

# Neonatal Abstinence Syndrome: 2020 Report

Bureau of Family  
Health and  
Bureau of  
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**pennsylvania**  
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# Executive Summary

This is the Pennsylvania Department of Health's (Department) third neonatal abstinence syndrome (NAS) surveillance annual report. This was the first year that hospitals submitted case reports for newborns meeting NAS criteria to the internet case management system (iCMS), a web-based software application that is also used to track and manage newborn screening results. Also beginning in 2020, the Department adopted the Council for State and Territorial Epidemiologists NAS surveillance case definition and now receives case reports for all confirmed and probable NAS cases for Pennsylvania resident newborns showing symptoms of withdrawal due to in utero exposure to opioids, benzodiazepines, or barbiturates via prescription, treatment for maternal substance use disorder, or illicit use. Management of NAS case reports also transitioned from the Bureau of Epidemiology to the Bureau of Family Health in 2020. However, ongoing intra-agency collaboration has been fundamental to the surveillance initiative and the generation of this report. The NAS surveillance initiative allows for rapid case ascertainment and improved quantification of the number of newborns with NAS across the state. Data in this report may be used to inform prevention to reduce the incidence of NAS in the state and development of public health strategies that support birthing people and their families before, during, and after pregnancy. Key findings from this report may also inform clinical care of newborns with NAS and discharge and referral practices for newborns and their families in hospitals across the state.

The Department of Health received a total of 1,825 case reports of newborns born in 2020 that met the NAS surveillance case definition. The incidence of NAS per 1,000 live births in 2020 was 14.0, an increase from the rate of 11.9 NAS cases per 1,000 live births reported in 2019. Of 90 active hospitals with iCMS reporting capability, 82 (91%) reported NAS cases in 2020. NAS resulting from opioid exposure remained most common in 2020 even after expansion of the case definition to include benzodiazepines and barbiturates; 90.96% of birthing people of newborns with NAS reported using opioids in the four weeks prior to delivery and 90.53% of newborns with NAS tested had a positive result for an opioid. Newborns with NAS were predominantly born to people who identified as non-Hispanic white and were covered by Medicaid at delivery, consistent with previously reported state and national data. Most newborns with NAS were of normal birthweight and born at or after 37 weeks of gestation. However, admission to the neonatal intensive care unit (NICU) is common among newborns with NAS with over 50% admitted during their hospital stay. Newborns with NAS born to people who identified as non-Hispanic black were more likely to be low birthweight or premature as compared to 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.

Findings from this report demonstrate that NICU admission, hospital length of stay, and administration of pharmacologic treatment to the newborn are interrelated and may be modified by the scoring method the hospital uses to assess newborn withdrawal symptoms. Most newborns with NAS in Pennsylvania were assessed using the Finnegan/Modified Finnegan NAS scoring system (82.68%) and a smaller subset were assessed using the more recently developed Eat, Sleep, Console (ESC) scoring method (15%) which promotes rooming-in and non-pharmacologic therapies. Newborns with NAS assessed using ESC were less likely to receive pharmacologic treatment and had a shorter hospital stay as compared to

newborns with NAS who were assessed using the Finnegan/Modified Finnegan NAS scoring system.

Among people who gave birth to a newborn with NAS in 2020, most initiated prenatal care (83.92%) and over half (56.58%) received medication-assisted treatment (MAT) during pregnancy. Data stratified by maternal race and ethnicity highlight disparities in receipt of prenatal care and MAT as non-Hispanic black birthing people were less likely to initiate prenatal care or receive MAT during pregnancy than non-Hispanic white birthing people. Linked surveillance data from 2018 to 2020 also demonstrate that nearly 10% of birthing people who had a newborn with NAS in 2020 had a prior birth to a newborn with NAS in the preceding two years.

Data on referral and discharge of the maternal-infant dyad are also presented in this report. While reporting on discharge planning and referrals is not comprehensive and may not reflect all referrals made, the available data suggest that birthing people and newborns are not being universally connected to social support and health care services at discharge, highlighting an opportunity to improve awareness and education of healthcare providers on available services and the importance of coordinated follow-up and referral.

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 incidence rates are higher in rural counties than in urban counties. The incidence rate of NAS remains highest in the state's northwestern region and increased from 23.7 NAS cases per 1,000 live births in 2019 to 30.8 NAS cases per 1,000 live births in 2020.

The Department of Health remains committed to advancing health equity and promoting the health and well-being of all birthing people and newborns with NAS. In 2021 the Department developed a Neonatal Abstinence Syndrome Family Guide Tool Kit as a resource for caregivers and funded a pilot baby basket program in the northwestern region of the state. The program distributes NAS baby baskets containing items essential to care and tool kits to families of newborns diagnosed with NAS. The tool kit is also available as a resource on the Department's [website](#) for Neonatal Abstinence Syndrome (<https://www.health.pa.gov/topics/programs/Newborn-Screening/Pages/NAS.aspx>), and copies can be requested 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 birthing people and newborns with NAS is a collaborative effort with fellow state agencies, local and county health departments, and other partners. While NAS surveillance is ongoing, this report is intended to provide data to these entities and members of the public to allow for data-driven decision-making and public health practice.

# Introduction

## Defining Neonatal Abstinence Syndrome (NAS)

Neonatal abstinence syndrome (NAS) is a series 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, poor ability to feed, or 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*

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 has since ended, the Pennsylvania Department of Health 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. In 2018 and 2019 NAS cases were defined as Pennsylvania resident newborns with clinical diagnosis 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/disease/Opioids/Pages/Prescribers-Providers.aspx) (<https://www.health.pa.gov/topics/disease/Opioids/Pages/Prescribers-Providers.aspx>).

### *Updates to the NAS Case Reporting System*

In 2020, the Department's Bureau of Family Health took over the management of NAS case reporting from the Bureau of Epidemiology and the method of reporting cases of NAS to the Department changed. Beginning in January 2020 hospitals started reporting NAS cases to the Bureau of Family Health's existing internet case management system (iCMS) instead of the prior system, REDCap. The development and inclusion of the NAS case report module in iCMS, a web-based software application that is also used to track and manage newborn screening results, was an innovation that allowed for further standardization and streamlining of NAS surveillance. Demographic data from the case report form can be further validated through comparison with linked newborn screening and birth record data. Additionally, the NAS case report module includes several fields that were not previously included on the case report form, namely whether the hospital made a notification to ChildLine, whether a plan of safe care was initiated, information on newborn and maternal discharge, and information on whether the birthing person was receiving treatment for substance use disorder (often called medication-assisted treatment, or MAT) during pregnancy. Accordingly, 2020 is the first year in which data on these variables are available.

### *Case Definition*

Concurrently, the Pennsylvania NAS surveillance case definition was updated in 2020 to align with the Council of State and Territorial Epidemiologists (CSTE) position statement and case

criteria. CSTE encourages use of the case definition described in their position statement to standardize NAS surveillance and resulting data in states across the country. 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 for maternal substance use disorder (MAT), 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

The present report summarizes the third calendar year (January 1, 2020, to December 31, 2020) of the NAS surveillance initiative in Pennsylvania. However, since the 2020 case definition was expanded to include cases of NAS resulting from exposure to benzodiazepines or barbiturates, 2020 data are not directly comparable to preceding years when solely cases of NAS resulting from in utero exposure to opioids were reported to the Department.

# Case Reporting and Statistical Methods

## NAS Case Reporting

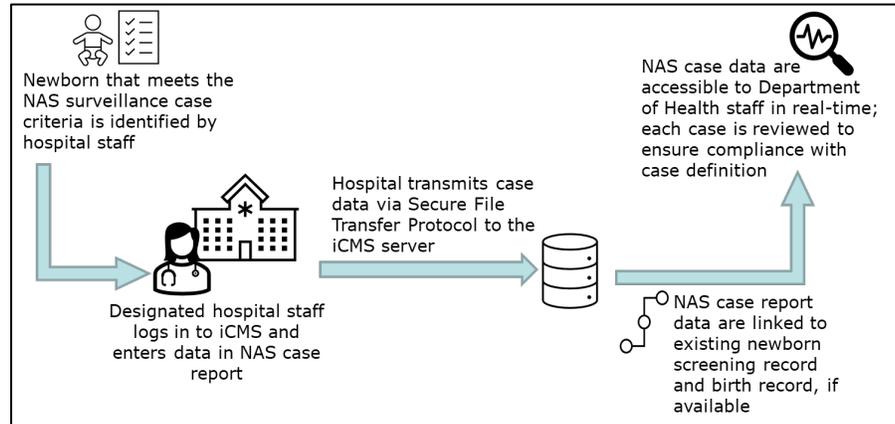
### **Data Flow and Confidentiality**

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 iCMS. Upon identification of a newborn 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 transmitted to the secure iCMS server and are available to the Department of Health staff in real time. Each newborn'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, 2020

### **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. Newborns 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 newborn are merged so that all information regarding the newborn and birthing person is retained. 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

Users of this report should be aware that NAS surveillance has inherent limitations that influence the interpretation of the data herein. Pennsylvania's NAS surveillance is reliant 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, validation of the data reported by hospitals on referrals to ChildLine and initiation of plans of safe care in 2020 is not required by the Department of Human Services, the agency responsible for receiving ChildLine notifications and plans of safe care initiation. It is important to note that reporting of a newborn 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 birthing people or their infants at birth. 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. While data on laboratory testing collected on the case report form are included in this report, results are not available for all cases or birthing people. When data for a given field of the NAS case report form were not provided or 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 also actively involved in the coronavirus (COVID-19) response and treatment of patients throughout 2020, which likely impacted the timeliness of reporting of NAS cases to the Department of Health. Incomplete or late submission of NAS case reports has an impact on data quality. The average time to report a NAS case in 2020 was 33 days following the newborn'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 competing patient care priorities, staffing challenges, and the demands placed on healthcare personnel by COVID-19.

Finally, Pennsylvania resident births that meet the NAS case reporting criteria but occur at hospitals outside of the state are not reported to iCMS. As a result, it is possible that there is 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 2020 are included in the report. Data on birth parameters and select maternal characteristics are from the birth certificate. NAS data are linked to the birth certificate based on maternal information. Bureau of Epidemiology staff performed descriptive analysis to characterize birth parameters, newborn testing, assessment, and treatment as well as discharge, and referrals. Preliminary

2020 data were also 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 2020 birth data and compared to previously published 2018 and 2019 rates to assess change in the rate of NAS cases per 1,000 live births over time.

