

# Neonatal Abstinence Syndrome Surveillance Annual Report 2020



Nyakeriga AM and McDonald M  
Tennessee Department of Health  
Division of Family Health and Wellness

### **A Note to the Reader:**

In some cases (particularly in looking at data at the regional level), the counts included in this report are small and therefore may be statistically unreliable. Therefore, readers should interpret all findings with caution. We especially encourage caution in interpreting findings and comparing differences across regions.

If you have questions about data points or need assistance in interpreting the data, please contact Alice M. Nyakeriga, PhD, MPH.

Phone: (615) 253-2655

Email: [alice.nyakeriga@tn.gov](mailto:alice.nyakeriga@tn.gov)

# Table of Contents

List of Tables .....	i
List of Figures .....	ii
Executive Summary .....	1
Introduction .....	2
Statewide Data .....	3
Case Reports .....	3
Number and Rate of Cases .....	3
Source of Exposure for NAS Infants .....	5
Source of Exposure .....	5
Regional Data .....	11
NAS Incidence by Region .....	11
Exposure Source by Region .....	11
Conclusion .....	20
Acknowledgements .....	22
References .....	23
Technical Notes .....	24
Suggested Citation .....	24

# List of Tables

Table 1: Derivation of Mutually Exclusive Categories of Exposure from Individual Exposures  
.....8

# List of Figures

Figure 1: Number of Cases of NAS as a Percentage of Live Births, Tennessee 2013-2020. .... 4

Figure 2: Non-mutually Exclusive Sources of Exposure for NAS Cases, 2017-2020. .... 7

Figure 3: Mutually Exclusive Sources of Exposure for NAS Cases, Tennessee 2016-2020..... 9

Figure 4: Class of Prescription Drug Use Among Those with Prescription Medication  
Exposure Only, 2017-2020..... 10

Figure 5: Rate per 1,000 Live Births of NAS Cases by TDH Health, 2020 ..... 13

Figure 6: NAS Rates by TDH Health Region, 2017-2020..... 14

Figure 7: Rate of NAS Cases by County, 2017 ..... 15

Figure 8: Rate of NAS Cases by County, 2018 ..... 15

Figure 9: Rate of NAS Cases by County, 2019 ..... 16

Figure 10: Rate of NAS Cases by County, 2020 ..... 16

Figure 11: Distribution of Mutually Exclusive Sources of Exposure by Health Region for NAS  
Cases, 2020 ..... 17

Figure 12 A-D: Prevalence of Exposure to Mutually Exclusive Sources among NAS Cases by  
Region, 2017-2020..... 18

Figure 13: Prevalence of Exposure to Medication Assisted Treatment among NAS Cases by  
Region, 2020..... 19

Figure 14: Prevalence of Exposure to Legally Obtained Prescription Medications among NAS  
Cases by Region, 2020 ..... 19

Figure 15: Prevalence of Exposure to Diverted Prescription Medications among NAS Cases  
by Region, 2020 .....19

Figure 16: Prevalence of Exposure to Illicit Drugs among NAS Cases by Region, 2020 ..... 19

# Executive Summary

The dramatic increase in maternal opioid use in the US and Tennessee from 2000-2017 paralleled a ten-fold increase in incidence of babies born with Neonatal Abstinence Syndrome (NAS) in Tennessee. NAS is a condition in which a newborn experiences withdrawal from certain drugs, often opioids, used during pregnancy. The Tennessee Department of Health (TDH) established NAS as a reportable condition on January 1, 2013. Since then Tennessee had seen annual increases in the number of cases of NAS until CY2018, which marked the first decrease in the number of cases. However, the convergence of the opioid epidemic and COVID-19 global pandemic in CY2020 created new health challenges resulting in an uptick in the number of opioid overdoses in addition to stalling the improvement seen in NAS in recent years.

During the CY2020 surveillance period, 824 cases of NAS were reported to the TDH surveillance portal. The rate of NAS increased slightly, following 2 years of consecutive decline. This underscores the negative impact of COVID-19 on efforts to reduce drug use in Tennessee.

## Key Findings

- The number of cases of NAS increased slightly from 810 in 2019 to 824 in 2020.
- The rate of cases of NAS per 1,000 live births had a slight increase from 10.0 in 2019 to 10.2 in 2020.
- The proportion of cases of NAS remained higher in males (52.4%) than females (47.6%) in 2020.
- Most cases of NAS (62%) involved Medication Assisted Treatment (MAT).
- The geographic distribution of cases of NAS varied across the counties of Tennessee. Counties in the east of Tennessee had the highest rate (57.8 cases of NAS per 1,000 live births).
- Type of exposure varied across geographic regions:
  - Exposure to prescription medication was highest in Northeast Tennessee (59.6% of NAS cases) and lowest in Shelby county (17.3%).
  - There was an increase in NAS cases exposed to illicit substances from 25% in 2019 to 29% in 2020. In Shelby County, over 50% of NAS cases were exposed to illicit substances, compared to an average of 25.8% in Eastern Tennessee. In addition, in Shelby County there was an increase in exposure to unknown substances, from 1.9% in 2019 to 13.6% in 2020.

The high percentage of infants diagnosed with NAS still points to the ongoing need for primary prevention of NAS—preventing substance misuse/abuse among women of childbearing age and preventing unintended pregnancies among women at risk of misusing/abusing substances. Further, this report underlines the need for continued targeted preventive measures in counties/regions with the highest burden of cases of NAS.

# Introduction

Neonatal Abstinence Syndrome (NAS) is a condition in which an infant undergoes withdrawal from a substance to which he or she was exposed in-utero. Different classes of substances, including opioids, antidepressants, and barbiturates, may cause NAS when used during pregnancy. The most common substances causing NAS are opioids. This can include legally prescribed opioids (such as pain relievers like morphine and medication assisted treatment opioids such as buprenorphine and methadone) or illegally obtained opioids, e.g., heroin. In addition, a pregnant woman may obtain a substance through drug diversion, i.e. transfer of legally prescribed controlled substance from the individual for whom it was prescribed to another person for any illicit use.

Since the early 2000s, the incidence of NAS in Tennessee increased by 10-fold, far exceeding the national 3-fold increase over the same time. A sub-cabinet working group focused on NAS and consisting of Commissioner-level representation from the Departments of Health, Children's Services, Mental Health and Substance Abuse Services, Medicaid (TennCare), Safety and the Children's Cabinet convened from 2012 to 2019. This group aligned efforts across state agencies, with a focus on upstream (primary) prevention strategies.

In 2013, Tennessee became the first state in the nation to require reporting of NAS for public health surveillance purposes. Providers are required to report all diagnoses of NAS within 30 days of diagnosis. This report provides an analysis of data reported to TDH during CY2020.



# Statewide Data

Highlights: Statewide Reporting
In CY 2020: <ul style="list-style-type: none"><li>• The number of cases increased from 810 in 2019 to 824.</li><li>• More males were diagnosed with NAS than females.</li><li>• The rate of cases of NAS increased slightly from 10.0 in 2019 to 10.2 per 1,000 live births.</li></ul>

## Case Reports

During CY2020, providers reported 824 cases of NAS to the surveillance portal. An additional 366 cases of infants with *in-utero* drug exposure but no clinical signs of withdrawal were also reported; these infants are not included in this analysis as clinical withdrawal is the definitive characteristic of NAS.

