

Neonatal Abstinence Syndrome: 2021 Report

Bureau of Family
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Abbreviations

ACOG	American College of Obstetricians and Gynecologists
ASQ	Ages and Stages Questionnaire
CAPTA	Child Abuse Prevention and Treatment Act
CARA	Comprehensive Addiction and Recovery Act
COVID-19	Coronavirus Disease, 2019
CSTE	Council of State and Territorial Epidemiologists
DHS	(Pennsylvania) Department of Human Services
DHHS	(United States) Department of Health and Human Services
ESC	Eat, Sleep, Console
HCUP-SID	Healthcare Cost and Utilization Project-State Inpatient Database
ICD-10	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision
iCMS	Internet Case Management System
MAT	Medication-assisted Treatment
MOUD	Medication for Opioid Use Disorder
NAS	Neonatal Abstinence Syndrome
NICU	Neonatal Intensive Care Unit
NIDA	National Institutes of Health's Institute on Drug Abuse
NOWS	Neonatal Opioid Withdrawal Syndrome
OCDEL	Office of Child Development and Early Learning
PA	Pennsylvania
PA DOH	Pennsylvania Department of Health
SAMHSA	Substance Abuse and Mental Health Services Administration
WIC	(Pennsylvania Special Supplemental Nutrition Program for) Women, Infants, and Children

Executive Summary

This is the Pennsylvania Department of Health's (Department) fourth neonatal abstinence syndrome (NAS) surveillance annual report. The NAS surveillance initiative allows for rapid case ascertainment and improved count of the number of infants with NAS across the state. Data in this report is intended for use by the Department or stakeholders to develop public health strategies that support families before, during, and after pregnancy. Key findings from this report may also inform clinical care and referral practices for infants with NAS and their families across the state.

The Department of Health received 1,606 case reports of infants born in 2021 that met the NAS surveillance case definition. The incidence of NAS per 1,000 live births in 2021 was 12.1, a decrease from the rate of 14.0 in 2020. Of 88 active hospitals with reporting capability, 82 (93%) reported NAS cases in 2021. NAS resulting from opioid exposure remained the most common in 2021; 93.6% of people who gave birth to an infant with NAS had used opioids in the four weeks before delivery and 90.2% of infants with NAS who were tested had a positive result for an opioid. Infants with NAS were predominantly born to people who identified as non-Hispanic white and had Medicaid insurance at delivery, consistent with previously reported state and national data. Although most infants with NAS were of normal birthweight and born at or after 37 weeks of gestation, over 50% were admitted to the neonatal intensive care unit (NICU) during their hospital stay. Infants with NAS born to people who identified as non-Hispanic Black were more likely to be low birthweight or premature than the non-Hispanic white population, mirroring persistent Black-white disparities in prematurity and low birthweight observed at the state and national levels for all resident live births.

NICU admission, hospital length of stay, and administration of pharmacologic treatment to the infant are interrelated and may be modified by the scoring method the hospital uses to assess infant withdrawal symptoms. Most infants with NAS in Pennsylvania were assessed using solely the Finnegan/Modified Finnegan NAS scoring system (70.2%), and a smaller subset were assessed using the more recently developed Eat, Sleep, Console (ESC) scoring method (27.1%) which promotes rooming-in and non-pharmacologic therapies. Notably, the percentage of infants with NAS assessed using ESC nearly doubled since 2020 (14%). Infants with NAS assessed using ESC were less likely to receive pharmacologic treatment and had a shorter hospital stay compared to infants assessed using the Finnegan/Modified Finnegan NAS scoring system.

Among people who gave birth to an infant with NAS in 2021, most had received prenatal care (81.5%) and over half (58.0%) received medication for opioid use disorder (MOUD) during pregnancy. Data stratified by maternal race and ethnicity highlight disparities in receipt of prenatal care and MOUD. Non-Hispanic Black people who gave birth to an infant with NAS were less likely than non-Hispanic white people to receive prenatal care during pregnancy (80.6% vs 84.2%) and were also less likely to receive MOUD during pregnancy (25.4% vs 63.3%). Linked surveillance data from 2018 to 2021 also demonstrate that 15.6% of people who gave birth to an infant with NAS in 2021 had a prior birth to an infant with NAS in the preceding three years.

Data on referral and discharge of the maternal-infant dyad in this report are not comprehensive and may not reflect all referrals made. The available data suggest that maternal-infant dyads are not universally referred to social support and health care services at discharge. This highlights an opportunity to improve awareness and education of healthcare providers and families on available services and the importance of referral and coordinated follow-up.

This report also includes NAS case counts and incidence rates for the 67 counties in Pennsylvania and its six regions. The incidence of NAS increases when moving from east to west across the state and is higher in rural counties than in urban counties. The incidence rate of NAS remains the highest in the state's northwestern region.

To support the Department's commitment to advancing health equity and promoting the health and well-being of all Pennsylvanians the Department developed a Neonatal Abstinence Syndrome Family Guide Tool Kit, a resource for caregivers, and piloted a baby basket program in the northwestern region of the state. The program distributed baby baskets containing items essential to infant care and the Tool Kit to families of infants diagnosed with NAS. The Tool Kit is also available as a resource on the Department's [website](https://www.health.pa.gov/topics/programs/Newborn-Screening/Pages/NAS.aspx) for Neonatal Abstinence Syndrome (<https://www.health.pa.gov/topics/programs/Newborn-Screening/Pages/NAS.aspx>), and printed copies are available by contacting the Bureau of Family Health's Division of Newborn Screening and Genetics at 717-783-8143.

Addressing the opioid epidemic, substance use, and promoting the health of families is a collaborative effort with fellow state agencies, local and county health departments, health care organizations and many other community partners. While NAS surveillance is ongoing, this report is intended to provide data to stakeholders and members of the public to allow for data-informed decision-making and public health practice.

Introduction

Defining Neonatal Abstinence Syndrome (NAS)

Neonatal abstinence syndrome (NAS) is a constellation of signs of withdrawal in a newborn following in utero exposure to prescribed medications (including medications used to treat substance use disorder) or illicit drugs including opioids, benzodiazepines, and barbiturates (CSTE 2019). NAS may occur at or shortly following birth due to the discontinuation of exposure to such substances and manifests as symptoms including body tremors, excessive crying, or inability to console, feeding difficulty, and increased muscle tone, among others. Withdrawal resulting from opioid exposure is sometimes referred to as Neonatal Opioid Withdrawal Syndrome or NOWS. Throughout this report, NAS will be used as an umbrella-term and includes cases of NOWS.

NAS Surveillance in Pennsylvania

Initiation of Rapid Case Ascertainment and Reporting Authority: 2018-2019

Surveillance for NAS was initiated in Pennsylvania following the issuance of an opioid emergency disaster declaration by Governor Tom Wolf on January 10, 2018. While the disaster declaration ended, the Department has the authority to require and receive reports of NAS cases from hospitals across the state under Title 28 PA codes 27.3 and 27.4, which are based on the statutory provisions act 35 PS 521.2 (k) and 521.4.

Case Definition:

2018-2019

In 2018 and 2019, NAS cases were defined as Pennsylvania resident infants with clinical diagnoses of NAS who had symptoms of withdrawal due to prenatal exposure to opioids. Annual NAS data from 2018 and 2019 surveillance were published in two reports, which can be found on the Department of Health's [website](https://www.health.pa.gov/topics/programs/Newborn-Screening/Pages/NAS.aspx) (<https://www.health.pa.gov/topics/programs/Newborn-Screening/Pages/NAS.aspx>).

2020-2021

Effective January 1, 2020, all hospitals in Pennsylvania are required to report confirmed and probable NAS cases in Pennsylvania residents' newborns (neonate that is less than 28 days old) showing withdrawal symptoms due to in utero exposure to opioids, benzodiazepines, or barbiturates via prescription, treatment with medication for opioid use disorder (MOUD), or illicit use. Confirmed and probable cases are defined as follows:

Confirmed NAS Case

Positive newborn drug screen for opioids, benzodiazepines, or barbiturates, AND the newborn meets at least one of the following criteria:

- Newborn diagnosis of NAS (including, but not limited to ICD-10 codes P96.1, P04.49, P04.14, P04.17)
- Chief complaint that mentions NAS
- Three or more clinically compatible symptoms of NAS

Probable NAS Case

Maternal self-report, positive maternal labs, or history of maternal drug use within four weeks prior to birth and the newborn meets one of the following criteria:

- Newborn diagnosis of NAS (including, but not limited to, ICD-10 codes P96.1, P04.49, P04.14, P04.17)
- Chief complaint that mentions NAS
- Three or more clinically compatible symptoms of NAS

Since the NAS case definition was expanded to include cases of NAS resulting from exposure to benzodiazepines or barbiturates in 2020, 2020 and 2021 data are not directly comparable to preceding years when solely cases resulting from in utero exposure to opioids were reported to the Department. Annual NAS data from 2020 surveillance were published in an annual report, which can be found on the Department of Health's website (<https://www.health.pa.gov/topics/programs/Newborn-Screening/Pages/NAS.aspx>).

Notes on Language

In the 2021 report we transitioned from using the term medication-assisted treatment, commonly abbreviated as MAT, to medication for opioid use disorder, abbreviated as MOUD. The Substance Abuse and Mental Health Services Administration (SAMHSA) and National Institutes of Health's Institute on Drug Abuse (NIDA) recommend MOUD as a more medically accurate term which describes the treatment being provided, is less stigmatizing, and emphasizes that such medications are not supplemental to treatment but are in fact a central component of treatment (DHHS 2022; NIDA 2021). For more information on this change and other recommended terms to reduce stigma and bias when discussing substance use or addiction, access the guide developed by the NIDA: <https://nida.nih.gov/nidamed-medical-health-professionals/health-professions-education/words-matter-terms-to-use-avoid-when-talking-about-addiction>.

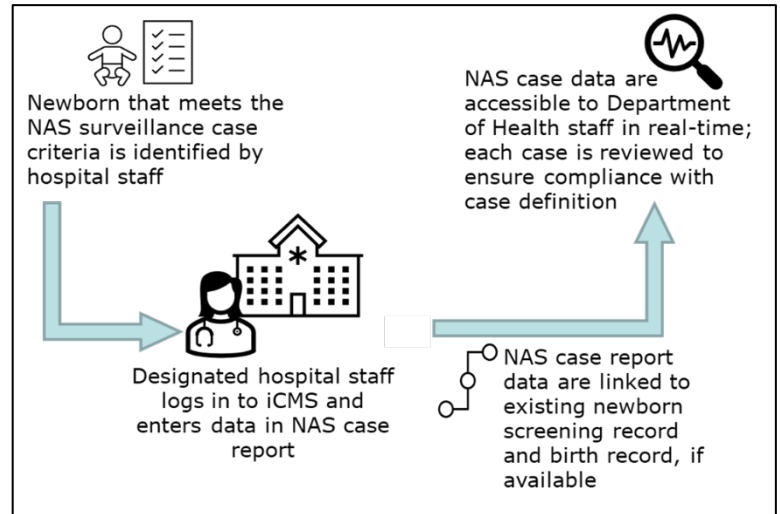
Case Reporting and Statistical Methods

NAS Case Reporting

Data Flow and Confidentiality

All hospitals providing treatment to infants diagnosed with NAS are required to configure their systems and complete training prior to electronic submission of NAS case data via the internet case management system (iCMS). Upon identification of an infant that meets the NAS reporting criteria, hospital staff responsible for reporting log in to the iCMS secure server and enter the data in the case report form. Hospitals are instructed to report cases of NAS to the Department of Health within four days of discharge or by 28 days of life, whichever comes sooner. Neometrics, a division of Natus, owns the application, hosts, and maintains iCMS, and houses the data on an offsite server. Data entered by the reporting hospital are available to the Department of Health staff in real time. Each infant's case report is then linked to their existing birth record and newborn screening record in iCMS, if available. Cases reported to the Department of Health are confidential. Neither the reports nor any information contained in them which identifies or is perceived by the Department as capable of being used to identify a person named in a case report, will be disclosed to any person who is not an authorized employee or agent of the Department or an entity identified in a Memorandum of Understanding, unless otherwise required by law.

Figure 1. NAS Case Report Data Flow Diagram



Source: Bureau of Family Health, Department of Health, 2021

Quality Assurance and Data Cleaning

Upon receiving NAS case reports, designated staff in the Department of Health's Bureau of Family Health conduct a detailed review of each case to ensure compliance with the NAS surveillance case definition and confirm Pennsylvania residency. Infants with no reported symptoms on their NAS case report form are confirmed to either have a diagnosis of NAS or a chief complaint of NAS prior to being included in the surveillance dataset, in accordance with the case definition. Multiple case report forms submitted for the same infant are merged to retain all information regarding the infant. Another component of case review is to verify reports of referral to Early Intervention through data sharing with the Office of Child Development and Early Learning (OCDEL), a collaborative between the Pennsylvania Departments of Education and Human Services. OCDEL provides the Bureau of Family Health with verified Early Intervention referral data on confirmed and probable NAS cases which are incorporated into the iCMS database.