Staff also generated statistics on maternal characteristics including demographics, maternal medical history, and maternal discharge and referrals. In order to analyze and describe maternal characteristics, case reports for plural births were identified and a single record was retained for each birthing person so that they are represented only once in tables. For maternal race/ethnicity, counts for people identifying as multiracial or Native American/Alaska Native were merged due to small numbers. The 2020 NAS surveillance dataset was then linked to 2018 and 2019 NAS surveillance datasets to characterize the number of birthing people who gave birth to a newborn with NAS in 2020 who also had a prior birth to a newborn with NAS that was reported to the surveillance database in the preceding two years.

For analysis by county and region, the residential address provided on the newborn's linked birth record was used to determine the maternal county of residence. If an 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 burden and facilitate comparison. Maps were generated to visually present differing counts and incidence 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 a total of 1,825 case reports of newborns that met the NAS surveillance case definition in the calendar year 2020, representing 1.4% of all births in the state. Approximately 58% of NAS cases were confirmed cases per the NAS surveillance case definition and 42% were probable cases (**Table 1**). The incidence rate of NAS in Pennsylvania increased from 11.9 NAS cases per 1,000 live births in 2019 to 14.0 NAS cases per 1,000 live births in 2020 (**Table 2; Figure 2**). The increase could be due, in full or in part, to the change in surveillance case definition that occurred in 2020 as it expanded to include NAS cases resulting from benzodiazepines or barbiturates.

## Birth Parameters of NAS Cases

Newborns with NAS were predominantly male (52.33%), of normal birthweight (79.12%), and were born at or after 37 weeks of gestation (82.03%). Most infants had normal 1-minute (66.08%) and 5-minute (72.71%) Apgar scores and a length of stay in the hospital of 4 to 7 days (45.37%). Nearly 97% of newborns with NAS were singleton births and over half of all newborns with NAS were admitted to the NICU for care (51.51%). When compared to all 2020 resident live births it is evident that a higher percentage of newborns with NAS had a low birthweight (19.29% versus 6.93%) and were born preterm (17.81% versus 9.27%). Most notably, only 9.13% of resident live births were admitted to the NICU according to vital records data whereas over 50% of newborns with NAS received care in the NICU during their hospital stay. Most newborns with NAS were born to parents who were non-Hispanic white (80%) (**Table 3**). However, newborns with NAS who were born to a parent identifying as non-Hispanic black, multiracial, American Indian/Alaska Native, Hispanic, or of unknown race and ethnicity were more likely to be of very low or low birthweight than newborns with a parent who was non-Hispanic white (32.50%, 25.71%, 20.21%, and 39.51%, respectively, versus 18.70%) (**Table 4**). A similar pattern is evident when stratifying gestational age at birth by maternal race and ethnicity; a higher proportion of newborns with NAS born to a parent identifying as non-Hispanic black or of unknown race and ethnicity were preterm as compared to newborns born to a non-Hispanic white parent (30.00% and 35.80%, respectively, versus 15.75%) (**Table 4**). These patterns in prematurity and low birthweight delivery among newborns with NAS mirror disparities by maternal race and ethnicity that are apparent among all resident live births.

## Maternal Characteristics

There were 1,803 people who gave birth to a newborn with NAS in 2020. Birthing people of newborns with NAS were predominantly between the ages of 20 and 34 (78.15%), identified as non-Hispanic white (79.98%), and their delivery was covered by Medicaid (46.42%). Most birthing people of newborns with NAS had initiated prenatal care (83.92%) and received MAT during pregnancy (56.68%) (**Table 5**). When assessing prenatal care and MAT jointly it appears that there is an association as 61.60% of those who initiated prenatal care received MAT during pregnancy whereas only 26.49% of people who did not initiate prenatal care received MAT (**Table 6**). Upon stratifying receipt of prenatal care and MAT by maternal race/ethnicity it is evident that there are disparities in the receipt of supportive healthcare during pregnancy. A lower proportion of birthing people who gave birth to a newborn with

NAS and identified as non-Hispanic black initiated prenatal care (76.27%) as compared to non-Hispanic white birthing people who gave birth to a newborn with NAS (85.85%). Additionally, only 33.90% of non-Hispanic black birthing people who gave birth to a newborn with NAS had received MAT for substance use disorder during pregnancy compared to 60.19% of non-Hispanic white birthing people (**Table 7**).

Approximately 94% of birthing people had used a substance in the four weeks prior to delivery. Of those, 90.95% reported opioid use (including opioid agonists and partial agonists such as methadone and buprenorphine), 6.66% reported use of benzodiazepines and 0.44% 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 (19.80%), use of tobacco/e-cigarettes (17.53%), and alcohol consumption (1.33%) were reported among some birthing people. Approximately 24.46% 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 also common among birthing people who delivered an infant with NAS as 53.86% 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 2020 suggest that approximately 9.65% of birthing people who gave birth to a newborn with NAS in 2020 had a prior birth to a newborn with NAS in the preceding two years (**Table 8**). Of the 174 people who had a prior birth to a newborn with NAS, 115 (66.09%) were receiving MAT during their 2020 pregnancy and there was a significant association between receipt of MAT and prior birth to a newborn with NAS. Approximately 18.39% of birthing people with a prior NAS birth had an interpregnancy interval less than 6 months, 63.79% of birthing people had an interval between 6 and 17 months, and 17.82% had an interpregnancy interval of 18 months or more.

## **Newborn Testing, Assessment, and Treatment**

### **Testing**

Of the 1,825 newborns with NAS, 90.19% (n=1646) were tested for in utero substance exposure (**Table 9A**). Of those who were tested, 80.86% (n=1331) had a positive test result for a substance. Substances identified through testing of newborn biological samples (such as urine or umbilical cord blood) included opioids (90.53%), benzodiazepines (4.06%), or barbiturates (0.15%). Other substances were also identified for 20.35% of newborns and 36% of newborns had a positive test result for more than one substance. Of those newborns with a positive test result for a substance (n=1331), over half (54.32%) had a parent who was receiving MAT during pregnancy (**Table 9B**).

### **Assessment and Scoring**

Nearly all newborns reported to the NAS surveillance system were assessed using a scoring and assessment tool or method (97.92%); a scoring method was not documented in the case report form for the remaining 2.08% of NAS cases. Approximately 82.68% of newborns were assessed with Finnegan/Modified Finnegan scoring, 14.68% were assessed using the Eat, Sleep, Console (ESC) method, and 0.55% were assessed using both methods (**Table 10A**).

While most newborns reported to the NAS surveillance system were symptomatic (96.71%), symptoms were not documented or assessed for 3.29% of cases reported (n=60). Of those newborns who were symptomatic (n=1765), most experienced 3 or more symptoms that were clinically compatible with NAS (86.06%). The most frequently reported symptoms among symptomatic newborns were body shakes/tremors (74.45%), elevated muscle tone (73.26%), and poor feeding (62.83%) **Table 10B**.

### ***Treatment and Therapy***

Treatment of newborns with NAS may be pharmacologic or non-pharmacologic depending on the severity of withdrawal and other circumstances of delivery. Receipt of pharmacologic treatment was common among newborns with NAS; 37.59% of newborns with NAS were administered medication during their hospital stay (n=686). Approximately 7.89% of newborns with NAS 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 24.93% of newborns with NAS during their hospital stay. No treatment was reported for 28.60% of newborns with NAS and treatment status was unknown for 8.88% of newborns with NAS (**Table 11A**).

Differences in newborn treatment are evident when stratifying the type of treatment received (pharmacologic or non-pharmacologic) by race/ethnicity and principal payor at delivery. By race/ethnicity, a lower proportion of non-Hispanic Black (33.33%) and non-Hispanic multi-race (32.85%) newborns with NAS received pharmacologic treatment as compared to non-Hispanic white (37.05%) or Hispanic (40.43%) newborns with NAS. Also, a higher proportion of non-Hispanic black newborns with NAS received solely non-pharmacologic treatment (32.50%) as compared to newborns with NAS who were non-Hispanic white (25.34%) **Table 11B**.

For 47% of newborns with NAS (n=863), payor was unknown/not reported and the denominators for self-pay (n=6), uninsured (n=5), and other (n=11) are small. However, when assessing the receipt of pharmacologic treatment among newborns with NAS who had Medicaid coverage as compared to those with private insurance, a higher proportion of newborns with NAS on Medicaid received pharmacologic treatment (41.68%) than newborns with private insurance (30.11%). Conversely, non-pharmacologic therapies were more common among newborns with NAS who had private insurance (33.33%) than among newborns with Medicaid coverage (20.54%).

Among the 686 newborns with NAS that received pharmacologic treatment, the most common medication administered was morphine (92.13%). Other medications were clonidine (11.66%), phenobarbital (9.18%), and methadone (1.31%). Most newborns with NAS that received treatment were administered a single medication (80.47%) and, in those instances, morphine was always the medication administered. For a smaller proportion of newborns (19.53%), more than one medication was administered to treat their symptoms of withdrawal. Additional notes on other medications and treatment can be found in **Table 11C**.

Scores from the Modified Finnegan/Finnegan tool are often interpreted and used to guide administration of medications to newborns to treat withdrawal; 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 newborns with NAS scores of 12 and below whereas most newborns with a score between 13 and 16 received pharmacologic treatment (83.88%). This pattern was also apparent among newborns with scores between 17 and 20 and greater than 20 as a higher proportion of newborns with those scores received pharmacologic treatment (80.88% and 90.91%, respectively) [**Table 11D**]. Data in Table 11D demonstrate an apparent association between ESC and likelihood to receive pharmacologic treatment as only 19.40% of newborns assessed using ESC received pharmacologic treatment during their hospital stay whereas 41.61% of newborns assessed using the Finnegan/Modified Finnegan scoring method received pharmacologic treatment.

### ***Length of Hospital Stay***

Scoring method, treatment, and other parameters of the newborn's birth influence the length of stay in the hospital, as demonstrated in **Table 12**. A higher proportion of newborns who were very low or low birthweight remained in the hospital for more than seven days (96.55% and 61.65%, respectively) as compared to newborns with NAS of normal birthweight (40.51%). Similarly, a higher proportion of newborns with NAS who were born preterm remained in the hospital for more than seven days (69.85%) compared to only 40.08% of newborns with NAS who were born at  $\geq 37$  weeks gestation. A longer hospital stay was also observed among newborns with NAS who received pharmacologic treatment or were cared for in the NICU (91.98% and 72.66%, respectively) as compared to their counterparts who received nonpharmacologic therapies or were not transferred to the NICU. Use of the ESC scoring method appears to be associated with a shorter length of stay in the hospital as only 28.06% of newborns with NAS who were assessed with ESC remained in the hospital for more than seven days. By comparison, 49.04% of newborns with NAS assessed using the Modified Finnegan/Finnegan scoring method had a length of stay exceeding seven days.