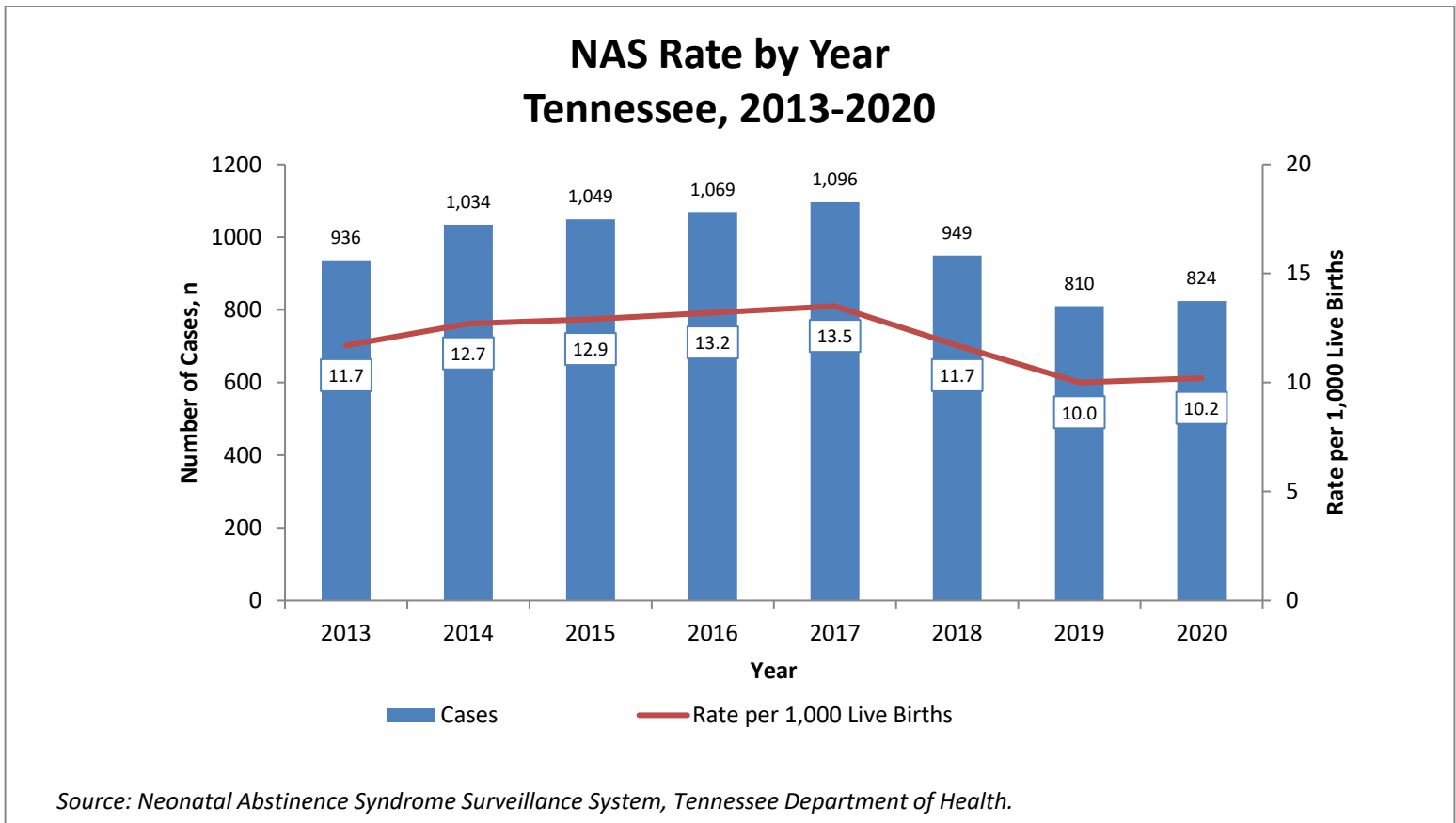
Many cases (94.4%; n=778) were reported by the baby’s birth hospital, and 5.6% (n=46) were reported after the baby was transferred to another facility.

Reported cases of NAS were more likely to be male than female (52.4% versus 47.6%;  $p=0.16$ ). This finding is consistent with previous years of NAS Surveillance data, as well as published literature.<sup>1,2</sup>

The Tennessee Department of Health (TDH) requires that all cases of NAS be reported within 30 days of diagnosis. In 2020, the average length of time between the date of birth and date of reporting was 26.6 days (range 0-230 days), which was a decrease from 30.6 days in 2019. Sixty six percent of cases were reported within 30 days of birth.

## Number and Rate of Cases

In 2020, 1.03% (n=824) of live births were diagnosed with NAS, a slight increase from 1.0% of live births (n=810) in 2019 (See *Technical Note*) (**Figure 1**). During the unprecedented COVID-19 pandemic, the number of NAS cases in CY2020 deviated from the previous two years of declining number of NAS cases. In addition, TDH did not receive any reports of NAS cases from non-Tennessee residents during the CY2020.



**Figure 1: Number of Cases of NAS as a Percentage of Live Births, Tennessee 2013-2020.**

# Source of Exposure for NAS Infants

Highlights: Source of Exposure
In CY 2020: <ul style="list-style-type: none"><li>• 62.0% of infants diagnosed with NAS were exposed to Medication Assisted Treatment (MAT) for treatment of substance use disorder.</li><li>• 65.0% of infants diagnosed with NAS were exposed to at least one legally prescribed medication.</li><li>• 88.4% of NAS infants with exposure to only prescription drugs were exposed to MAT.</li></ul>

## Source of Exposure

The NAS Surveillance System collects nine categories of substances to which an infant was exposed (**Figure 2**). Individual cases could have been exposed to multiple substances; therefore, percentages may sum to greater than 100%. Consistent with previous years' data, most infants were exposed to medications used to treat substance use disorders (medication assisted treatment, MAT; 62.0%). In 2020, 23.5% of infants were exposed to diverted prescription opioid medications, and 11.5% were exposed to diverted prescription non-opioid medications. Overall, exposure to prescription medication (including diverted prescription opioids) decreased from that of 2019.

When categorized into mutually exclusive categories of exposure (**Table 1**), 65.0% of NAS infants were exposed to at least one prescription medication, a decrease from 70.0% in 2019. Forty-six percent of cases were exposed to prescription medications only, and 18.9% were exposed to a mix of prescription and illicit or diverted drugs (**Figure 3**). Another 31.71% were exposed only to illicit or diverted drugs. The remainder (3.3%) had no known exposure, or exposure information was not reported. Overall, the proportion of NAS cases exposed to drugs involving only prescription drugs continued to decrease while those involving only illegal drugs continued to increase.

Since 2013, there was an overall upward trend in the percentage of NAS cases exposed only to prescription medications peaking in 2016 (data not shown). Thereafter, the trend changed course and has continued to show slight but steady decrease over the years with a 3.7 point decrease from 49.8% in 2019 to 46.1% in 2020 ( $p=0.08$ ; **Figure 3**). On the other hand, the proportion of cases exposed to illicit drugs or diverted medications have continued to increase since 2016 to 2020, reaching statistically significant levels ( $p=0.03$ ). Similar trends have been observed for proportions of cases exposed to a mix of illegal and prescription medications ( $p=0.04$ ).

Of those infants with exposure only to prescription medications (**Figure 4**), most (88.4%) were exposed to medication assisted treatment. This percentage has continued to increase since 2016, though the overall percentage of infants exposed to MAT has decreased (**Figure 2**). There was an increase in the proportion of cases of NAS involving prescription medications only. In addition to MAT, 7.8% of prescription-only exposures were to legal non-opioid medications, and 3.8% were to legal opioid medications (**Figure 4**).