Limitations of Reporting

NAS surveillance has inherent limitations that influence the interpretation of the data herein. Pennsylvania's NAS surveillance relies on timely and accurate reporting by hospitals and their staff. Not all fields of the case report form are currently mandatory or are further verified by the Department of Health. In particular, the data reported by hospitals on referrals to ChildLine and initiation of plans of safe care has not been validated by the Department of Human Services, the agency responsible for receiving ChildLine notifications and plan of safe care initiation. Reporting of an infant that meets the criteria of NAS per the surveillance case definition to the Department of Health is different from reporting of substance affected infants to the Department of Human Services, and the requirements of reporting to the two Departments also differ. Accordingly, NAS surveillance data and data on substance affected infants published by the Department of Human Services are not directly comparable.

Additionally, there is no mandate in Pennsylvania for universal drug testing for people giving birth or their infants at birth. Testing is not always performed. While data on laboratory testing collected on the case report form are included in this report, results were not available for all cases. When data for a given field of the NAS case report form were not provided or were unknown by the hospital, this is noted in the tables and figures throughout the report.

The Department of Health provides ongoing technical assistance to case reporters at hospitals across the state to promote comprehensive reporting of NAS cases to iCMS. However, differences in reporting by county may be influenced by the capacity of hospitals to report NAS cases. Hospital staff across the state were involved in the coronavirus (COVID-19) response and treatment of patients throughout 2021, which may have impacted the timeliness of reporting of NAS cases to the Department of Health. Incomplete or late submission of NAS case reports impacts data quality. The average time to report a NAS case in 2021 was 43 days following the infant's date of birth. Several hospitals across the state were unable to report within the required timeline of 4 days after discharge or within 28 days of birth due to demands placed on healthcare personnel by COVID-19.

Finally, Pennsylvania resident births that meet the NAS case reporting criteria but occur at hospitals outside the state are not reported to iCMS. As a result, there may be underreporting of NAS among Pennsylvania resident births, especially in counties that are adjacent to state boundaries.

Analysis

Statistical Methods

All NAS cases that met the surveillance definition and were born in 2021 are included in the report. NAS case data were linked to birth certificate based on maternal information. This linkage allowed for inclusion and evaluation of data on birth parameters and select maternal characteristics that are not captured on the NAS case report form. Birth parameters, infant testing, assessment, treatment, discharge, and referrals are characterized with descriptive statistics. Preliminary 2021 data were obtained from vital records and were summarized in descriptive tables for comparison with the NAS surveillance data where applicable. Incidence rates were calculated using preliminary 2021 birth data and compared to 2020 rates to assess change in the rate of NAS cases per 1,000 live births over time.

Maternal characteristics including demographics, maternal medical history, and maternal discharge and referrals were also characterized. Case reports for plural births were identified and a single record was retained for each person who gave birth to an infant with NAS so that they are represented only once in the data. For maternal race/ethnicity, counts for people identifying as Non-Hispanic American Indian/Alaska Native and Asian/Pacific Islander were merged into a non-Hispanic other category due to small numbers. The 2021 NAS surveillance dataset was then linked to 2018, 2019, and 2020 NAS surveillance datasets to characterize the number of people who gave birth to an infant with NAS in 2021 who also had a prior birth to an infant with NAS that was reported to the surveillance database in the preceding three years. However, this analysis may underestimate recurrent NAS births due to the changing case definition across surveillance years. While data from 2020 and 2021 are directly comparable and were collected using the same case definition, data from 2018 and 2019 are limited to opioid-exposed infants with NAS – those infants that had NAS resulting from exposure to benzodiazepines or barbiturates did not meet the case definition. Accordingly, if someone who gave birth to an infant with NAS resulting from exposure to benzodiazepines or barbiturates in 2021 also had a prior NAS birth in 2018 or 2019 that resulted from exposure to one of those substances, the prior birth would not be captured in this analysis.

For analysis by county and region, the residential address provided on the infant's linked birth record was used to determine the maternal county of residence. If a full address could not be verified or was not provided, the county was determined based on the centroid of the residential zip code. For a small proportion of cases, no address was provided or available. Those cases were excluded from analyses by county of maternal residence but are included when assessing cases by county of the hospital. Incidence rates were calculated by county and region of maternal residence to assess the burden and facilitate comparison. Maps were generated to visually present varying counts and incidences of NAS across the state. SAS 9.4 was used for data processing and ArcGIS 10.4.1 for Desktop was used for geocoding and map generation.

Findings

Case Count and Incidence Rate of NAS

The Department of Health received 1,606 case reports of infants that met the NAS surveillance case definition in the calendar year 2021, representing 1.2% of all births in the state. Approximately 54% of NAS cases were confirmed cases per the NAS surveillance case definition and 46% were probable cases (**Table 1**). The incidence rate of NAS in Pennsylvania decreased from 14.0 NAS cases per 1,000 live births in 2020 to 12.1 in 2021 (**Table 2; Figure 2**).

Table 1. Number and percentage of infants with NAS by case status

	N	% of total NAS cases
Total NAS Cases	1606	100%
Case Status		
Confirmed*	866	53.9%
Probable†	740	46.1%

*Confirmed cases had a positive infant drug screen for an opioid, barbiturate, or benzodiazepine and met at least one of the following criteria: 1) a newborn diagnosis of NAS; 2) chief complaint of NAS or; 3) three or more clinically compatible symptoms of NAS

†Probable cases positive maternal drug screen for an opioid, barbiturate, or benzodiazepine, history of maternal use of one of those substances within 4 weeks prior to birth, or maternal self-report of such use within the 4 weeks prior to birth and met at least one of the following criteria: 1) newborn diagnosis of NAS; 2) chief complaint that mentions NAS; 3) three or more clinically compatible symptoms of NAS

Data Source: NAS Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health (PA DOH))

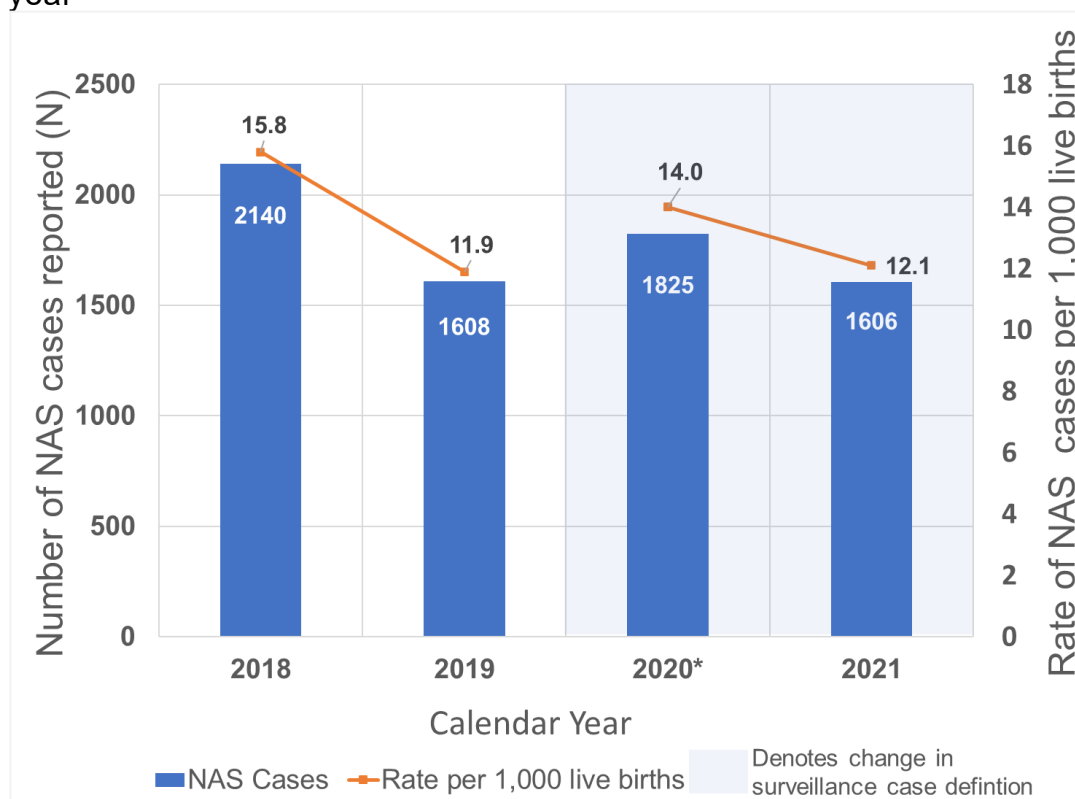
Table 2. NAS incidence rate per 1,000 live births by calendar year

	Year	NAS Cases	Total live births	NAS rate per 1,000 live births (95% Confidence Interval) *
Pennsylvania	2018	2140	135677	15.8 (15.1, 16.4)
	2019	1608	134247	11.9 (11.3, 12.4)
	2020	1825	130187	14.0 (13.3, 14.6)
	2021	1606	133036	12.1 (11.5, 12.7)

*2018 incidence rate was calculated using 2017 occurrent resident live birth data; 2019 incidence rate was calculated using 2018 resident live birth data; 2018 and 2019 incidence rates were previously published in 2018 and 2019 NAS Annual Reports; 2020 incidence rate was calculated using preliminary 2020 resident live birth data; 2021 incidence rate was calculated using preliminary 2021 resident live birth data. Resident live birth data for 2021 are preliminary and are subject to change. Please note that the NAS case definition expanded to include exposure to barbiturates or benzodiazepines in addition to opioids in 2020 whereas the case definition in 2018-2019 included solely those infants with exposure to opioids.

Data Source: 2018 and 2019 NAS Reports (Bureau of Epidemiology, PA DOH), 2020 NAS Report (Bureau of Family Health and Bureau of Epidemiology, PA DOH), NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Figure 2. Number of infants with NAS and incidence rate per 1,000 live births by calendar year



*The NAS Case definition expanded to include cases of NAS exposed to barbiturates, benzodiazepines, or opioids. In 2018 and 2019 solely cases resulting from in utero exposure to opioids were reported to the Department of Health

Data Sources: 2018 and 2019 NAS Reports (Bureau of Epidemiology, PA DOH), 2020 NAS Report (Bureau of Family Health and Bureau of Epidemiology, PA DOH), NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Birth Parameters of NAS Cases

Infants with NAS were predominantly male (51.4%), of normal birthweight (78.5%), born at or after 37 weeks of gestation (78.0%), and had a length of hospital stay of 4 to 7 days (46.7%). Nearly 97% of infants with NAS were singleton births and over half were admitted to the NICU for care (52.9%). When compared to all 2021 resident live births, a higher percentage of infants with NAS had a low birthweight (19.8% versus 6.9%) and were born preterm (20.2% versus 9.7%). Most notably, only 9.6% of resident live births were admitted to the NICU according to vital records data compared to 52.9% of infants with NAS **[Table 3]**. Most people who gave birth to an infant with NAS were non-Hispanic white (78%). However, non-Hispanic Black, multiracial, and Hispanic infants with NAS or infants of unknown race and ethnicity were more likely to be of very low or low birthweight than non-Hispanic white infants (25.5%, 30.5%, 21.1%, and 37.1%, respectively, versus 19.8%) **[Table 4]**. A similar pattern is seen with prematurity; a higher proportion of infants with NAS born to a parent identifying as non-Hispanic Black, non-Hispanic multiracial, or of unknown race and ethnicity were born preterm as compared to infants born to a non-Hispanic white parent (26.3%, 37.3%, and 24.3% respectively, versus 15.75%) **[Table 4]**. These patterns in prematurity and low birthweight among infants with NAS mirror disparities by maternal race and ethnicity that are apparent among all resident live births.

Table 3. Birth parameters of infants with NAS compared to select parameters of the resident live birth population

	NAS Cases		Pennsylvania Resident Live Births (2021)*	
	N	% of total NAS cases	N	% of total births
Total	1606	100.0%	133036	100%
Sex				
Male	825	51.4%	68472	51.5%
Female	781	48.6%	64563	48.5%
Birthweight (grams)				
Very low birthweight (<1500g)	27	1.7%	2790	2.1%
Low birthweight (1500-2500g)	318	19.8%	9160	6.9%
Normal birthweight (>2500g)	1260	78.5%	120926	90.9%
Unknown	1	0.1%	160	0.1%
Gestational age at birth				
Preterm (<37 weeks)	324	20.2%	12918	9.7%
Full-term (>37 weeks)	1253	78.0%	118783	89.3%
Unknown	29	1.8%	1335	1.0%
Plurality				
Singleton	1551	96.6%	128884	96.9%
Multiple	55	3.4%	4151	3.1%
Unknown	-	-	1	0.0%
1-minute Apgar Score				
< 7 (Abnormal)	129	8.0%	-	-
≥7 (Normal)	1011	63.0%	-	-
Unknown/Not Reported	466	29.0%	-	-
5-minute Apgar Score				
< 7 (Abnormal)	36	2.2%	2760	2.1%
≥7 (Normal)	1111	69.2%	128691	96.7%
Unknown/Not Reported	459	28.6%	1585	1.2%
Location of Infant Care†				
NICU	849	52.9%	12717	9.6%
Nursery only	753	46.9%	-	-
Other	4	0.2%	-	-
Infant Length of Stay‡				
0-3 days	101	6.3%	-	-
4-7 days	750	46.7%	-	-
8-14 days	233	14.5%	-	-
15-21 days	216	13.4%	-	-
22-28 days	123	7.7%	-	-
>28 days	183	11.4%	-	-

*Resident live birth data for 2021 are preliminary and are subject to change

†Presented categories are mutually exclusive but 350 infants that received care in the neonatal intensive care unit (NICU) also received some care in a nursery/postpartum unit. The other category includes case reports where the submitter indicated that the infant was transferred and the care location was not reported, had been reported upon readmission, or it was indicated that the infant received outpatient care.

