and non-Hispanic Asian very preterm infants had significantly higher composite Baby-MONITOR scores than non-Hispanic white infants in the same NICUs. However, a single score from a composite measure masked important differences by race/ethnicity and process/outcome measures.
Figure 1: Mean score difference in process, outcome, and composite scores for non-Hispanic black (red), Hispanic (orange), non-Hispanic Asian (green), and non-Hispanic Native American (purple) infants compared to non-Hispanic white infants in the same NICU. Error bars represent 95% confidence interval for the difference.

Figure 2: Mean score difference by Baby-MONITOR component for non-Hispanic black (red), Hispanic (orange), non-Hispanic Asian (green), and non-Hispanic Native American (purple) infants compared to non-Hispanic white infants in the same NICU. Error bars represent 95% confidence interval for the difference.

IMAGE CAPTION:
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ABSTRACT BODY:

**Background:** Although neonatal abstinence syndrome (NAS) affects thousands of newborns in the U.S. annually and has increased 5-fold in recent years, little is known about how these children fare clinically beyond the immediate postpartum period, and no study has yet examined national hospital readmission rates for NAS infants.

**Objective:** To examine the clinical characteristics and hospital rates of readmission for NAS infants.

**Design/Methods:** We used the 2016 Nationwide Readmissions Database, a nationally representative sample of hospital readmissions, to compare 90-day, all-cause readmissions for two cohorts: NAS infants (identified by ICD-10-CM codes P961, P04.9, and P04.49) vs. healthy newborns (identified by DRG code 795). To allow for equal follow-up time for all births, only infants born between January 1 and September 30, 2016 were included in the analysis. Logistic regression was used to compare clinical characteristics.

**Results:** Of the 1,840,128 newborns included in the study, 52,038 (2.8%) were diagnosed at birth with NAS. For healthy newborns, the 90-day readmission rate was 25.6 per 1,000, compared to 46.3 per 1,000 for NAS newborns ($P < .001$). Among the 49,443 infants readmitted for any cause, NAS infants were more likely than healthy newborns to be diagnosed with failure to thrive (odds ratio [OR] 1.86, 95% confidence interval [CI] 1.50-2.31), respiratory distress (OR 2.11, 95% CI 1.87-2.38), seizures (OR 1.59, 95% CI 1.31-1.92), or child maltreatment (OR 1.91, 95% CI 1.49-2.46). NAS infants were also more likely to die (OR 5.86, 95% CI 4.40-7.81) during a hospital readmission. The median charge (interquartile range) for the first readmission for NAS newborns was $12,313 ($6,262-$25,669), compared to $9,322 ($4,890-$16,718) for healthy newborns ($P < .001$). NAS infants were 6 times more likely to be covered by Medicaid (OR 6.11, 5.97-6.25).

**Conclusion(s):** Infants with NAS suffer substantial medical complications in the first 3 months of life. They are nearly twice as likely as healthy newborns to be readmitted to the hospital and more than 5 times as likely to die during a readmission. NAS infants are also nearly twice as likely to suffer from child maltreatment. Overall, these findings underscore the need for prevention efforts to reduce the misuse of prescription and illicit opioids among women of childbearing age. They also speak to the need for comprehensive, family-centered care, including social and home-health services and addiction treatment, to support parents in caring for these clinically complex infants.
CURRENT SUBCATEGORY: Neonatal Epidemiology, Health Services Research

KEYWORDS: neonatal mortality, NICU volume.

SESSION TITLE: Neo-Perinatal Care Delivery: Epi-HSR - What's Trending? | Neo-Perinatal Care Delivery: Epi-HSR - What's Trending?

SESSION TYPE: Webinar|Platform

ABSTRACT BODY:
Background: Numerous prior studies demonstrate lower mortality and morbidity when high-risk infants, or those delivering prematurely or with a very-low birth weight, deliver at a hospital with a level 3 or 4 neonatal intensive care unit (NICU). However, such studies have led to a proliferation of low-volume, high-level NICUs. There is little evidence for specific volume thresholds that optimize outcome of high-risk infants.