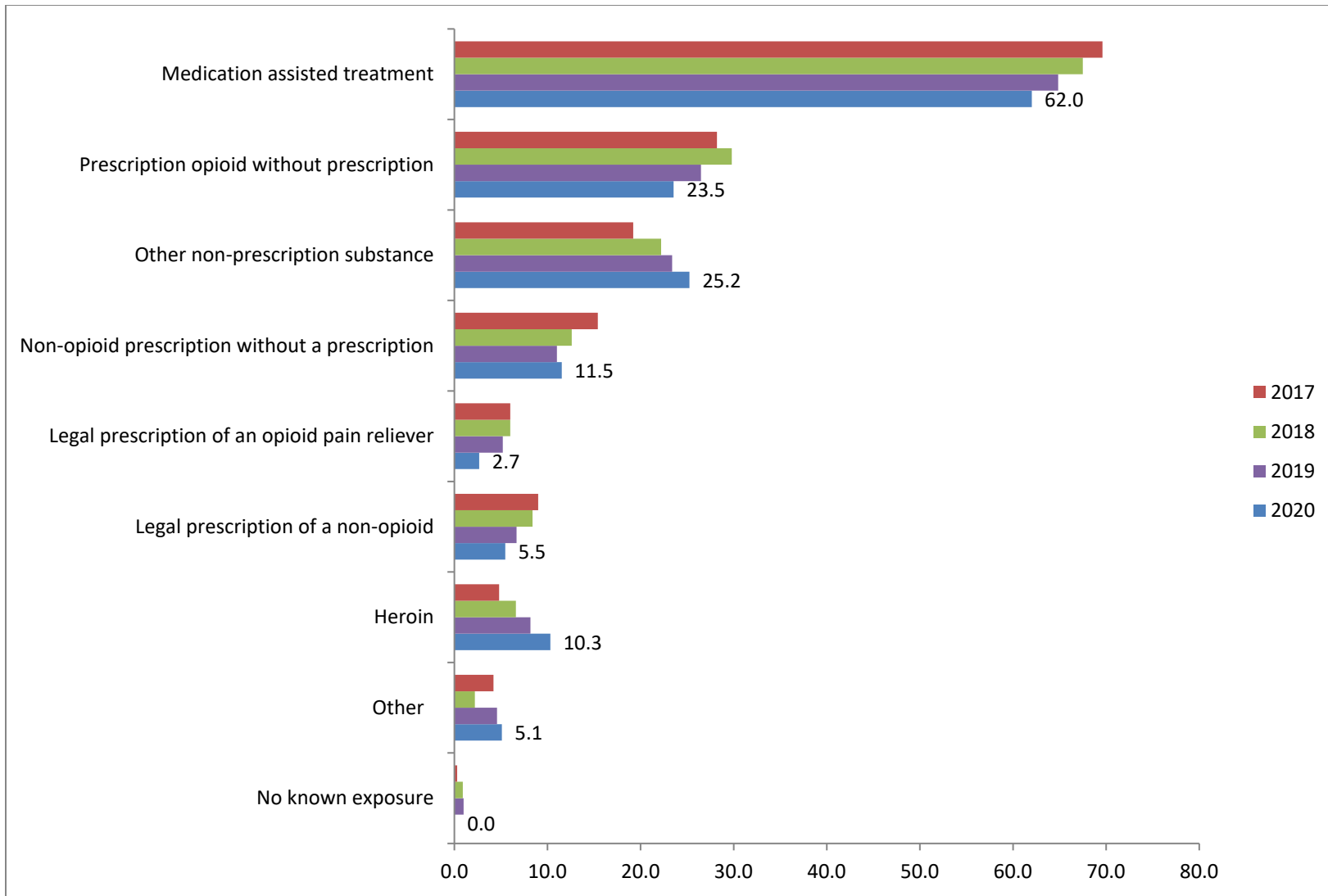
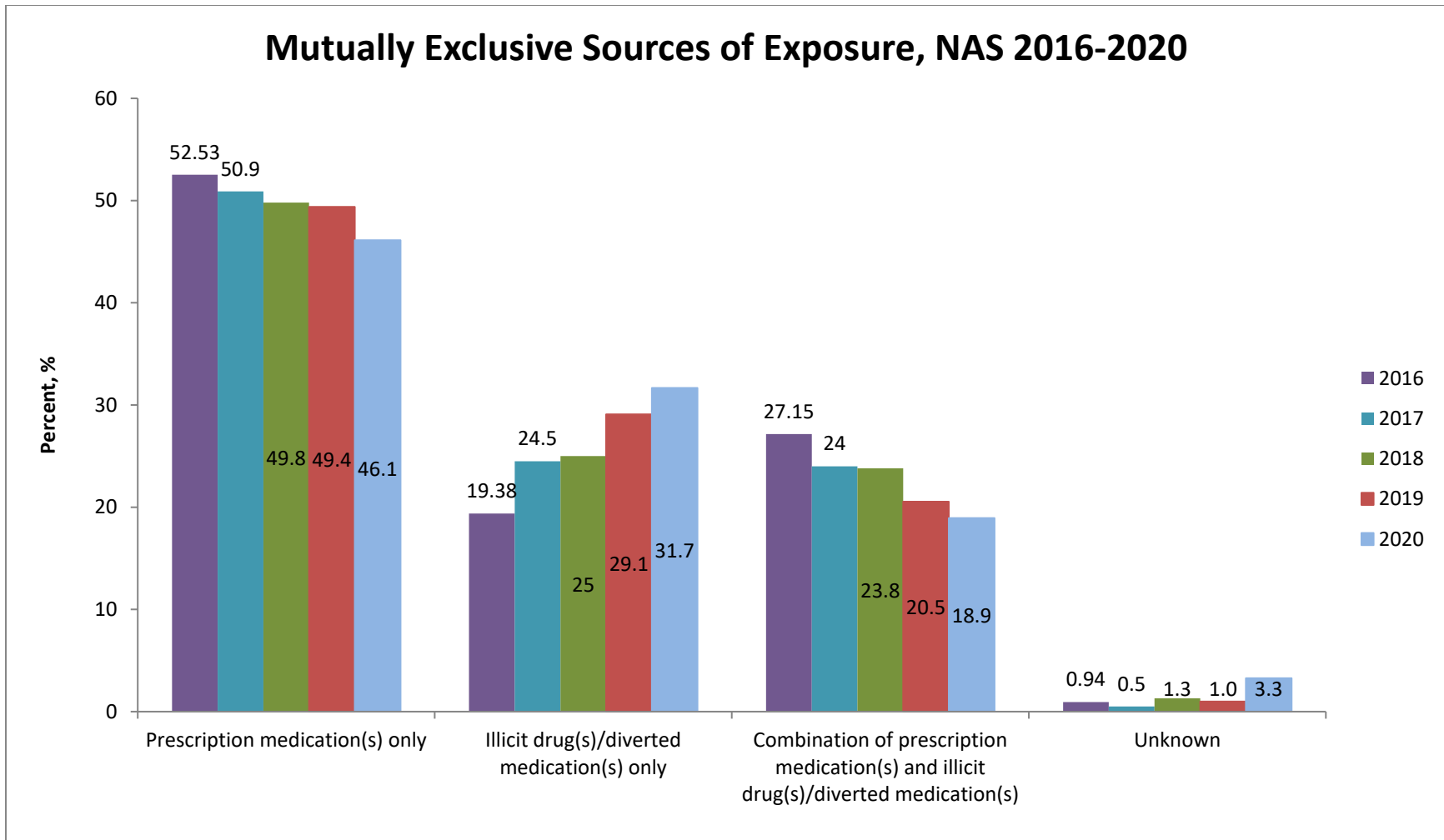