### **Newborn and Maternal Discharge and Referrals**

Hospital staff indicated on the NAS case report forms that a ChildLine notification was made for 84.49% of newborns with NAS and a plan of safe care was initiated for 56.27% of newborns with NAS in 2020. Case report data on discharge suggest that most newborns with NAS were discharged with their parent (78.36%). For approximately 9.92% of newborns with NAS, a children and youth services agency was engaged at discharge to facilitate placement in a foster home. For the remaining 11.73% of newborns with NAS the discharge person was not specified or was unknown at the time that the case report was made (**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.

Newborns and their parents should be referred for follow-up services at the time of discharge from the hospital. The most common referral made for newborns with NAS was to a pediatrician experienced with NAS, a referral received by 30.90% of newborns with NAS. Newborns with NAS also received referrals to home visiting services (21.59%), developmental assessment clinics (12.66%), and medical homes (2.74%). Early Intervention received referrals for 24.6% of the newborns with NAS reported to the surveillance system 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 birthing people at the time of discharge was to MAT; 48.42% of birthing people received a referral to MAT. Most birthing people who received a referral to MAT at discharge had already been on MAT during their pregnancy. Referrals were also made to services such as parenting support, community support programs, and home visiting services, but were less common. For half of all birthing people (50.97%) 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.

## **Hospital Reporting and Findings by County and Region**

### ***Active Hospitals: Changes since 2019***

In 2019 there were 94 hospitals capable of reporting NAS cases. Four hospitals since closed or no longer have an active obstetrics unit. Closures occurred in McKean, Philadelphia, Fayette, and Erie counties. Two midwiferies were included in the list of active facilities in 2019; in 2020 these facilities were excluded as they confirmed that birthing people with known substance use during pregnancy would give birth at a hospital and that any newborn with symptoms of withdrawal would be immediately transferred to a hospital for care. Finally, in 2020 two hospitals opened, one in Lackawanna County and one in Northampton County, resulting in a total of 90 hospitals with iCMS reporting capabilities in 2020.

### ***Case Reporting by Hospital***

Of the 75 hospitals that reported NAS cases in 2019, 69 continued reporting in 2020. There were 13 facilities that did not report NAS cases in 2019 that started reporting in 2020, including the two newly opened hospitals. Of the 90 active hospitals with iCMS reporting capabilities in 2020 82 (91%) reported cases that met the NAS surveillance case definition. Four of the 8 active hospitals that did not report NAS cases in 2020 closed during the calendar year. Of the remaining four hospitals, only one had reported cases in 2019 and it reported only 2 cases for that calendar year. Each of these four hospitals indicated that they did not have any newborns that met the NAS case criteria 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 an NAS case in 2020. The map demonstrates that counties with a higher number of hospitals, such as Philadelphia and Allegheny counties, reported more cases of NAS during 2020. NAS cases were not reported in 22 counties (33%) but 20 of those counties did not have an active birth or pediatric hospital in 2020. Armstrong 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 294 in Allegheny County. **Map 2** depicts case counts by county of maternal residence. Case counts by county ranged from 0 in Cameron and Sullivan counties to 254 in Philadelphia County. Map 2 demonstrates that birthing 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**.

### ***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 (63.5), Venango (59.9), Clearfield (54.7), Greene (48.0), and Lawrence (41.8) counties. Incidence rates by county of maternal residence are included in **Table 16**; incidence rates based on fewer than 10 events are not reliable 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 case count (254) and the highest incidence rate of 30.8 NAS cases per 1,000 live births – a rate that is 2.8 times higher than the lowest incidence rate in the Southeast (10.9). Incidence rates by region of maternal residence are included in **Table 17**. Table 17 demonstrates that incidence rates significantly increased in the Northwestern region from 23.7 cases of NAS per 1,000 live births in 2019 to 30.8 cases of NAS per 1,000 live births in 2020. Similar significant increases were observed in the Northeast (8.2 cases of NAS in 2019 to 13.0 cases of NAS in 2020) and Southeast regions (8.4 cases of NAS in 2019 to 10.9 cases of NAS in 2020), respectively.

## Discussion

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

The burden of NAS in Pennsylvania remains high with 1,825 cases reported to the Department of Health in 2020, resulting in 14.0 newborns with NAS per 1,000 live births. This represents an increase from the incidence rate of 11.9 newborns with NAS per 1,000 live births that was reported in 2019 (Department of Health, 2019). Differences in case definition may account for some of this variation. Yet, NAS resulting from opioid exposure remained most common in 2020 even after expansion of the case definition to include benzodiazepines and barbiturates; NAS surveillance data indicate that 90.96% of birthing people of a newborn with NAS reported using opioids in the four weeks prior to delivery and 90.53% of newborns with NAS who were tested had a positive result for an opioid. Several states, including Georgia and Tennessee, are in the process of transitioning to the CSTE case definition (Jilani et al. 2022) but the lack of a standardized national surveillance system for NAS makes interstate and national comparison difficult. However, hospitalization data indicate that the national incidence rate of NAS in 2019 was 6.1 per 1,000 hospital births, suggesting that the rate of NAS in Pennsylvania is at least two times higher than the national rate; the rate of NAS hospitalization in Pennsylvania in 2019 was 12.9 per 1,000 hospital births (HCUP-SID 2019). The rate of NAS hospitalization in Pennsylvania is higher than reported NAS hospitalization rates in neighboring states of New York (4.6), Ohio (9.5), Maryland (12.4), and New Jersey (5.8), but remains lower than the rate of NAS hospitalizations in Delaware (18.5) and West Virginia (43.6) [HCUP-SID 2019].

In Pennsylvania, newborns with NAS in 2020 were predominantly born to birthing 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 a newborn 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 is likely an underestimate. Polysubstance use, defined in this report as reported use of more than one substance listed on the case report form in the four weeks prior to delivery, was also common with 54% of people who gave birth to a newborn with NAS using more than one substance during pregnancy. Approximately 17.53% of birthing people who had a newborn with NAS reported smoking during pregnancy compared to 9.5% of birthing people who smoke during pregnancy statewide. 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 2018-2019; Hirai et al. 2021; Jarlenski et al. 2020).

Notably, over half of all birthing people who gave birth to a newborn with NAS in Pennsylvania in 2020 had received MAT during their pregnancy. This is the first time that it has been possible to characterize the receipt of MAT during pregnancy among this population using Pennsylvania NAS surveillance data. Receipt of MAT during pregnancy to treat a substance use disorder may increase the risk of NAS. However, prescription of

medications such as buprenorphine or methadone during pregnancy to treat substance use disorder in accordance with Pennsylvania's prescribing guidelines should not be dissuaded. MAT during pregnancy is the recommended standard of care for people in recovery from a substance use disorder (Commonwealth of Pennsylvania, 2016; ACOG 2017). Findings from this report demonstrate that receipt of MAT during pregnancy among people with a newborn with NAS differs by maternal race/ethnicity; only 33.90% of non-Hispanic black birthing people with a newborn with NAS had received MAT during pregnancy compared to 60.19% of non-Hispanic white birthing people who received MAT.

Similarly, while most people with a newborn with NAS had received prenatal care, a lower proportion of non-Hispanic Black people had initiated prenatal care compared to birthing people who identified as non-Hispanic white. These data 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 birthing people in the state. 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 MAT and counseling. Findings from this report demonstrate that a higher proportion of people who had received prenatal care also received MAT during their pregnancy. 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 promote maternal health outcomes and should be coordinated prior to discharge. Given that it was not possible to characterize referrals for birthing people 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, the available data suggest that birthing people are not being universally connected to social support and health care services, such as MAT, 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.

Findings in this report also demonstrate that birthing people in recovery from a substance use disorder or who are using substances during pregnancy may have more than one birth to a newborn with NAS. Nearly 10% of birthing people who had a newborn with NAS in 2020 had a prior birth to a newborn with NAS in 2018 or 2019. Most birthing people with a prior birth to a newborn with NAS were on MAT during their 2020 pregnancy (66.09%). This analysis is limited to NAS surveillance data from 2018 to 2020 and, accordingly, does not assess complete pregnancy or birth history. It was not possible to consider births to newborns who did not have NAS or births that occurred prior to 2018 or after 2020. 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 2020, the interpregnancy interval was less than 18 months for 82.18% of birthing people who had a prior birth to a newborn with NAS. Notably, 18.39% of birthing people 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 provision of

patient-centered postpartum and interpregnancy care that integrates sexual and reproductive health care and 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 newborns with NAS presented in this report are also consistent with previously published reports and literature. A higher proportion of newborns with NAS in 2020 were male (Department of Health 2018-2019; Charles et al. 2017), were of normal birthweight, and born at or after 37 weeks gestation. Yet, newborns with NAS were two times as likely to be low birthweight than newborns without NAS. Findings from this report also highlight that prematurity and low birthweight were more common among newborns with NAS born to birthing people of color than among non-Hispanic white birthing 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 newborns with NAS.

In 2020, most newborns with NAS remained in the hospital for 4 to 7 days or longer (90.85%). While hospital protocols differ, standard clinical practice is to observe a newborn with in 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. 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). Given that NICU admission, pharmacologic treatment, and scoring method are interrelated and potentially modifiable elements of clinical care, these will be discussed in greater detail.

NICU admission was markedly higher among newborns with NAS as compared to the overall resident live birth population. Newborns with NAS that require a higher level of care 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 newborn to room in with the birthing person when feasible to facilitate breastfeeding, non-pharmacologic interventions (skin-to-skin, swaddling, reduced stimulation), and encourage the birthing person and other caregivers to participate in symptom assessment and newborn care for the duration of their hospital stay (Wachman et al. 2018).

Admission to the NICU may be influenced by whether or not the newborn receives pharmacologic treatment. Pharmacologic treatment was administered to a third of all newborns with NAS in 2020. However, there were differences in type of treatment received among newborns with NAS by race/ethnicity and principal source of payment at delivery (Table 11B). Findings suggest that newborns with NAS who were non-Hispanic black or non-Hispanic multiracial were less likely to receive pharmacologic treatment than other newborns with NAS. While non-pharmacologic therapies are increasingly recommended to care for newborns with NAS, there is a long history of differential opioid prescribing by race nationally and at the state-level among adults (Harrison et al. 2018; Santoro et al. 2018) and pregnant people (Gao et al. 2022). Recent studies (Parikh et al. 2019; Campbell et al. 2020) suggest that racial disparities in opioid prescribing may begin in infancy among newborns with NAS. Differential receipt of pharmacologic treatment has been attributed to racial bias of clinicians

assessing newborns with NAS (Grossman et al. 2020; Clark et al. 2021; Campbell et al. 2020). While it was not possible to assess biases among providers in Pennsylvania, this finding of a potential racial disparity in treatment type among newborns with NAS highlights the importance of standardized care and education on unconscious and implicit racial bias among clinicians and nursing staff.