Objective: (1) Determine the relationship between volume of very preterm infants with a GA < 32 wks (VPT) and mortality of high-risk infants, and (2) determine this volume-outcome relationship for mortality or morbidity.

Design/Methods: A retrospective cohort was created of all infants born at a GA<32 wks or BW<1500 grams in California, South Carolina, and Missouri from 1995-2012 using birth certificates linked to infant death certificates, maternal hospital administrative records, and infant hospital administrative records until the infant’s discharge to home. For each hospital and year, we determined the number of VPT delivered. Multivariable logistic regression models determined the association between this annual VPT volume and mortality or mortality or any morbidity (BPD, NEC, IVH) after adjusting for education, insurance, and race/ethnicity; antepartum and intrapartum medical conditions; gestational age, congenital anomalies, and a fixed effect for hospital.

Results: There was wide variation in the annual hospital volume of VPT in the study (median 58, IQR 29-100, range 0-421). Risk-adjusted mortality rates varied substantially across different volumes for both mortality and mortality+morbidity outcomes (Figures 1 and 2). 35.5% of all infants delivered at a NICU with < 40 VPT/year, while 25.2% delivered at a NICU caring for > 100 VPT/year. Low volume NICUs cared for fewer mothers with hypertension or diabetes, or infants with a GA<28 wks compared to higher volume NICUs (Table 1). In multivariable analysis, mortality improved for high-risk infants delivering at hospitals with at least 40 VPT/year, while mortality+morbidity was optimized at the NICUs caring for at least 100 VPT/year (Figure 3).

Conclusion(s): High-risk, premature infants have improved rates of both survival and the combined outcome of mortality or morbidity when they deliver at higher volume hospitals. Volume thresholds vary by outcome. The more precisely estimated effect of NICU volume will help policy makers address the trend towards de-regionalization of NICU care with increased mortality and morbidity.

Table 1: Demographic characteristics of patients delivering at NICUs of varying VPT censuses.

Figure 1: Association of hospital VPT annual volume and risk-adjusted mortality rate. Green line shows the lowess trend line for this association.
Figure 2: Association of hospital VPT annual volume and risk-adjusted mortality or morbidity rate. Green line shows the lowess trend line for this association.

Figure 3: Adjusted odds ratios for the association of various VPT annual volumes on mortality (top) or mortality + morbidity (bottom), compared to delivering at a NICU caring for > 100 VPT infants annually. For mortality, there was a volume threshold reached at 40 VPT annually, while for mortality or morbidity, the volume threshold was at 100 VPT annually.

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CONTROL ID: 3363609

TITLE: Systemic inflammation and neonatal growth outcomes in extremely low gestational age newborns: a multicenter observational study

PRESENTER: Mandy Brown Belfort

AUTHORS (LAST NAME, FIRST NAME): Belfort, Mandy B.¹; Ramel, Sara E.²; Martin, Camilia R.³; Fichorova, Raina⁴; Dammann, Olaf⁵; Kuban, Karl⁶; Heeren, Timothy⁷; O'Shea, T. Michael⁸

AUTHORS/INSTITUTIONS: M.B. Belfort, Pediatric Newborn Medicine, Brigham & Women's Hospital, Newton, Massachusetts, UNITED STATES;
S.E. Ramel, Pediatrics, University of Minnesota Masonic Children's Hospital, Minneapolis, Minnesota, United States, UNITED STATES;
C.R. Martin, Beth Israel Deaconess Medical Center, Boston, Massachusetts, UNITED STATES;
R. Fichorova, Obstetrics/Gynecology, Brigham and Women's Hospital, Boston, Massachusetts, UNITED STATES;
O. Dammann, Public Health, Tufts University, Boston, Massachusetts, UNITED STATES; K. Kuban, Pediatrics, Boston Medical Center, West Roxbury, Massachusetts, UNITED STATES; T. Heeren, Biostatistics, Boston University, Boston, Massachusetts, UNITED STATES; T. O’Shea, Pediatrics, University of North Carolina School of Medicine, Chapel Hill, North Carolina, UNITED STATES;

CURRENT CATEGORY: Neonatology
CURRENT SUBCATEGORY: Neonatal Epidemiology, Health Services Research
KEYWORDS: Growth, Inflammation, Nutrition.