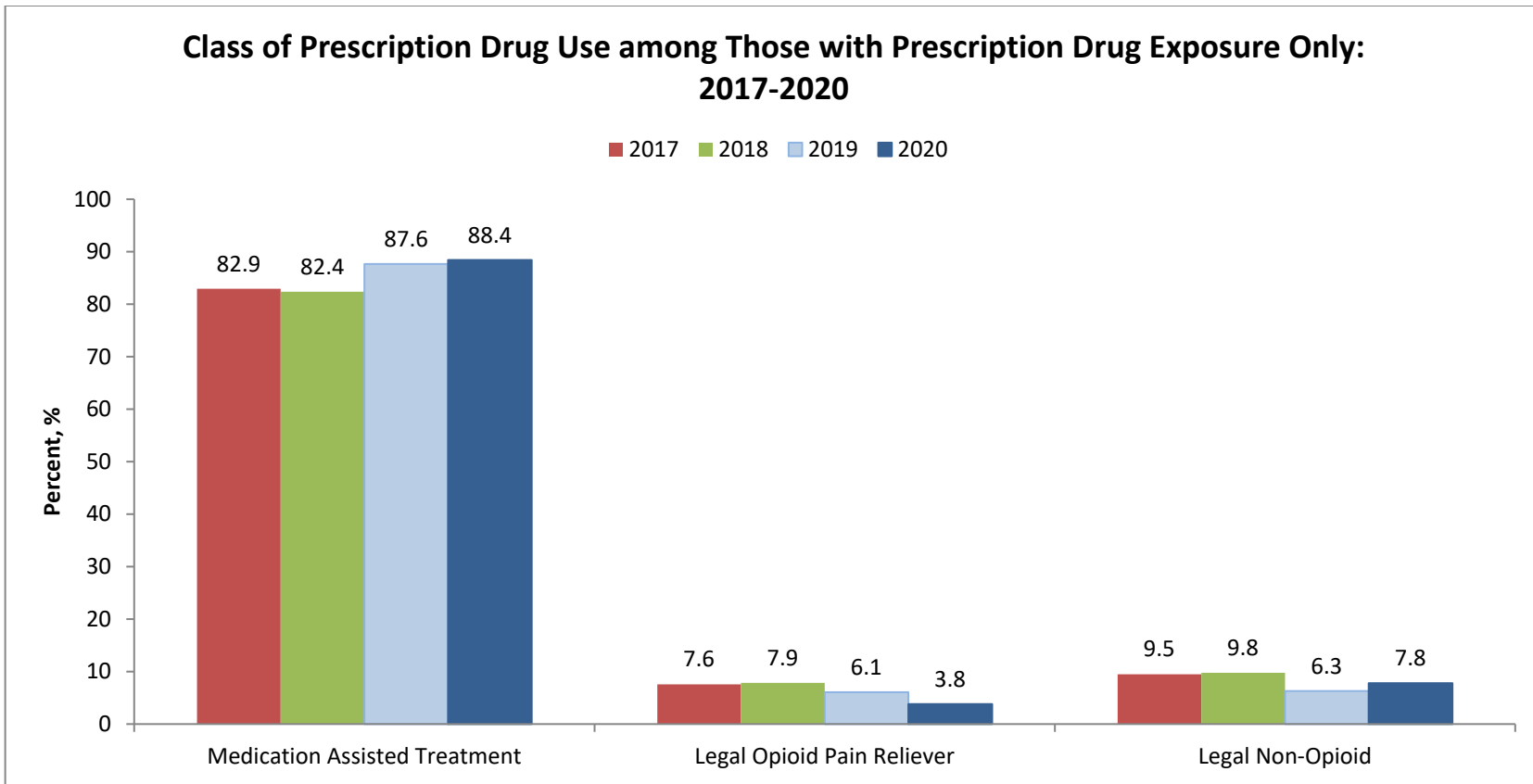
Figure 2: Non-mutually Exclusive Sources of Exposure for NAS Cases, 2017-2020.

**Table 1: Derivation of Mutually Exclusive Categories of Exposure from Individual Exposures**

Prescription Medications Only	Illicit Drugs or Diverted Medications Only	Combination of Prescription Medications and Illicit Drugs/ Diverted Medications	Unknown
<p>Exposure to one or more of the following <b>ONLY</b>:</p> <ul style="list-style-type: none"> <li>• Medication Assisted Treatment (MAT)</li> <li>• Legal prescription of an opioid pain reliever</li> <li>• Legal prescription of a non-opioid medication</li> </ul>	<p>Exposure to one or more of the following <b>ONLY</b>:</p> <ul style="list-style-type: none"> <li>• Prescription opioid medication obtained without a prescription</li> <li>• Non-opioid prescription medication obtained without a prescription</li> <li>• Heroin</li> <li>• Other Illicit drug</li> </ul>	<p>At least one medication from "Prescription Medications Only"</p> <p><b>AND</b></p> <p>At least one substance from "Illicit Drugs or Diverted Medications Only"</p>	<p>"No known source of exposure but clinical signs consistent with NAS" was selected at time of report</p> <p><b>OR</b></p> <p>No exposure options were selected at time of report</p>



**Figure 3: Mutually Exclusive Sources of Exposure for NAS Cases, Tennessee 2016-2020.**



**Figure 4: Class of Prescription Drug Use Among Those with Prescription Medication Exposure Only, 2017-2020.**



# Regional Data

Highlights: Regional Trends for NAS
In CY 2020: <ul style="list-style-type: none"><li>• Overall, rates of cases of NAS increased when moving from west to east across Tennessee.</li><li>• Patterns of exposure source varied, with prescription-only exposures being most common in East Tennessee, and illicit drug only exposure being most common in West Tennessee.</li><li>• The number of infants exposed to heroin decreased by 50% from 2019 in Shelby county.</li></ul>

## ***NAS Incidence by Region***

Rates of cases of NAS varied by health region. Rates of NAS cases were lowest in West Tennessee and increased in an easterly fashion (**Figure 5**). Generally, most regions saw a decrease in the rate of cases of NAS in 2020, when compared to 2019 (**Figure 6**). The East and Upper Cumberland Regions showed a statistically significant overall decrease in the rate of cases of NAS over time ( $p < 0.05$  for both regions). However, Shelby County had an increase in the number and rate of cases of NAS in 2020 from 2019, with an overall statistically significant increase in the rate over time, from 2013 to 2020 ( $p < 0.05$ ).

In 2020, there was an increase in the number of counties that did not report any cases of NAS, from 19 to 22. Data were suppressed for 51 counties because of the small number of cases in each county that could lead to concerns about privacy or statistical validity. From 2017-2020 (**Figure 7 - Figure 10**), rates of cases of NAS in the western portion of the state have continued to decrease or remain low (lighter shades or suppressed on the maps). Similarly, many counties in the West and Southcentral Regions were suppressed. In the eastern part of Tennessee, the rate of cases of NAS remained high, though there were fewer counties with the highest rates (represented by the darkest shade on the map).

## ***Exposure Source by Region***

Geographic variation in the substance causing NAS was noted (**Figure 11 & 12 A-D**). Like the geographic distribution of the rate of cases of NAS, exposure to prescription medications increased from West Tennessee to East Tennessee (Figure 12A). In East Tennessee, prescription medication(s) was identified as the source of exposure in 59.6% of

cases of NAS in the Northeast Region and 55.3% of NAS cases in Sullivan County. In contrast, prescription medication(s) was identified as the source of exposure in 17.3% of cases in Shelby County. Exposure to illicit drugs only is more common in West Tennessee (over 55.6% of cases in Shelby County and 41.7% of cases in the West Health Region), and less common in East Tennessee (**Figure 12C**). Overall, the distribution of prescription and illicit/diverted drug combination remained similar from West to East Tennessee (**Figure 12B**).

Exposure to medication assisted treatment (MAT) varied geographically, ranging from 25.9% in West Tennessee (Shelby County) to 75.0% in the East Health Region (**Figure 13**).

In 2020, the use of legally obtained medications as the source of exposure was less common statewide and decreased from 2019 (with an average of 2.6%, range of 0-8.3%, for opioid medications and an average of 3.9%, range of 0-12.1% for non-opioid medications). It is important to note, however, that the East Health Region saw the highest increase (10.3 percentage points) in NAS cases exposed to legally obtained non-opioids (**Figure 14**). The West to East geographic gradients seen with other exposure categories is less evident with diverted medications. However, exposure to diverted opioid medications was more common than diverted non-opioid medications. The highest proportion of cases of NAS exposed to diverted opioids was observed in Shelby, Davidson and Knox Counties, and the Mid-Cumberland and East Regions (**Figure 15**). Exposure of NAS cases to heroin remained less than 10.3% of cases of NAS (n=85) and varied across the state. In 2020, Knox and Davidson Counties saw an increase in the number of NAS cases exposed to heroin, 22.8% and 22.7% (**Figure 16**), compared to 17.3% and 17.9% in 2019, respectively. In Shelby County, the number of NAS cases exposed to heroin decreased from 37.3% in 2019 to 18.5% in 2020. Similarly, exposure to other illicit substances varied across the state; the prevalence was highest in Shelby and Hamilton Counties.

