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Disparities in neonatal abstinence syndrome and health insurance status: A statewide study using non–claims real-time surveillance data

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Abstract

Background: Most studies examining the relationship between neonatal abstinence syndrome (NAS) and health insurance status in the United States (USA) have used administrative insurance claims data, which is subject to myriad limitations. We examined the association between NAS and health insurance status in a large geographically defined rural population in the United States, using non–claims data.

Methods: We utilized data from a population-based cohort of all newborns born in 2017–2019 in the rural state of West Virginia (WV) and restricted analyses to WV residents' births (n = 46 213). NAS was defined as neonatal withdrawal from many substances, including opiates and not limited to those cases that require pharmacological treatment.

Results: Medicaid covered more than half (52.6%) of all infants' births in the state of WV. The incidence of NAS was 85.8 and 12.7 per 1000 livebirths in the Medicaid and privately insured groups, respectively. Among all infants diagnosed with NAS, 86.1% were enrolled in the state's Medicaid programme. The risk of NAS in the Medicaid-insured newborns was higher than privately insured newborns in the unadjusted analysis (risk ratio (RR) 6.76, 95% confidence interval (CI) 5.95, 7.68) and the adjusted analysis (RR 3.00, 95% CI 2.01, 4.49); adjusted risk difference 20.3 (95% CI 17.5, 23.1 cases per 1000 livebirths).

Conclusions: NAS is an important indicator of the immediate effect of the opioid crisis. This study shows the disparity in NAS by health insurance status for a large rural population in the

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SUPPORTING INFORMATION

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United States, and its burden on the state's Medicaid programme. Providing timely and accurate estimates of NAS is important for public health policies and decision making.

Keywords

Medicaid; neonatal abstinence syndrome; non–claims data; West Virginia

1 | BACKGROUND

The current opioid crisis began in the United States in the early 1990s and, over the past three decades, has had devastating personal, medical, economic, societal, and public health impact.[1] The economic burden encompasses the cost associated with health care, substance use treatment, criminal justice, lost productivity, and premature mortality.[2] In 2015, the opioid epidemic cost to the US economy was more than $500 billion and the highest estimated per-capita cost was $4378 for the state of West Virginia (WV),[2] which has the highest drug overdose death rate in the nation as well.[3]

The effects of the opioid crisis on pregnant women have serious health consequences for both the mother and the infant.[4,5] Nationally, more than 20% and in WV more than 30% of the Medicaid-enrolled women filled an opioid prescription during pregnancy.[6] Neonatal abstinence syndrome (NAS) refers to the newborn's withdrawal from several substances including opioids used or abused during pregnancy.[7] The incidence of NAS parallels the opioid crisis prevalence across states and is higher in rural vs urban counties and is higher in the Appalachian region as well.[8–10] In the rural Appalachian state of WV, the rate of NAS in per 1000 livebirths increased by more than 50% from 33.4 in 20138 to 51.2 in 2017,[11] which is six times higher than the national rate of 8.0 per 1000 livebirths in 2014.[12]

Disparities in rates of NAS exist by the type of health insurance coverage financing the delivery and birthing cost of the newborn. National Inpatient Sample data from 2004 to 2014 showed that NAS incidence in 2014 (14.4 per 1000 livebirths) rose over fivefold among infants with Medicaid in the 10-year study period.[12] In 2016, the Healthcare Cost and Utilization Project (HCUP) Kids' Inpatient Database (KID) showed that of the total hospitalization cost ($572.7 million) associated with NAS, Medicaid was responsible for 83% of that expenditure ($477.0 million).[13] These national-level[12,14] and other state-level[15,16] studies examining this association have utilized administrative insurance claims data (hospital billing and coding data). The use of claims data by public health researchers and planners has shown to be cost-effective, feasible, and instrumental in documenting racial and geographical variations in health care and health status (ie, morbidity and mortality).[17] However, claims data are subject to several inherent limitation as it is intended for billing and reimbursement purposes,[18] and not primarily collected for research.[19] Some of the main limitations include variations in providers coding patterns, missing, incomplete, or inaccurate due to under-coding (provider omits a diagnosed condition on the billing form) and/or miscoding (wrong code submitted in error).[18,20] Moreover, it does not relay real-time information due to lag in the data collection to analysis phase,[21,22] which prevents rapid prioritizing and channelling of public health resources.[23] Additionally, depending on the source of claims data (eg, commercial health care database) it does not contain information

on all segments of the population, that is those without health insurance.[18,24] Furthermore, it lacks information on important confounders that would be important to adjust for in the research study.[25] Lastly, pertinent to our study, claims data have shown to underestimate NAS rates.[26,27]

The main objective of the study was to provide population-level non–claims-based NAS rates by type of health insurance coverage for the rural Appalachian state of WV. This contributes to prior literature that has examined this association using claims data, which have shown to have myriad limitations.[21,22,24,26,27] A secondary objective was to estimate substate regional variations of NAS rates by health insurance categories. Providing timely estimates of NAS is important for public health policies and decision-making targeting certain subgroups and subregions of greatest need within the state.

