Newborn and Birthing Parent Characteristics of Neonatal Abstinence Syndrome Cases in Rhode Island, 2020–2023

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INTRODUCTION

Neonatal abstinence syndrome (NAS) is a set of clinical features in a newborn resulting from withdrawal from certain prenatal drug exposure, primarily from opioids. Some United States (U.S.) jurisdictions have reported NAS case criteria used for public health surveillance,[1] mainly based on Council of State and Territorial Epidemiologists (CSTE) guidance.[2] Prior to 2020, the Rhode Island Department of Health (RIDOH) reported NAS using solely administrative data. When a 2020 regulations update required birthing hospitals to report newborns diagnosed with NAS (§ 216-RICR-10-10-3), RIDOH developed and implemented its NAS case definition for public health surveillance, based on the ability to confirm cases via medical record review.[3] Having more specific case criteria, rather than relying on administrative reporting, allows for a better picture of the burden of NAS in Rhode Island (RI). This study adds to previously reported NAS epidemiology in RI by examining demographic characteristics of newborns and birthing parents using RIDOH's current NAS case definition.

METHODS

Per regulations, RI birthing hospitals report newborns diagnosed with the NAS-related 10th Clinical Modification of the International Classification of Diseases (ICD-10) codes of P96.1, P04.4, or P04.41 routinely to RIDOH through automated discharge reporting. Once reported, staff abstract information from medical records to ensure accurate case classification and gather additional information, including toxicology results and receipt of pharmaceutical therapy. An NAS case is a newborn with either a (1) positive newborn or maternal lab result for an opioid, benzodiazepine, or barbiturate or (2) chronic maternal history of opioid, benzodiazepine, or barbiturate use; along with one of the following: three or more withdrawal symptoms, or a diagnosis or chief complaint mentioning NAS. This analysis examined cases and RI resident births from January 1, 2020 to December 31, 2023.

NAS cases were linked via medical record number to birth certificate data from RIDOH's Center for Vital Records to obtain additional newborn (including infant sex, birth weight, gestational age, and neonatal intensive care unit (NICU) admission) and birthing parent demographics. The birth file was also linked to KIDSNET's newborn developmental risk assessment data to obtain hospital discharge date (used to calculate days in hospital). City/town of residence was defined as a core city (municipality where 25% or more children live below poverty level; Central Falls, Pawtucket, Providence, and Woonsocket) or non-core (rest of the state). Maternal race and ethnicity were defined as follows: Hispanic (regardless of race), non-Hispanic White, non-Hispanic Black, and Other (included those reporting as non-Hispanic and Asian, Hawaiian/Pacific Islander, Native American, or more than one race). Insurance type at delivery categories were defined as: private and public (Medicaid) (Self-pay, unknown, and no insurance were not included in analyses due to small numbers). Initiation of prenatal care was defined as care beginning in the first trimester or delayed/no prenatal care (if prenatal care began in second or third trimester, or prenatal care wasn't received). Adequacy of prenatal care (Adequate, Inadequate, and No Care) was measured using the Kotelchuck index. NAS cases were compared to all other newborns from the same timeframe.

Incidence rates were calculated using the RI resident live birth population as the denominator. Substances found in NAS cases were calculated as a percent of cases who had a positive toxicology test for an opioid, benzodiazepine, or barbiturate. Analyses were conducted in SAS Version 9.4 (SAS Institute, Cary, NC). Statistical significance at the <0.05 level was determined using chi-squared tests.

RESULTS

From 2020 to 2023, NAS incidence in RI decreased from 6.9 to 5.2 cases per 1,000 live births (**Figure 1**). There were 258 NAS cases in this four-year timeframe, with an overall incidence rate of 6.4 cases per 1,000 live births. Seven cases could not be linked to the birth file. In addition to having symptoms or a chief complaint/diagnosis of NAS, 196 (76.0%) of newborns met case criteria based on a positive newborn toxicology result; 15 (5.8%; interpret with caution as estimate is statistically unstable) had a positive maternal toxicology (negative, no, or unknown newborn toxicology result); and 47 (18.2%) were classified as cases based on a maternal history (negative, no, or unknown newborn and/or maternal toxicology results).

Newborns with NAS were more often low (<2500g) birthweight (19.8%) and preterm (<37 week) gestational age (21.7%) compared to all other newborns (**Table 1**). NAS cases were more likely to be admitted to a NICU (19.0%) than all other newborns (4.4%). Cases most frequently were hospitalized for 15 to 21 days (37.6%), with an average hospital stay of 17.5 days (range: 2–312 days), compared to all other newborns being most frequently hospitalized for 0–7 days (89.6%), with an average hospital stay of 3.9 days (range: 0–378 days). Pharmaceutical therapy was required by 71.3% of cases to manage NAS symptoms.