‡ The infant's length of stay was calculated using the reported date of birth and reported date of discharge from the reporting facility/birth hospital. If the infant was transferred and the transfer facility did not submit a case report form, the discharge date may represent the transfer date and the length of stay may be an underestimate. If the infant was identified as an NAS case solely upon readmission to the hospital, the length of stay may be an overestimate. Data Sources: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Table 4. Birth parameters of infants with NAS stratified by maternal race and ethnicity compared to the resident live birth population

NAS Cases												
Maternal Race/Ethnicity												
Parameter	Non-Hispanic White		Non-Hispanic Black		Non-Hispanic Multiracial		Non-Hispanic Other*		Hispanic		Unknown	
	n	% of total	n	% of total	n	% of total	n	% of total	n	% of total	n	% of total
NAS Cases (N=1606)	1246	77.6.0%	137	8.5%	59	3.7%	4	0.2%	90	5.6%	70	4.4%
Birthweight (grams)												
Very low or low birthweight (\leq 2500g)	247	19.8%	35	25.5%	18	30.5%	-	-	19	21.1%	26	37.1%
Normal birthweight (>2500g)	999	80.2%	102	74.5%	41	69.5%	-	-	70	77.8%	44	62.9%
Unknown	0	0.0%	0	0.0%	0	0.0%	-	-	1	1.1%	0	0.0%
Gestational age at birth (weeks)												
Preterm (<37 weeks)	235	18.9%	36	26.3%	22	37.3%	-	-	14	15.6%	17	24.3%
Full-term (>37 weeks)	993	79.7%	99	72.3%	37	62.7%	-	-	75	83.3%	45	64.3%
Unknown	18	1.4%	2	1.5%	0	0.0%	-	-	1	1.1%	8	11.4%
Pennsylvania Resident Live Births (N=133036)	86056	64.7%	18359	13.8%	-	-			17090	12.8%	11531	8.7%
Birthweight (grams)												
Very low or low birthweight (\leq 2500g)	5914	6.9%	2646	14.4%	-	-	-	-	1481	8.7%	-	-
Normal birthweight (>2500g)	80051	93.0%	15701	85.5%	-	-	-	-	15591	91.2%	-	-
Unknown	91	0.1%	12	0.1%	-	-	-	-	18	0.1%	-	-
Gestational age at birth (weeks)												
Preterm (<37 weeks)	7490	8.7%	2559	13.9%	-	-	-	-	1777	10.4%	-	-
Full-term (\geq 37 weeks)	78311	91.0%	15758	85.8%	-	-	-	-	15280	89.4%	-	-
Unknown	255	0.3%	42	0.2%	-	-	-	-	33	0.2%	-	-

*Births among people identifying as Non-Hispanic American Indian/Alaska Native and Asian/Pacific Islander were merged due to small numbers

Data Sources: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Maternal Characteristics

Of the 1,586 people who gave birth to an infant with NAS in 2021, they were predominantly between the ages of 20 and 34 (77.9%), identified as non-Hispanic white (77.7%), and their delivery was insured by Medicaid (43.1%). Most had initiated prenatal care (81.5%) and received medication for opioid use disorder (MOUD) during pregnancy (58.0%) [Table 5]. There may be an association between prenatal care and MOUD as 62.8% of those who initiated prenatal care received MOUD during pregnancy whereas only 24.8% of people who did not initiate prenatal care received MOUD (Table 6). There were disparities in the receipt of supportive healthcare during pregnancy. Hispanic (75.6%), non-Hispanic multiracial (78.9%) or non-Hispanic Black people initiated prenatal care (80.6%) at lower rates than non-Hispanic white people (85.85%). Additionally, only 25.4% of non-Hispanic Black people who gave birth to an infant with NAS had received MOUD during pregnancy compared to 63.3% of non-Hispanic white people (Table 7).

There was evidence of maternal substance use or infant exposure for all cases of NAS, consistent with the case definition. For 96% of people who had an infant with NAS, substance use in the four weeks prior to delivery was confirmed on the case report form based on the maternal health record. Of those, 93.6% reported opioid use (including opioid agonists and partial agonists such as methadone and buprenorphine), 7.7% reported use of benzodiazepines, and 0.4% reported use of barbiturates. In addition to the substances included and assessed in the NAS case definition, the case report form also collects data on other substances used in the four weeks prior to delivery. Marijuana use (21.4%), use of tobacco/e-cigarettes (18.7%), and alcohol consumption (0.8%) were reported among some people. Approximately 28.0% of people used some other substance in the four weeks prior to delivery. Other substances reported on the case report form are listed in the notes of Table 5. Polysubstance use was common among people who gave birth to an infant with NAS; 59.0% reported using more than one of the substances listed on the case report form in the four weeks prior to delivery.

Linked surveillance data from 2018 to 2021 suggest that approximately 15.6% of people who gave birth to an infant with NAS in 2021 had a prior birth to an infant with NAS in the preceding three years (Table 8). Given the change in case definition between 2018-2019 and 2020-2021, this may be an underestimate. Of the 247 people who had a prior birth to an infant with NAS, 177 (71.7%) were receiving MOUD during their 2021 pregnancy and there was a significant association between receipt of MOUD and prior birth to an infant with NAS. Data on interpregnancy interval (the number of months between the end of one pregnancy and the start of another) for people who gave birth to more than one infant with NAS between 2018 and 2021 are presented in Table 8. The interpregnancy interval among people who gave birth to more than one infant with NAS between 2018 and 2021 was shorter than the interval observed statewide. Approximately 55% of people who had a prior infant with NAS had an interpregnancy interval <18 months as compared to 33% of residents who gave birth in Pennsylvania between 2018 and 2021.

Table 5. Select maternal characteristics of people who gave birth to an infant with NAS as compared to Pennsylvania resident live births

Characteristic	People who gave birth to an infant with NAS*		Pennsylvania Resident Live Births (2021)†	
	N	% of total ‡	N	% of total births
Total	1586	100.00%	133036	100%
Maternal age (years)				
≤19	12	0.8%	4653	3.5%
20-34	1235	77.9%	99923	75.1%
35+	339	21.4%	26394	19.8%
Unknown	-	-	2066	1.6%
Maternal race/ethnicity				
Non-Hispanic Black	134	8.4%	18359	13.8%
Non-Hispanic White	1232	77.7%	86056	64.7%
Non-Hispanic Multiracial	57	3.6%	-	-
Non-Hispanic Other^	4	0.3%	-	-
Hispanic	90	5.7%	17090	12.9%
Unknown/Not Reported	69	4.4%	11531	8.7%
Prenatal care initiation				
Initiated prenatal care	1292	81.5%	124251	93.4%
No prenatal care	125	7.9%	3706	2.8%
Unknown	169	10.7%	5079	3.8%
Principal source of payment at delivery				
Medicaid	683	43.1%	43684	32.8%
Private Insurance	52	3.3%	75099	56.5%
Uninsured	5	0.3%	-	-
Other	4	0.3%	6715	6.7%
Unknown/Not Reported	842	53.1%	6528	24.7%
Received medication for opioid use disorder during pregnancy				
Yes	920	58.0%	-	-
No	245	15.4%	-	-
Unknown/Not Reported	421	26.5%	-	-
Maternal substance use in the 4 weeks prior to delivery				
Yes	1523	96.0%	-	-
No	63	4.0%	-	-
Specific substances used/reported‡				
Alcohol	12	0.8%	-	-
Tobacco/E-cigarettes	297	18.7%	-	-
Marijuana/Hash	340	21.4%	-	-
Opioids/Opiates†	1484	93.6%	-	-
Benzodiazepines	122	7.7%	-	-
Barbiturates	7	0.4%	-	-
Other Substances‡	444	28.0%	-	-

* This table presents demographic information on people who had a live birth; a person who had a plural birth is represented only once

† Resident live birth data for 2021 are preliminary and are subject to change

‡ Percentages may not add to 100% due to rounding. Frequencies by specific substances do not sum to 100% as categories are not mutually exclusive and one person may have used multiple substances in the four weeks prior to pregnancy. Polysubstance use was common with 59% of people using more than one of the substances listed in the four weeks prior to pregnancy (934 of 1586).

^ Births among people identifying as Non-Hispanic American Indian/Alaska Native and Asian/Pacific Islander were merged due to small numbers

‡Opioids/opiates include Buprenorphine (Subutex or suboxone), Methadone, Codeine, Fentanyl, Heroin, Hydrocodone, Hydromorphone, Morphine,

Opiates, Oxycodone or Tramadol; Other substances include Amphetamines, Antidepressants, Cocaine, Gabapentin, Kratom, or Phencyclidine
Data Sources: NAS Surveillance Program - Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Table 6. Initiation of prenatal care and receipt of medication for opioid use disorder during pregnancy among people who gave birth to an infant with NAS

People who gave birth to an infant with NAS				
Medication for Opioid Use Disorder during pregnancy				
Prenatal Care	n	Yes	No	Unknown/Not Reported
Initiated prenatal care	1292	812 (62.8%)	168 (13.0%)	312 (24.1%)
No prenatal care	125	31 (24.8%)	41 (32.8%)	53 (42.4%)
Unknown	169	77 (45.6%)	36 (21.3%)	56 (33.1%)
Total	1586	920 (58.0%)	245 (15.4%)	421 (26.5%)

Data Sources: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Table 7. Initiation of prenatal care and receipt of medication for opioid use disorder during pregnancy among people who gave birth to an infant with NAS stratified by maternal race/ethnicity

People who gave birth to an infant with NAS												
Maternal race/ethnicity												
Characteristic	Non-Hispanic White		Non-Hispanic Black		Non-Hispanic Multiracial		Non-Hispanic Other*		Hispanic		Unknown	
	n	%	n	%	n	%	n	%	n	%	n	%
Total (N=1586)	1232	77.7%	134	8.4%	57	3.6%	4	0.3%	90	7.3%	69	5.6%
Prenatal Care												
Initiated prenatal care	1037	84.2%	108	80.6%	45	78.9%	-	-	68	75.6%	31	44.9%
No prenatal care	80	6.5%	13	9.7%	4	7.0%	-	-	9	10.0%	19	27.5%
Unknown	115	9.3%	13	9.7%	8	14.0%	-	-	13	14.4%	19	27.5%
Received medication for opioid use disorder during pregnancy												
Yes	780	63.3%	34	25.4%	37	64.9%	-	-	46	51.1%	19	27.5%
No	147	11.9%	49	36.6%	8	14.0%	-	-	21	23.3%	20	29.0%
Unknown	305	24.8%	51	38.1%	12	21.1%	-	-	23	25.6%	30	43.5%

* Births among people identifying as Non-Hispanic American Indian/Alaska Native and Asian/Pacific Islander were merged due to small numbers
Data Sources: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Table 8. Select characteristics of people who gave birth to an infant reported to the NAS surveillance system in 2021 and a prior birth to an infant with NAS between 2018-2020 as compared to characteristics of people with no prior birth to an infant with NAS during that period

	People who gave birth to an infant with NAS		p-value
	Prior birth to infant with NAS during 2018-2020 n (%)	No prior birth to infant with NAS during 2018-2020 n (%)	
Total (N=1586)	247 (15.6%)	1339 (84.4%)	
Received medication for opioid use disorder during pregnancy			
Yes	177 (71.7%)	743 (55.5%)	<0.001
No	15 (6.1%)	230 (17.2%)	
Unknown	55 (22.3%)	366 (27.3%)	
Referred for medication for opioid use disorder at discharge			
Yes	161 (65.2%)	692 (51.7%)	<0.001
No	86 (34.8%)	647 (48.3%)	
Interpregnancy Interval*			
<6 months	36 (14.6%)	N/A	
6-17 months	100 (40.5%)	N/A	
≥18 months	111 (44.9%)	N/A	

*Interpregnancy interval is the number of months between the end of one pregnancy and the start of another. This is limited to known live births to infants with NAS to each person; other pregnancies that may not have resulted in a live birth or an infant with NAS during the 2018-2020 period were not reported or known and, therefore, were not considered. Additionally, prior births to infants with NAS resulting from exposure to barbiturates or benzodiazepines that occurred in 2018 or 2019 would not have been captured by the NAS surveillance system as they would not have met the case definition. Estimated the date of conception by subtracting infant gestational age at birth in weeks from the date of birth. Then subtracted date of conception from date of last NAS birth reported to the surveillance system in 2018, 2019, or 2020 to estimate interpregnancy interval in months. Interpregnancy interval for people with no known prior birth to an infant with NAS were not assessed as birth history was not reported on the NAS case report form. P-values below 0.05 are indicative of a significant association between the maternal characteristic and prior birth to an infant with NAS; there is a significant association between receipt of or referral for medication for opioid use disorder and prior birth to an infant with NAS. Data sources: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Infant Testing, Assessment, and Treatment

Testing

Of the 1,606 infants with NAS, 88.6% (n=1423) were tested for in utero substance exposure (**Table 9A**). Of those who were tested, 79.4% (n=1130) had a positive test result for a substance. Substances identified through testing of infant biological samples (such as urine or umbilical cord blood) included opioids (90.2%), benzodiazepines (5.0%), or barbiturates (0.5%). Other substances were also identified for 43.1% of infants. Of those infants with a positive test result for a substance (n=1331), over half (56.5%) had a parent who was receiving MOUD during pregnancy (**Table 9B**).