2 | Methods

2.1 | Cohort selection

The study used de-identified data from a population-based cohort of all newborns born in 2017–2019 (N = 55 500) in WV from a statewide-mandated (House Bill 2388)[28] surveillance system called the Project WATCH (Working in Appalachia to identify at-risk infants, Critical congenital heart disease, and Hearing loss). Project WATCH surveillance data aim to identify newborns who are at a higher risk of infant mortality and developmental delay to initiate close follow-ups. The mothers and infants are followed only during birth hospitalization from date of birth to discharge date. More information about Project WATCH can be found elsewhere. [29] The nurses at each birth facility complete the Project WATCH surveillance tool before hospital discharge. Project WATCH provides continuous training to nurses across the state on data abstraction and periodically conducts audits to compare the data with the medical records and linking the data to the state's birth certificate data to ensure higher reliability.

2.2 | Outcomes

The main outcome for this study was a binary variable for NAS (yes/no) documented in the medical charts of each newborn and recorded by the nurses in Project WATCH tool. In September 2014, key state stakeholders including neonatologists, paediatricians, epidemiologist, hospital coders, and members of the West Virginia Perinatal Partnership (WVPP) met to develop a standardized definition for NAS as well as guidance for documenting exposure and withdrawal in newborns.[11] The definition that was agreed upon was as follows: NAS includes neonatal withdrawal from many substances, including opiates. It is exposure with clinical symptoms, and it is not limited to those cases that require pharmacological treatment. In 2015–2016, training sessions were held at all birth facilities in the state on the standardized definition for NAS. Following the statewide training efforts, in October 2016, Project WATCH started collecting data on IUSE and NAS surveillance items. IUSE data were collected as a binary response (yes/no) and assessed using several possible sources (self-report, documented in medical record or/and positive drug screening test). The nurses filling out Project WATCH tool were also provided training on the types of neuroactive substances (mainly but not limited to opioids, stimulants, sedatives-

hypnotics, phencyclidine (PCP), cannabinoids, gabapentin and antidepressants) to consider as IUSE, though data on specific substances used during pregnancy were not captured in the Project WATCH tool. Infants who had IUSE were assessed for signs of NAS consistent with the agreed upon statewide definition. NAS diagnosis included a baby with IUSE to a neuroactive substance, exhibiting clinical signs/symptoms of withdrawal, regardless of whether or not pharmacological treatment was required.[30]

2.3 | Exposure

The main independent variable for this study included the payment method that financed the delivery and birthing cost of the newborn. For this variable, the four categories included Medicaid, private, uninsured, and other (health insurance status unclear or pending birth of the newborn). A fifth category, labelled as unknown, was set to missing (n = 889).

2.4 | Confounders

Possible confounders included sociodemographic and life style factors that were associated with both the outcome and the exposure. The infant factor included sex (male/female) and the maternal factors included age (<20 and ≥20), race (white and others), education (≤10 grades and ≥11 grades), and smoking during pregnancy (yes/no).

2.5 | Region

The 55 counties in WV are divided into six Substance Abuse and Mental Health Services Administration (SAMHSA) regions. This national organization (SAMHSA) works with the state's DHHR to define these regions to understand the geographical variability of substance use within each state and to identify the state's needs.[31] This information is vital for planning, reporting, programme development, prevention and intervention efforts, and allocation of funds to areas in need for services in the counties clustered together in one region.[31,32] This variable was created from mother's county of residence at the time of delivery.

2.6 | Statistical analysis

Analysis for this project included computing measures of occurrence (incidence proportions), along with NAS incidence rates reported as the number per 1000 livebirths. The measures of association were calculated on the relative scale (risk ratio [RR]) and on the absolute scale (risk difference [RD]) along with their corresponding 95% confidence interval (CI).[33,34] These were calculated using log-binomial regression model for the crude association (link = log for RR and link = identity for RD) between health insurance groups (private insurance as referent category) and NAS.[35] For the multivariable-adjusted RR and RD, the log-binomial model failed to converge and the modified Poisson regression method was used to estimate the RR and RD using a robust error variance that has shown to produce 95% CIs with the correct coverage.[35] The multilevel-modified Poisson regression model clustered on SAMHSA regions to take into account the intra-regional variations within clusters[36] and adjusting for confounders that were associated with both the outcome and the exposure guided by the literature. The substate SAMHSA regional-specific results were reported for the 2017–2019 study period and stratified by health insurance status. Small cell

counts of <10 were suppressed for the regional data. The incidence of NAS was ranked from highest to lowest (rank 1–rank 6) for the six regions. All analyses were conducted in SAS version 9.4.