SESSION TITLE: Neo-Perinatal Care Delivery: Epi-HSR - What's Trending? | Neo-Perinatal Care Delivery: Epi-HSR - What's Trending?
SESSION TYPE: Webinar|Platform

ABSTRACT BODY:
Background: Slow weight gain and linear growth stunting are common among preterm infants during the neonatal intensive care unit (NICU) hospitalization and reflect impaired nutrient accretion during a critical period in development of multiple organ systems. In addition to deficiencies in nutrient intake, non-dietary factors such as postnatal systemic inflammation may impair nutrient accretion and contribute to slow weight gain, linear growth, and head growth.

Objective: To examine the contribution of systemic inflammation to impaired weight gain, linear growth, and head growth among extremely low gestational age newborns admitted to the neonatal intensive care unit.

Design/Methods: We studied 850 infants born <28 weeks' gestation between 2002-2004. We defined inflammatory protein elevation as being in the highest quartile of c-reactive protein (CRP), interleukin 6 (IL-6), tumor necrosis factor alpha (TNF-α), or interleukin 8 (IL-8) on postnatal days 1, 7, and 14 and 'sustained' elevation as being in the highest quartile on 2 of 3 days measured. We compared growth outcomes (z-scores of weight, length, head circumference) at hospital discharge or transfer between infants with vs. without protein elevation. We adjusted in linear regression for birth weight, length, or head circumference z-score, sex, gestational age at birth, diet (mean of energy and protein delivered on postnatal days 7, 14, 21, and 28), and length of NICU hospitalization.

Results: Mean gestational age was 25.8 weeks (range, 23 to 27) and birth weight 859 grams (range, 420 to 1450) [Table 1]. Infants with elevated CRP or IL-6 on day 7 and/or 14 were lighter and shorter at discharge or transfer than infants without elevation of these proteins, adjusting for covariates [Table 2]. IL-8 was associated with lower weight if elevated on day 1 or 14, and TNFα was associated with lower weight only if elevated on day 14. IL-6 elevation was most predictive of growth outcomes when sustained over 2 interval measurements. CRP elevation on postnatal days 1 or 14 were associated with smaller head circumference at discharge or transfer.

Conclusion(s): Among extremely low gestational age newborns, postnatal systemic inflammation may contribute to impaired nutrient accretion as indicated by poorer weight gain, linear growth, and head growth.

Table 1. Infant characteristics

Table 2. Inflammatory protein elevation and neonatal growth outcomes
TITLE: Associations between Maternal Level of Care at Delivery and Perinatal Outcomes Among High Risk Women

PRESENTER: Sara Handley

AUTHORS (LAST NAME, FIRST NAME): Handley, Sara\(^1\); Passarella, Molly\(^1\); Hsu, Jesse Y.\(^2\); Srinivas, Sindhu\(^3\); Lorch, Scott\(^1\)

AUTHORS/INSTITUTIONS: S. Handley, M. Passarella, S. Lorch, Department of Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, UNITED STATES; J.Y. Hsu, Center for Clinical Epidemiology and Biostatistics, Perelman School of Medicine-University of Pennsylvania, Philadelphia, Pennsylvania, UNITED STATES; S. Srinivas, Department of Obstetrics and Gynecology, Perelman School of Medicine-University of Pennsylvania, Philadelphia, Pennsylvania, UNITED STATES;

CURRENT CATEGORY: Neonatology

CURRENT SUBCATEGORY: Neonatal-Perinatal Health Care Delivery: Epidemiology/Health Services Research

KEYWORDS: Level of care.