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 is the most common system used to assess withdrawal symptoms nationally and was used to assess nearly 83% of newborns with NAS in Pennsylvania in 2020. 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 newborns that received pharmacologic treatment gradually increases as the highest Finnegan/Modified Finnegan score observed increases (Table 11D).

In contrast, non-pharmacologic interventions are promoted by hospitals using the ESC method for withdrawal assessment. Approximately 15% of newborns with NAS were assessed using the ESC method in 2020. The ESC method focuses on the newborn'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 newborn (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 newborns with NAS assessed using ESC as compared to newborns with NAS who were assessed using the Finnegan/Modified Finnegan method. A higher proportion of newborns assessed using ESC remained in the hospital for <7 days as compared to newborns assessed using the Finnegan/Modified Finnegan method. Given that the ESC promotes the maternal-infant dyad and has demonstrable benefits in reducing pharmacologic intervention, admission to the NICU, and hospital length of stay, implementation of this method should be considered by hospitals in addition to or as an alternative to the Finnegan/Modified Finnegan scoring method.

Continued adoption of the ESC method may result in documentation of fewer symptoms in the newborn medical record since only three primary functions (eating, sleeping, consoling) are assessed whereas the Finnegan/Modified Finnegan method assesses up to 21 signs and symptoms. However, recent studies suggest that there is high correlation between ESC and Finnegan/Modified scores and that both methods are effective in identifying NAS (Ryan et al. 2021). Given that Pennsylvania's surveillance case definition includes NAS diagnosis or chief complaint of NAS, the potential for reduced documentation of symptoms in the medical record or case report form should not unduly impact surveillance or reported incidence of NAS.

Discharge planning and coordinated referral by hospitals ensure that newborns with NAS receive needed follow-up care. This is the first year that it was possible to characterize newborn discharge and referral. Most newborns with NAS were discharged with their parents (78.36%), 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 newborns

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 newborns 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 84.49% of newborns with NAS and 56.27% had a plan of safe care initiated. Given that all newborns 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 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 further validation by the Department of Human Services or the Office of Children, Youth, and Families is not required. 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 newborns 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. Newborns 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 a very 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 EI, evaluated, or enter services or tracking. This data system is utilized to determine the Early Intervention status for newborns with NAS. Early Intervention status is then entered into

iCMS. Approximately 24.6% of newborns with NAS were located in the Early Intervention database in 2020, and therefore, confirmed as having received a referral. While it is possible that a newborn 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 and may be useful when considering allocation of resources and implementation of public health programming. Data by county of reporting hospital demonstrate that counties with a higher number of hospitals are reporting and caring for newborns with NAS who reside across county lines. Birthing people are traveling 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 for birthing people and their newborns both prior to and after delivery. NAS data by county of maternal residence indicate that the incidence of NAS remains highest in the rural counties of Venango, Elk, Clearfield, Lawrence, and Greene.

The continued increase in the incidence of NAS in the northwestern region of the state suggests that this is an area where resources, community-based social support services, and substance use disorder treatment options should be optimized. It is also important to note that birthing 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 occurs in other regions of the state as well, the impact on reporting 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 Pennsylvania Department of Health and such case reports would only be captured if the newborn was transferred to a Pennsylvania-based hospital after delivery. Accordingly, the incidence rate in the southwestern counties and region of the state may be underestimated. In 2020 the incidence rates in the northeast and southeast regions of the state increased and are comparable to rates last reported in 2018. This rebound in incidence rates may be due in part to increased reporting. Reporting expanded from 75 hospitals in 2019 to 82 hospitals in 2020. In addition to the new hospitals that opened in Lackawanna and Northampton counties in 2020, six of the hospitals in these regions did not report cases in 2019 but resumed reporting in 2020, cumulatively accounting for over 60 case reports.

## Tables and Figures

**Table 1.** Number and percentage of newborns with neonatal abstinence syndrome (NAS) by case status

	N	% of total NAS cases
Total NAS Cases	1825	100%
<b>Case Status</b>		
Confirmed*	1061	58.14%
Probable†	764	41.86%

\*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: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

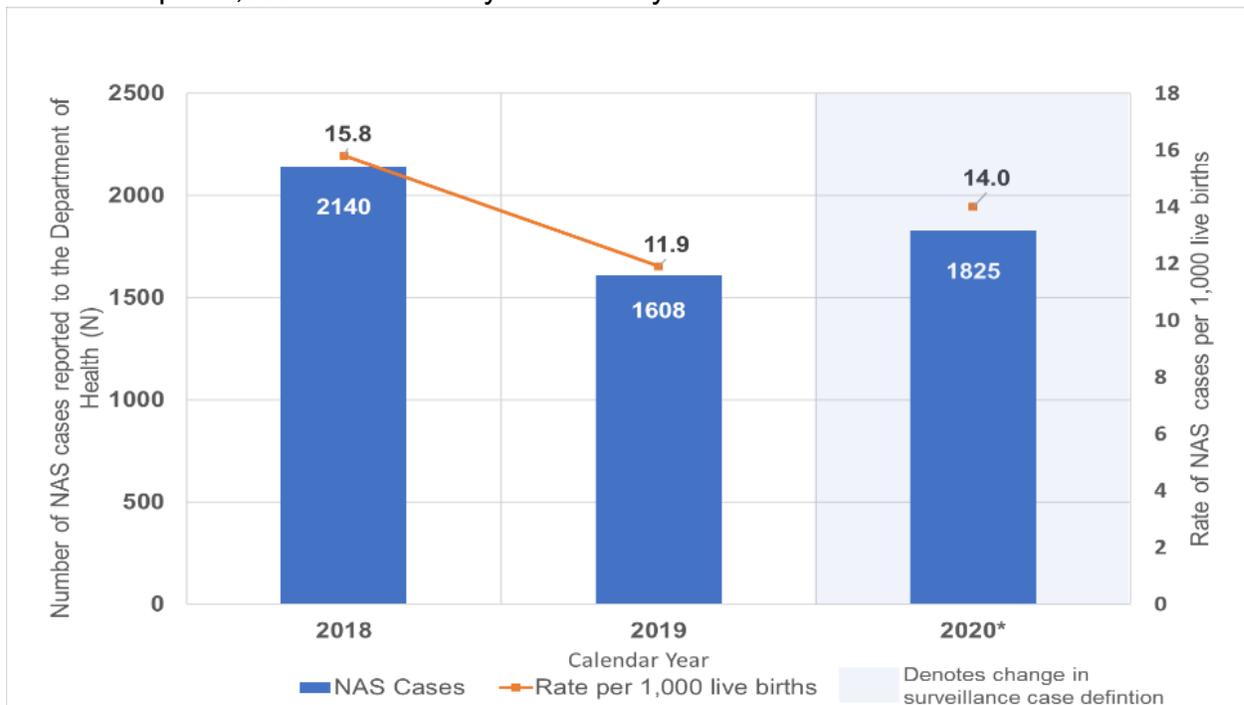
**Table 2.** Neonatal abstinence syndrome (NAS) incidence rate per 1,000 live births by calendar year

	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)

\*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 Neonatal Abstinence Syndrome Annual Reports; 2020 incidence rate was calculated using preliminary 2020 resident live birth data. Resident live birth data for 2020 are preliminary and are subject to change. Please note that the NAS case definition expanded to include exposure to barbiturates or benzodiazepines in 2020 whereas the case definition in 2018-2019 included solely those infants with exposure to opioids.

Data source: 2018 and 2019 Neonatal Abstinence Syndrome Reports (Bureau of Epidemiology, Pennsylvania Department of Health), Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Figure 2.** Number of newborns with neonatal abstinence syndrome (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: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Epidemiology [2018-2019], Bureau of Family Health [2020], Pennsylvania Department of Health)

**Table 3.** Birth parameters of newborns with neonatal abstinence syndrome (NAS) compared to select parameters of the resident live birth population

	NAS Cases		Pennsylvania Resident Live Births (2020)*	
	N	% of total NAS cases	N	% of total births
<b>Total</b>	1825	100%	130187	100%
<b>Sex</b>				
Male	955	52.33%	66372	50.98%
Female	870	47.67%	63813	49.02%
Unknown			2	0.00%
<b>Birthweight (grams)</b>				
Very low birthweight (<1500g)	29	1.59%	1452	1.12%
Low birthweight (1500-2499g)	352	19.29%	9024	6.93%
Normal birthweight (≥2500g)	1444	79.12%	119479	91.77%
Unknown			232	0.18%
<b>Gestational age at birth</b>				
Preterm (<37 weeks)	325	17.81%	12074	9.27%
Full-term (≥37 weeks)	1497	82.03%	117658	90.38%
Unknown	3	0.16%	455	0.35%
<b>Plurality</b>				
Singleton	1770	96.99%	126081	96.85%
Multiple	55	3.01%	4103	3.15%
Unknown			3	0.00%
<b>1-minute Apgar score</b>				
< 7 (Abnormal)	136	7.45%	-	-
≥7 (Normal)	1206	66.08%	-	-
Unknown/Not Reported	483	26.47%	-	-
<b>5-minute Apgar score</b>				
< 7 (Abnormal)	34	1.86%	2812	2.16%
≥7 (Normal)	1327	72.71%	126657	97.29%
Unknown/Not Reported	464	25.42%	716	0.55%
<b>Location of infant care†</b>				
NICU	940	51.51%	11892	9.13%
Nursery only	870	47.67%	-	-
Other	15	0.82%	-	-
<b>Infant length of stay‡</b>				
0-3 days	167	9.15%	-	-
4-7 days	828	45.37%	-	-
8-14 days	267	14.63%	-	-
15-21 days	208	11.40%	-	-
22-28 days	169	9.26%	-	-
>28 days	186	10.19%	-	-

\*Resident live birth data for 2020 are preliminary and are subject to change

†Presented categories are mutually exclusive but 389 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, or it was indicated that the infant received outpatient care. For resident live birth data, admission to the NICU noted on the birth record was used as a proxy.

‡ The infant's length of stay was calculated using the reported date of birth and 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.

