HHS Public Access

Author manuscript

J Addict Med. Author manuscript; available in PMC 2024 June 01.

Published in final edited form as:

J Addict Med. 2023 ; 17(5): 587–591. doi:10.1097/ADM.0000000000001184.

Neonatal outcomes following medications for opioid use disorder during pregnancy in a state women's prison facility, 2016–2019

Andrea K Knittel, MD, PhD[a,*], **Rita A Swartzwelder, MD**[b], **Samantha Zarnick, BS**[b], **Tamy Moraes Tsujimoto, PhD**[c], **Timeli Horne, BS**[b], **Feng Chang Lin, PhD**[c], **James Edwards, MD**[d], **Elton Amos, MD, MPH**[e], **James Alexander, DBA**[e], **John Thorp, MD**[a], **Hendree E Jones, PhD**[f]

[a]Division of General Obstetrics and Gynecology, Department of Obstetrics and Gynecology, University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, NC

[b]University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, NC

[c]Department of Biostatistics, Gillings School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC

[d]WakeMed Maternal-Fetal Medicine, Raleigh, NC

[e]North Carolina Department of Public Safety, Raleigh, NC

[f]UNC Horizons, Department of Obstetrics and Gynecology, University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, NC

Abstract

Objective: Although medications for opioid use disorder improve both maternal and neonatal outcomes, little is known about opioid-exposed infants born during episodes of incarceration. The study sought to examine birth outcomes for infants born with opioid exposure during perinatal incarceration.

Methods: Participants were identified from clinic rosters in a Southeastern women's prison (2016–2019). Included infants born to pregnant people with opioid use disorder incarcerated in the study facility at the time of delivery. We abstracted hospital length of stay (LOS), neonatal opioid withdrawal syndrome (NOWS) severity, and discharge plan from hospital records and report descriptive statistics, ANOVA F-tests and Chi-squared tests to compare outcomes by opioid exposure type.

Results: There were 125 infants born following exposure to methadone (n=34), buprenorphine (n=15), oxycodone (n=22), or no opioid medication (n=54) during prenatal incarceration. Most infants exposed to methadone or buprenorphine had difficulty with eating, sleeping, or consoling (97% and 80%), and 59% and 47% were treated with medication for NOWS, respectively. The majority with prenatal opioid exposure required intervention for NOWS symptoms after their

[*]Corresponding author: Andrea K. Knittel, 3027 Old Clinic Building CB#7570, Chapel Hill, North Carolina, 27599, Phone: (919) 843-7851, Fax: (919) 996-6001, aknittel@umich.edu.

Conflicts of Interest: None.

birthing parent was discharged to the prison. The average hospital LOS was different for infants with no opioid, methadone, buprenorphine, and oxycodone exposure during incarceration (4, 15, 12, and 9 days, respectively, p <0.001).

Conclusions: Neonatal hospitalization experiences of infants with perinatal opioid exposures during maternal incarceration mirror those of similarly-exposed infants born outside the context of incarceration, except for hospital length of stay. Consideration of avoiding separation of the parent-infant dyad may be needed to improve outcomes for these infants.

Keywords

Opioid use disorder; incarceration; neonatal abstinence syndrome; neonatal opioid withdrawal syndrome; medications for opioid use disorder (MOUD)

Introduction

Increases in opioid use nationally have been paralleled by increases in neonatal opioid withdrawal syndrome (NOWS) amongst newborns.[1] While there has been an increase in the incidence of NOWS, treatment with medications for opioid use disorder (MOUD) during pregnancy provides great benefit, including reduction of fetal exposure to non-prescribed opioid use, improved adherence to prenatal care, and improved neonatal birth weights, generally outweighing the short-term effects of medication-induced NOWS.[2,3] Standard-of-care MOUD treatment also reduces the risk of parental overdose death, which is otherwise increased in the postpartum period.[4] The type of medication exposure during pregnancy affects NOWS, and in particular buprenorphine may decrease the incidence and severity of NOWS when compared to methadone.[5]

While not all infants exposed to opioids during pregnancy will develop NOWS, care recommendations are typically to monitor prenatally-opioid exposed neonates for multiple days using clinical scoring methods.[2] Neonates who develop NOWS are treated with non-pharmacologic interventions with added pharmacologic intervention when needed, typically with morphine or methadone.[2,6] Recent studies of NOWS treatment favor the “Eat, Sleep, Console” (ESC) model as first-line therapy that avoids scoring symptoms and includes the parent in the care approach.[7,8] If any ESC goal is not met, non-pharmacologic intervention is prioritized, including: maximizing feeding on demand, swaddling, a low-stimulation environment, and the presence of a parent.[7] Recent studies have shown that the ESC protocol leads to shorter average hospital length of stay (LOS), decreased need for pharmacologic treatment, and lower doses of opioid medications when needed.[8,9]