Birthing parents of NAS cases were most often 30 or older (70.9%), single (71.7%), had a 12th grade or less education (56.2%), on public insurance at time of delivery (79.8%), and non-Hispanic White (71.7%) (**Table 2**). Compared to all other

Figure 1. Neonatal abstinence syndrome incidence, Rhode Island, 2020–2023

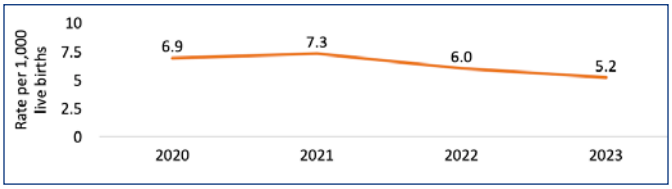

Table 1. Demographics for newborns with neonatal abstinence syndrome (NAS) and all other newborns, Rhode Island, 2020–2023.

	Newborns with NAS (%)	All Other Newborns (%)
Total Count	258	40,345
Infant Sex[1]		
Male	133 (51.6)	20,475 (50.8)
Female	118 (45.7)	19,868 (49.3)
Birthweight[1]		
Low (<2500g)	51 (19.8)	3,085 (7.7)
Normal (≥2500g)	200 (77.5)	36,974 (91.6)
Gestational Age[1]		
Preterm (<37 weeks)	56 (21.7)	3,702 (9.2)
Full Term (≥37 weeks)	195 (75.6)	36,398 (90.2)
Admitted to NICU[1]		
Yes	49 (19.0)	1,788 (4.4)
No	202 (78.3)	38,557 (95.6)
Days in hospital[1]		
0 to 7	67 (26.0)	36,137 (89.6)
8 to 14	53 (20.5)	643 (1.6)
15 to 21	97 (37.6)	298 (0.7)
22 to 28	21 (8.1)*	188 (0.5)
>28	19 (6.6)*	629 (1.6)
Received pharmaceutical therapy for NAS		
Yes	184 (71.3)	N/A
No	74 (28.7)	N/A

[1] Chi-square test with a statistical significance level less than <0.05.

*Estimates are statistically unstable (relative standard error between 20–30%) and should be interpreted with caution.

Table 2. Birthing parent demographics for newborns with neonatal abstinence syndrome (NAS) and all other newborns, Rhode Island, 2020–2023.

	Newborns with NAS (%)	All Other Newborns (%)
Age Group[1]		
<30	68 (26.4)	16,895 (41.9)
30-39	158 (61.2)	21,597 (53.5)
40 and older	25 (9.7)	1,766 (4.4)
Marital Status[1]		
Single	185 (71.7)	17,409 (43.2)
Married	44 (17.1)	22,817 (56.6)
Education[1]		
<12th Grade	61 (23.6)	4,419 (11.0)
12th Grade	84 (32.6)	8,151 (20.2)
>12th Grade	90 (34.9)	27,295 (67.7)
Insurance Type at Delivery[1]		
Public	206 (79.8)	17,711 (43.9)
Private	43 (16.7)	22,224 (55.1)
Race and ethnicity[1]		
Hispanic	19 (7.4)*	11,774 (29.2)
Non-Hispanic Black	13 (5.0)*	2,869 (7.1)
Non-Hispanic White	185 (71.7)	20,361 (50.5)
Other	16 (3.1)*	5,203 (12.9)
Core City Residence[2]		
Core	106 (41.1)	15,589 (38.6)
Non-Core	144 (55.8)	24,614 (61.0)
Initiation of Prenatal Care[1,3]		
First Trimester Care	136 (52.7)	31,686 (78.5)
Delayed/No Prenatal Care	104 (40.3)	6,023 (14.9)
Adequacy of Prenatal Care[1,4]		
Adequate	162 (63.0)	33,481 (82.9)
Inadequate	42 (16.3)	1,415 (3.5)
No Care	19 (7.4)*	121 (0.3)

[1] Chi-square test with a statistical significance level less than <0.05.

[2] A core city (Central Falls, Pawtucket, Providence, and Woonsocket) is a municipality where 25% or more children live below poverty level.

[3] Delayed prenatal care is prenatal care beginning in the second or third trimester.

[4] The Kotelchuck Index is a measure that assesses the adequacy of prenatal care initiated.

*Estimates are statistically unstable (Relative standard error between 20–30%) and should be interpreted with caution.

Table 3. Substances identified via newborn toxicology results among neonatal abstinence syndrome (NAS) cases (n=196), Rhode Island, 2020–2023.

Substance	Count (% of positive samples)[a]
Fentanyl	101 (51.5%)
Methadone	88 (44.9%)
Buprenorphine	65 (33.2%)
Opiate	31 (15.8%)
Cocaine	30 (15.3%)
Cannabinoid	24 (12.4%)
Amphetamine	14 (7.1%)*
Benzodiazepine	13 (6.6%)*
Barbiturate	0 (0%)

[a] Not mutually exclusive; more than one substance was found in 62.2% of newborns with positive toxicology results.

*Estimates are statistically unstable (Relative standard error between 20–30%) and should be interpreted with caution.

infants (14.9%), 40.3% of birthing parents of newborns with NAS had delayed or no prenatal care. They also received inadequate (16.3%) or no prenatal care (7.4%) more often compared to all other newborns (3.5% and 0.3% respectively). Except for core city residence, all chi-square tests were significant at the <0.05 level.