Table 9A. Laboratory testing for in utero exposure to substances and results among infants with NAS*

	NAS Cases	
	N	% of total NAS cases
Total NAS Cases	1606	100%
Testing for substance exposure		
Not tested	183	11.4%
Tested	1423	88.6%
Testing results (n=1423)		
Tested - Negative Result	201	14.1%
Tested - Results Unknown or Pending	92	6.5%
Tested - Positive for Any Substance	1130	79.4%

*There is no mandate in Pennsylvania for universal drug testing for infants at birth and any testing that is performed must be done solely with the consent of the patient or caregiver. If laboratory testing results are available hospital staff may report them on the NAS case report form for infants as these results may be used to ascertain whether the infant meets the NAS surveillance case definition. However, resulting data are not comprehensive as testing is not always performed, especially if a history of substance use or in utero exposure to substances is already documented in the medical record. Data on laboratory testing collected on the case report form included in this table should be interpreted with consideration of these qualifying factors
Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Table 9B. Substance-specific results of laboratory testing of biological samples among infants with NAS tested for in utero exposure

	NAS Cases	
	n	% of tested NAS cases with positive test result
Total NAS cases with positive test result	1130	100.0%
Positive result by substance*		
Positive test result for any opioid	1019	90.2%
Positive test result for benzodiazepines	57	5.0%
Positive test result for barbiturates	6	0.5%
Positive test result for other substance	487	43.1%
Received medication for opioid use disorder (MOUD) during pregnancy		
Parent received MOUD	638	56.5%
Parent did not receive MOUD	179	15.8%
Unknown	313	27.7%

*Positive results by substance frequencies are not mutually exclusive and percentages do not sum to 100% as an infant may have tested positive for more than one substance
Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Assessment and Scoring

Nearly all infants reported to the NAS surveillance system were assessed using a scoring and assessment tool or method (98.5%). Over two thirds (70.2%) of infants were assessed with Finnegan/Modified Finnegan scoring, and just over a quarter (27.1%) were assessed using the Eat, Sleep, Console (ESC) method ([Table 10A](#)).

Most infants reported to the NAS surveillance system were symptomatic (98.5%). Of those infants who were symptomatic (n=1582), most experienced 3 or more symptoms that were clinically compatible with NAS (81.2%). The most frequently reported symptoms among

symptomatic infants were elevated muscle tone (68.1%), poor feeding (64.4%), and body shakes/tremors (63.1%) [Table 10B].

Table 10A. Scoring method for identification of NAS and reporting of clinically compatible symptoms among infants with NAS

	NAS Cases	
	N	% of total NAS cases
Total NAS Cases	1606	100.0%
Scoring method		
Finnegan/Modified Finnegan Only	1128	70.2%
Eat, Sleep, Console Only	435	27.1%
Finnegan/ Modified Finnegan and Eat, Sleep, Console	19	1.2%
None	24	1.5%
Clinically compatible symptoms of NAS		
Symptoms Not Documented/Unable to Assess Symptoms	24	1.5%
Symptomatic	1582	98.5%

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Table 10B. Clinically compatible symptoms of NAS exhibited among symptomatic infants

	NAS Cases	
	n	% of symptomatic NAS cases
Total symptomatic NAS cases	1582	100.0%
Number of symptoms reported		
1-2 symptoms	298	18.8%
3 or more symptoms	1284	81.2%
Frequency of reported symptoms*		
Body shakes (tremors)	1108	63.1%
Seizures (convulsions)	7	0.4%
Hyperactive moro reflex	343	21.7%
Myoclonus (including hiccups)	43	2.7%
Hypertonia (Elevated muscle tone)	1077	68.1%
Continuous, excessive, or high-pitched cry/inability to console	710	44.9%
Poor feeding (including poor or excessive suck)	1019	64.4%
Tachypnea/Respiratory distress	688	43.5%
Fever	710	44.9%
Blotchy skin/mottling	321	20.3%
Poor sleep	901	57.0%
Lots of yawning	153	9.7%
Loose stools	645	40.8%
Vomiting/Regurgitation	357	22.6%
Nasal congestion	334	21.1%
Sneezing	659	41.7%
Skin abrasions or excoriation	421	26.6%

*Symptoms are not mutually exclusive as most infants experienced three or more symptoms. Submitters also had the opportunity to document other symptoms experienced by the infant. However, not all symptoms reported can be solely attributed to NAS and therefore were not included in the table or considered when assessing the number of clinically compatible symptoms of NAS experienced by each infant. Other symptoms were reported for 56 cases (3.5%) and included: sweating, nasal flaring, weight loss, failure to thrive, heart rate issues, slow weight gain, hypoglycemia, and hypothermia.

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Treatment and Therapy

Treatment of infants with NAS may include supportive non-pharmacologic strategies and medications (pharmacologic). Receipt of pharmacologic treatment was common among infants with NAS; 38.7% of infants with NAS were administered medication during their hospital stay (n=621). Approximately 10.6% of NAS infants received both pharmacologic treatment and non-pharmacologic therapy. Non-pharmacologic therapy may include activities such as rooming-in with the parent, swaddling, skin-to-skin contact, breastfeeding, and maintaining a quiet care environment. Non-pharmacologic therapy alone was provided to 28.6% of infants with NAS during their hospital stay. No treatment was reported for 26.4% of infants with NAS and treatment status was unknown for 6.3% of infants with NAS (**Table 11A**).

In 2020, differences in infant treatment were evident when stratifying the type of treatment received (pharmacologic or non-pharmacologic) by race/ethnicity; infants with NAS born to non-Hispanic Black and non-Hispanic multiracial people were less likely to receive pharmacologic treatment than those born to non-Hispanic white or Hispanic people. The same trend was not observed in 2021. Infants with NAS who had Medicaid coverage were more likely to receive pharmacologic treatment (41.0%) than infants with private insurance (21.2%). Conversely, non-pharmacologic therapies were more common among infants with NAS who had private insurance (44.2%) than among infants with Medicaid coverage (23.4%) [**Table 11B**]. However, for 37.5% of infants with NAS (n=853), payor was unknown/not reported and the denominators for uninsured (n=5), and other (n=4) are small. Given that stratification results in small numbers across groups, the results presented in Table 11B should be interpreted with caution.

Among the 621 infants with NAS that received pharmacologic treatment, the most common medication administered was morphine (89.9%). Most infants with NAS that received treatment were administered a single medication (77.9%). Additional notes on other medications and treatment can be found in **Table 11C**.

Scores from the Modified Finnegan/Finnegan tool are often used to guide administration of medications to infants to treat withdrawal symptoms. Since repeated scores between 8 and 12 and above are indicative of greater severity of withdrawal symptoms, non-pharmacologic treatment and supportive care were most common among infants with NAS scores of 7 and below and pharmacologic treatment was more common among infants with a score exceeding 8 (52.9%). (see **Table 11D**). Infants assessed using the ESC method were less likely to receive pharmacologic treatment (18.2%) during their hospital stay compared to infants assessed using the Finnegan/Modified Finnegan scoring method (46.9%).

Table 11A. Type of treatment received among infants with NAS

	NAS Cases	
	N	% of total NAS cases reported
Total NAS Cases	1606	100%
Infant treatment		
Pharmacologic treatment	451	28.1%
Pharmacologic and non-pharmacologic treatment	170	10.6%
Non-pharmacologic treatment	460	28.6%
No treatment	424	26.4%
Unknown/Not Reported	101	6.3%

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Table 11B. Type of treatment received among infants with NAS stratified by maternal race/ethnicity and principal source of payment at delivery

Characteristic	N	NAS Cases - Treatment							
		Received Pharmacologic Treatment		Non-Pharmacologic Treatment Only		No Treatment		Unknown/Not Reported	
		n	%	n	%	n	%	n	%
Maternal Race/Ethnicity									
Non-Hispanic Black	137	56	40.9%	28	20.4%	44	32.1%	9	6.6%
Non-Hispanic White	1246	461	37.0%	371	29.8%	330	26.5%	84	6.7%
Non-Hispanic Multiracial	59	23	39.0%	20	33.9%	13	22.0%	3	5.1%
Non-Hispanic Other*	4	-	-	-	-	-	-	-	-
Hispanic	90	40	44.4%	22	24.4%	24	26.7%	4	4.4%
Unknown/Not Reported	70	40	57.1%	18	25.7%	11	15.7%	1	1.4%
Principal source of payment at delivery									
Medicaid	692	284	41.0%	162	23.4%	222	32.1%	24	3.5%
Private insurance	52	11	21.2%	23	44.2%	16	30.8%	2	3.8%
Uninsured	5	-	-	-	-	-	-	-	-
Other	4	-	-	-	-	-	-	-	-
Unknown/Not Reported	853	320	37.5%	274	32.1%	185	21.7%	74	8.7%

* Births among people identifying as Non-Hispanic American Indian/Alaska Native and Asian/Pacific Islander were merged due to small numbers

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Table 11C. Medications administered among infants with NAS that received pharmacologic treatment

NAS Cases		
	n	% of NAS cases that received pharmacologic treatment
Total NAS cases that received pharmacologic treatment	621	100%
Medications administered *		
Morphine	558	89.9%
Clonidine	81	13.0%
Methadone	12	1.9%
Phenobarbital	73	11.8%
Other drug (unspecified)	57	9.2%
Number of medications administered†		
Single medication	484	77.9%
Multiple medications	137	22.1%

*Frequencies by medications administered are not mutually exclusive and do not sum to 100% as an infant may have received more than one medication as treatment

†When a single medication was administered, the medication administered was either morphine or methadone. When multiple medications were administered, the combination was most frequently morphine and clonidine, but other combinations included morphine and phenobarbital, clonidine, morphine, and phenobarbital, or a combination of the aforementioned medications and some other medication.

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Table 11D. Scoring method and score by treatment type among infants with NAS

Scoring Method	N	Received Pharmacologic Treatment		No Pharmacologic Treatment		Unknown/Not Reported	
		n	%	n	%	n	%
Finnegan/Modified Finnegan	1147	538	46.9%	530	46.2%	79	6.9%
Highest Score							
0-7	375	18	4.8%	315	84.0%	42	11.2%
8-12	471	249	52.9%	192	40.8%	30	6.4%
13-16	238	211	88.7%	20	8.4%	7	2.9%
17-20	57	54	94.7%	3	5.3%	0	0.0%
>20	6	6	100.0%	0	0.0%	0	0.0%
Eat, Sleep, Console Only	435	79	18.2%	337	77.5%	19	4.4%
Not reported/other scoring system used	24	4	16.7%	17	70.8%	3	12.5%

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Length of Hospital Stay

Scoring method, treatment, and other parameters of the infant's birth influence the length of stay in the hospital (**Table 12**). Infants who were very low or low birthweight or born preterm remained in the hospital for more than seven days. A longer hospital stay was also observed among infants with NAS who received pharmacologic treatment or were cared for in the NICU (92.1% and 73.9%, respectively) as compared to their counterparts who received nonpharmacologic therapies or were not transferred to the NICU. Only 25.8% of infants with NAS who were assessed with ESC remained in the hospital for more than seven days compared to 55.1% of infants with NAS assessed using the Modified Finnegan/Finnegan scoring method.

Table 12. Birth parameters and other characteristics of infants with NAS stratified by hospital length of stay

		NAS Cases				
		N	Infant Length of Stay*			
			0-7 days		>7 days	
Total NAS cases		1606	851	53.0%	755	47.0%
Birthweight (grams)						
	Very low birthweight (<1500g)	27	2	7.4%	25	92.6%
	Low birthweight (1500-2500g)	318	104	32.7%	214	67.3%
	Normal birthweight (>2500g)	1260	745	59.1%	515	40.9%
	Unknown	1	-	-	-	-
Gestational age at birth						
	Preterm (<37 weeks)	324	87	26.9%	237	73.1%
	Full-term (≥37 weeks)	1253	757	60.4%	496	39.6%
	Unknown	29	7	24.1%	22	75.9%
Scoring method						
	Eat, Sleep, Console	454	337	74.2%	117	25.8%
	Finnegan or Modified Finnegan only	1128	506	44.9%	622	55.1%
	None	24	8	33.3%	16	66.7%
Infant treatment						
	Received pharmacologic treatment	621	49	7.9%	572	92.1%
	No pharmacologic treatment	424	333	78.5%	91	21.5%
	Unknown/Not Reported	101	80	79.2%	21	20.8%
Infant care location						
	NICU care	849	222	26.1%	627	73.9%
	No NICU care (Nursery or Other)	757	629	83.1%	128	16.9%

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

*The infant's length of stay was calculated using the reported date of birth and reported date of discharge from the reporting hospital. If the infant was transferred and the transfer facility did not submit a case report form, the discharge date may represent the transfer date and the length of stay may be an underestimate. If the infant was identified as an NAS case solely upon readmission to the hospital, the length of stay may be an overestimate.

Infant and Maternal Discharge and Referrals

In 2021, Hospital staff indicated on the NAS case report forms that a ChildLine notification was made for 89.5% of infants with NAS and a plan of safe care was initiated for 61.5% of infants with NAS. Case report data on discharge suggest that most infants with NAS were discharged to their parent (79.6%). For approximately 10.6% of infants with NAS, a children and youth services agency was engaged at discharge to facilitate placement in a foster home. For 7.5% of infants with NAS a discharge person was listed but the relationship between the discharge person and the infant was unknown or not specified on the case report form. The remaining 2.2% of infants with NAS had not been discharged at the time that the case report was made, or the discharge status was unknown or not specified (**Table 13**). It is important to note that these data were not verified or confirmed by the Office of Children, Youth, and Families and are the result of hospital self-reported data.