Perinatal incarceration raises additional potential challenges in the management of NOWS for some infants. The intersection between rising perinatal opioid use and criminal-legal approaches to substance use in the United States (US) has resulted in increasing numbers of births during incarceration. Based on the prevalence of births to people in a sample of jails and prisons across the US, more than 5,500 infants are born during episodes of incarceration each year and this number is likely rising.[10–12]

Although the treatment models for infants affected by OUD and born during episodes of incarceration are not different than for other infants, incarceration significantly changes the context of NOWS management. For instance, MOUD is not available during pregnancy in all jail and prison facilities and access to methadone as compared to buprenorphine may be different in settings of incarceration.[13,14] Infants experiencing NOWS may also remain hospitalized beyond when caregivers who are incarcerated are permitted to remain in the hospital following delivery. Infants born in the context of incarceration far from home may have fewer caregivers who can be present in the hospital. Data on the NOWS experiences of infants born during episodes of incarceration of the pregnant parent are limited.

Objective.

This study describes NOWS outcomes for babies born to pregnant people with OUD during an episode of incarceration in a Southeastern prison from 2016–2019.

Methods

Setting.

Reported are the secondary outcomes of a retrospective cohort study of pregnant people with OUD at the North Carolina Correctional Institution for Women (NCCIW) from 2016–2019. NCCIW is the only North Carolina state prison facility housing pregnant people and has a total capacity of 1776.[15] During the study period, the total daily pregnancy census ranged from 20 to 60 people and the prevalence of OUD among pregnant people was 58%.[16] Additional details about overall study are described elsewhere.[16] Obstetrician-gynecologists from the University of North Carolina at Chapel Hill (UNC) provide prenatal services inside the prison facility. Pregnant people who labored spontaneously received intrapartum and postpartum care at the nearest hospital to NCCIW, an academically-affiliated community hospital (WakeMed). Inductions of labor and scheduled cesarean sections occurred at UNC Women's Hospital. Both hospitals are designated as "Baby Friendly" by the Baby Friendly Hospital Initiative.

Study participants.

Pregnant participants were eligible if they were incarcerated at NCCIW from 2016 to 2019 and were identified as having OUD. Potential participants were identified through prison prenatal clinic roster problem lists and OUD was confirmed through review of clinic records. Deliveries that occurred during incarceration were identified during review of the NCDPS electronic medical record and confirmed through review of the delivering hospital record. When there were twins, only twin A was included. Neonates exposed during incarceration to either buprenorphine, methadone, oxycodone or no opioid medication were included.

Medication administration.

Intake procedures at NCCIW during pregnancy include assessment for substance use and withdrawal symptoms by nursing staff, facility primary care physicians and later by behavioral health clinicians. If there was no evidence of acute withdrawal, no opioid medications were prescribed. Per NCCIW protocols during the study period, oxycodone was used to treat acute withdrawal until initiation/continuation of MOUD (most often in the

second and third trimesters), withdrawal via gradual taper of the oxycodone dose (most often during the first trimester), or, if incarceration occurred late in the third trimester, delivery of the pregnancy. The practice of prescribing oxycodone for management of withdrawal until delivery rather than being referred for MOUD was discontinued in mid-2018. Both methadone and buprenorphine were prescribed and administered daily for MOUD initiation and/or continuation at a contracted off-site facility. Approximately one-third of pregnant people had received MOUD prior to incarceration, with half of those continuing treatment while at NCCIW.[16] MOUD was continued during the entire delivery hospitalization and was discontinued at the time of discharge to NCCIW.

NOWS Care.

Infants born in either delivery hospital roomed-in with the birthing parent during the delivery hospitalization unless there was a parental or neonatal medical reason not to do so. Infants who were unable to room-in could receive visits and pumped human milk from the birthing parent until the parent was discharged from the hospital. Birthing parents were encouraged to breastfeed and/or pump during the delivery hospitalization but neither option was available at NCCIW after hospital discharge. At the start of the study period, both hospitals used Finnegan scoring and beginning in 2017 and then throughout the study period engaged in a transition to monitoring infants using an Eat, Sleep, Console protocol. Throughout the study period, hospital staff documented difficulties with infant feeding, sleep, and consolation in various parts of the medical record, including as part of the Finnegan assessment when that protocol was in use. Infants with opioid exposure were generally monitored for at least 72 hours prior to discharge or for 24 hours after discontinuation of pharmacologic treatment for NOWS.[9]

Measures.