2.7 | Missing data

Of the 46 213 WV residents' births, there were missing data for health insurance status (n = 824, 1.8%), maternal age (n = 159, 0.3%), maternal education (n = 157, 0.3%), race (n = 562, 1.2%), and sex (n = 824, 1.8%). For the 824 missing health insurance status cases, 23 had NAS (2.7%) and 801 (97.2%) did not have NAS. Default pairwise deletion was used for missing data. The complete case analysis for the multiple regression models had missing data on 1515 cases (3.3%). As missing data were less than 5%, no multiple imputation was performed.

2.8 | Ethics approval

This study was approved by the West Virginia University Institutional Review Board (protocol, 2002912565).

3 | RESULTS

This study used data from population-based cohort of all newborns born in 2017–2019 (N = 55 500) in the state and restricted analyses to WV residents' births only (n = 46 213; 83.3%). For the WV residents only, the per cent of infant's births according to the health insurance categories of Medicaid, private, other, and uninsured was 52.6%, 45.3%, 1.5%, and 0.7%, respectively (Table 1). Among all the WV resident women who gave birth during this time frame 6.9% were <20 years old (Medicaid [5.6%], private [1.2%], other [0.1%], and uninsured [0.1%]); 6.7% had ≤10 grades of education (Medicaid [5.7%], private [0.9%], other [0.1%], and uninsured [<0.1%]); 23.7% smoked during pregnancy (Medicaid [19.6%], private [3.7%], other [0.3%], and uninsured [0.1%]); and 14.0% used substances during pregnancy (Medicaid [11.7%], private [2.0%], other [0.2%], and uninsured [0.1%]).

The incidence of NAS for WV residents' births was 52.4 per 1000 livebirths. Among the Medicaid-insured, the incidence of NAS was 85.8 per 1000 livebirths (95% CI 8.22, 8.93) and 12.7 per 1000 livebirths (95% CI 1.12, 1.42) in the privately insured group (Table 2). The substate SAMHSA regional results are displayed in Figure 1. Region 1 had the highest NAS rates by all four health insurance categories (Table S1).

The risk of NAS for Medicaid-insured newborns was 6.76 (95% CI: 5.95, 7.68) times that of private health insurance group. Uninsured and those who had "other" health insurance were also more likely to develop NAS compared with the privately insured (Table 2). After adjusting for maternal age, race, education, and smoking and taking into account the regional clustering, this association attenuated for all health insurance categories compared with privately insured group. For the adjusted model, the risk of NAS for infants covered by Medicaid was 3.00 (95% CI 2.01, 4.49) times that of privately insured newborns (Table 3). For the absolute measure of association, the adjusted excess risk (RD) associated with NAS in the Medicaid vs privately insured newborns was 20.3 cases per 1000 livebirths (95% CI 17.5, 23.1) (Table 3).

4 | COMMENT

4.1 | Principal findings

The study provides the most recent NAS estimates by the type of health insurance coverage using population-level non–claims data for the state of WV. The results showed that among all infants diagnosed with NAS, 86% were enrolled in the state's Medicaid programme in WV. This finding is consistent with other national/state-level studies that also suggest that Medicaid consistently pays for nearly 80% of NAS cases.[14] However, our study showed that the incidence of NAS in WV was nearly six times the national average in the Medicaid (85.8 vs 14.4 per 1000 livebirths) and privately insured (12.7 vs 2.0 per 1000 livebirths) groups.[12] The northern panhandle region of the state (Region 1) had the highest NAS rates overall and alarmingly high incidence in the Medicaid population of nearly 10 times the national Medicaid average (146.2 vs 14.4 per 1000 livebirths).

4.2 | Strengths of the study

Project WATCH's data capture NAS cases using population-level data for all newborns born in the state, recorded by the nurses using medical charts at the time of discharge.[11,26] Moreover, data are captured in real time with only a lag time of 1 week, providing the most current NAS rates compared with publicly available all-payer paediatric inpatient care database for children (KID) or the State Inpatient Databases (SID) for community hospitals in WV, currently available for the years 2016 and 2018, respectively.[37] This tool also uses a standard statewide definition for NAS diagnosis that helps in ascertaining NAS cases more systematically compared with studies that have not adopted a standard definition.[23] In addition, Project WATCH has information on important covariates including maternal substance use, smoking during pregnancy, and other sociodemographic factors. Furthermore, we present both relative and absolute epidemiological measures of this association compared with other studies presenting relative measures only. For example, similar to our study, Atwell and colleagues' observed high RRs (RR 8.4, 95% CI 7.4, 9.5) for this association in the state of Wisconsin (WI).[15] However, on the absolute scale (RD) we observed more than sixfolds increase in NAS cases in the Medicaid vs private health insurance group compared with WI (73.1 vs 10.5 cases per 1000 livebirths in WI).