SESSION TITLE: Neo-Perinatal Care Delivery: Epi-HSR - What's Trending? |Neo-Perinatal Care Delivery: Epi-HSR - What's Trending?

SESSION TYPE: Webinar|Platform

ABSTRACT BODY:

**Background:** The American College of Obstetricians and Gynecologists (ACOG) described maternal levels of care in an effort to improve maternal outcomes. Research has shown that high level neonatal care is associated with better outcomes for high risk infants, however the impact of maternal levels of care on perinatal outcomes for high risk mothers and infants remains unclear.

**Objective:** To determine if the maternal level of care, high (level 3 or 4) versus low (level 1 or 2), at the time of delivery is associated with maternal and neonatal outcomes among high risk women after adjusting for unmeasured differences in case-mix using an instrumental variable.

**Design/Methods:** Retrospective cohort study of high risk women (e.g. disorders of placentation, multiple gestation, hypertension, diabetes, renal disease, severe chronic and severe cardiac conditions) and their infants who delivered in a hospital with \(\geq 100\) births/year in California (CA), Missouri (MO), and Pennsylvania (PA) from 2000 to 2009. Hospitals were assigned a maternal level of care based on the ACOG guidelines, using data on the types of patients who delivered at each center which were identified using International Disease Classification codes. Models were used to examine the association between outcomes, such as maternal or infant death, severe maternal morbidity (SMM), cesarean section (CS), maternal hemorrhage, and neonatal asphyxia and maternal levels of care in a cohort that matched women with similar illness severity who lived close to a high level center with those who lived far from a high level center.

**Results:** Characteristics differed between women who delivered in high versus low level maternal centers (Table 1). Differences were not significant after the match (Table 2), but women who lived close to a high level maternal center were much more likely to deliver at such a hospital compared to those who lived far away. In the matched cohort, associated outcomes differed by state (Figure 1 & 2). Delivery at a high level maternal center suggested more positive effects in MO and PA with less SMM, CS, and neonatal death. In CA, high level maternal care was associated with lower odds of maternal hemorrhage and neonatal asphyxia.

**Conclusion(s):** This study illustrates the state-level variation in the effect of maternal levels of care on both maternal and neonatal outcomes. Delivery at a high level maternal center in PA and MO was associated with less SMM and neonatal death. Further study of differences in state perinatal structures and policies is needed.
Table 1. Pre-Match Characteristics of High Risk Mothers Delivering at Hospitals with High-Level versus Low-Level Maternal Care in Pennsylvania, Missouri, and California, 2000-2009

Table 2. Improved Balance of Measured Characteristics in Pennsylvania, Missouri, and California after applying an Instrumental Variable and Matching, 2000-2009

Figure 1. Adjusted Maternal Outcomes of Matched Cohort by State
CONTROL ID: 3380658

TITLE: Intra-country Trends in Variation of Mortality and Morbidity of Extremely Preterm Neonates – A evaluation among 11 countries

PRESENTER: Kei Lui

AUTHORS (LAST NAME, FIRST NAME): Shah, Prakesh1; Lui, Kei2; Yang, Jie17; Vento, Maximo3; Lee, Shoo4; Håkansson, Stellan5; Modi, Neena6; Bassler, Dirk7; Rusconi, Franca8; Darlow, Brian9; Helenius, Kjell10; Reichman, Brian11; Lehtonen, Liisa12; Kusuda, Satoshi13; Adams, Mark14; Isayama, Tetsuya15; Norman, Mikael16