Neonatal outcomes were abstracted from the problem list, provider and nursing notes, and flow sheets from the delivery hospital record. All data were abstracted by trained research assistants (SZ, RS) and reviewed by a board-certified OB/GYN (AK). Measures of NOWS symptoms and treatment were assessed for the first 10 days of infant hospitalization to capture the onset of NOWS. Measures included whether 1) staff documented any ESC difficulty (yes/no); 2) the infant received any ESC interventions (yes/no); 3) the infant received morphine (yes/no); and duration of 4) ESC difficulty (days); and 5) treatment with morphine (days). Two binary measure of any treatment for NOWS after maternal hospital discharge were also created. These were defined as receipt of ESC intervention/morphine during 1) postpartum days #3–10 and 2) postoperative days #5–10. Postpartum day #2 and postoperative day #4 are typical discharge dates for the delivering hospitals. Additionally, we described neonatal hospital LOS (days) and discharge plans categorically.

Statistical Analyses.

Missing data were handled using complete case analysis, i.e., cases with incomplete data for any variable included in the analysis were excluded from that analysis. We generated descriptive statistics for four groups based on medication exposure during prenatal incarceration (methadone, buprenorphine, oxycodone only, or no opioid medication). For categorical variables, we calculated frequencies and proportions. We described continuous

variables with both means (standard deviations) and medians (interquartile ranges) in order to facilitate comparisons with the literature despite evidence of significantly non-normal distributions. We compared measures of NOWS severity and hospital LOS between groups using one way ANOVA F-test test for continuous variables and Pearson Chi-Square test for categorical variables. We used a post-hoc Bonferroni correction for multiple comparisons.

Terminology.

We strive to use the gender inclusive terms “pregnant person” or “birthing parent” to affirm that some people with the capacity to become pregnant and give birth do not identify as women. When previously published research has reported on “females” or “women,” we use those terms for consistency. NCDPS public and medical records do not include gender identity but report only sex-assigned-at-birth.

Ethics Approval.

The Institutional Review Board at our institution (#18–2027 and #19–3247) and the NCDPS Human Subjects Research Committee (#1908–03 and #2005–01) reviewed and approved this project with waivers of informed consent and Health Insurance Portability and Accountability Act authorization.

Results

Study sample.

N=279 pregnant people with OUD were included in the primary analysis; n=154 left the prison with an ongoing pregnancy and n=125 delivered during incarceration. There was missing data on the mode of delivery and discharge plan for 2 infants and MOUD start date for 1 pregnancy. Maternal characteristics are described with the primary outcomes from the study.[16] Prior to incarceration, pregnant people who delivered during incarceration most commonly reported use of tobacco (n=100, 80%), alcohol (n=37, 30%), cannabis (n=43, 34%), cocaine (n=42, 34%), amphetamines (n=42, 34%). Pre-incarceration opioid exposure included heroin (n=25, 20%), other opioids (n=114, 91%), prescribed methadone (n=14, 11%), and prescribed buprenorphine (n=24, 19%). Of the pregnant people who delivered during incarceration, 24 (19%) received a selective serotonin reuptake inhibitor (SSRI) during pregnancy. Of the n=125 infants born during an episode of incarceration, 91 were born vaginally and 31 via cesarean. There were 71 infants with prenatal exposure during incarceration to methadone (n=34, 49%), buprenorphine (n=15, 21%), or oxycodone (n=22, 30%). The mean duration of prenatal exposure during incarceration ranged from 89 days (SD=54) for methadone and 105 days (SD=75) for buprenorphine. Oxycodone was generally administered for 7–21 days beginning on intake and continued until completion of a taper or delivery; the mean interval between intake and delivery for this group was 94 days (SD=64). In pregnancies without opioid exposure during incarceration, the mean interval between intake and delivery was also 94 days (SD=71).

Neonatal Outcomes.

The mean gestational age at delivery was 37.7 weeks (SD=2.3) for infants with prenatal methadone exposure, 38.8 weeks (SD=1.3) for infants with prenatal buprenorphine