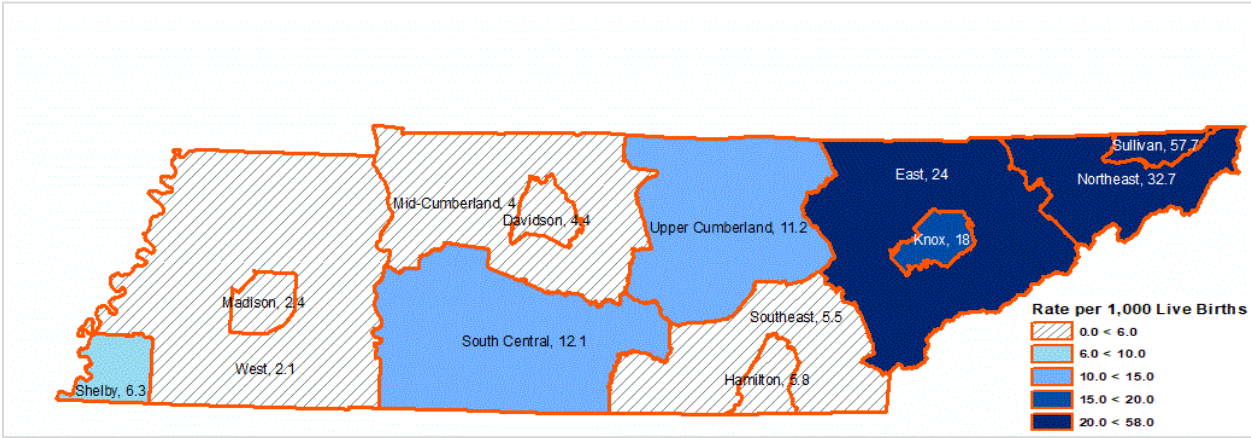
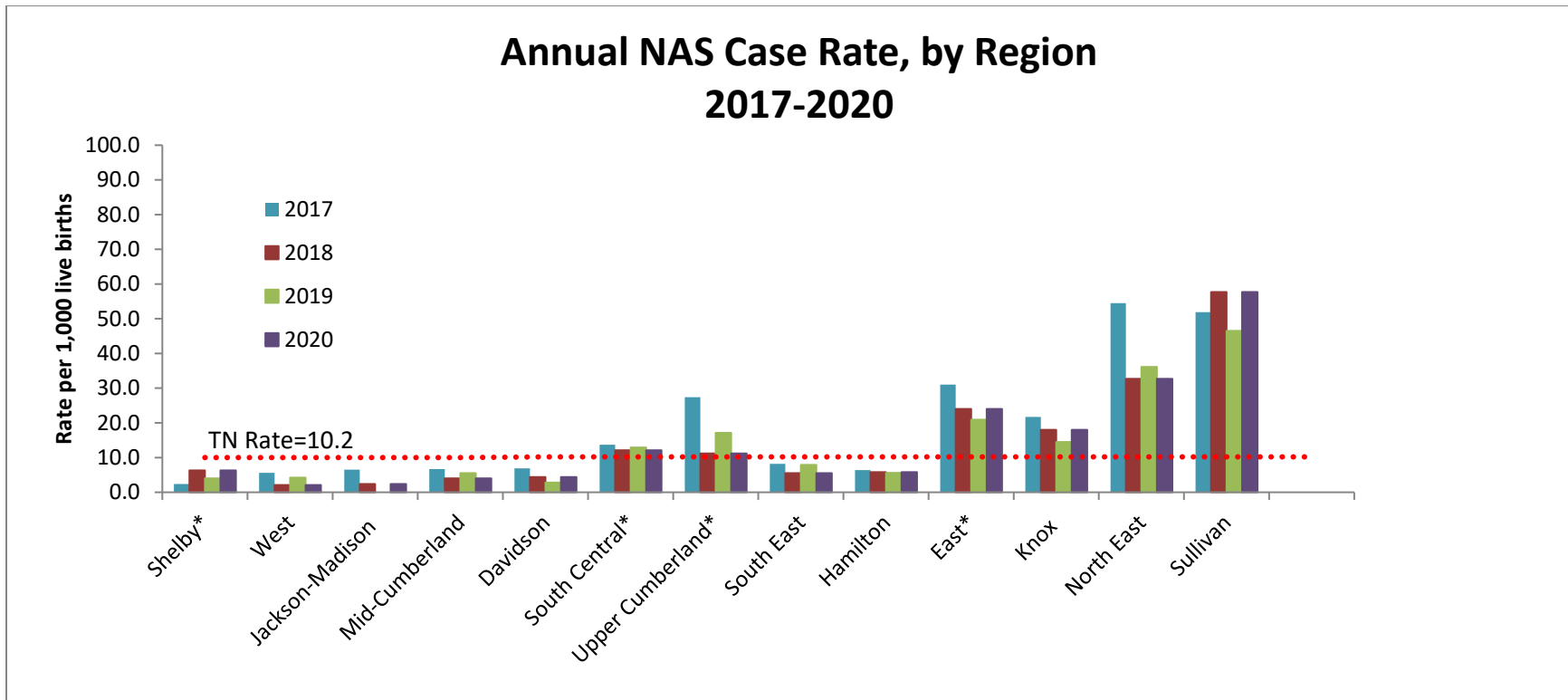


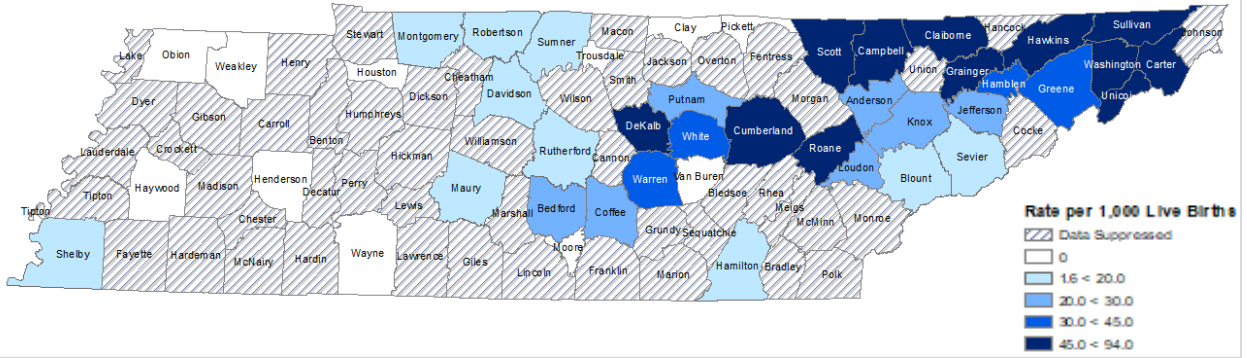
Figure 5: Rate per 1,000 Live Births of NAS Cases by TDH Health Region, 2020



**Figure 6: NAS Rates by TDH Health Region, 2017-2020.**

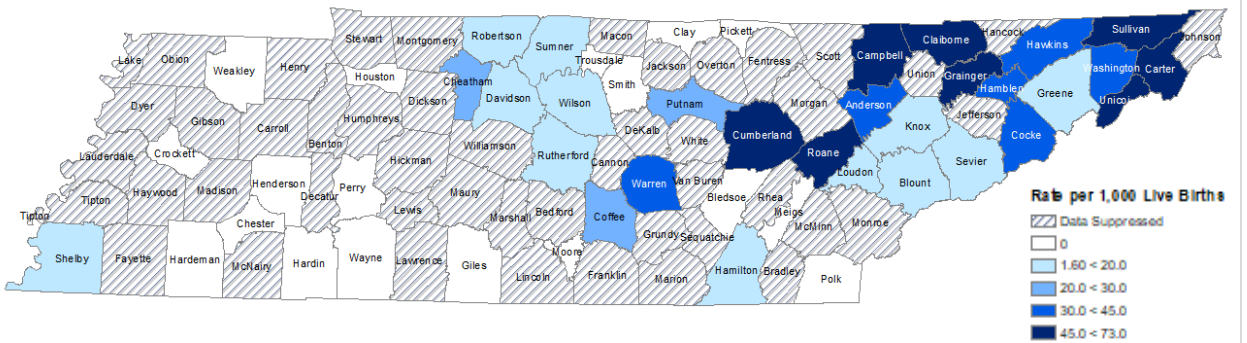
\* Regions/counties with statistically significant trends over the years.