4.3 | Limitations of the data

Some of the limitations of our data include lack of information on severity of NAS, the type(s) of specific maternal substances used, prescribed or illicit drug use, medication-assisted treatment (MAT) enrolment, duration and timing of exposure in utero, and the specific detail of the types of health insurance plan within the private and public insurance groups. Moreover, information on some of the sociodemographic covariates (maternal age and education) was gathered limited to binary data. Additionally, WV does not have a universal drug screening programme and hospitals without a universal test may miss infants potentially at risk of NAS that are discharged prior to the infants exhibiting symptoms. Furthermore, even though a standardized tool is used to assess for signs and symptoms of withdrawal, there is a degree of subjectivity in how symptoms may be interpreted, which is difficult to assess. Lastly, it is difficult to compare results with prior studies without a standardized national definition of NAS as well as comparison of NAS rates in WV using

non–claims data with other state and national studies that use claims–based method. Our future research aims to conduct a validation study comparing claims data to Project WATCH data in the same time period (2017–2019) for an ideal comparison.

4.4 | Interpretation

Our results showed the incidence of NAS in WV in 2017–2019 was nearly six times the national (2014) average in the Medicaid and privately insured groups. Moreover, compared to other state-level studies as well [Florida,[38] Louisiana,[39] Tennessee,[4] and WI[15]] our study observed much higher NAS rates in the Medicaid-insured group in WV (85.8 vs 8.0–25.2 cases per 1000 livebirths in other states).[4,15,38,39] Additionally, a prior study by Stabler and colleagues for the state of WV using 2007–2013 claims data based on NAS diagnostic code (ICD9-CM 779.5) showed that NAS incidence in the Medicaid population was 25.6 per 1000 livebirths.[40] They point out "*the HCA-UB (claims) data was created for payment use; therefore, it is restrictive in its use to research a statewide health condition*."[40] Moreover, our earlier work in 2017 showed that ICD-10-CM code for NAS was recorded by less than half (47.3%) of the infants diagnosed with NAS compared with NAS cases captured in Project WATCH database.[11] Though previous studies have examined disparities in NAS rates by health insurance, the novel contribution of our study is presenting the most up-to-date NAS rates by health insurance using statewide non–claims data. However, it should be noted that the prior state and national studies were conducted prior to 2015 and as NAS rates have increased across the country the rates from earlier studies would also have increased. Nonetheless, having ~700 cases of NAS/year in the Medicaid population is an alarmingly high rate showing the current magnitude of the problem in the state.

West Virginia is a rural Appalachian state in the United States that has high Medicaid participation rate (53% vs 45% nationally) due to a depressed economy, low income, and high unemployment rates.[41] Medicaid is also the primary payer among pregnant women with substance use,[42] and WV has high prevalence of substance use during pregnancy as well (14% vs 8.5% nationally).[11,43] Additionally, more than half of the state's population lives in rural areas,[40,44,45] and disparities in access to MAT programmes for pregnant women with opioid use disorders,[40] are significantly higher in the rural[10] and Medicaid populations.[46] Though WV Medicaid expansion provides coverage to MAT services that has shown to improve MAT utilization,[47] this population faces several additional barriers that include distance to the nearest facility, lack of transportation, childcare, and financial constraints.[45] We identified the geographical disparities of NAS by health insurance status by SAMHSA regions and accounted for the intra-regional variability in our statistical model. However, future research needs to explore the reasons for the regional variations observed.

It is important to point out that the measures of association should be interpreted with caution. Although disparities exist based on insurance status and NAS will be higher in the Medicaid population given the diverse socio-economic risk factors associated with Medicaid enrolment, the reverse is not true, and it is not the insurance status per se that causes NAS. However, given that Medicaid pays for more than 85% of newborn hospital stays related to substance use, state Medicaid agencies are uniquely positioned to develop policies to target this public health crisis.[12] "*Eligible pregnant women should be enrolled in Medicaid*

as quickly as possible to facilitate expedited access to routine prenatal care that may allow access to MAT services earlier in pregnancy."[48] These policies could include access to comprehensive and a fear-free, integrated health care model that includes a high-quality prenatal care, screenings for substance use disorder and mental health co-morbidities, early identification of substance use in pregnancy, mental health services, and psychosocial counselling and treatment of substance using women.[7] Additional strategies could include educating women of childbearing age about the risks of prenatal substance exposure and offer contraception services at addiction treatment programmes,[49] mental health facilities, and at needle exchange programmes. Multidisciplinary team consisting of clinicians, public health workers, social workers, and policymakers need to be trained on evidence-based strategies for prevention and treatment especially focusing on low-income families. Some of the long-term health outcomes of NAS include behavioural/cognitive problems and developmental delays.[50] Medicaid can play a critical role in providing and facilitating continued access to services for the newborn and the mother in the postpartum period to prevent maternal relapse and mitigate the potential negative long-term health outcomes for these newborns. Additionally, states such as WV need to focus on some of the upstream factors and develop or expand infrastructure (eg, schools, hospitals, libraries) to improve economic condition especially in rural areas.[51]

