

# Racial Disparities and Trends in Neonatal Intensive Care Unit Use, 2012-2016

Extended abstract for 2019 PAA Proposed Paper

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## **Abstract**

Neonatal Intensive Care Unit (NICU) care is highly valuable and appropriate use has been linked to substantial reductions in infant mortality. Research assessing the quality of neonatal intensive care has largely focused on utilization by risk factors such as low birthweight and gestational age. Few studies have assessed the utilization of neonatal intensive care by race and ethnicity.

This study examined trends of admission rates to the NICU over a 5-year (2012-2016) period by race and ethnicity. We found that crude NICU admission rates increased from 77.6 in 2012 to 86.9 in 2016 per 1,000 live births. All races experience an increase ( $p < 0.001$ ) in adjusted NICU admission rates, with the rate for Non-Hispanic whites increasing by 17.3%, non-Hispanic blacks by 17.1%, and Hispanics by 20.5% from 2012 to 2016. Although we adjusted for maternal and infant socio-demographics as well as clinical risk factors, Hispanics still had a higher rate of NICU admission compared with non-Hispanic whites. In addition, the gap between Hispanics and non-Hispanics whites widened over time.

US newborns on all races are increasingly likely to be admitted into NICU. Our results decompose the increase by race and ethnicity and provide further insight on disparities across time. Further study is needed for the causes of the increased NICU utilization and expanded racial disparities.

## **Introduction**

The infant mortality rate in the United States has declined from 29.21 per 1,000 live births on average in the 1950s to on average 9.22 in 1990s and is 5.87 per 1,000 live birth in 2016 (Xu, Murphy, Kochanek, Bastian, & Arias, 2018). The decline is mainly driven by the drop in neonatal infant mortality (under 28 days from birth) rate that happened mainly to preterm infants (Cutler & Meara, 2000). The great reductions come along with the diffusion of technologies related to birth and the corresponding development of NICU. The NICU is defined as a facility that “staffed and equipped to provide continuous mechanical ventilatory support” and provides highly specialized care to newborns (Martin & Menacker, 2004).

While infant mortality differs across races, little is known about how the utilization of NICU among races. Lacking in the knowledge on highly effective neonatal case use may hinder the equity and effectiveness to further decrease infant mortality rate. This study is to describe admission rates of NICUs for US newborns across race/ethnicity and investigate how the racial disparities change over a 5-year time period from 2012 to 2016.

## **Data and Methodology**

We conducted a retrospective study using data from the Natality Public Use File of the Vital Statistics comprising near census births in the US (NCHS, 2016). The Vital Statistics micro-data contained nationwide information on natality, mortality, fetal deaths, and linked birth/infant death annually within the United States and its territories. The natality file has information on all births happened in the US of mother’s demographic characteristics, medical and public services utilization, maternal lifestyle and health characteristics, infant health characteristics, and NICU admission. The NICU admission was first collected in 2004 using the 2003 revised version of US Birth Certificates. The revision was first implemented in seven states in 2004 and expanded to all states, the District of Columbia, Guam, Puerto Rico, the US Virgin Islands, and the Northern Marianas as of January 1, 2016 (CDC, 2016). In this study, we only used those states that using 2003 version which accounts for 86.16% of the total US born in 2012 and 99.74% in 2016. And we excluded those non-US residents and those not reported birthweight which account for less than 1% of our sample.

Multivariable logistic regressions were used for our study purpose. To investigate the disparities across the year, we added either linear or discrete time trend. We adjusted for mother’s demographic characteristics including Hispanic origin and race (non-Hispanic White, non-Hispanic

Black, non-Hispanic others, Hispanic), age ( $\leq 19$ , 20-29, 30-39, 40+), education level (less than high school, high school, some college, university and above), as well as parity (0, 1, 2, 3+) and delivery method (vaginal or cesarean) information; infant health characteristics including gender, gestation age ( $\leq 27$ , 28-31, 32-36,  $\geq 37$ ), birthweight (500-1499, 1500-2499, 2500-3999, 4000+), 5 min Apgar score (0-3, 4-6, 7-8, 9-10), and plurality (single, twin, triplet and more).

## **Preliminary Results**

Table 1 describes some major characteristics of our sample that has around 3 million newborns for each year. On average, the NICU admission rate is 8.22%.