Data sources: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 4.** Birth parameters of newborns with neonatal abstinence syndrome (NAS) stratified by maternal race and ethnicity compared to the resident live birth population

Parameter	Maternal Race/Ethnicity									
	Non-Hispanic White		Non-Hispanic Black		Hispanic		Non-Hispanic Multiracial or Native American/Alaska Native*		Unknown/Other	
	n	% of total	n	% of total	n	% of total	n	% of total	n	% of total
<b>NAS Cases (N=1825)</b>	1460	80.00%	120	6.58%	94	5.15%	70	3.84%	81	4.44%
<b>Birthweight (grams)</b>										
Very low or low birthweight (<2500g)	273	18.70%	39	32.50%	19	20.21%	18	25.71%	32	39.51%
Normal birthweight (≥2500g)	1187	81.30%	81	67.50%	75	79.79%	52	74.29%	49	60.49%
<b>Gestational age at birth</b>										
Preterm (<37 weeks)	230	15.75%	36	30.00%	19	20.21%	11	15.71%	29	35.80%
Full-term (≥37 weeks)	1228	84.11%	83	69.17%	75	79.79%	59	84.29%	52	64.20%
Unknown	2	0.14%	1	0.83%	0	0.00%	0	0.00%	0	0.00%
<b>Pennsylvania Resident Live Births (N=130187)</b>	84184	64.66%	18837	14.47%	16647	12.79%	-	-	10519	8.08%
<b>Birthweight (grams)</b>										
Very low or low birthweight (<2500g)	5523	6.56%	2595	13.78%	1377	8.27%	-	-	-	-
Normal birthweight (≥2500g)	78661	93.44%	16242	86.22%	15270	91.73%	-	-	-	-
<b>Gestational age at birth</b>										
Preterm (<37 weeks)	6924	8.22%	2480	13.17%	1652	9.92%	-	-	-	-
Full-term (≥37 weeks)	76968	91.43%	16298	86.52%	14954	89.83%	-	-	-	-
Unknown	292	0.35%	59	0.31%	41	0.25%	-	-	-	-

\*Births among people identifying as non-Hispanic multiracial or non-Hispanic American Indian/Alaska Native were merged due to small numbers. Preliminary 2020 resident live birth data were not available for all categories of race/ethnicity  
 Data sources: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 5.** Select maternal characteristics of birthing people with a newborn with neonatal abstinence syndrome (NAS) as compared to Pennsylvania resident live births

Characteristic	People who gave birth to a newborn with NAS*		Pennsylvania Resident Live Births (2020)†		
	N	% of total birthing people‡	N	% of total births	
Total	1803		130187		
<b>Maternal age (years)</b>					
	≤19	11	0.61%	4904	3.77%
	20-34	1409	78.15%	100144	76.92%
	35+	383	21.24%	25121	19.30%
	Unknown	-	-	18	0.01%
<b>Maternal race/ethnicity^</b>					
	Non-Hispanic Black	118	6.54%	18837	14.5%
	Non-Hispanic White	1442	79.98%	84184	64.7%
	Non-Hispanic Multiracial or American Indian/Alaska Native	69	3.83%	-	-
	Hispanic	94	5.21%	16647	12.80%
	Unknown/Not Reported	80	4.44%	-	-
<b>Principal source of payment at delivery</b>					
	Medicaid	837	46.42%	43735	33.59%
	Private Insurance	93	5.16%	73091	56.14%
	Self-Pay	6	0.33%	6111	4.69%
	Uninsured	5	0.28%	-	-
	Other	10	0.55%	2486	1.91%
	Unknown/Not Reported	852	47.25%	4764	3.66%
<b>Prenatal care initiation</b>					
	Initiated prenatal care	1513	83.92%	123532	94.90%
	No prenatal care	185	10.26%	2227	1.70%
	Unknown	105	5.82%	4428	3.40%
<b>Received medication-assisted treatment during pregnancy</b>					
	Yes	1022	56.68%	-	-
	No	267	14.81%	-	-
	Unknown/Not Reported	514	28.51%	-	-
<b>Maternal substance use in the 4 weeks prior to delivery</b>					
	Yes	1695	94.01%	-	-
	No	108	5.99%	-	-
<b>Specific substances used/reported‡</b>					
	Alcohol	24	1.33%	-	-
	Tobacco/E-cigarettes	316	17.53%	-	-
	Marijuana/Hash	357	19.80%	-	-
	Opioids/Opiate‡	1640	90.96%	-	-
	Benzodiazepines	120	6.66%	-	-
	Barbiturates	8	0.44%	-	-
	Other Substances‡	441	24.46%	-	-

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

† Resident live birth data for 2020 are preliminary and are subject to change

‡ Frequencies by specific substances do not sum to 100% as categories are not mutually exclusive. Polysubstance use was common with 54% of people using more than one of the substances listed in the four weeks prior to pregnancy (913 of 1695).

^ Births among people identifying as non-Hispanic multiracial or Non-Hispanic American Indian/Alaska Native were merged

‡ Opioids/opiates include Buprenorphine (Subutex or suboxone), Methadone, Codeine, Fentanyl, Heroin, Hydrocodone, Hydromorphone, Hydromorphone, Meperidine, Morphine, Opiates, Oxycodone, Propoxyphene, or Tramadol; Other substances include Amphetamines, Antidepressants, Antipsychotics, Bupropion (e.g., Wellbutrin), Cocaine, Gabapentin, Hallucinogens/inhalants, Kratom, Methamphetamine, or Phencyclidine

Data sources: Neonatal Abstinence Syndrome Surveillance Program - Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 6.** Initiation of prenatal care and receipt of medication assisted treatment during pregnancy among birthing people with a newborn with neonatal abstinence syndrome (NAS)

People who gave birth to a newborn with NAS				
Medication-Assisted Treatment During Pregnancy				
Prenatal Care	N	Yes	No	Unknown/Not Reported
Initiated prenatal care	1513	932 (61.60%)	180 (11.90%)	401 (26.50%)
No prenatal care	185	49 (26.49%)	66 (35.68%)	70 (37.84%)
Unknown	105	41 (39.05%)	21 (20.00%)	43 (40.95%)
<b>Total</b>	<b>1803</b>	<b>1022 (56.68%)</b>	<b>267 (14.81%)</b>	<b>514 (28.51%)</b>

Data sources: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 7.** Initiation of prenatal care and receipt of medication assisted treatment during pregnancy among birthing people with a newborn with neonatal abstinence syndrome (NAS) stratified by maternal race/ethnicity

People who gave birth to a newborn with NAS										
Maternal race/ethnicity										
Characteristic	Non-Hispanic White		Non-Hispanic Black		Non-Hispanic Multiracial or American Indian/Alaska Native*		Hispanic		Unknown	
	n	%	n	%	n	%	n	%	n	%
Total (N=1803)	1442	79.98%	118	6.54%	69	3.83%	94	5.21%	80	4.44%
<b>Prenatal Care</b>										
Initiated prenatal care	1238	85.85%	90	76.27%	58	84.06%	76	80.85%	51	63.75%
No prenatal care	131	9.08%	19	16.10%	8	11.59%	5	5.32%	22	27.50%
Unknown	73	5.06%	9	7.63%	3	4.35%	13	13.83%	7	8.75%
<b>Maternal medication-assisted treatment during pregnancy</b>										
Yes	868	60.19%	40	33.90%	39	56.52%	50	53.19%	25	31.25%
No	169	11.72%	44	37.29%	12	17.39%	24	25.53%	18	22.50%
Unknown	405	28.09%	34	28.81%	18	26.09%	20	21.28%	37	46.25%

\*Births among people identifying as non-Hispanic multiracial or Non-Hispanic American Indian/Alaska Native were merged due to small numbers

Data sources: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 8.** Select characteristics of birthing people with a newborn reported to the neonatal abstinence syndrome (NAS) surveillance system in 2020 and a prior birth to a newborn with NAS between 2018-2019 as compared to characteristics of birthing people with no prior birth to a newborn with NAS during that period

People who gave birth to a newborn with NAS			
	Prior birth to newborn with NAS during 2018-2019	No prior birth to newborn with NAS during 2018-2019	p-value
Total (N=1803)	174 (9.65%)	1629 (90.35%)	
<b>Received MAT During Pregnancy</b>			
Yes	115 (66.09%)	907 (55.68%)	0.04
No	21 (12.07%)	246 (15.10%)	
Unknown	38 (21.84%)	476 (29.22%)	
<b>Referred for MAT at Discharge</b>			
Yes	87 (50.00%)	786 (48.25%)	0.70
No	87 (50.00%)	843 (51.75%)	
<b>Interpregnancy Interval*</b>			
<6 months	32 (18.39%)	N/A	
6-17 months	111 (63.79%)	N/A	
≥18 months	31 (17.82%)	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 birthing person; other pregnancies that may not have resulted in a live birth or an infant with NAS during the 2018-2019 time period were not reported or known and, therefore, were not considered. 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 or 2019 to estimate interpregnancy interval in months.

Interpregnancy interval for birthing 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 MAT and a prior birth to an infant with NAS

Data sources: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 9A.** Laboratory testing for in utero exposure to substances and results among newborns with neonatal abstinence syndrome (NAS)

	NAS Cases	
	N	% of total NAS cases
Total NAS Cases	1825	100%
<b>Testing for substance exposure</b>		
Not tested	179	9.81%
Tested	1646	90.19%
<b>Testing results (n=1646)</b>		
Tested - Negative Result	218	13.24%
Tested - Results Unknown or Pending	97	5.89%
Tested - Positive for Any Substance	1331	80.86%

\*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 newborns as these results may be used to ascertain whether the newborn 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: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 9B.** Substance-specific results of laboratory testing of biological samples among newborns with neonatal abstinence syndrome tested for in utero exposure

	NAS Cases	
	N	% of tested NAS cases with positive test result
Total NAS cases with positive test result	1331	100.00%
<b>Positive result by substance*</b>		
Positive test result for any opioid	1205	90.53%
Positive test result for benzodiazepines	54	4.06%
Positive test result for barbiturates	2	0.15%
Positive test result for other substance	271	20.36%
<b>Maternal medication-assisted treatment during pregnancy</b>		
Parent received MAT	723	54.32%
Parent did not receive MAT	200	15.03%
Unknown	408	30.65%

\*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: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 10A.** Scoring method for identification of neonatal abstinence syndrome (NAS) and reporting of clinically compatible symptoms among newborns with NAS

	NAS Cases	
	N	% of total NAS cases
Total NAS Cases	1825	100%
<b>Scoring method</b>		
Finnegan/Modified Finnegan Only	1509	82.68%
Eat, Sleep, Console Only	268	14.68%
Finnegan/ Modified Finnegan and Eat, Sleep, Console	10	0.55%
None	38	2.08%
<b>Clinically compatible symptoms of NAS</b>		
Symptoms Not Documented/Unable to Assess Symptoms	60	3.29%
Symptomatic	1765	96.71%

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 10B.** Clinically compatible symptoms of neonatal abstinence syndrome (NAS) exhibited among symptomatic newborns

	NAS Cases	
	N	% of symptomatic NAS cases
Total symptomatic NAS cases	1765	100.00%
<b>Number of symptoms reported</b>		
1-2 symptoms	246	13.94%
3 or more symptoms	1519	86.06%
<b>Frequency of reported symptoms*</b>		
Body shakes (tremors)	1314	74.45%
Seizures (convulsions)	4	0.23%
Hyperactive moro reflex	352	19.94%
Myoclonus (including hiccups)	40	2.27%
Hypertonia (Elevated muscle tone)	1293	73.26%
Continuous, excessive, or high-pitched cry/inability to console	761	43.12%
Poor feeding (including poor or excessive suck)	1109	62.83%
Tachypnea/Respiratory distress	793	44.93%
Fever	768	43.51%
Blotchy skin/mottling	407	23.06%
Poor sleep	1049	59.43%
Lots of yawning	154	8.73%
Loose stools	726	41.13%
Vomiting/Regurgitation	388	21.98%
Nasal congestion	322	18.24%
Sneezing	804	45.55%
Skin abrasions or excoriation	427	24.19%

\*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 85 cases (4.66%) and included: sweating, nasal flaring, weight loss, jaundice, touch sensitivity, flailing, temperature instability, hyperthermia, head lag, poor weight gain, hand salute, hypoglycemia, and failure to thrive.