5 | CONCLUSION

We studied a critically important topic in a state considered the epicentre of the opioid crisis.[52] NAS is an important indicator of the immediate effect of this crisis,[13] and this study provides the most up-to-date NAS rates by health insurance coverage for the state. Computing timely and accurate population parameter is undoubtedly the essence of epidemiological research studies, and our approach was able to demonstrate the true magnitude of this serious public health crisis in the state of WV. The result from this study also demonstrates the relative disparity in NAS rates in WV compared with other states and national estimates. As state Medicaid is the predominant payer for infants diagnosed with NAS, these programmes must expand coverage for low-income women and facilitate linkages of care for mother-infant dyad affected by substance use, to decrease the incidence, morbidity, and cost-associated with NAS.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

1. Rummans TA, Burton MC, Dawson NL. How good intentions contributed to bad outcomes: the opioid crisis. Mayo Clin Proc. 2018;93:344–350. [PubMed: 29502564]
2. Florence CS, Zhou C, Luo F, Xu L. The economic burden of prescription opioid overdose, abuse, and dependence in the United States, 2013. Med Care. 2016;54:901–906. [PubMed: 27623005]

3. Hedegaard H, Bastian BA, Trinidad JP, Spencer M, Warner M. Drugs most frequently involved in drug overdose deaths: United States, 2011–2016. Natl Vital Stat Rep. 2018;67:1–14.
4. Patrick SW, Dudley J, Martin PR, et al. Prescription opioid epidemic and infant outcomes. Pediatrics. 2015;135:842–850. [PubMed: 25869370]
5. NSDUH. Center for Behavioral Health Statistics and Quality. National Survey on Drug Use and Health: Detailed Tables. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2017. https://www.samhsa.gov/data/sites/default/files/cbhsq-reports/NSDUHDetailedTabs2017/NSDUHDetailedTabs2017.pdf2018.
6. Desai RJ, Hernandez-Diaz S, Bateman BT, Huybrechts KF. Increase in prescription opioid use during pregnancy among Medicaid-enrolled women. Obstet Gynecol. 2014;123:997–1002. [PubMed: 24785852]
7. Gomez-Pomar E, Finnegan LP. The epidemic of neonatal abstinence syndrome, historical references of its' origins, assessment, and management. Front Pediatr. 2018;6:33. [PubMed: 29520355]
8. Ko JY, Patrick SW, Tong VT, Patel R, Lind JN, Barfield WD. Incidence of neonatal abstinence syndrome - 28 States, 1999–2013. MMWR Morb Mortal Wkly Rep. 2016;65:799–802. [PubMed: 27513154]
9. Villapiano NL, Winkelman TN, Kozhimannil KB, Davis MM, Patrick SW. Rural and urban differences in neonatal abstinence syndrome and maternal opioid use, 2004 to 2013. JAMA Pediatr. 2017;171:194–196. [PubMed: 27942711]
10. Brown JD, Goodin AJ, Talbert JC. Rural and appalachian disparities in neonatal abstinence syndrome incidence and access to opioid abuse treatment. J Rural Health. 2018;34:6–13. [PubMed: 28685864]
11. Umer A, Loudin S, Maxwell S, et al. Capturing the statewide incidence of neonatal abstinence syndrome in real time: the West Virginia experience. Pediatr Res. 2019;85:607–611. [PubMed: 30287893]
12. Winkelman TNA, Villapiano N, Kozhimannil KB, Davis MM, Patrick SW. Incidence and costs of neonatal abstinence syndrome among infants with Medicaid: 2004–2014. Pediatrics. 2018;141:e20173520. [PubMed: 29572288]
13. Strahan AE, Guy GP Jr, Bohm M, Frey M, Ko JY. Neonatal abstinence syndrome incidence and health care costs in the United States, 2016. JAMA Pediatr 2020;174(2):200. [PubMed: 31841581]
14. Patrick SW, Davis MM, Lehmann CU, Cooper WO. Increasing incidence and geographic distribution of neonatal abstinence syndrome: United States 2009 to 2012. J Perinatol. 2015;35:650–655. [PubMed: 25927272]
15. Atwell KA, Weiss HB, Gibson C, Miller R, Corden TE. Neonatal abstinence syndrome and maternal substance use in Wisconsin, 2009–2014. WMJ. 2016;115:287–294. [PubMed: 29094858]
16. Hussaini KS, Garcia Saavedra LF. Neonatal abstinence syndrome (NAS) in Southwestern Border States: examining trends, population correlates, and implications for policy. Matern Child Health J. 2018;22:1352–1359. [PubMed: 29572587]
17. Virnig BA, McBean M. Administrative data for public health surveillance and planning. Annu Rev Public Health. 2001;22:213–230. [PubMed: 11274519]
18. Stein JD, Lum F, Lee PP, Rich WL 3rd, Coleman AL. Use of health care claims data to study patients with ophthalmologic conditions. Ophthalmology. 2014;121:1134–1141. [PubMed: 24433971]
19. Ward MM. Estimating disease prevalence and incidence using administrative data: some assembly required. J Rheumatol. 2013;40:1241–1243. [PubMed: 23908527]
20. Tyree PT, Lind BK, Lafferty WE. Challenges of using medical insurance claims data for utilization analysis. Am J Med Qual. 2006;21:269–275. [PubMed: 16849784]
21. Birnbaum HG, Cremieux PY, Greenberg PE, LeLorier J, Ostrander JA, Venditti L. Using healthcare claims data for outcomes research and pharmacoeconomic analyses. Pharmacoeconomics. 1999;16:1–8.
22. Neubauer S, Kreis K, Klora M, Zeidler J. Access, use, and challenges of claims data analyses in Germany. Eur J Health Econ. 2017;18:533–536. [PubMed: 27878393]