AUTHORS/INSTITUTIONS: P. Shah, Pediatrics, Mount Sinai Hospital, Toronto, Ontario, CANADA; K. Lui, School of Women's and Children's Health, University of New South Wales, Randwick, New South Wales, AUSTRALIA; M. Vento, Division of Neonatology, University and Polytechnic Hospital La Fe, Valencia, SPAIN; S. Lee, Pediatrics, Mount Sinai Hospital, Toronto, Ontario, CANADA; N. Modi, Medicine, Imperial College London, London, UNITED KINGDOM; D. Bassler, Neonatology, University Hospital Zurich, Zurich, Zurich, SWITZERLAND; F. Rusconi, Meyer Children's University Hospital, Florence, ITALY; B. Darlow, Paediatrics, University of Otago, Christchurch, New Zealand, Christchurch, NEW ZEALAND; K. Helenius, University of Turku, Turku, FINLAND; B. Reichman, Gertner Institute for Epidemiology and Health Policy Research, Ramat Gan, ISRAEL; L. Lehtonen, Pediatrics, Turku University Hospital, Turku, FINLAND; S. Kusuda, Pediatrics, Kyorin University, Taito, Tokyo, JAPAN; M. Adams, University of Zurich, Swiss Neonatal Network, Zurich, SWITZERLAND; T. Isayama, Division of Neonatology, National Center for Child Health and Development, Tokyo, Japan, Setagaya-ku, Tokyo, JAPAN; M. Norman, Dept of Clinical Science, Intervention and Technology, Karolinska Institutet, Stockholm, SWEDEN; J. Yang, Paediatrics, Mount Sinai Hospital, University of Toronto, Toronto, Ontario, CANADA;

CURRENT CATEGORY: Neonatology

CURRENT SUBCATEGORY: Neonatal-Perinatal Health Care Delivery: Quality Improvement

KEYWORDS: QUALITY IMPROVEMENT, CHANGE, VARIATIONS.

SESSION TITLE: Neo-Perinatal Care Delivery: Epi-HSR - What's Trending? |Neo-Perinatal Care Delivery: Epi-HSR - What's Trending?

SESSION TYPE: Webinar|Platform

ABSTRACT BODY:

Background: The basic tenets of network quality improvement (QI) are measured in two dimensions: one is improvement at individual unit level and the second is reducing variation in outcomes between units within a network/region/country. Reducing outcome variation and decreasing adverse outcome rates over time would signal favorable QI within the respective setting.

Objective: To evaluate outcome trends and intra-country variations in mortality and major morbidities within neonatal units in the iNeo collaboration from Australia-New Zealand [ANZ], Canada, Finland, Israel, Japan, Spain, Sweden,
Switzerland, UK and Tuscany, Italy.

**Design/Methods:** We retrospectively evaluated the trends and variations of changes in outcomes of hospitalized neonates of 23-29 weeks’ gestation over 10 years (2007-16). The neonatal mortality and composite outcome of mortality or any of the three major morbidities including severe neurological injury (SNI), treated retinopathy of prematurity (ROP) and bronchopulmonary dysplasia (BPD) were examined. Variation of outcomes between units within each country was measured by the weighted coefficients of variance (CV), as the ratio of the weighted standard deviation to weighted mean of the standardized rate across a number of given units. Change in adjusted CV over study years were analyzed for trend and reported as decreasing, widening or no change.

**Results:** A total of 162919 infants are included in the study. Mortality rates and adjusted CV are summarised in [Table 1]. Mortality decreased over time in ANZ, Canada, Finland, Japan, Spain and UK, but widening variations within country were seen in ANZ, Japan, Spain and Switzerland. Significant mortality rate and CV reduction in mortality was seen in Canada only. For the composite outcome [Table 2], increased rates over time were found in ANZ, Japan, Sweden and UK. Reduced composite outcome rate was seen in Tuscany and Canada. Canada had reduced mortality and composite outcome rates with narrowing CV demonstrating significantly reduced country-wide outcome variations.

**Conclusion(s):** Most countries showed improvement in mortality rates, but variation increased in some countries due to widening rate differences between units within country. Conversely, composite adverse outcome rates in most countries were either worsening or unchanged without significant changes in variation trends except Canada. QI initiatives in a regional/national setting need to include a concerted emphasis on reducing outcome variation among participating units.