Best practices indicate that infants and their parents should be referred for follow-up services at the time of discharge from the hospital; 32% of infants with NAS were referred to a pediatrician experienced with NAS and 20.3% to home visiting services. Early Intervention received referrals for 27.7% of the infants with NAS reported to the surveillance system in 2021, a slight increase from 24.6% in 2020. As noted elsewhere in this report, the Office of Child Development and Early Learning reviewed and verified data on referrals to Early Intervention (**Table 13**).

The most frequent referral made for people who gave birth to an infant with NAS at the time of hospital discharge was to receive MOUD; 53.8% of people received a referral for MOUD. Referrals were also made to services such as parenting support, other forms of care for substance use, community support programs, and home visiting services, but these were less common. For half of all people (45.5%) referrals were made to other services (detailed in **Table 14**), were not reported, or were unknown at the time that the case report form was submitted.

Table 13. Characteristics of discharge plan and referrals among infants with NAS

NAS Cases		
	N	% of total NAS cases
Total NAS cases	1606	100.0%
ChildLine notification		
Yes	1438	89.5%
No	168	10.5%
Plan of Safe Care initiated		
Yes	988	61.5%
No	618	38.5%
Discharged to*		
Parent	1279	79.6%
Children and Youth Services/Foster System	171	10.6%
Other	121	7.5%
Unknown	35	2.2%
Referralst		
Early Intervention	444	27.7%
Home visiting services	326	20.3%
Medical home	53	3.3%
Pediatrician experienced with NAS	550	34.2%
High-risk infant follow-up clinic	99	6.2%
Developmental assessment Clinic	221	13.8%
Other/Unknown†	411	25.6%

* The other category includes infants for whom the discharge person's relationship to the infant was unknown or not specified in the case report form. The unknown categories include infants that had not been discharged at the time that the case report was made or for whom the discharge person was unknown or not reported.

† The frequencies by type of referral are not mutually exclusive and do not sum to 100% as infants were referred to multiple services

‡ The other category includes infants with referrals made to other services such as a pediatrician or primary care provider, children and youth services, a specialist, WIC, or a community organization. Infants who were not discharged at the time of the report or for whom referrals were unknown or not reported are also included

Data source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH)

Table 14. Characteristics of maternal discharge plan and referrals among people who gave birth to an infant with NAS

People who gave birth to an infant with NAS		
	N	% of total
Total	1586	100%
Referrals		
Medication for Opioid Use Disorder	853	53.8%
Parenting support	169	10.7%
Care for substance use	156	9.8%
Community support program	138	8.7%
Home visiting services	131	8.3%
Other behavioral health services	107	6.7%
Other/Unknown*	721	45.5%

*The other category includes referral to other services such as WIC, a primary care provider, Children and Youth, and substance use treatment services. Those who were not discharged at the time of the report or for whom referrals were unknown or not reported are also included.

Hospital Reporting and Findings by County and Region

Active Hospitals: Changes since 2020

In 2020 there were 90 hospitals capable of reporting NAS cases. Five hospitals have since closed or no longer have active labor and delivery units. Closures occurred in Allegheny, Northampton, Montgomery, Franklin, and Lehigh counties. In 2021 three hospitals opened, one in Bucks County, one in Allegheny county, and one in Cumberland county, resulting in a total of 88 hospitals with iCMS reporting capabilities in 2021.

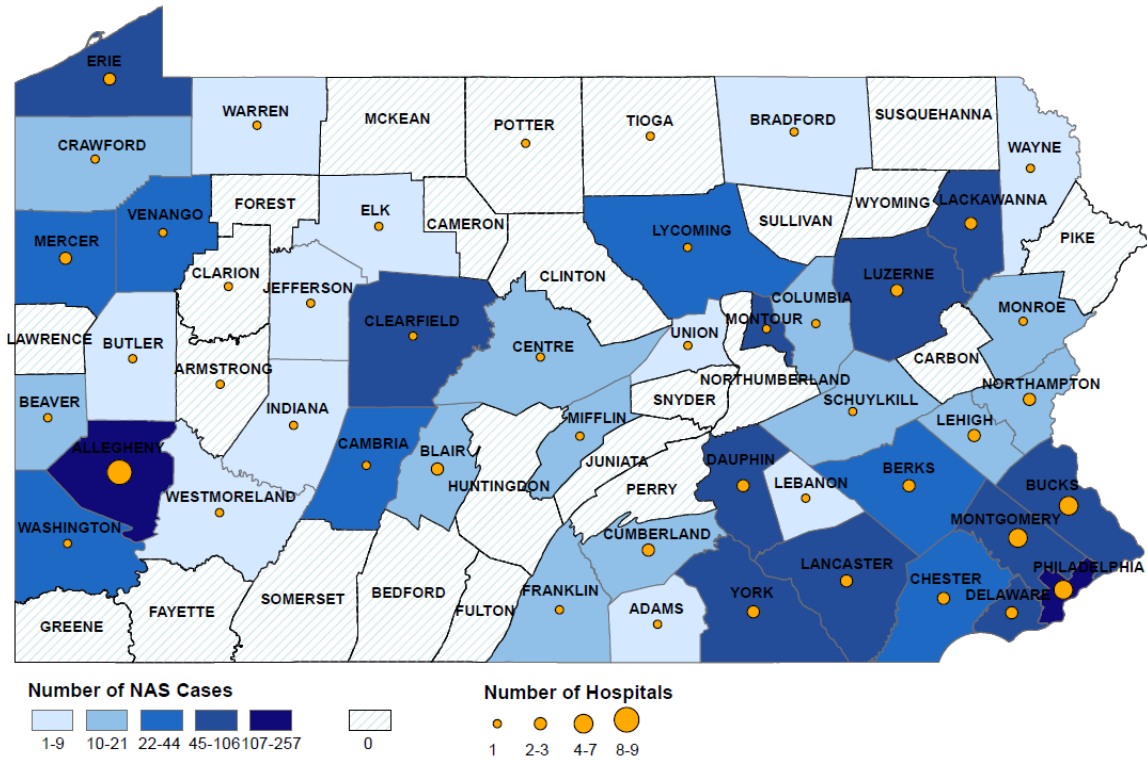
Case Reporting by Hospital

Of the 82 hospitals that reported NAS cases in 2020, 79 continued reporting in 2021. Three facilities that did not report NAS cases in 2020 started reporting in 2021, including one of the three newly opened hospitals. Of the 88 active hospitals with iCMS reporting capabilities in 2021, 82 (93%) reported cases that met the NAS surveillance case definition. Of the remaining 6 active hospitals three hospitals reported cases that did not meet the case definition and three hospitals indicated that they did not have any cases to report for the 2021 calendar year. Two of the non-reporting hospitals opened within the last 5 months of the calendar year and one hospital that did not report in 2021 also had no cases to report in 2020.

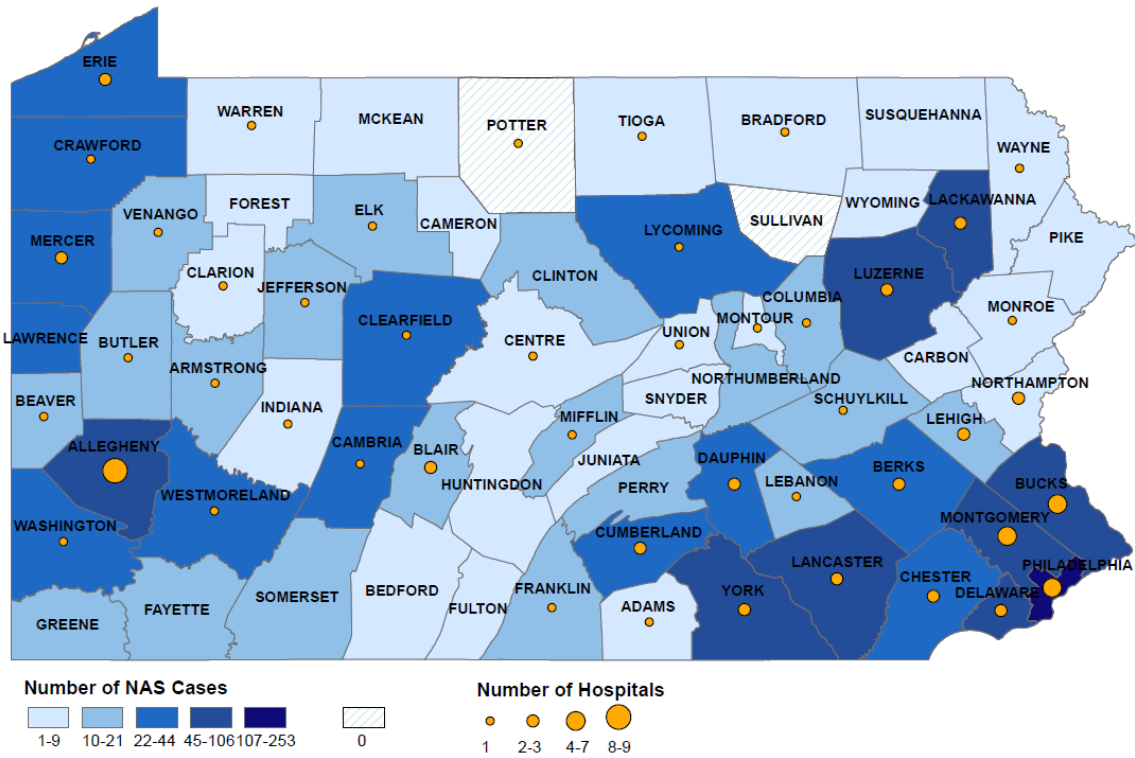
Cases by County of Facility and County of Maternal Residence

Map 1 depicts the number of active hospitals and the number of NAS cases reported by county. Counts on the map include all hospitals, regardless of whether they reported a NAS case in 2021. The map demonstrates that counties with a higher number of hospitals, such as Philadelphia and Allegheny counties, reported more cases of NAS during 2021. NAS cases were not reported in 24 counties (36%) but 20 of those counties did not have an active birth or pediatric hospital in 2021. Armstrong, Clarion, Potter, and Tioga counties are the only counties for which there was an active hospital, and no cases were reported. Case counts by county of facility ranged from 0 to 257 in Philadelphia County. **Map 2** depicts case counts by county of maternal residence. Case counts by county of residence ranged from 0 in Potter and Sullivan counties to 253 in Philadelphia County. Map 2 demonstrates that people who reside in counties that lack a hospital migrate to surrounding counties to give birth. Case counts by county of hospital and county of maternal residence are included in **Table 15**.

Map 1. Number of hospitals and reported NAS cases by county of hospital



Map 2. Number of hospitals and NAS cases by county of maternal residence



Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Table 15. NAS cases reported by county of hospital and by maternal residence

County	Hospitals	NAS Cases Reported by County of Hospital		NAS Cases Reported by County of Maternal Residence		County	Hospitals	NAS Cases Reported by County of Hospital		NAS Cases Reported by County of Maternal Residence	
	N	N	% of total NAS cases	N	% of total NAS cases		N	N	% of total NAS cases	N	% of total NAS cases
Total	88	1606	100.0%	1606	100.0%						
ADAMS	1	2	0.1%	9	0.6%	LACKAWANNA	2	50	3.1%	53	3.3%
ALLEGHENY	9	243	15.1%	106	6.6%	LANCASTER	3	51	3.2%	53	3.3%
ARMSTRONG	1	0	0.0%	14	0.9%	LAWRENCE	0	0	0.0%	30	1.9%
BEAVER	1	18	1.1%	21	1.3%	LEBANON	1	6	0.4%	15	0.9%
BEDFORD	0	0	0.0%	9	0.6%	LEHIGH	2	14	0.9%	16	1.0%
BERKS	2	24	1.5%	23	1.4%	LUZERNE	3	75	4.7%	64	4.0%
BLAIR	2	15	0.9%	12	0.7%	LYCOMING	1	28	1.7%	29	1.8%
BRADFORD	1	2	0.1%	3	0.2%	MCKEAN	0	0	0.0%	2	0.1%
BUCKS	4	56	3.5%	77	4.8%	MERCER	2	40	2.5%	30	1.9%
BUTLER	1	3	0.2%	18	1.1%	MIFFLIN	1	12	0.7%	13	0.8%
CAMBRIA	1	43	2.7%	28	1.7%	MONROE	1	14	0.9%	8	0.5%
CAMERON	0	0	0.0%	2	0.1%	MONTGOMERY	5	94	5.9%	57	3.5%
CARBON	0	0	0.0%	9	0.6%	MONTOUR	1	57	3.5%	1	0.1%
CENTRE	1	11	0.7%	8	0.5%	NORTHAMPTON	2	20	1.2%	8	0.5%
CHESTER	3	24	1.5%	24	1.5%	NORTHUMBERLAND	0	0	0.0%	19	1.2%
CLARION	1	0	0.0%	7	0.4%	PERRY	0	0	0.0%	11	0.7%
CLEARFIELD	1	46	2.9%	25	1.6%	PHILADELPHIA	7	257	16.0%	253	15.8%
CLINTON	0	0	0.0%	18	1.1%	PIKE	0	0	0.0%	5	0.3%
COLUMBIA	1	15	0.9%	11	0.7%	POTTER	1	0	0.0%	0	0.0%
CRAWFORD	1	11	0.7%	27	1.7%	SCHUYLKILL	1	14	0.9%	16	1.0%
CUMBERLAND	3	13	0.8%	24	1.5%	SNYDER	0	0	0.0%	9	0.6%
DAUPHIN	2	66	4.1%	29	1.8%	SOMERSET	0	0	0.0%	13	0.8%
DELAWARE	3	47	2.9%	67	4.2%	SULLIVAN	0	0	0.0%	0	0.0%
ELK	1	6	0.4%	12	0.7%	SUSQUEHANNA	0	0	0.0%	4	0.2%
ERIE	2	71	4.4%	44	2.7%	TIOGA	1	0	0.0%	5	0.3%
FAYETTE	0	0	0.0%	15	0.9%	UNION	1	7	0.4%	2	0.1%
FOREST	0	0	0.0%	1	0.1%	VENANGO	1	24	1.5%	20	1.2%
FRANKLIN	1	18	1.1%	16	1.0%	WARREN	1	8	0.5%	9	0.6%
FULTON	0	0	0.0%	1	0.1%	WASHINGTON	1	31	1.9%	41	2.6%
GREENE	0	0	0.0%	13	0.8%	WAYNE	1	4	0.2%	6	0.4%
HUNTINGDON	0	0	0.0%	7	0.4%	WESTMORELAND	1	4	0.2%	38	2.4%
INDIANA	1	1	0.1%	7	0.4%	WYOMING	0	0	0.0%	7	0.4%
JEFFERSON	1	1	0.1%	14	0.9%	YORK	3	60	3.7%	60	3.7%
JUNIATA	0	0	0.0%	3	0.2%	UNKNOWN*	-	-	-	5	0.3%

* Residence or discharge to a person/entity in Pennsylvania was confirmed for all cases. If a residential address was not provided those cases are included in "Unknown."

Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Incidence Rates by County and Region of Maternal Residence

Map 3 depicts incidence rates of NAS cases per 1,000 live births by county of maternal residence. Incidence rates of NAS were highest in Elk (46.5), Clinton (45.5), Greene (45.3), Venango (42.5), and Lawrence (38.3) counties. Incidence rates by county of maternal residence are included in **Table 16**; incidence rates based on fewer than 10 events are unstable and should be interpreted with caution.

Map 4 depicts case counts and incidence rates of NAS per 1,000 live births by region of maternal residence. The northwestern region of the state had the highest incidence rate of 26.4 NAS cases per 1,000 live births – a rate that is 2.8 times higher than the lowest incidence rate in the Southeast (9.6). Incidence rates by region of maternal residence are included in **Table 17**. While the Northwestern region still has the highest incidence rate of NAS in the state, there was a slight decrease from 30.8 cases per 1,000 live births in 2020 to 26.4 cases per 1,000 in 2021. No significant increases were observed by region in 2021 but a significant decrease was observed in the Southwest (16.7 cases of NAS in 2020 to 12.1 cases of NAS in 2021).

Map 3. NAS incidence rate per 1,000 live births by county of maternal residence

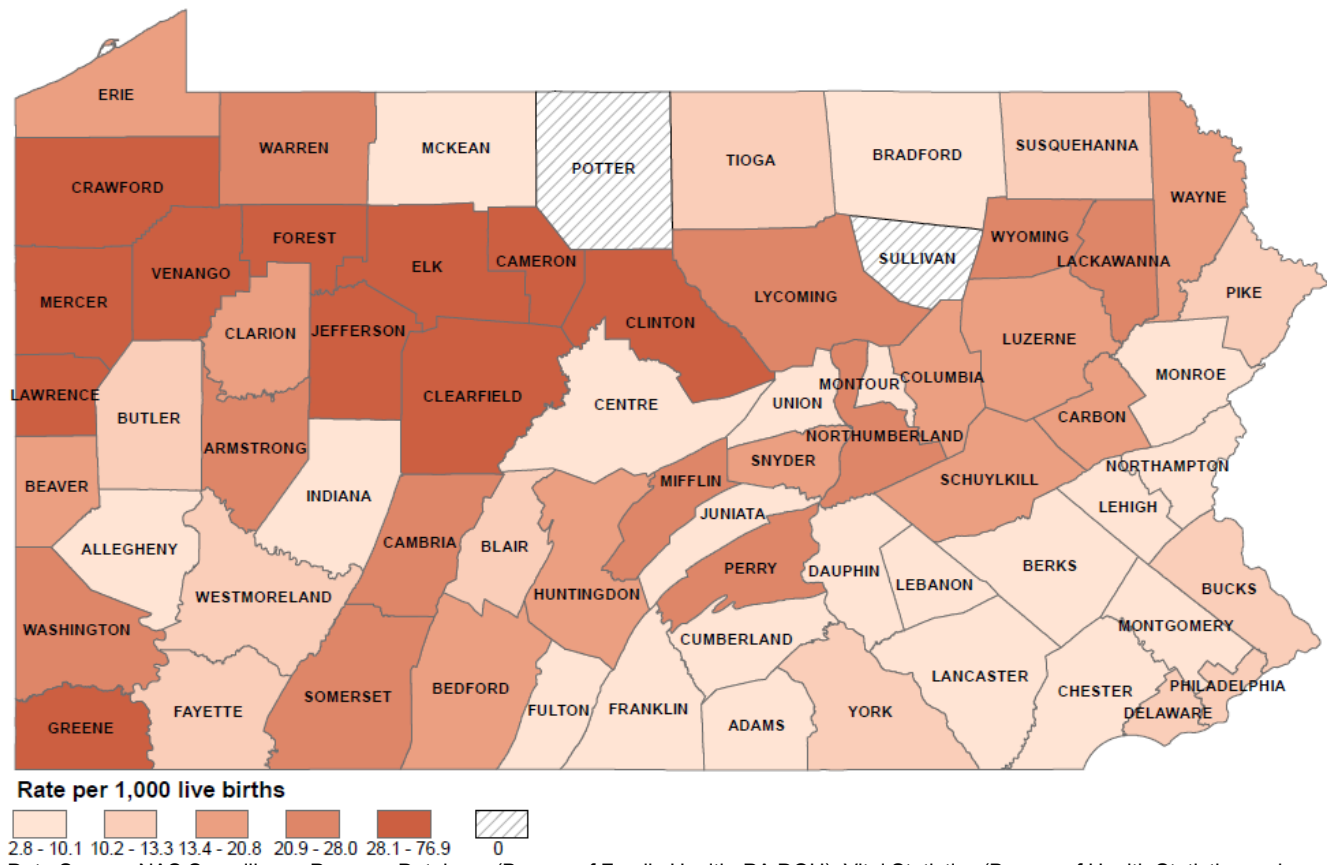


Table 16. NAS cases and incidence rate per 1,000 live births by county of maternal residence

NAS Cases Reported by County of Maternal Residence					NAS Cases Reported by County of Maternal Residence				
County	NAS Cases (N)*	Resident Live Births (2021) †	Rate per 1,000 live births	(95% CI)	County	NAS Cases (N)*	Resident Live Births (2020) †	Rate per 1,000 live births	95% CI
Total	1606	133036	12.1	(11.5, 12.7)	LACKAWANNA	53	2113	25.1	(19.2, 32.7)
ADAMS	9	941	9.6	(5.0, 18.3)	LANCASTER	53	7055	7.5	(5.7, 9.8)
ALLEGHENY	106	12420	8.5	(7.1, 10.3)	LAWRENCE	30	784	38.3	(26.9, 54.2)
ARMSTRONG	14	545	25.7	(15.3, 42.9)	LEBANON	15	1586	9.5	(5.7, 15.6)
BEAVER	21	1500	14.0	(9.1, 21.4)	LEHIGH	16	3991	4.0	(2.5, 6.5)
BEDFORD	9	472	19.1	(10.0, 36.2)	LUZERNE	64	3203	20.0	(15.7, 25.4)
BERKS	23	4594	5.0	(3.3, 7.5)	LYCOMING	29	1127	25.7	(17.9, 36.8)
BLAIR	12	1135	10.6	(6.0, 18.5)	MCKEAN	2	322	6.2	(1.6, 24.5)
BRADFORD	3	631	4.8	(1.5, 14.6)	MERCER	30	1042	28.8	(20.2, 40.9)
BUCKS	77	6053	12.7	(10.2, 15.9)	MIFFLIN	13	565	23.0	(13.4, 39.2)
BUTLER	18	1673	10.8	(6.8, 17.0)	MONROE	8	1377	5.8	(2.9, 11.6)
CAMBRIA	28	1138	24.6	(17.0, 35.4)	MONTGOMERY	57	8765	6.5	(5.0, 8.4)
CAMERON	2	26	76.9	(19.3, 260.7)	MONTOUR	1	188	5.3	(0.7, 36.8)
CARBON	9	587	15.3	(8.0, 29.2)	NORTHAMPTON	8	2823	2.8	(1.4, 5.7)
CENTRE	8	1128	7.1	(3.6, 14.1)	NORTHUMBERLAND	19	899	21.1	(13.5, 32.9)
CHESTER	24	5672	4.2	(2.8, 6.3)	PERRY	11	483	22.8	(12.7, 40.6)
CLARION	7	355	19.7	(9.4, 40.8)	PHILADELPHIA	253	19345	13.1	(11.6, 14.8)
CLEARFIELD	25	686	36.4	(24.7, 53.4)	PIKE	5	427	11.7	(4.9, 27.8)
CLINTON	18	396	45.5	(28.8, 71.0)	POTTER	0	167	-	-
COLUMBIA	11	546	20.1	(11.2, 36.0)	SCHUYLKILL	16	1203	13.3	(8.2, 21.6)
CRAWFORD	27	890	30.3	(20.9, 43.9)	SNYDER	9	433	20.8	(10.8, 39.5)
CUMBERLAND	24	2682	8.9	(6.0, 13.3)	SOMERSET	13	610	21.3	(12.4, 36.4)
DAUPHIN	29	3339	8.7	(6.0, 12.5)	SULLIVAN	0	46	0.0	
DELAWARE	67	6438	10.4	(8.2, 13.2)	SUSQUEHANNA	4	360	11.1	(4.2, 29.2)
ELK	12	258	46.5	(26.6, 80.1)	TIOGA	5	396	12.6	(5.3, 30.0)
ERIE	44	2765	15.9	(11.9, 21.3)	UNION	2	357	5.6	(1.4, 22.1)
FAYETTE	15	1182	12.7	(7.7, 20.9)	VENANGO	20	471	42.5	(27.6, 64.9)
FOREST	1	24	41.7	(5.8, 243.5)	WARREN	9	361	24.9	(13.0, 47.2)
FRANKLIN	16	1717	9.3	(5.7, 15.2)	WASHINGTON	41	1956	21.0	(15.5, 28.3)
FULTON	1	132	7.6	(1.1, 51.8)	WAYNE	6	408	14.7	(6.6, 32.3)
GREENE	13	287	45.3	(26.5, 76.4)	WESTMORELAND	38	2867	13.3	(9.7, 18.2)
HUNTINGDON	7	428	16.4	(7.8, 33.9)	WYOMING	7	250	28.0	(13.4, 57.6)
INDIANA	7	776	9.0	(4.3, 18.8)	YORK	60	4884	12.3	(9.6, 15.8)
JEFFERSON	14	459	30.5	(18.1, 50.8)					
JUNIATA	3	296	10.1	(3.3, 30.9)					

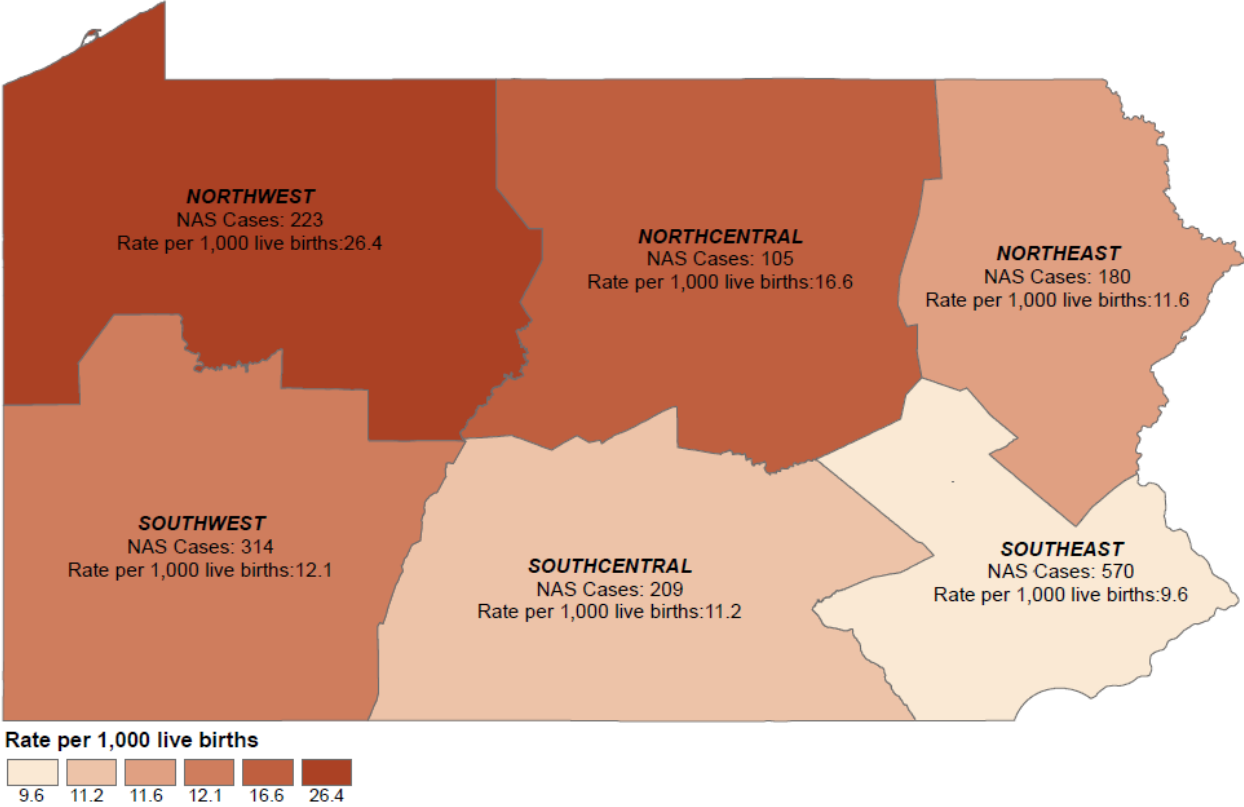
*Residence or discharge to a person/entity in Pennsylvania was confirmed for all cases. For 5 cases, a residential address was not provided; these cases are excluded from the table as county of residence was undetermined. Maternal county of residence was unknown for 1 birth from the preliminary 2021 birth file, and it was excluded from the table.