23. Jilani SM, Frey MT, Pepin D, et al. Evaluation of state-mandated reporting of neonatal abstinence syndrome - six states, 2013–2017. MMWR Morb Mortal Wkly Rep. 2019;68:6–10. [PubMed: 30629576]
24. Hyman J. The limitations of using insurance data for research. J Am Dent Assoc. 2015;146:283–285. [PubMed: 25925509]
25. Strom BL. Data validity issues in using claims data. Pharmacoepidemiol Drug Saf. 2001;10:389–392. [PubMed: 11802582]
26. Burns L, Mattick RP. Using population data to examine the prevalence and correlates of neonatal abstinence syndrome. Drug Alcohol Rev. 2007;26:487–492. [PubMed: 17701511]
27. Ernst KD, Makkar A. The opioid-exposed neonate: a review of the oklahoma experience. J Okla State Med Assoc. 2018;111:768–774. [PubMed: 31354174]
28. ARTICLE 22B. BIRTH SCORE PROGRAM. 1998.
29. Mullett MD, Britton CM, John C, Hamilton CW. WV birth score: maternal smoking and drugs of abuse. W V Med J. 2010;106:16–8, 20.
30. WV Birth Score/Project WATCH https://www.wvdhhr.org/birthscore/substance_Exposure_NAS.html. Accessed July 20, 2020.
31. Hughes A, Lipari RN, Williams MR. Marijuana use and perceived risk of harm from marijuana use varies within and across states. The CBHSQ Report: July 26, 2016. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, 2016.
32. Zhang Z, Infante A, Meit M, English N, Dunn M, Bowers K. An analysis of mental health and substance abuse disparities and access to treatment services in the Appalachian region. 2008. Retrieved from https://www.arc.gov/resea?rch/resea?rchre?portd?etails.asp?REPORT_ID=71
33. Siegerink B, Rohmann JL. Impact of your results: beyond the relative risk. Res Pract Thromb Haemost. 2018;2:653–657. [PubMed: 30349882]
34. Noordzij M, van Diepen M, Caskey FC, Jager KJ. Relative risk versus absolute risk: one cannot be interpreted without the other. Nephrol Dial Transplant. 2017;32(suppl_2):ii13–ii18. [PubMed: 28339913]
35. Spiegelman D, Hertzmark E. Easy SAS calculations for risk or prevalence ratios and differences. Am J Epidemiol. 2005;162:199–200. [PubMed: 15987728]
36. Amorim LD, Bangdiwala SI, McMurray RG, Creighton D, Harrell J. Intraclass correlations among physiologic measures in children and adolescents. Nurs Res. 2007;56:355–360. [PubMed: 17846557]
37. HCUP Central Distributor Availability of Databases. Healthcare Cost and Utilization Project (HCUP). June 2020. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/db/availability_public.jsp. Accessed July 15, 2020.
38. Wang X, Zhu Y, Dave CV, Alrwisan AA, Voils SA, Winterstein AG. Trends of neonatal abstinence syndrome epidemic and maternal risk factors in Florida. Pharmacotherapy. 2017;37:806–813. [PubMed: 28500694]
39. Okoroh EM, Gee RE, Jiang B, McNeil MB, Hardy-Decuir BA, Zapata AL. Neonatal abstinence syndrome: trend and expenditure in Louisiana Medicaid, 2003–2013. Matern Child Health J. 2017;21:1479–1487. [PubMed: 28168591]
40. Stabler ME, Long DL, Chertok IR, Giacobbi PR Jr, Pilkerton C, Lander LR. Neonatal abstinence syndrome in West Virginia substate regions, 2007–2013. J Rural Health. 2017;33:92–101. [PubMed: 26879950]
41. Kowlessar NM, Jiang HJ, Steiner C. Hospital stays for newborns, 2011: statistical brief #163. Rockville, MD: Healthcare Cost and Utilization Project (HCUP) Statistical Briefs, 2006.
42. Whiteman VE, Salemi JL, Mogos MF, Cain MA, Aliyu MH, Salihu HM. Maternal opioid drug use during pregnancy and its impact on perinatal morbidity, mortality, and the costs of medical care in the United States. J Pregnancy. 2014;2014:906723. [PubMed: 25254116]
43. NSDUH. Center for Behavioral Health Statistics and Quality. 2017 national survey on drug use and health: detailed tables. Rockville, MD: Substance Abuse and Mental Health Services Administration. (Table 6.65B)2018