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 11A.** Type of treatment received among newborns with neonatal abstinence syndrome (NAS)

	NAS Cases	
	N	% of total NAS cases reported
Total NAS Cases	1825	100%
<b>Infant treatment</b>		
Pharmacologic treatment	542	29.70%
Pharmacologic and non-pharmacologic treatment	144	7.89%
Non-pharmacologic treatment	455	24.93%
No treatment	522	28.60%
Unknown/Not Reported	162	8.88%

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 11B.** Type of treatment received among newborns with neonatal abstinence syndrome (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	(%)	
<b>Maternal Race/Ethnicity</b>										
Non-Hispanic Black	120	40	33.33%	39	32.50%	29	24.17%	12	10.00%	
Non-Hispanic White	1460	541	37.05%	370	25.34%	427	29.25%	122	8.36%	
Non-Hispanic Multiracial or American Indian/Alaskan Native*	70	23	32.85%	16	22.86%	21	30.00%	10	14.29%	
Hispanic	94	38	40.43%	17	18.09%	32	34.04%	7	7.45%	
Unknown/Not Reported	81	44	54.32%	13	16.05%	13	16.05%	11	13.58%	
<b>Principal source of payment at delivery</b>										
Medicaid	847	353	41.68%	174	20.54%	270	31.88%	50	5.90%	
Private insurance	93	28	30.11%	31	33.33%	28	30.11%	6	6.45%	
Self-pay	6	1	16.67%	0	0.00%	3	50.00%	2	33.33%	
Uninsured	5	3	60.00%	2	40.00%	0	0.00%	0	0.00%	
Other	11	5	45.45%	5	45.45%	1	9.09%	0	0.00%	
Unknown/Not Reported	863	296	34.30%	243	28.16%	220	25.49%	104	12.05%	

\*Births among people identifying as non-Hispanic multiracial or non-Hispanic American Indian/Alaska Native were merged due to small numbers.

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 11C.** Medications administered among newborns with neonatal abstinence syndrome (NAS) that received pharmacologic treatment

	NAS Cases	
	N	% of NAS cases that received pharmacologic treatment
Total NAS cases that received pharmacologic treatment	686	100%
<b>Medications administered *</b>		
Morphine	632	92.13%
Clonidine	80	11.66%
Methadone	9	1.31%
Phenobarbital	63	9.18%
Other drug (unspecified)	47	6.85%
<b>Number of medications administered†</b>		
Single medication (morphine)	552	80.47%
Multiple medications	134	19.53%

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

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 11D.** Scoring method and score by newborn treatment type among newborns with neonatal abstinence syndrome (NAS)

Scoring method	N	NAS Cases - Treatment					
		Received		No		Unknown/Not Reported	
		Pharmacologic Treatment		Pharmacologic Treatment		n	(%)
		n	(%)	n	(%)	n	(%)
Finnegan/ ModifiedFinnegan	1519	632	41.61%	768	50.56%	119	7.83%
Highest Score							
0-7	450	23	5.11%	391	86.89%	36	8.00%
8-12	655	263	40.15%	335	51.15%	57	8.70%
13-16	335	281	83.88%	31	9.25%	23	6.87%
17-20	68	55	80.88%	10	14.71%	3	4.41%
>20	11	10	90.91%	1	9.09%	0	0.00%
Eat, Sleep, Console Only	268	52	19.40%	179	66.79%	37	13.81%
Not reported	38	2	5.26%	30	78.95%	6	15.79%

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 12.** Birth parameters and other characteristics of newborns with neonatal abstinence syndrome (NAS) stratified by hospital length of stay

	NAS Cases						
	N	Infant Length of Stay*				n	(%)
		0-7 days		>7 days			
		n	(%)	n	(%)		
Total NAS cases	1825	995	54.52%	830	45.48%		
<b>Birthweight (grams)</b>							
Very low birthweight (<1500g)	29	1	3.45%	28	96.55%		
Low birthweight (1500-2499g)	352	135	38.35%	217	61.65%		
Normal birthweight (≥2500g)	1444	859	59.49%	585	40.51%		
<b>Gestational age at birth</b>							
Preterm (<37 weeks)	325	98	30.15%	227	69.85%		
Full-term (≥37 weeks)	1497	897	59.92%	600	40.08%		
Unknown	3	0	-	3	100.00%		
<b>Scoring method</b>							
Eat, Sleep, Console	278	200	71.94%	78	28.06%		
Finnegan or ModifiedFinnegan only	1509	769	50.96%	740	49.04%		
None	38	26	68.42%	12	31.58%		
<b>Infant treatment</b>							
Received pharmacologic treatment	686	55	8.02%	631	91.98%		
No pharmacologic treatment	977	828	84.75%	149	15.25%		
Unknown/Not Reported	162	112	69.14%	50	30.86%		
<b>Infant care location</b>							
NICU care	940	257	27.34%	683	72.66%		
No NICU care (Nursery or Other)	885	738	83.39%	147	16.61%		

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

\*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.

**Table 13.** Characteristics of discharge plan and referrals among newborns with neonatal abstinence syndrome (NAS)

<b>NAS Cases</b>			
	<b>N</b>	<b>% of total NAS cases</b>	
Total NAS cases	1825	100.00%	
<b>ChildLine notification</b>			
Yes	1542	84.49%	
No	283	15.51%	
<b>Plan of safe care initiated</b>			
Yes	1027	56.27%	
No	798	43.73%	
<b>Discharged to</b>			
Parent	1430	78.36%	
Children and Youth Services/Foster System	181	9.92%	
Other/Unknown*	214	11.73%	
<b>Referral†</b>			
Early Intervention	449	24.60%	
Home visiting services	394	21.59%	
Medical home	50	2.74%	
Pediatrician experienced with NAS	564	30.90%	
High-risk infant follow-up clinic	78	4.27%	
Developmental assessment Clinic	231	12.66%	
Other/Unknown‡	517	28.33%	

\* The Other/Unknown category includes newborns with NAS that were not discharged at the time that the case report was made and for whom the discharge person was unknown, not reported, or unspecified

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

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

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 14.** Characteristics of maternal discharge plan and referrals among birthing people with a newborn with neonatal abstinence syndrome (NAS)

<b>People who gave birth to a newborn with NAS</b>		
	<b>N</b>	<b>% of total</b>
Total Birthing People	1803	100%
<b>Referrals</b>		
Medication Assisted Treatment	873	48.42%
Parenting support	108	5.99%
Care for substance use	173	9.60%
Community support program	146	8.10%
Home visiting services	127	7.04%
Other behavioral health services	89	4.94%
Other/Unknown*	919	50.97%

\*The other category includes referral to other services such as WIC, Children and Youth, care management, and addiction/pain treatment services. Birthing people who were not discharged at the time of the report or for whom referrals were unknown or not reported are also included.

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health)

**Table 15.** Neonatal abstinence syndrome (NAS) cases reported by county of hospital and by maternal residence

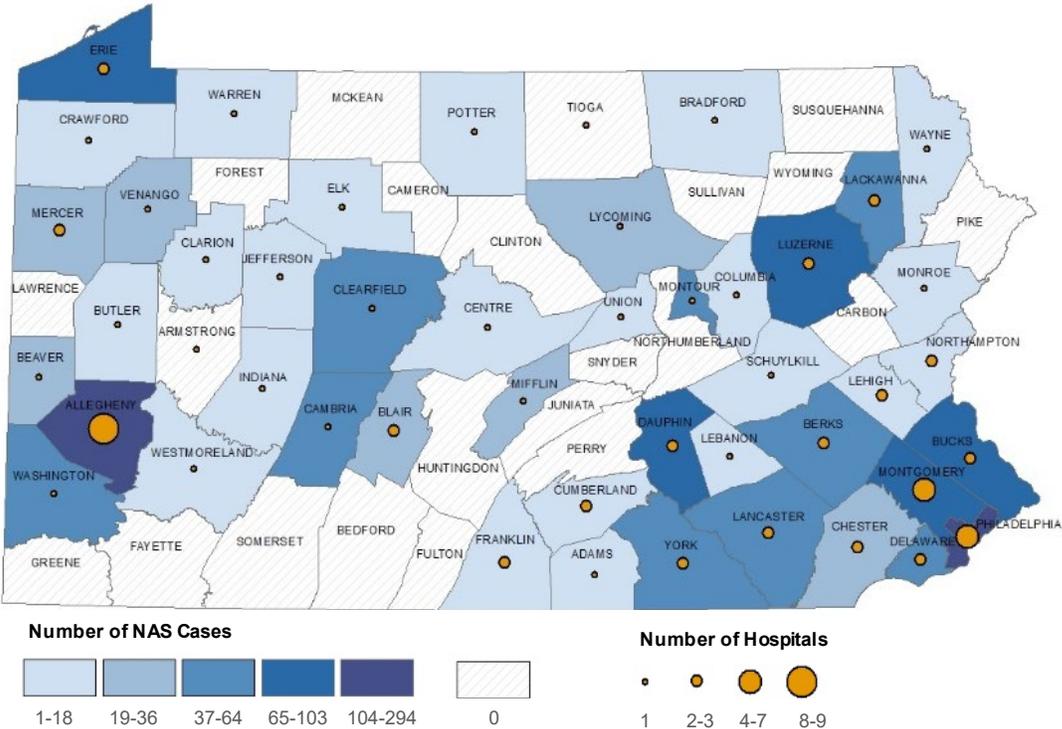
County	Hospitals	NAS Cases Reported by County of Hospital		NAS Cases Reported by County of Maternal Residence	
	N	N	% of total NAS cases	N	% of total NAS cases
Total	90	1825		1825	
ADAMS	1	2	0.11%	14	0.77%
ALLEGHENY	9	294	16.11%	129	7.07%
ARMSTRONG	1	0	0.00%	14	0.77%
BEAVER	1	27	1.48%	27	1.48%
BEDFORD	0	0	0.00%	12	0.66%
BERKS	2	43	2.36%	36	1.97%
BLAIR	2	34	1.86%	22	1.21%
BRADFORD	1	2	0.11%	2	0.11%
BUCKS	3	85	4.66%	92	5.04%
BUTLER	1	4	0.22%	23	1.26%
CAMBRIA	1	64	3.51%	49	2.68%
CAMERON	0	0	0.00%	0	0.00%
CARBON	0	0	0.00%	7	0.38%
CENTRE	1	7	0.38%	3	0.16%
CHESTER	3	25	1.37%	28	1.53%
CLARION	1	2	0.11%	10	0.55%
CLEARFIELD	1	50	2.74%	37	2.03%
CLINTON	0	0	0.00%	9	0.49%
COLUMBIA	1	6	0.33%	7	0.38%
CRAWFORD	1	7	0.38%	23	1.26%
CUMBERLAND	2	18	0.99%	28	1.53%
DAUPHIN	2	85	4.66%	42	2.30%
DELAWARE	3	54	2.96%	79	4.33%
ELK	1	7	0.38%	16	0.88%
ERIE	2	88	4.82%	61	3.34%
FAYETTE	0	0	0.00%	47	2.58%
FOREST	0	0	0.00%	1	0.05%
FRANKLIN	2	9	0.49%	10	0.55%
FULTON	0	0	0.00%	1	0.05%
GREENE	0	0	0.00%	17	0.93%
HUNTINGDON	0	0	0.00%	2	0.11%
INDIANA	1	5	0.27%	13	0.71%
JEFFERSON	1	4	0.22%	6	0.33%
JUNIATA	0	0	0.00%	6	0.33%