†Preliminary 2021 resident live birth data are subject to change

Rates calculated based on 10 or fewer events are unstable. Please note the wide confidence intervals and interpret these estimates with caution

Data Sources: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Map 4. NAS incidence rate per 1,000 live births by region of maternal residence



Data Source: NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Table 17. NAS case counts and incidence rates per 1,000 live births by calendar year and region of maternal residence

NAS Cases Reported by County of Maternal Residence								
Region	2018*		2019*		2020†		2021‡	
	NAS Cases (n)	Rate per 1,000 live births (95% CI)	NAS Cases (n)	Rate per 1,000 live births (95% CI)	NAS Cases (n)	Rate per 1,000 live births (95% CI)	NAS Cases (n)	Rate per 1,000 live births (95% CI)
Northwest	251	28.0 (24.8, 31.7)	207	23.7 (20.5, 26.9)	254	30.8 (27.3, 34.8)	223	26.4 (23.2, 30.1)
Southwest	670	26.0 (24.1, 28.0)	438	16.8 (15.2, 18.4)	414	16.7 (15.2, 18.4)	314	12.1 (10.8, 13.5)
Northcentral	90	14.3 (11.7, 17.6)	85	15.0 (11.8, 18.2)	95	15.1 (12.3, 18.4)	105	16.6 (13.8, 20.1)
Southcentral	280	15.4 (13.7, 17.3)	244	13.1 (11.5, 14.7)	232	12.8 (11.3, 14.6)	209	11.2 (9.8, 12.8)
Northeast	198	12.7 (11.0, 14.6)	132	8.2 (6.8, 9.6)	200	13 (11.3, 14.9)	180	11.6 (10.0, 13.4)
Southeast	618	10.4 (9.6, 11.3)	500	8.4 (7.7, 9.1)	625	10.9 (10.1, 11.8)	570	9.6 (8.9, 10.5)

*2018 incidence rates were calculated using 2017 occurrent resident live birth data; 2019 incidence rates were calculated using 2018 resident live birth data; 2018 and 2019 incidence rates were previously published in 2018 and 2019 NAS Annual Reports; 2020 incidence rates were calculated using preliminary 2020 resident live birth data. Preliminary 2020 resident live birth data are subject to change. Please note that the NAS case definition expanded to include exposure to barbiturates or benzodiazepines in addition to opioids in 2020 whereas the case definition in 2018-2019 included solely those infants with exposure to opioids.

†Residence or discharge to a person/entity in Pennsylvania was confirmed for all cases. For 5 cases in 2020, a residential address was not provided; these cases are excluded from the table as region of residence was undetermined

‡Residence or discharge to a person/entity in Pennsylvania was confirmed for all cases. For 5 cases in 2020, a residential address was not provided; these cases are excluded from the table as region of residence was undetermined

A statistically significant decrease in the incidence rate of NAS was observed in the Southwest region of the state between 2020 and 2021

Data Sources: 2019 NAS Report (Bureau of Epidemiology, PA DOH), NAS Surveillance Program Database (Bureau of Family Health, PA DOH), Vital Statistics (Bureau of Health Statistics and Registries, PA DOH)

Discussion

This report presents findings from the fourth year of Pennsylvania's NAS surveillance initiative. This surveillance initiative enables the Department of Health to quantify the number of infants with NAS in the state, making it possible to better understand the burden of NAS and inform the development of public health strategies that aim to support families before, during, and after pregnancy.

The burden of NAS in Pennsylvania remains high with 1,606 cases reported to the Department of Health in 2021. The incidence of 12.1 infants with NAS per 1,000 live births is a decrease from the 2020 rate of 14.0 infants with NAS per 1,000 live births (Department of Health, 2020). As in 2020, NAS resulting from opioid exposure remained most common in 2021; NAS surveillance data indicate that 93.6% of people who gave birth to an infant with NAS reported using opioids in the four weeks prior to delivery and 90.2% of infants with NAS who were tested had a positive result for an opioid.

The lack of a standardized national surveillance system for NAS makes interstate and national comparisons difficult. Accordingly, hospitalization data are often used for comparison. In 2021 the national rate of NAS per 1,000 birth hospitalizations was 6.3. In Pennsylvania, the 2021 rate of NAS per 1,000 birth hospitalizations was 10.9, still nearly two times higher than the observed national rate (HCUP-SID 2021). The rate of NAS hospitalization in Pennsylvania also remains higher than reported NAS hospitalization rates in neighboring states of New York (4.0), Ohio (8.4), and Maryland (10.1), but remains lower than the rate of NAS hospitalizations in West Virginia (40.8) [HCUP-SID 2021].

Overall, many trends apparent in 2021 data are similar to those identified in 2020 and, accordingly, many recommendations in the discussion section of this report are similar to those presented in the 2020 report. However, differences or changes since 2020 are noted and discussed. As in 2020, infants with NAS in 2021 were predominantly born to people who identified as non-Hispanic white, were between the ages of 20 and 34, and were covered by Medicaid at delivery. Case report data suggest that 94% of people who gave birth to an infant with NAS used a substance in the four weeks prior to delivery. Given that this field is not mandatory on the case report form, this may be an underestimate. Polysubstance use also remained common with 59% of people who gave birth to an infant with NAS using more than one substance during pregnancy – an increase from 54% in 2020. Approximately 18.7% of people who gave birth to an infant with NAS reported smoking in the four weeks prior to delivery. By comparison, approximately 6% of people with a live birth statewide reported smoking during the third trimester in Pennsylvania in 2021. These data are consistent with previously published Pennsylvania NAS data and national data which suggest that polysubstance use during pregnancy may be increasing, particularly among people with opioid use disorder (Department of Health 2018-2020; Hirai et al. 2021; Jarlenski et al. 2020).

Over half of all people who gave birth to an infant with NAS in Pennsylvania in 2021 had received MOUD during their pregnancy (58%), consistent with the 2020 data. While receipt of MOUD during pregnancy to treat a substance use disorder may increase the risk of infants with NAS, MOUD during pregnancy should not be dissuaded. MOUD during pregnancy is the recommended standard of care for people in recovery from opioid use disorder

(Commonwealth of Pennsylvania, 2016; ACOG 2017; Dowell et al. 2022). Findings from this report also demonstrate that receipt of MOUD during pregnancy among people with an infant with NAS differs by maternal race/ethnicity; only 25.4% of non-Hispanic Black people who gave birth to an infant with NAS had received MOUD during pregnancy compared to 63.3% of non-Hispanic white people who received MOUD.

Similarly, while most people who gave birth to an infant with NAS had received prenatal care, a lower proportion of non-Hispanic Black, non-Hispanic multiracial, and Hispanic people had initiated prenatal care compared to people who identified as non-Hispanic white in 2021. These data continue to highlight the need for more equitable access to and receipt of treatment for substance use disorder (Peeler et al. 2020) as well as preconception and prenatal care for all. Screening for substance use disorder and other co-morbidities often occurs during prenatal care, making it a key opportunity for providers to connect people using substances with MOUD and counseling. Identifying and addressing system-level issues such as access, stigma, provider biases, patient mistrust of the medical system, and other barriers to care is essential to promote optimal care before and during pregnancy (Frazer et al. 2019; Renbarger et al. 2020).

Postpartum and interpregnancy care are also integral to better maternal health outcomes and should be coordinated prior to discharge. Given that it was not possible to characterize referrals for people who gave birth to an infant with NAS who were not discharged at the time the NAS case report was submitted, related findings presented in this report may not provide a comprehensive characterization of all referrals. Yet, 2021 data suggest that connection to social support and health care services, such as MOUD, at discharge, is not universal highlighting an opportunity to improve awareness and education of hospital providers on available services and the importance of coordinated follow-up and referral.

Findings in this report also demonstrate that people in recovery from a substance use disorder or who are using substances during pregnancy may have more than one birth to an infant with NAS; this is consistent with findings from prior annual reports. Nearly 16% of people who gave birth to an infant with NAS in 2021 had a prior birth to an infant with NAS in 2018, 2019, or 2020. As previously discussed, this may be an underestimate as infants with NAS resulting from exposure to benzodiazepines or barbiturates that were born in 2018 or 2019 would not have met the case definition at that time. Accordingly, if someone who gave birth to an infant with NAS resulting from exposure to benzodiazepines or barbiturates in 2021 also had a prior NAS birth in 2018 or 2019 that resulted from exposure to one of those substances, the prior birth would not be captured in this analysis. Most people with a prior birth to an infant with NAS received MOUD during their 2021 pregnancy (71.7%). This analysis is limited to NAS surveillance data from 2018 to 2021 and, accordingly, does not assess complete pregnancy or birth history. It was not possible to consider births to infants who did not have NAS or births that occurred prior to 2018 or after 2021. Additionally, this analysis is limited to live births – pregnancy loss, fetal death, or termination were also not considered. When assessing linked births reported to the NAS surveillance system between 2018 and 2021, the interpregnancy interval was less than 18 months for 55.1% of people who had a prior birth to an infant with NAS. Notably, 14.6% of people who gave birth to an infant with NAS had a short interpregnancy interval of less than six months. Interpregnancy intervals that are less than 18 months have been associated with increased risk of adverse infant and maternal health outcomes such as preterm birth and maternal morbidity (Garg et

al. 2021; Hanley et al. 2017; ACOG 2019). Given that interpregnancy interval is a modifiable risk factor, the continued provision of patient-centered postpartum and interpregnancy care that includes discussion of pregnancy intention, family planning counseling, and birth spacing may optimize maternal and infant health across the life course (Morse et al. 2018; Charron et al. 2020; Terplan et al. 2016).

Characteristics and birth parameters of infants with NAS presented in this report are also consistent with previously published reports and literature. A higher proportion of infants with NAS in 2021 were male (Department of Health 2018-2020; Charles et al. 2017), were of normal birthweight, and born at or after 37 weeks gestation. Yet, infants with NAS were two times as likely to be low birthweight than infants without NAS. Findings from this report also highlight that prematurity and low birthweight were more common among infants with NAS born to people of color than among non-Hispanic white people. This is consistent with national and statewide trends (Table 4) which illustrate a persistent racial disparity in preterm birth and birthweight.

Findings from this report may also inform clinical care of infants with NAS. As in 2020, findings suggest that hospital length of stay is impacted by prematurity and low birthweight, receipt of pharmacological treatment, withdrawal scoring method (ESC versus Finnegan/Modified Finnegan), and level of care (NICU versus nursery). In 2021, most infants with NAS remained in the hospital for 4 to 7 days or longer (93.7%). While hospital protocols differ, standard clinical practice is to observe an infant within utero exposure to substances who may develop NAS in the hospital for at least 3 to 5 days to assess symptoms and provide treatment and care as needed.

In 2021 NICU admission remained markedly higher among infants with NAS as compared to the overall resident live birth population. Infants with NAS should be admitted to the NICU when clinically indicated. However, recent studies and practice have demonstrated the importance of promoting the maternal-infant dyad by allowing the infant to room in with their parent when feasible to facilitate breastfeeding, non-pharmacologic interventions (skin-to-skin, swaddling, reduced stimulation), and encourage the person who gave birth and other caregivers to participate in symptom assessment and care for the duration of their hospital stay (Wachman et al. 2018).

Admission to the NICU may be influenced by whether the infant receives pharmacologic treatment. Pharmacologic treatment was administered to over a third of all infants with NAS in 2021. The Finnegan/Modified Finnegan scoring system is often used to direct administration of pharmacologic treatment despite limited validation (Schiff et al. 2019). The Finnegan/Modified Finnegan scoring system remains the most common system used to assess withdrawal symptoms nationally and was used to assess 71.4% of infants with NAS in Pennsylvania in 2021. The relationship between the Finnegan/Modified Finnegan scoring method and administration of pharmacologic treatment is evident in the findings of this report as the proportion of infants that received pharmacologic treatment gradually increases as the highest Finnegan/Modified Finnegan score observed increases (Table 11D).