44. United States Census Bureau. Census urban and rural classification and urban area criteria: lists of population, land area, and percent urban and rural in 2010 and changes from 2000 to 2010. https://www.census.gov/progr?ams-surve?ys/geogr?aphy/guida?nce/geo-areas/urban-rural/2010-urban-rural.html. Accessed July 13, 2020.
45. Lilly CL, Ruhnke AM, Breyel J, Umer A, Leonard CE. Drug free moms and babies: qualitative and quantitative program evaluation results from a rural Appalachian state. Prev Med Rep. 2019;15:100919. [PubMed: 31223561]
46. Krans EE, Patrick SW. Opioid use disorder in pregnancy: health policy and practice in the midst of an epidemic. Obstet Gynecol. 2016;128:4–10. [PubMed: 27275812]
47. Meinhofer A, Witman AE. The role of health insurance on treatment for opioid use disorders: evidence from the affordable care act Medicaid expansion. J Health Econ. 2018;60:177–197. [PubMed: 29990675]
48. Moore JA, Bateman BT, Patrick SW. Opioid crisis in Medicaid: saving mothers and babies. Health affairs blog. 2018.
49. Terplan M, Hand DJ, Hutchinson M, Salisbury-Afshar E, Heil SH. Contraceptive use and method choice among women with opioid and other substance use disorders: a systematic review. Prev Med. 2015;80:23–31. [PubMed: 25900803]
50. Maguire DJ, Taylor S, Armstrong K, et al. Long-term outcomes of infants with neonatal abstinence syndrome. Neonatal Netw. 2016;35:277–286. [PubMed: 27636691]
51. Patrick SW, Faherty LJ, Dick AW, Scott TA, Dudley J, Stein BD. Association among county-level economic factors, clinician supply, metropolitan or rural location, and neonatal abstinence syndrome. JAMA. 2019;321:385–393. [PubMed: 30694320]
52. Merino R, Bowden N, Katamneni S, Coustasse A. The opioid epidemic in West Virginia. Health Care Manag (Frederick). 2019;38:187–195. [PubMed: 30920991]

Synopsis

Studyquestion

To examine the incidence of NAS by health insurance status in the rural Appalachian state of West Virginia in the United States using population-level statewide non–claims data.

What's already known?

Neonatal abstinence syndrome disproportionately impacts Medicaid population. The national average of NAS is 14.4 per 1000 livebirths in Medicaid-insured newborns. Most prior studies use claims data to examine this association.

What this study adds?

Our study utilized a population-level non–claims data to provide timely (2017–2019) and accurate estimates of NAS by health insurance status for the rural state of West Virginia (WV). The incidence of NAS was 85.8 per 1000 livebirths in the WV Medicaid population.

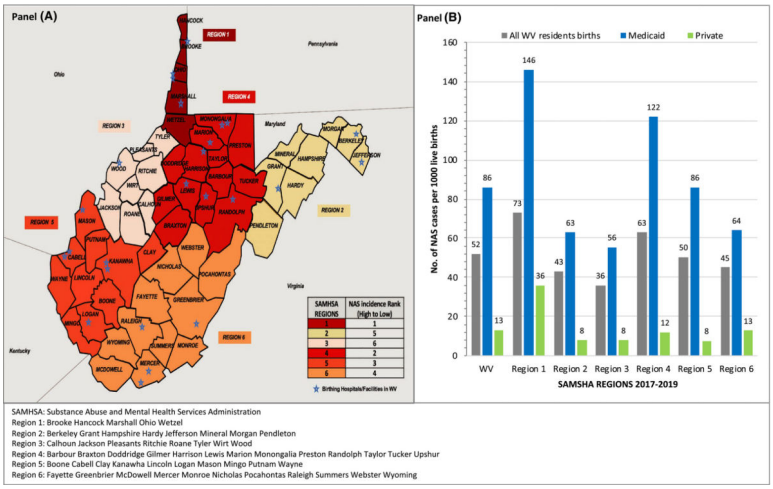

FIGURE 1.

Panel A: West Virginia SAMHSA substate regional classification system for West Virginia. Colour coding the incidence of NAS across regions from high to low. Panel B: Incidence of NAS stratified by Medicaid (n = 23 861) and private (n = 20 558) health insurance groups for WV residents by SAMHSA regions (2017–2019)

TABLE 1

Study characteristic of the all women who gave birth and all infants born in the state of West Virginia in 2017–2019 (N = 55 500) and West Virginia residents births only (N = 46 213)