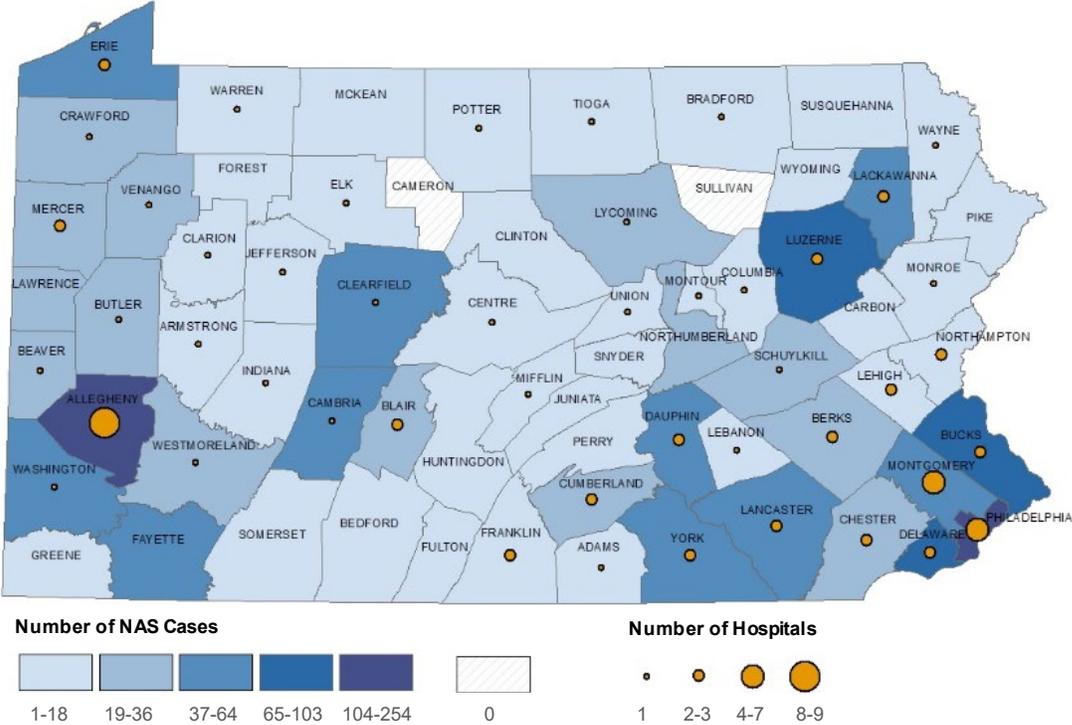
County	Hospitals	NAS Cases Reported by County of Hospital		NAS Cases Reported by County of Maternal Residence	
	N	N	% of total NAS cases	N	% of total NAS cases
LACKAWANNA	2	42	2.30%	47	2.58%
LANCASTER	3	47	2.58%	48	2.63%
LAWRENCE	0	0	0.00%	35	1.92%
LEBANON	1	6	0.33%	17	0.93%
LEHIGH	3	13	0.71%	15	0.82%
LUZERNE	3	95	5.21%	86	4.71%
LYCOMING	1	32	1.75%	33	1.81%
MCKEAN	0	0	0.00%	6	0.33%
MERCER	2	36	1.97%	24	1.32%
MIFFLIN	1	21	1.15%	18	0.99%
MONROE	1	14	0.77%	18	0.99%
MONTGOMERY	6	103	5.64%	63	3.45%
MONTOUR	1	59	3.23%	2	0.11%
NORTHAMPTON	3	18	0.99%	9	0.49%
NORTHUMBERLAND	0	0	0.00%	23	1.26%
PERRY	0	0	0.00%	15	0.82%
PHILADELPHIA	7	250	13.70%	254	13.92%
PIKE	0	0	0.00%	6	0.33%
POTTER	1	5	0.27%	3	0.16%
SCHUYLKILL	1	14	0.77%	25	1.37%
SNYDER	0	0	0.00%	5	0.27%
SOMERSET	0	0	0.00%	15	0.82%
SULLIVAN	0	0	0.00%	0	0.00%
SUSQUEHANNA	0	0	0.00%	2	0.11%
TIOGA	1	0	0.00%	6	0.33%
UNION	1	5	0.27%	2	0.11%
VENANGO	1	24	1.32%	26	1.42%
WARREN	1	12	0.66%	9	0.49%
WASHINGTON	1	43	2.36%	48	2.63%
WAYNE	1	10	0.55%	4	0.22%
WESTMORELAND	1	7	0.38%	32	1.75%
WYOMING	0	0	0.00%	6	0.33%
YORK	3	47	2.58%	45	2.47%
UNKNOWN*		-	-	5	0.27%

\*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: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Map 1.** Number of hospitals and reported neonatal abstinence syndrome (NAS) cases by county of hospital



**Map 2.** Number of hospitals and neonatal abstinence syndrome (NAS) cases by county of maternal residence



Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 16.** Neonatal abstinence syndrome (NAS) cases and incidence rate per 1,000 live births by county of maternal residence