We observe an overall crude rate of NICU admission is 77.6 in 2012 and increases to 86.9 in 2016 per 1,000 live births (Table 2). The crude rate for non-Hispanic Whites increases from 74.3 to 81.8 per 1,000 live births, from 103.8 to 115.8 for non-Hispanic Blacks, from 71.5 to 84.6 for non-Hispanic others, and from 71.0 to 81.8 for Hispanics. These crude rates correspond to 11%, 13%, 20%, and 16.5% increase. After adjusting sociodemographic characteristics and risk factors, rates for non-Hispanic White, Black, others, and Hispanic increase 17.3%, 17.1%, 23.3%, and 20.5%, respectively.

The probabilities of admitting into a NICU are higher for non-Hispanic Blacks (OR=1.44,  $P < 0.001$ ) and non-Hispanic others (OR=1.01,  $P < 0.001$ ) compared with non-Hispanic Whites, while lower for Hispanics (OR=0.98,  $P < 0.001$ ) (Table 3). After adjustment, the disparities for non-Hispanic others (OR=1.02,  $P < 0.001$ ) and Hispanic (OR=1.07,  $P < 0.001$ ) persist.

Table 4 compares time trends of NICU admission rate across race. Assuming linear time trend, we observe a significant increase of racial disparities after adjustment between non-Hispanic Whites and non-Hispanic others as well as Hispanics that their admission rates are 1.4% and 0.7% higher than non-Hispanic Whites, respectively. The disparities of NICU admissions change inconsistently when discrete year dummies are used. For example, the discrepancy for admission rates between non-Hispanic Whites and Hispanics are significant increases in the year 2013, 2015, and 2016 compared with the year 2012, while not in 2014.

**Table 1. Descriptive Statistics**

Characteristic	n	%
<b>Total</b>	18,507,524	
Admitted into NICU		
Yes	1,522,189	8.22
No	16,985,335	91.78
Race/Ethnicity		
Non-Hispanic White	9,922,262	53.61
Non-Hispanic Black	2,675,482	14.46
Non-Hispanic Others	1,583,776	8.56
Hispanic	4,326,004	23.37
Birthweight, g		
500-1499	231,879	1.25
1500-2499	1,228,435	6.64
2500-3999	15,566,144	84.11
4000+	1,481,066	8
Gestational age, week		
<=27	101,811	0.55
28-31	216,564	1.17
32-36	1,751,382	9.47
>=37	16,426,150	88.81
Year		
2012	3,439,719	18.59
2013	3,512,091	18.98
2014	3,797,555	20.52
2015	3,861,745	20.87
2016	3,896,414	21.05
Plurality		
Single	17,878,533	96.6
Twin	609,199	3.29
Triplet and more	19,792	0.11
Delivery Method		
Cesarean	5,969,594	32.27
Vaginal	12,531,221	67.73
Infant Sex		
Female	9,038,083	48.83
Male	9,469,441	51.17
Parity		
0	7,178,964	38.96
1	5,884,366	31.93
2	3,108,443	16.87
3+	2,254,892	12.24

**Table 1. Descriptive Statistics (Cont.)**

Characteristic	n	%
Mother's age		
<=19	1,194,876	6.46
20-29	9,415,811	50.88
30-30	7,347,176	39.7
40+	549,661	2.97
Mother's education		
Less than high school	2,791,396	15.21
High school	4,600,587	25.06
Some college	5,373,112	29.27
University and above	5,591,404	30.46
Apgar score (5 min)		
0-3	89,359	0.48
4-6	260,178	1.41
7-8	2,311,228	12.54
9-10	15,776,764	85.57