Approximately 27.1% of infants with NAS were assessed using the ESC method in 2021, an increase from 2020. The ESC method focuses on the infant's ability to eat, sleep, and be consoled and their level of function informs care management. Research indicates that the

ESC method, which maintains emphasis on the maternal-infant dyad, can decrease average length of stay and reduce likelihood of admission to the NICU, and the need for pharmacologic intervention of the infant (Grossman et al. 2018; Blount et al., 2019; Holmes et al. 2016). Findings from this report further support an apparent reduction in pharmacologic intervention among infants with NAS assessed using ESC as compared to infants with NAS who were assessed using the Finnegan/Modified Finnegan method. As in 2020 a higher proportion of infants assessed using ESC remained in the hospital for <7 days as compared to infants assessed using the Finnegan/Modified Finnegan method. Given that the ESC promotes the maternal-infant dyad and has demonstrable benefits this method should be considered by hospitals in addition to or as an alternative to the Finnegan/Modified Finnegan scoring method.

Discharge planning and coordinated referral by hospitals ensure that infants with NAS receive needed follow-up care. This is the second year that it was possible to characterize infant discharge and referral. As in 2020, most infants with NAS were discharged with their parents in 2021 (79.6%), highlighting the importance of continued support of birth parents after discharge. As with data on maternal referrals, it was not possible to characterize referrals for infants with NAS who were not discharged at the time the NAS case report was submitted. While related findings presented in this report may not provide a comprehensive characterization of all referrals made at discharge, the available data suggest that infants with NAS are not being universally connected to services at discharge, highlighting an opportunity to improve awareness and education of hospital providers on available services and the importance of coordinated follow-up and referral.

Prior to discharge, hospitals are also required to notify the Department of Human Services that they are caring for a substance affected infant (defined as a child, less than one year of age, who the provider has determined to be born affected by substance use or withdrawal symptoms resulting from prenatal substance exposure or Fetal Alcohol Spectrum Disorder) in accordance with Pennsylvania Act 54 of 2018 and federal Comprehensive Addiction and Recovery Act of 2016 (P.L. 114-198, 7/22/2016) (CARA), title V, section 503 amended sections 106 (b)(2)(B)(ii) and (iii) of the Child Abuse Prevention and Treatment Act (CAPTA). Medical providers must submit this notification to the Department of Human Services' ChildLine and a plan of safe care including multidisciplinary team input, to address the needs of both the infant and family, must be offered to the family member or caregiver. Per findings presented in this report, a notification to ChildLine was made for 89.5% of infants with NAS and 61.5% had a plan of safe care initiated. Given that all infants with NAS who meet the Department of Health's NAS case definition may also be considered substance affected infants per the Department of Human Services definition, these percentages should be higher and, as in 2020, may indicate a need for improved provider education on reporting requirements. However, as noted elsewhere in this report, data on ChildLine notifications and plans of safe care are self-reported by the hospital and are not validated by the Department of Human Services or the Office of Children, Youth, and Families. Accordingly, reported data may not accurately reflect notifications received by DHS or involvement of the Office of Children, Youth, and Families. Additionally, it should be noted that DHS' substance affected infant definition is more expansive than the NAS surveillance case definition; while reports included in NAS surveillance must have evidence of in-utero exposure to specific substances (benzodiazepine, barbiturate, or opioid), reporting and plan of safe care requirements for substance affected infants are not defined by the type or legality of substances. Accordingly,

not all substance affected infants meet the NAS surveillance case definition and data collected by DHS on substance affected infants are not directly comparable to NAS surveillance data.

A referral to Early Intervention should also be considered for infants with NAS.

Pennsylvania's Early Intervention program provides developmental screening, evaluation, and services to families with children, birth to age five, with developmental concerns and disabilities. Infants diagnosed with NAS are eligible for, at minimum, Early Intervention tracking services which provide routine screening using the Ages and Stages Questionnaire (ASQ). The ASQ is an effective screening tool used for infants and toddlers who may have developmental delays. Referrals to Early Intervention can be made by telephone, email or online form, and parental permission must be received prior to a referral submission by a provider. The Bureau of Early Intervention Services and Family Supports has a statewide data system that includes all infants, toddlers, and preschool-aged children that are referred to Early Intervention, evaluated, or enter services or tracking. This data system is utilized to determine the Early Intervention status for infants with NAS. Early Intervention status is then entered into iCMS. Approximately 27.7% of infants with NAS were located in the Early Intervention database in 2021, and therefore, confirmed as having received a referral. While it is possible that an infant received a referral to Early Intervention but was not located in the database, findings indicate an opportunity for targeted education to hospitals, agencies, and other providers involved in Early Intervention referrals.

County and regional NAS data demonstrate varying burden of NAS across the state of Pennsylvania. Data by county of reporting hospital demonstrate that counties with a higher number of hospitals are reporting and caring for infants with NAS who reside across county lines. People travel to hospitals in surrounding counties to give birth, particularly when there is no hospital in their county of residence. This highlights the importance of location-appropriate referrals and system-level health care coordination both prior to and after delivery. NAS data by county of maternal residence indicate that the incidence of NAS was highest in the rural counties of Greene, Lawrence, Venango, Elk, and nearby Clinton counties. The incidence of NAS in the northwestern region of the state remained high in 2021 and still suggests that this is an area where resources, community-based support services, and treatment options should be optimized. It is also important to note that people in the southwestern region of the state may cross state lines into neighboring Ohio and West Virginia to give birth. While cross-state travel likely also occurs in other regions of the state, the impact may be more significant in the southwestern region of the state where there are fewer Pennsylvania hospitals. Hospitals in other states do not report NAS cases to the Department and such case reports would only be captured if the infant was transferred to a Pennsylvania hospital after delivery. Accordingly, the incidence rate in the southwestern counties and region of the state may be underestimated and may account, in part, for the significant decrease in incidence observed in that region in 2021.

Citations

American College of Obstetricians and Gynecologists. Opioid use and opioid use disorder in pregnancy. Committee Opinion. No. 711. August 2017. Available at: <https://www.acog.org/clinical/clinical-guidance/committee-opinion/articles/2017/08/opioid-use-and-opioid-use-disorder-in-pregnancy>.

American College of Obstetricians and Gynecologists. Interpregnancy Care. Obstetrics Care Consensus. Obstetrics & Gynecology. 2019. 133 (1): e51-e72. Available at: <https://www.acog.org/clinical/clinical-guidance/obstetric-care-consensus/articles/2019/01/interpregnancy-care>

Blount, T., Painter, A., Freeman, E., Grossman, M., & Sutton, A.G. (2019). Reduction in Length of Stay and Morphine Use for NAS With the “Eat, Sleep, Console” Method. Hospital Pediatrics, 9 (8), 615-623. <https://doi.org/10.1542/hpeds.2018-0238>

Charles, M. K., Cooper, W. O., Jansson, L. M., Dudley, J., Slaughter, J. C., & Patrick, S. W. 2017. Male sex associated with increased risk of neonatal abstinence syndrome. Hospital pediatrics, 7(6), 328-334.

Charron E, Mayo RM, Heavner-Sullivan SF, Eichelberger KY, Dickes L, Truong KD, Rennert L. “It’s a very nuanced discussion with every woman”: Health care providers’ communication practices during contraceptive counseling for patients with substance use disorders. Contraception. 2020 Nov 1;102(5):349-55.

Commonwealth of Pennsylvania. Prescribing Guidelines for Pennsylvania: Use of addiction treatment medications in the treatment of pregnant patients with opioid use disorder. 2016. Available at: [https://www.health.pa.gov/topics/Documents/Opioids/Use%20of%20Addiction%20Treatment%20Medications%20in%20the%20Treatment%20of%20Pregnant%20Patients%20with%20Opioid%20Use%20Disorder%20\(FINAL\).pdf](https://www.health.pa.gov/topics/Documents/Opioids/Use%20of%20Addiction%20Treatment%20Medications%20in%20the%20Treatment%20of%20Pregnant%20Patients%20with%20Opioid%20Use%20Disorder%20(FINAL).pdf)

Council of State and Territorial Epidemiologists (CSTE). “Neonatal Abstinence Syndrome Standardized Case Definition.” 2019 (19-MCH-01). Accessed 24 April 2023. Available at: https://cdn.ymaws.com/www.cste.org/resource/resmgr/2019ps/final/19-MCH-01_final_7.31.19.pdf

Department of Health and Human Services (DHHS). (2022, December 16). Medications for the treatment of opioid use disorder. Federal Register. Accessed 25 April 2023. Available at: <https://www.federalregister.gov/documents/2022/12/16/2022-27193/medications-for-the-treatment-of-opioid-use-disorder>

Dowell D, Ragan KR, Jones CM, Baldwin GT, Chou R. CDC Clinical Practice Guideline for Prescribing Opioids for Pain — United States, 2022. MMWR Recomm Rep 2022;71(No. RR-3):1–95. DOI: <http://dx.doi.org/10.15585/mmwr.rr7103a1>.

Frazer Z, McConnell K, Jansson LM. Treatment for substance use disorders in pregnant women: Motivators and barriers. Drug and alcohol dependence. 2019 Dec 1;205:107652. _____

Garg B, Darney B, Pilliod RA, Caughey AB. Long and short interpregnancy intervals increase severe maternal morbidity. *American journal of obstetrics and gynecology*. 2021 Sep 1;225(3):331-e1.

Grossman MR, Lipshaw MJ, Osborn RR, Berkwitz AK. A novel approach to assessing infants with neonatal abstinence syndrome. *Hospital Pediatrics*. 2018 Jan 1;8(1):1-6.

Hanley GE, Hutcheon JA, Kinniburgh BA, Lee L. Interpregnancy interval and adverse pregnancy outcomes. *Obstetrics & Gynecology*. 2017 Mar 1;129(3):408-15.

Hirai AH, Ko JY, Owens PL, Stocks C, Patrick SW. Neonatal Abstinence Syndrome and Maternal Opioid-Related Diagnoses in the US, 2010-2017. *JAMA*. 2021;325(2):146–155. doi:10.1001/jama.2020.24991

Holmes AV, Atwood EC, Whalen B, Beliveau J, Jarvis JD, Matulis JC, Ralston SL. Rooming-in to treat neonatal abstinence syndrome: improved family-centered care at lower cost. *Pediatrics*. 2016 Jun 1;137(6).

Jarlenski MP, Paul NC, Krans EE. Polysubstance use among pregnant women with opioid use disorder in the United States, 2007–2016. *Obstetrics and gynecology*. 2020 Sep;136(3):556.

Healthcare Cost and Utilization Project (HCUP) – State Inpatient Database (SID). Agency for Healthcare Research and Quality (AHRQ). HCUP Fast Stats: Neonatal Abstinence Syndrome (NAS) Among Newborn Hospitalizations, 2021. Accessed 24 April 2023. Available at: <https://datatools.ahrq.gov/hcup-fast-stats/?type=subtab&tab=hcupfsse&count=2#datanotes9>

National Institute on Drug Abuse (NIDA). Words Matter – Terms to Use and Avoid When Talking About Addiction. 2021. Accessed 25 April 2023. Available at: <https://nida.nih.gov/nidamed-medical-health-professionals/health-professionals-education/words-matter-terms-to-use-avoid-when-talking-about-addiction>.

Peeler M, Gupta M, Melvin P, et al. Racial and Ethnic Disparities in Maternal and Infant Outcomes Among Opioid-Exposed Mother-Infant Dyads in Massachusetts (2017-2019). *Am J Public Health*. 2020;110(12):1828-1836. doi:10.2105/AJPH.2020.305888

Pennsylvania Department of Health. Bureau of Epidemiology. Neonatal Abstinence Syndrome: 2018 Report. August 2019. Accessed 24 April 2023. Available at: <https://www.health.pa.gov/topics/Documents/Diseases%20and%20Conditions/2018%20NAS%20REPORT.pdf>.

Pennsylvania Department of Health. Bureau of Epidemiology. Neonatal Abstinence Syndrome: 2019 Report. June 2021. Accessed 24 April 2023. Available at: <https://www.health.pa.gov/topics/Documents/Opioids/2019%20NAS%20REPORT.pdf>

Pennsylvania Department of Health. Bureaus of Family Health and Epidemiology. Neonatal Abstinence Syndrome: 2020 Report. August 2022. Accessed 24 April 2023. Available at: <https://www.health.pa.gov/topics/Documents/Opioids/2020%20NAS%20REPORT.pdf>

Renbarger KM, Shieh C, Moorman M, Latham-Mintus K, Draucker C. Health care encounters of pregnant and postpartum women with substance use disorders. *Western Journal of Nursing Research*. 2020 Aug;42(8):612-28.

Schiff DM, Grossman MR. Beyond the Finnegan scoring system: novel assessment and diagnostic techniques for the opioid-exposed infant. In *Seminars in Fetal and Neonatal Medicine* 2019 Apr 1 (Vol. 24, No. 2, pp. 115-120). WB Saunders.

Terplan M, Lawental M, Connah MB, Martin CE. Reproductive health needs among substance use disorder treatment clients. *Journal of addiction medicine*. 2016 Jan 1;10(1):20-5.

Wachman EM, Grossman M, Schiff DM, Philipp BL, Minear S, Hutton E, Saia K, Nikita FN, Khattab A, Nolin A, Alvarez C. Quality improvement initiative to improve inpatient outcomes for neonatal abstinence syndrome. *Journal of Perinatology*. 2018 Aug;38(8):1114-22.