	Total population (N = 55 500)	**West Virginia residents only (N = 46 213; 83.3%)**
Population characteristics	**N (%)**	**N (%)**
Health insurance status		
Medicaid	24 477 (44.8)	23 861 (52.6)
Private	26 017 (47.6)	20 558 (45.2)
Other	3651 (6.7)	674 (1.5)
Uninsured	466 (0.9)	296 (0.7)
Missing	889	824
Intrauterine substance exposure		
Yes	7631 (13.8)	6465 (13.9)
No	47 869 (86.3)	3 9 748 (86.0)
Maternal age (years of age)		
<20	3709 (6.7)	3201 (6.9)
≥20	51 629 (93.3)	42 853 (93.1)
Missing	162	159
Maternal education (grades)		
≤10	3464 (6.3)	3076 (6.7)
≥11	51 877 (93.7)	42 980 (93.3)
Missing	159	157
Maternal smoking in pregnancy		
Yes	12 812 (23.1)	10 943 (23.7)
NO	42 688 (76.9)	35 270 (76.3)
Neonatal abstinence syndrome (NAS)		
Yes	2891 (5.2)	2401 (5.2)
NO	52 609 (94.8)	43 812 (94.8)
Race		
White	50 685 (92.6)	42 009 (92.0)
All–others combined[a]	4030 (7.4)	3642 (7.9)

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	Total population (N = 55 500)	West Virginia residents only (N = 46 213; 83.3%)
Population characteristics	**N (%)**	**N (%)**
Missing	785	562
Sex of newborn		
Male	28 532 (51.4)	23 714 (51.3)
Female	26 969 (48.6)	22 499 (48.7)
Missing	889	824

Note:

[a] All others combined include.

All births: Asian, 0.7%; Black, 2.7%; Hispanic, 0.7%; mixed, 1.0%; other, 2.2%.

WV residents: Asian, 0.7%; Black, 2.9%; Hispanic, 0.8%; mixed, 1.0%; other, 2.5%.

TABLE 2

Frequencies, measures of occurrence (risk per 1000), and unadjusted measures of association (RR and RD) of neonatal abstinence syndrome (NAS) by health insurance categories for West Virginia (WV) resident-only births 2017–2019 (N = 46 213)

		NAS (Yes)		NAS (No)				
Health insurance	**WV residents N (%)**	**n**	**Col %**	**n**	**Col %**	**Risk (per 1000)**	**RR (95% CI)**	**RD (95% CI) per 1000**
Medicaid	23 861 (52.6)	2047	86.1	21 814	50.7	85.79	6.76 (5.95, 7.68)	73.1 (69.2, 77.0)
Other	674 (1.5)	47	2.0	627	1.5	69.73	5.49 (4.07, 7.42)	57.0 (37.7, 76.3)
Uninsured	296 (0.7)	23	1.0	273	0.6	77.7	6.12 (4.06, 9.23)	65.0 (34.5, 95.5)
Private	20 558 (45.3)	261	10.9	20 297	47.2	12.69	1.00 (Reference)	0.0 (Reference)
Total N (%)	45 389	2378 (5.2)		43 011 (94.8)				
Missing	824							

Note: RR is the ratio of the risk of the outcome in one group (Medicaid, other, and uninsured) compared with the risk in the privately insured group. RD was computed by calculating the difference between the risks in two groups.

Abbreviations: CI, confidence interval; RD, risk difference; RR, risk ratio.

TABLE 3

Results of the multilevel crude and adjusted multiple regression analyses for the measures of association (RR and RD) of neonatal abstinence syndrome (NAS) by health insurance categories for West Virginia (WV) resident-only births 2017–2019 (N = 46 213)

Factors	Unadjusted RR[a] (95% CI)	Adjusted RR[a] (95% CI)	Unadjusted RD/1000[a] (95% CI)	Adjusted RD/1000 (95% CI)
Health insurance Medicaid vs private	6.78 (4.29, 10.71)	3.00 (2.01, 4.49)	73.2 (53.2, 93.3)	20.3 (17.5, 23.1)
Health insurance Other vs private	5.51 (3.38, 8.90)	3.62 (2.52, 5.22)	57.2 (30.2, 84.1)	25.5 (10.4, 40.6)
Health insurance Self-pay (no) vs private	6.17 (3.72, 10.24)	3.49 (2.24, 5.42)	65.6 (46.9, 84.2)	1.5 (−10.9, 13.8)
Maternal age (years) (≥20 vs <20)		2.82 (2.19, 3.64)		3.5 (1.6, 5.4)
Maternal race (White vs others)		1.31 (1.04, 1.65)		-
Maternal education (≤10 vs ≥11 grade)		1.28 (1.17, 1.40)		18.1 (9.0, 27.2)
Maternal smoking (Yes vs no)		8.29 (6.64, 10.35)		150.8 (142.5, 159.1)

Note: Crude models–log-binomial regression (link = log for RR and link = identity for RD).

Adjusted models–modified Poisson regression using a robust error variance.

Abbreviations: CI, confidence interval; RD, risk difference; RR, risk ratio.

[a]The multilevel crude and adjusted models clustered on SAMHSA regions (repeated subject = region) to take into account the degree of similarity between subjects within clusters.

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