**Table 2. Trend of Crude and Adjusted NICU Admission Rates by Race**

Admission by Race	2012	2013	2014	2015	2016
<b>All newborns</b>					
Crude Rate	77.6	79.2	82	84.7	86.9
Unadjusted, OR	Ref.	1.02***	1.06***	1.10***	1.13***
		[1.020-1.028]	[1.055-1.066]	[1.093-1.104]	[1.125-1.136]
Adjusted, OR	Ref.	1.019***	1.076***	1.142***	1.185***
		[1.012 - 1.026]	[1.069 - 1.083]	[1.134 - 1.149]	[1.178 - 1.193]
<b>Stratified by Race</b>					
<b>Non-Hispanic White</b>					
Crude Rate	74.3	75.5	78.0	80.0	81.8
Unadjusted, OR	Ref.	1.018***	1.053***	1.084***	1.110***
		[1.010-1.026]	[1.045-1.061]	[1.076-1.092]	[1.101-1.118]
Adjusted, OR	Ref.	1.0156**	1.0677***	1.1315***	1.1728***
		[1.006 - 1.025]	[1.058 - 1.078]	[1.121 - 1.142]	[1.162 - 1.184]
<b>Non-Hispanic Black</b>					
Crude Rate	103.8	103.6	108.1	111.6	115.8
Unadjusted, OR	Ref.	0.998	1.046***	1.084***	1.130***
		[0.985-1.010]	[1.033-1.058]	[1.070-1.097]	[1.116-1.144]
Adjusted, OR		0.9903	1.0442***	1.1057***	1.1714***
		[0.975 - 1.006]	[1.028 - 1.061]	[1.089 - 1.123]	[1.153 - 1.190]
<b>Non-Hispanic Others</b>					
Crude Rate	71.5	74.4	78.1	82.6	84.6
Unadjusted, OR	Ref.	1.044***	1.100***	1.170***	1.200***
		[1.022-1.067]	[1.078-1.121]	[1.147-1.192]	[1.178-1.223]
Adjusted, OR	Ref.	1.0376**	1.1059***	1.1904***	1.2333***
		[1.011 - 1.064]	[1.080 - 1.132]	[1.163 - 1.218]	[1.206 - 1.262]
<b>Hispanic</b>					
Crude Rate	71.0	73.7	76.7	79.6	81.8
Unadjusted, OR	Ref.	1.041***	1.086***	1.131***	1.165***
		[1.028-1.053]	[1.074-1.100]	[1.118-1.144]	[1.152-1.179]
Adjusted, OR	Ref.	1.0411***	1.1081***	1.1756***	1.2052***
		[1.026 - 1.056]	[1.093 - 1.124]	[1.160 - 1.192]	[1.189 - 1.222]

Note. The crude rate is per 1,000 live births. The 95% CIs are in the bracket. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05

**Table 3. Racial Disparities in NICU Admission**

	Unadjusted			Adjusted		
	Odds Ratio	95% CI		Odds Ratio	95% CI	
<b>Race/Ethnicity</b>						
Non-Hispanic White	Ref.			Ref.		
Non-Hispanic Black	1.441***	0.991	1.003	0.997	1.435	1.448
Non-Hispanic Others	1.013***	1.016	1.031	1.023***	1.007	1.020
Hispanic	0.982***	1.064	1.076	1.07***	0.978	0.986
Pseudo R2	0.0026			0.31		
Number of Observation	18,507,524			18,197,344		

Note. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05

**Table 4. Racial Disparities across Years**

	Unadjusted			Adjusted		
	Odds Ratio	95% CI		Odds Ratio	95% CI	
<b>Panel A: Linear Year Trend</b>						
Race/Ethnicity*c.Year						
Non-Hispanic White	Ref.					
Non-Hispanic Black	1.006***	1.003	1.009	1.003	0.998	1.007
Non-Hispanic Others	1.021***	1.016	1.025	1.014***	1.009	1.020
Hispanic	1.012***	1.009	1.015	1.007***	1.003	1.010
Pseudo R2	0.0029			0.31		
<b>Panel B: Discrete Year Trend</b>						
Race/Ethnicity*i.Year						
Non-Hispanic Black*2013	0.980***	0.966	0.995	0.975**	0.957	0.994
Non-Hispanic Black*2014	0.993	0.979	1.008	1.023	0.995	1.052
Non-Hispanic Black*2015	1	0.986	1.015	1.026**	1.009	1.044
Non-Hispanic Black*2016	1.019*	1.004	1.033	0.979*	0.961	0.998
Non-Hispanic Others*2013	1.026*	1.003	1.049	1.04**	1.014	1.068
Non-Hispanic Others*2014	1.044***	1.022	1.066	1.038***	1.021	1.056
Non-Hispanic Others*2015	1.079***	1.057	1.101	0.982	0.964	1.000
Non-Hispanic Others*2016	1.082***	1.060	1.104	1.058***	1.031	1.085
Hispanic*2013	1.022**	1.008	1.037	1.041***	1.024	1.058
Hispanic*2014	1.032***	1.017	1.046	1.006	0.988	1.025
Hispanic*2015	1.043***	1.029	1.058	1.057***	1.031	1.084
Hispanic*2016	1.05***	1.036	1.065	1.029***	1.013	1.046
Pseudo R2	0.0029			0.31		
Number of Observation	18,507,524			18,197,344		

Note. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05



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