Note: Counties with 1-9 cases were suppressed.



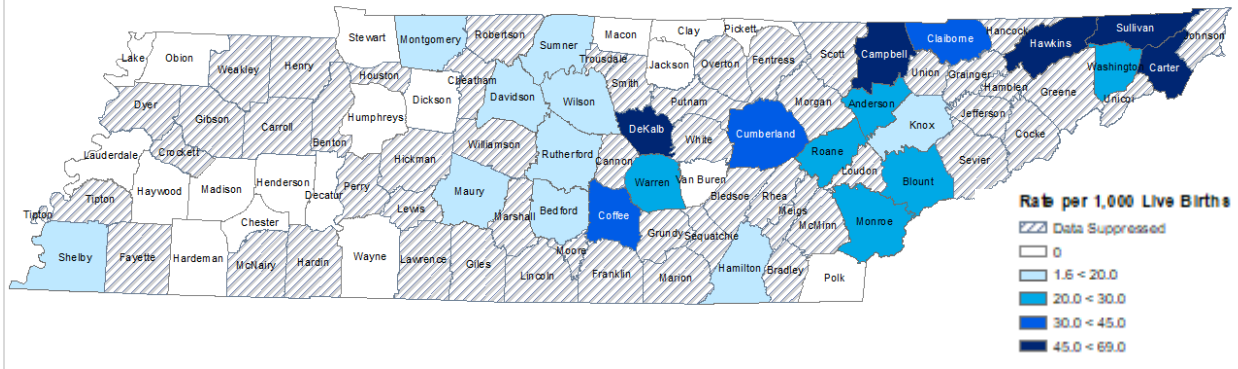
**Figure 7: Rate of NAS Cases by County, 2017**

Note: Counties with 1-9 cases were suppressed.



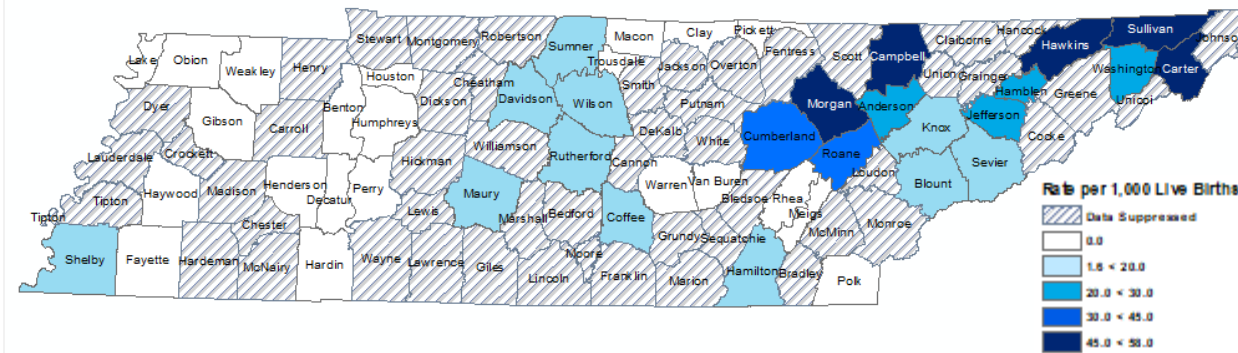
**Figure 8: Rate of NAS Cases by County, 2018**

Note: Counties with 1-9 cases were suppressed.

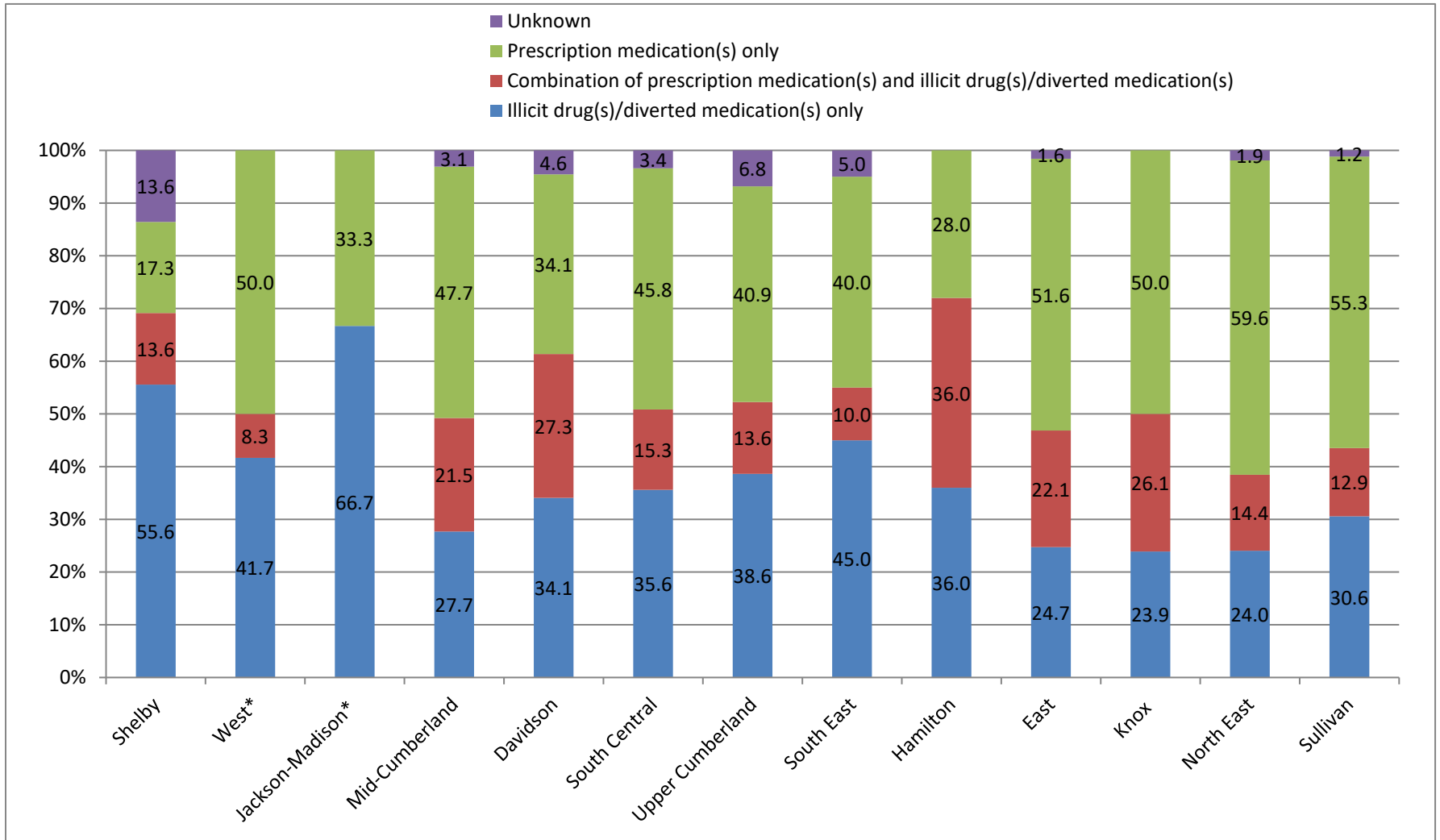


**Figure 9: Rate of NAS Cases by County, 2019**

Note: Counties with 1-9 cases were suppressed.



**Figure 10: Rate of NAS Cases by County, 2020**



**Figure 11: Distribution of Mutually Exclusive Sources of Exposure by Health Region for NAS Cases, 2020**

\*West and Jackson had few cases (six and three cases, respectively; findings should be interpreted with caution due to small case numbers).