![IMAGE CAPTION]
AUTHORS/INSTITUTIONS: J. Profit, D. Helkey, C.S. Phibbs, J. Gould, Department of Pediatrics, Stanford University School of Medicine, Palo Alto, California, UNITED STATES; C. Moreno, S. Karakash, M.L. Druzin, Department of Obstetrics & Gynecology, Stanford University School of Medicine, Palo Alto, California, UNITED STATES; M. Cheyney, Department of Anthropology, Oregon State University, Corvallis, Oregon, UNITED STATES;

CURRENT CATEGORY: Neonatology
CURRENT SUBCATEGORY: Neonatal General

KEYWORDS: Infant Mortality, Birth Setting, CDC Vital Statistics.

SESSION TITLE: Neo-Perinatal Care Delivery: Epi-HSR - What's Trending? |Neo-Perinatal Care Delivery: Epi-HSR - What's Trending?
SESSION TYPE: Webinar|Platform

ABSTRACT BODY:

**Background:** The percentage of births at home (HB) or in a freestanding birth center (FBC) has increased over the past decade. Past data on increased neonatal mortality in home and birth center (H&BC) settings has been disputed due to data challenges with the gradual state-by-state adoption of the 2003 revision of the birth certificate indicating planned delivery setting.

**Objective:** Trend and compare early neonatal mortality rates by intended birth setting.

**Design/Methods:** We used CDC period-linked birth and infant death files from 2006-2017 to identify birth location and attendant. The 2003 revision of the birth certificate was adopted by all states by 2015. We studied HB, FBC, and hospital births attended by a doctor or midwife and excluded multiple births, infants with gestational age <37 weeks, birthweight <2500g, non-vertex presentation, infants born to foreign residents and homicides. Because only 1.4% of HB with a midwife present were unplanned (Table 1), we classified HB attended by a midwife as planned unless specified as unplanned. Trends in early (<7 day) neonatal mortality are displayed by birth setting and attendant, including infants born at home, in birth center, or in hospital. Outcome is attributed to location of birth, not according to intended location, i.e. H&BC transfers accrue to hospitals. We compared differences in early neonatal mortality by birth setting from 2014-17, using a chi-square test.

**Results:** Between 2006-17 annual US births decreased from 4,273,264 to 3,864,781; H&BC births increased from 25,014/12,790 to 38,394/21,077. Of 48,667,982 births, 38,397,795 met inclusion criteria. Table 2 displays sample characteristics. On average, mothers with planned H&BC birth were older, predominantly white, and more highly educated. Figure 1 shows increasing precision in mortality rates over time and increased mortality for H&BC settings. For 2014-17, the odds ratio (95% CI) for planned HB (96,541 births, 68 deaths) and FBC (68,495 births, 45 deaths) vs. hospital midwife births (1,185,870 births, 189 deaths) was 4.44 (3.37, 5.86) and 4.15 (3.0, 5.74), respectively. The odds ratio for planned HB vs all hospital births was 2.33 (1.83, 2.96). With current practice, an increase of the HB rate to 5% (133,103 additional HB) would incur an annual excess 54 infant deaths.

**Conclusion(s):** Compared with hospital births, H&BC births were associated with substantially increased odds of early neonatal mortality, despite a favorable patient sample, and analyses biased against hospital births.

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*Calculated with HB of all births does not report planned birth setting

Intended birth status by attendant for all home births 2006-2017 (2863/ (197546+2863) = ~1.4%).

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Early (<7 day) mortality by birth setting for infants meeting our exclusion criteria. Confidence bands are displayed around each trendline such that non-overlap indicates a significant difference between groups at the p=0.05 level. FBC – freestanding birth center; HB – home birth; MW – midwife.

**IMAGE CAPTION:**
Intended birth status by attendant for all home births 2006-2017 (2863/ (197564+2863) = ~1.4%).


Early (<7 day) mortality by birth setting for infants meeting our exclusion criteria. Confidence bands are displayed around each trendline such that non-overlap indicates a significant difference between groups at the p=0.05 level. FBC – freestanding birth center; HB – home birth; MW – midwife.