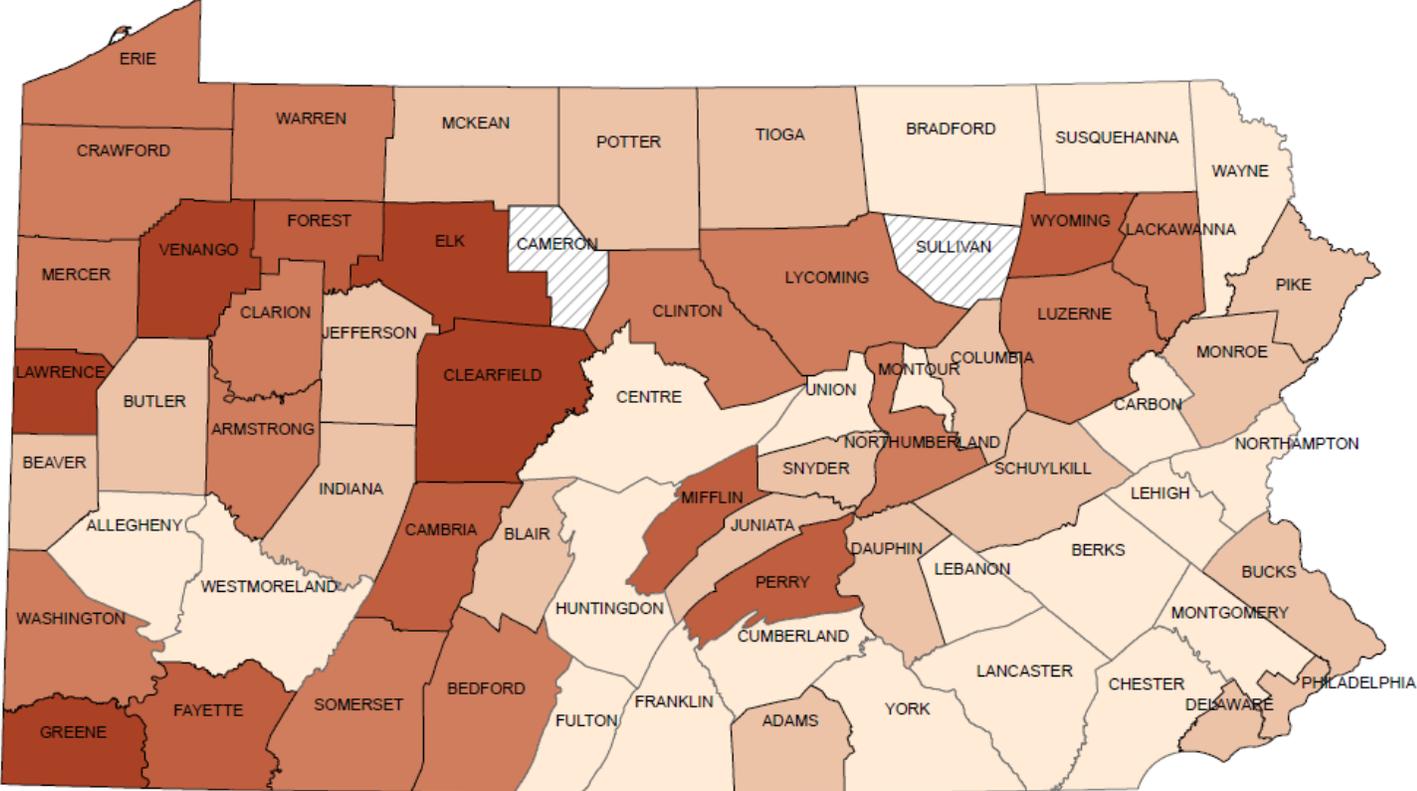
NAS Cases Reported by County of Maternal Residence					NAS Cases Reported by County of Maternal Residence				
County	NAS Cases (N)*	Resident Live Births (2020)†	Rate per 1,000 live births	(95% CI)	County	NAS Cases (N)*	Resident Live Births (2020)†	Rate per 1,000 live births	95% CI
Total	1825	130187	14.0	(13.3, 14.6)	LACKAWANNA	47	2033	23.1	(17.4, 30.6)
ADAMS	14	901	15.5	(9.2, 26.1)	LANCASTER	48	6832	7.0	(5.3, 9.3)
ALLEGHENY	129	12146	10.6	(8.9, 12.6)	LAWRENCE	35	837	41.8	(30.2, 57.7)
ARMSTRONG	14	575	24.3	(14.5, 40.7)	LEBANON	17	1546	11.0	(6.8, 17.6)
BEAVER	27	1536	17.6	(12.1, 25.5)	LEHIGH	15	4065	3.7	(2.2, 6.1)
BEDFORD	12	469	25.6	(14.6, 44.5)	LUZERNE	86	3160	27.2	(22.1, 33.5)
BERKS	36	4347	8.3	(6.0, 11.5)	LYCOMING	33	1168	28.3	(20.2, 39.5)
BLAIR	22	1175	18.7	(12.4, 28.3)	MCKEAN	6	374	16.0	(7.2, 35.2)
BRADFORD	2	637	3.1	(0.8, 12.5)	MERCER	24	1013	23.7	(15.9, 35.1)
BUCKS	92	5438	16.9	(13.8, 20.7)	MIFFLIN	18	526	34.2	(21.7, 53.7)
BUTLER	23	1672	13.8	(9.2, 20.6)	MONROE	18	1407	12.8	(8.1, 20.2)
CAMBRIA	49	1189	41.2	(31.3, 54.1)	MONTGOMERY	63	8251	7.6	(6.0, 9.8)
CAMERON	0	28	0.0	(0.0, 0.1)	MONTOUR	2	219	9.1	(2.3, 35.8)
CARBON	7	601	11.6	(5.6, 24.2)	NORTHAMPTON	9	2764	3.3	(1.7, 6.2)
CENTRE	3	1062	2.8	(0.9, 8.7)	NORTHUMBERLAND	23	874	26.3	(17.5, 39.3)
CHESTER	28	5213	5.4	(3.7, 7.8)	PERRY	15	466	32.2	(19.5, 52.7)
CLARION	10	358	27.9	(15.1, 51.1)	PHILADELPHIA	254	19790	12.8	(11.4, 14.5)
CLEARFIELD	37	676	54.7	(39.9, 74.6)	PIKE	6	399	15.0	(6.8, 33.1)
CLINTON	9	409	22.0	(11.5, 41.7)	POTTER	3	171	17.5	(5.7, 53.0)
COLUMBIA	7	540	13.0	(6.2, 26.9)	SCHUYLKILL	25	1274	19.6	(13.3, 28.9)
CRAWFORD	23	827	27.8	(18.5, 41.5)	SNYDER	5	376	13.3	(5.5, 31.5)
CUMBERLAND	28	2592	10.8	(7.5, 15.6)	SOMERSET	15	615	24.4	(14.8, 40.1)
DAUPHIN	42	3324	12.6	(9.4, 17.1)	SULLIVAN	0	46	0.0	(0.0, 0.1)
DELAWARE	79	6251	12.6	(10.1, 15.7)	SUSQUEHANNA	2	338	5.9	(1.5, 23.3)
ELK	16	252	63.5	(39.3, 101.1)	TIOGA	6	400	15.0	(6.8, 33.0)
ERIE	61	2603	23.4	(18.3, 30.0)	UNION	2	405	4.9	(1.2, 19.5)
FAYETTE	47	1267	37.1	(28.0, 49.0)	VENANGO	26	434	59.9	(41.1, 86.5)
FOREST	1	30	33.3	(4.7, 202.0)	WARREN	9	338	26.6	(13.9, 50.4)
FRANKLIN	10	1610	6.2	(3.3, 11.5)	WASHINGTON	48	1823	26.3	(19.9, 34.8)
FULTON	1	142	7.0	(1.0, 48.3)	WAYNE	4	433	9.2	(3.5, 24.3)
GREENE	17	354	48.0	(30.1, 75.9)	WESTMORELAND	32	2830	11.3	(8.0, 15.9)
HUNTINGDON	2	366	5.5	(1.4, 21.6)	WYOMING	6	206	29.1	(13.1, 63.3)
INDIANA	13	775	16.8	(9.8, 28.7)	YORK	45	4631	9.7	(7.3, 13.0)
JEFFERSON	6	470	12.8	(5.7, 28.1)					
JUNIATA	6	309	19.4	(8.7, 42.5)					

\*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.

†Preliminary 2020 resident live birth data are subject to change

Rates calculated based on 10 or fewer events are not reliable. Please note the wide confidence intervals and interpret these estimates with caution  
 Data sources: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Map 3.** Neonatal abstinence syndrome (NAS) incidence rate per 1,000 live births by county of maternal residence



Rate per 1,000 live births



2.8 - 11.6    11.7- 19.6    19.7 - 29.0    29.1 - 41.7    41.8 - 63.5    0

Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Table 17.** Neonatal abstinence syndrome (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†	
	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)
Southwest	670	26.0 (24.1, 28.0)	438	16.8 (15.2, 18.4)	414	16.7 (15.2, 18.4)
Northcentral	90	14.3 (11.7, 17.6)	85	15.0 (11.8, 18.2)	95	15.1 (12.3, 18.4)
Southcentral	280	15.4 (13.7, 17.3)	244	13.1 (11.5, 14.7)	232	12.8 (11.3, 14.6)
Northeast	198	12.7 (11.0, 14.6)	132	8.2 (6.8, 9.6)	200	13 (11.3, 14.9)
Southeast	618	10.4 (9.6, 11.3)	500	8.4 (7.7, 9.1)	625	10.9 (10.1, 11.8)

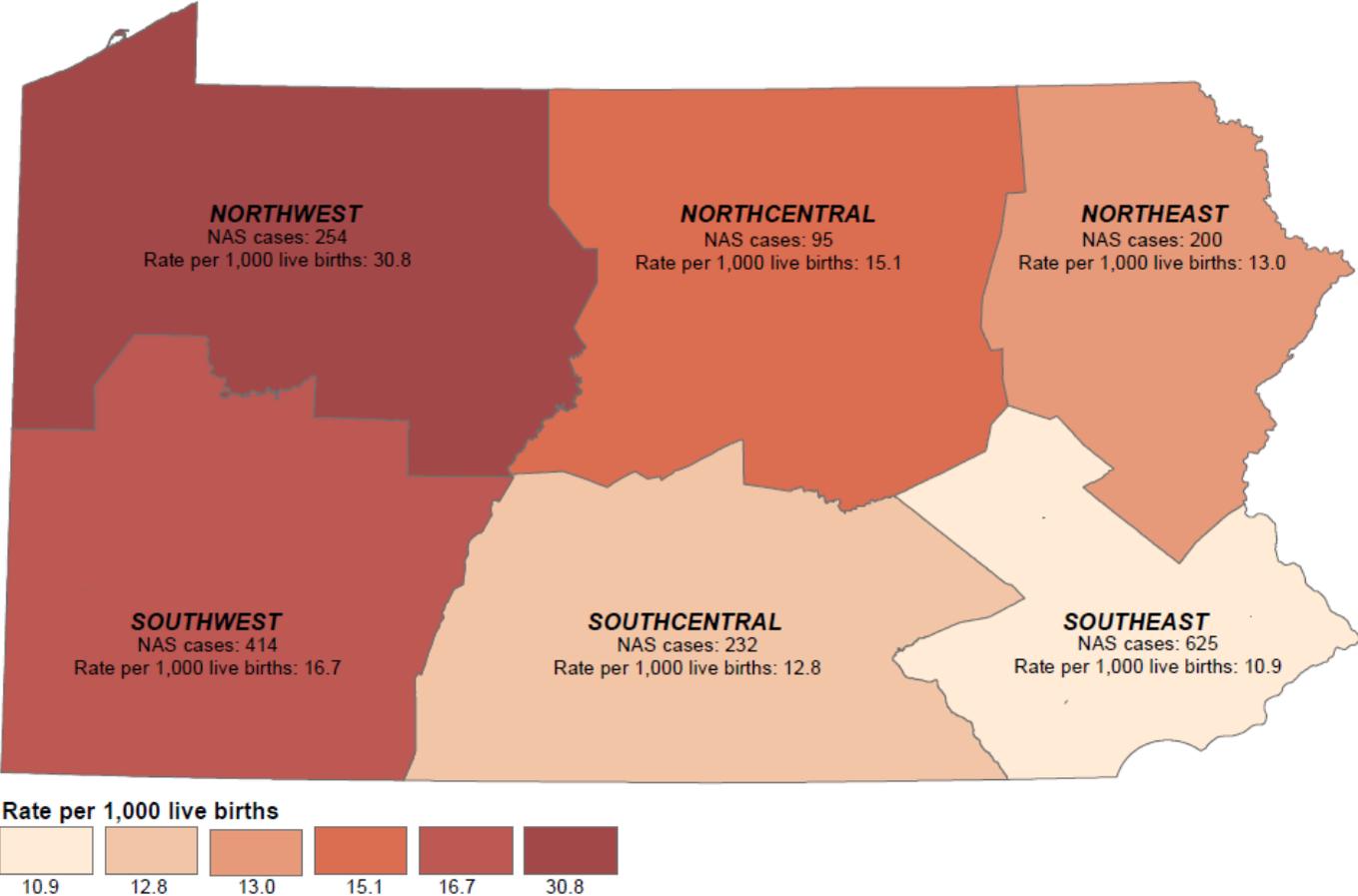
\*2018 incidence rates were calculated using 2017 occurrent resident live birth data; 2019 incidence rates were calculated using 2018 resident live birth data; 2018 and 2019 incidence rates were previously published in 2018 and 2019 Neonatal Abstinence Syndrome Annual Reports; 2020 incidence rates were 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 2020 whereas the case definition in 2018-2019 included solely those newborns with NAS due to 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

A statistically significant increase in the incidence rate of NAS was observed in the Northwest, Northeast, and Southeast regions of the state between 2019 and 2020

Data sources: 2019 Neonatal Abstinence Syndrome Report (Bureau of Epidemiology, Pennsylvania Department of Health), Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

**Map 4.** Neonatal abstinence syndrome (NAS) incidence rate per 1,000 live births by region of maternal residence



Data source: Neonatal Abstinence Syndrome Surveillance Program Database (Bureau of Family Health, Pennsylvania Department of Health), Vital Statistics (Bureau of Health Statistics and Registries, Pennsylvania Department of Health)

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