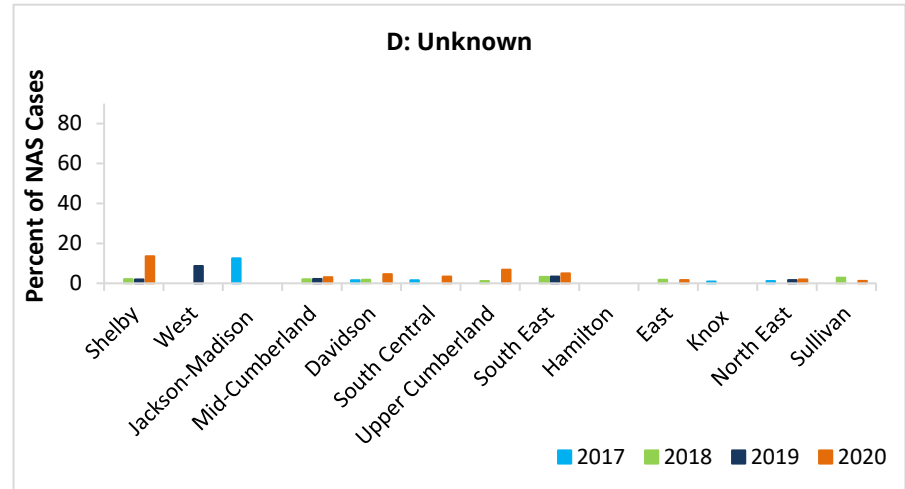
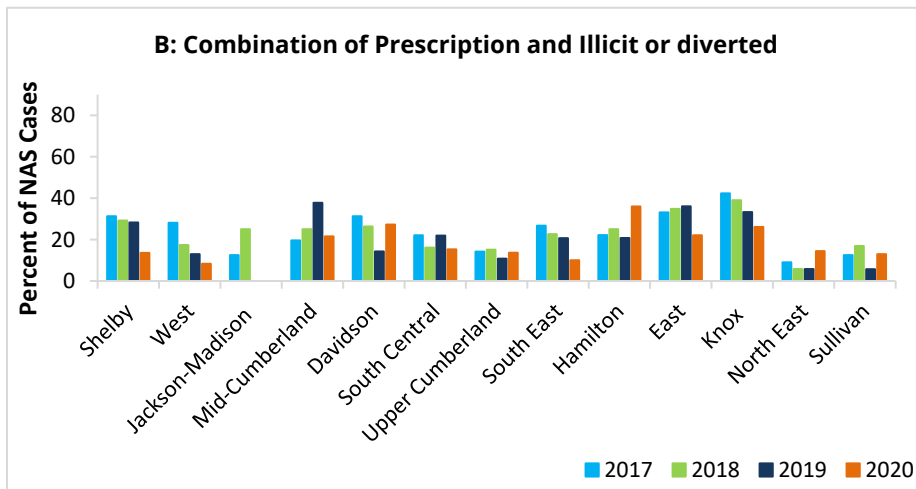
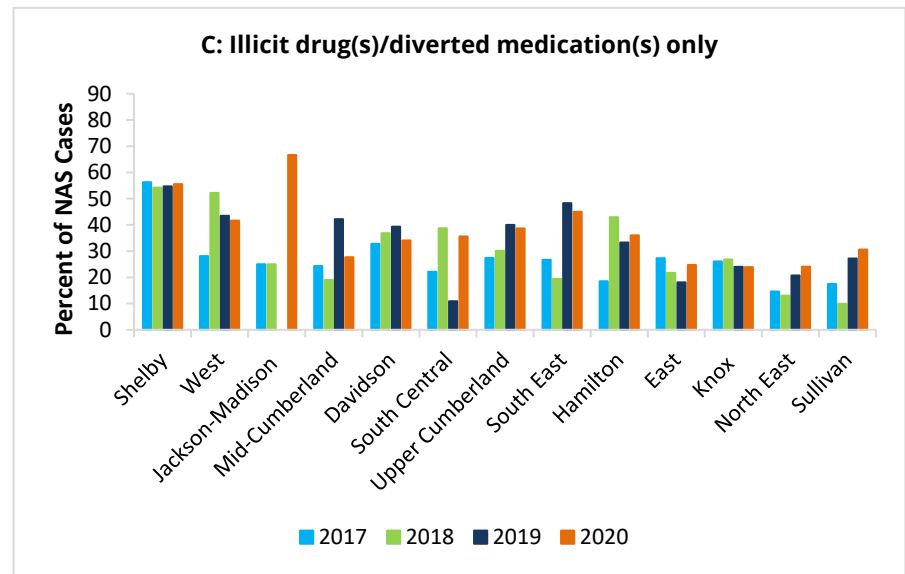
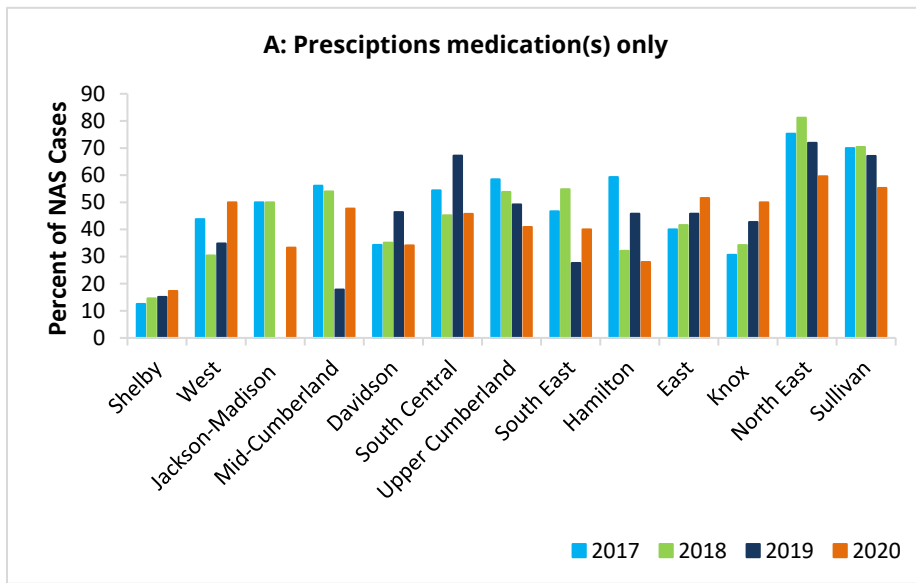


Figure 12 A-D: Prevalence of Exposure to Mutually Exclusive Sources among NAS Cases by Region, 2017-2020



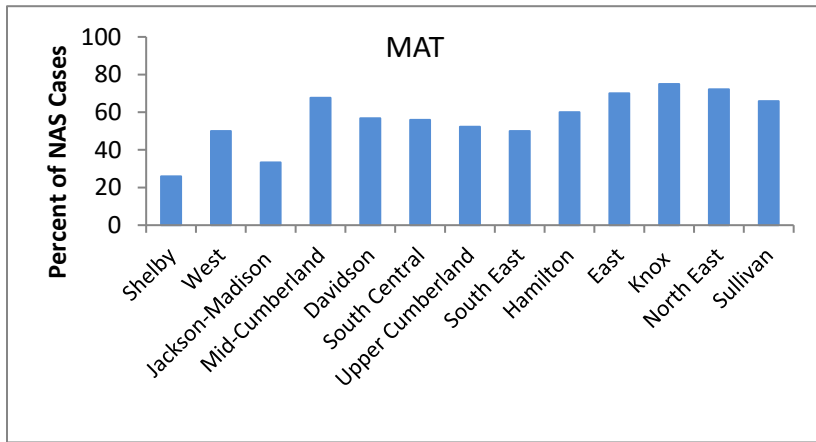


Figure 13: Prevalence of Exposure to Medication Assisted Treatment among NAS Cases by Region, 2020