Of the 196 positive toxicology tests in newborns with NAS, more than one substance was found in 62.2% of cases. Fentanyl was the most common substance found (51.5%) (**Table 3**). Although medication for opioid use disorder (MOUD) (buprenorphine or methadone) was found in 78.1% of newborns testing positive, it was the only substance found in 26.5% of newborns.

DISCUSSION

Our findings present the first description of newborns with NAS in RI using a non-administrative data source. Since 2020, NAS incidence has declined. RI's neighbors, Massachusetts and Connecticut, also show a decreasing trend in NAS incidence in recent years.[4] Like other states, newborns with NAS were more frequently low birthweight,[5-7] preterm,[5,6] and required a NICU-level of care[5,8] compared to all other newborns. Hospital stays for newborns with NAS were about 4.5 times as long as all other newborns. Seven in 10 newborns with NAS required pharmaceutical therapy to manage their symptoms. In comparison to other states reporting NAS data where birthing parents were most often under 30,[5,6,8] RI birthing parents were more often 30 and older. Birthing parents of newborns with NAS were most often of single marital status,[7] had a 12th grade or less education,[5,6,7] on public insurance at delivery,[5-9] and identified as non-Hispanic White,[5,6,8,9] similar findings from other states.

Birthing parents of newborns with NAS were less likely to receive adequate or timely prenatal care than all other birthing parents. More than one in five birthing parents received inadequate or no prenatal care and four in ten had delayed or no prenatal care. Birthing parents may be discouraged from seeking care, as there may be stigma surrounding substance use while pregnant and fear of repercussions.[6,10] Additionally, suddenly stopping opioid use while pregnant is not recommended, as it may cause complications such as preterm labor.[11] Connections to prenatal care may facilitate MOUD access. MOUD use during pregnancy is safe and recommended by numerous agencies, including the Centers for Disease Control and Prevention (CDC) and the American College of Obstetricians and Gynecologists (ACOG), with buprenorphine and methadone leading to improved maternal and newborn outcomes.[11,12] In RI, buprenorphine dispensation to pregnant individuals has decreased in recent years,[13] with females less likely to be dispensed buprenorphine despite an increase in dispensation overall.[14] Additionally, RI birthing hospitals are not required to report newborns with exposure to MOUD or other prescribed substances to the Department of Children, Youth, and Family (DCYF) unless there are safety concerns.[15] Fear of losing custody of a child should not be a deterrent to starting MOUD. RIDOH should focus future interventions on reducing stigma surrounding substance use during pregnancy, ensuring birthing parents are connected to prenatal care in a timely manner, and expanding MOUD use in this population.

As expected, the most common substances in newborns with positive toxicology were fentanyl, MOUD, opiates, and cocaine, all of which are also found in most fatal overdoses in RI. Barbiturates contributed to less than five fatal overdoses in RI each year from 2009 to 2022 (unpublished). They were also not a substance of exposure for NAS cases in our analysis, but little is known about the prevalence of barbiturate use in RI, particularly in birthing individuals. In another state with published data, barbiturate presence was seen in about 1% of NAS cases.[7] Given the low prevalence of barbiturates in fatal overdoses and NAS cases, birthing individuals may not be commonly exposed. RIDOH will explore the prevalence of barbiturate use in birthing individuals in future Prescription Drug Monitoring Program (PDMP) analyses.

Although newborns with NAS generally require a higher level of care than all other newborns in RI, as seen in longer hospital stays and more NICU admissions than other births, it is expected MOUD exposure may cause NAS, even if there are less severe symptoms.[11,12] Approximately one in four newborns with NAS in RI who had a positive toxicology test had only MOUD exposure. Awareness of exposure allows the birthing hospital to closely monitor these newborns for NAS symptoms.[11] Future analyses are planned to compare newborns with only MOUD exposure to other newborns with NAS to determine if there is a difference in outcomes, including shorter hospital stays and fewer NICU admissions.

There may be long-term impacts on newborns with NAS, which are difficult to monitor via existing NAS surveillance.[2] To facilitate connections to supports after the birth hospitalization, RI requires a Plan of Safe Care (POSC) for each newborn with any substance exposure during pregnancy.[15] The POSC is unique to each family, with referrals to health, educational, social, and developmental services that may benefit each family.[15] Referral and receipt of many of these services, such as family visiting, early intervention, and hospital-level care can be determined by linking cases to other RIDOH datasets to determine longer-term impacts and outcomes of NAS-affected newborns.

Future analyses will focus on monitoring trends in demographics and substances of exposure, along with examining disparities in race and ethnicity and socio-economic factors in this population. PDMP linkages can help determine prescription exposures versus illicit to inform future interventions and assess the accuracy of medical records at birth. RIDOH will continue to use its NAS surveillance to define the burden in RI and inform interventions to improve the outcomes of newborns with NAS and their birthing parents.

Limitations

All maternal characteristics were self-reported on the birth certificate, which may over- or underestimate some characteristics. MOUD exposure was likely under-reported in **Table 3** as toxicology testing was not always conducted for known MOUD exposures. Information on illicit versus prescription drug use was not collected.

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