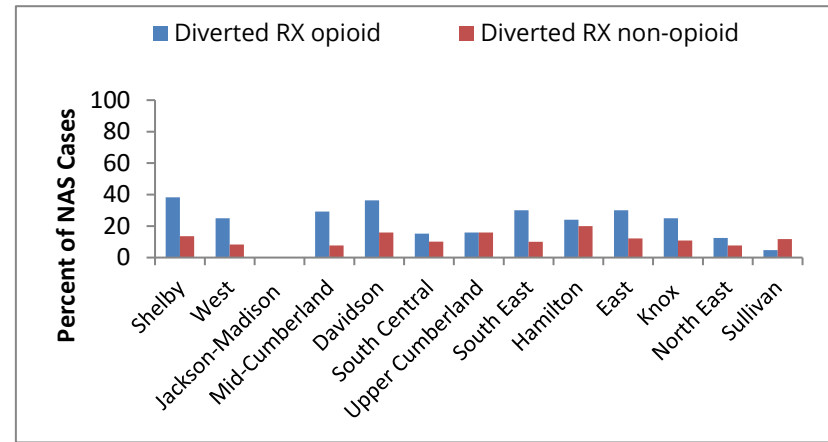


Figure 15: Prevalence of Exposure to Diverted Prescription Medications among NAS Cases by Region, 2020

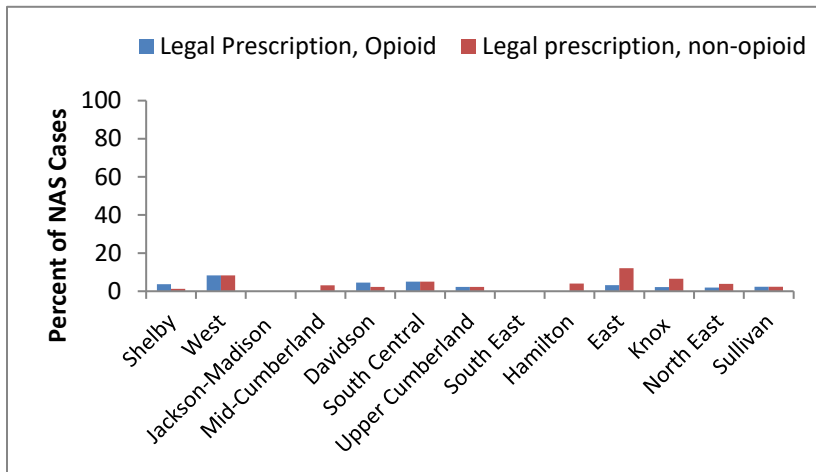


Figure 14: Prevalence of Exposure to Legally Obtained Prescription Medications among NAS Cases by Region, 2020

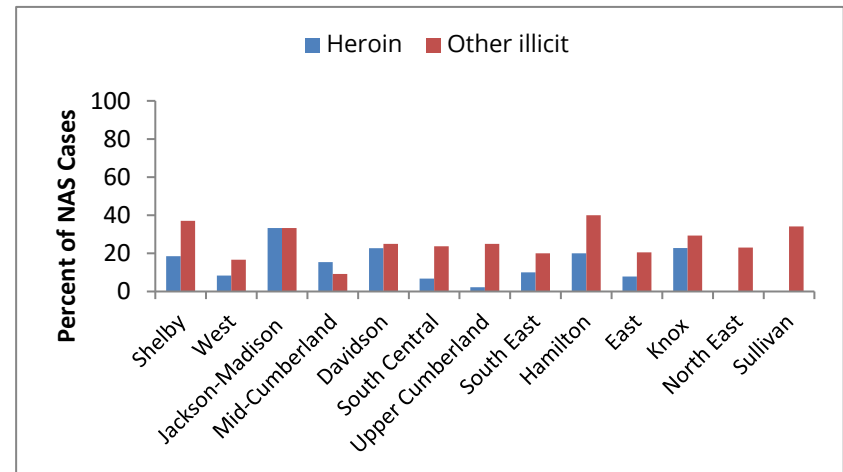


Figure 16: Prevalence of Exposure to Illicit Drugs among NAS Cases by Region, 2020

## Conclusion

Since becoming a reportable condition in 2013, the proportion of births affected by NAS each year increased through 2017, with a decrease seen in 2018 and 2019. However, in CY2020 Tennessee saw a small increase in the number of NAS cases, which is consistent with an overall increase in the number of opioid overdoses<sup>3</sup>. This reporting period converged with the COVID-19 pandemic, which may have contributed to some of the geographic variability of NAS cases across the state and the increase in the number of NAS cases. Shelby and Sullivan Counties reported the largest increases in the number of NAS cases while Mid-Cumberland, Northeast and Upper-Cumberland Health regions had the largest decreases in the number of NAS cases in CY2020 compared to CY2019. Similarly, the Upper Cumberland Health and the Northeast Health Regions saw a decrease in the rate of NAS cases with statistically significant decline over the years in the Upper Cumberland Health Region. Shelby County and the East Health Region showed both an increase in the rate of cases of NAS from 2019 and a statistically significant upward trend over time since 2013. However, the largest increase in the rate of cases of NAS occurred in Sullivan and Knox Counties but were not statistically significant over time.

In addition, geographic differences in the source of exposure persist, with less than 50% of infants exposed to MAT in West Tennessee, compared to over 75% in some regions of East Tennessee. Conversely, more than 55% of NAS cases were exposed to illegal substances in West Tennessee versus less than 45% in the East, with an overall statewide increase in exposure to illegal substances. Of note, when comparing exposure sources, the percentage of cases exposed to illegal drugs increased in the East while the percentage of cases exposed to prescription drugs decreased in West Tennessee compared to CY2019.

Since 2013, there has been a shift in the exposure sources associated with NAS, with more mothers of NAS infants taking medications prescribed by a provider. The high proportion of cases of NAS involving medication assisted treatment suggest that women with a history of substance use disorder are receiving treatment during pregnancy. Notably, there was decrease in the percent of infants with NAS exposed to MAT from 64.9% in 2019 to 62.0% in 2020.

The patterns of exposure (with nearly 65% of cases being exposed to at least one substance prescribed by a healthcare provider) highlight opportunity for primary prevention. Healthcare providers should be encouraged to explore non-opioid treatment modalities in women of childbearing age and should promote effective contraceptive methods to prevent unintended pregnancies among women who use opioids. Additionally, the increasing prevalence of illicit and diverted substance exposure, particularly in Western Tennessee, highlights the importance of comprehensive addiction prevention resources and treatment availability. It is our hope that the information contained in this report be

used to celebrate areas of success and inform additional strategies and resource allocation for areas most impacted by NAS.

# Acknowledgements

The Tennessee Department of Health would like to acknowledge the reporting hospitals and providers across the State of Tennessee and TDH Staff as well as the families affected by NAS.

## References

1. Charles MK, Cooper WO, Jansson LM, et al. Male Sex Associated with Increased Risk of NAS. *Hosp Pediatr* 2018 Jun; 7(6):328-334. DOI:10.1542/hpeds.2016-0218.
2. O'Connor AB, O'Brien L, Alto WA. Are there gender related differences in neonatal abstinence syndrome following buprenorphine during pregnancy?. *J Perinat Med* 2013 Sep;41(5):621-3. DOI: 10.1515/jpm-2012-0288.
3. Tennessee's Annual Overdose Report, 2021. Report on Epidemiologic Data, Efforts, and Collaborations to Address the Overdose Epidemic (<https://www.tn.gov/content/dam/tn/health/documents/pdo/2021%20TN%20Annual%20Overdose%20Report.pdf>).

## Technical Notes

1. At publication of the 2019 Neonatal Abstinence Syndrome Surveillance Annual Report, 808 cases with a birth year of 2019 had been reported. After publication of the 2019 report, an additional 2 cases were reported and are included here.

2. All rates for 2020 were calculated using the 2019 Birth Statistical File as the denominator.

## Suggested Citation

This report was prepared by Alice M Nyakeriga, PhD, MPH, and Morgan McDonald, MD.

Suggested citation: Nyakeriga AM, McDonald M (2020). Neonatal Abstinence Syndrome Surveillance Annual Report 2020. Tennessee Department of Health, Nashville, TN.