exposure, 37.7 weeks (SD=1.9) for infants with prenatal oxycodone exposure, and 38.8 weeks (SD=1.5) for infants without opioid exposure during incarceration. Among methadone-, buprenorphine-, oxycodone-exposed, and unexposed infants, 21% (n=7), 7% (n=1), 18% (n=4), and 9% (n=5) were born between 32 and 37 weeks gestational age. Neonatal delivery hospitalization outcomes are presented in Table 1. There were statistically significant differences by opioid exposures in the proportions of infants with documented difficulties with eating, sleeping, and consoling and the proportions ever treated with medication for NOWS, with infants exposed to methadone showing the highest rates of intervention. For those infants with documented difficulties, the average times to first documentation of a difficulty were 0.8 days (n=33, SD=1.3) for methadone-exposed, 1.8 days (n=12, SD=1.3) for buprenorphine-exposed, 0.5 days (n=6, SD=0.8) for oxycodone-exposed, and 2.7 days (n=3, SD=0.6) for unexposed infants. Neonatal intervention for NOWS following maternal return to prison (post-operative day #5 or postpartum day #3) was necessary for approximately one-third of all infants. The proportion needing intervention for NOWS after at both time points was statistically significantly different between exposure groups, with trends mirroring those for intervention overall. Among those requiring any intervention, the duration of intervention did not differ by opioid exposure group.

The mean hospital LOS was 9 days (SD=9), which was significantly different between exposure groups, with mean hospital LOS of 15 days (SD=11), 12 days (SD=10), 9 days (SD=10), and 4 days (SD=2) for methadone-, buprenorphine-, oxycodone-exposed, and unexposed infants during incarceration, respectively (Table 1). For infants with opioid exposure during incarceration, the mean hospital LOS was 12 days (SD=10), the mean number of days with documented issues with eating, sleeping, and/or consoling was 12 days (SD=10), and neither differed by opioid exposure during incarceration. The majority (60%, n=74) of infants were discharged to a non-parental family member or friend, and 26% (n = 32) were discharged to foster care, 8.9% (n=11) into the custody of the infant's other parent, and 1% (n = 1) to adoptive families. There were 4% (n = 5) of infants discharged with the birthing parent, presumably when release from incarceration was coincident with discharge from the hospital after birth.

Conclusions

Although the neonatal outcomes described in this paper are largely descriptive in nature, they nonetheless highlight important considerations for pregnant people with OUD who experience incarceration. Our neonatal findings are consistent with the extensive literature demonstrating that buprenorphine is associated with decreased frequency of NOWS symptoms.[17] In this small sample of neonates born during incarceration, any opioid exposure during perinatal incarceration was associated with a longer hospital LOS. Among those infants with opioid exposure, there was no difference in hospital LOS or the duration of pharmacologic and/or non-pharmacologic interventions across infants perinatally exposed to methadone, buprenorphine, or an oxycodone taper during incarceration.

Importantly, our results show that the majority of infants continued to require intervention for NOWS symptoms after their parent was discharged from the hospital to return to

prison. Our findings represent a conservative estimate of the proportion of infants requiring NOWS treatment after parent-dyad separation, as many incarcerated birthing parents may have been discharged as early as 24–48 hours after birth. Infants in our sample were permitted to remain with their birthing parents prior to separation at hospital discharge. In other systems where rooming-in is not permitted, the effects of incarceration on NOWS management are anticipated to be even greater. The presence of the birthing parent/rooming-in is an important part of NOWS treatment that reduce hospital LOS, neonatal medication administration, and cost of care.[18,19] In addition, breastfeeding, which for participants in this study was only an option during their brief hospital stay, also decreases NOWS severity, pharmacologic treatment, and neonatal hospital LOS.[20,21] Interventions to improve NOWS outcomes implemented in other prison contexts include postpartum leaves of absence with community supervision, prison nursery programs, and breastfeeding programs.[22–24]

This study did not directly compare infants born during incarceration with infants born to parents who were not incarcerated. The frequency of NOWS symptoms and pharmacologic intervention in this study were similar to published estimates from infants not affected by perinatal incarceration. However the 12-day average hospital LOS in this study was remarkably longer than hospital LOS at one of the study hospitals during this time period (10.3 days prior to ESC and 4.9 days with ESC), published in a study of infants not affected by incarceration.[9,17,25] This suggests that infants born during incarceration may not have benefitted from ESC. This longer hospital LOS for infants born during incarceration is consistent with a Connecticut study of 28 infants born during incarceration compared with 138 infants born to non-incarcerated birthing parents.[26] That study identified treatment with methadone, dyad separation, and lack of breastfeeding as drivers of this difference.

The findings of this study are limited by its retrospective nature and available prison records. Participants were identified using paper records available for portions of each year during the study period. While the missing records are not expected to differ significantly, there are some infants who would only have been identified in the inaccessible records. Despite including several years of data, analysis of these neonatal outcomes is also limited by small sample sizes, particularly when dividing groups by opioid exposure. Our ascertainment of NOWS severity was also limited by the overlap between our study period and the transition from Finnegan scoring to ESC at the delivery hospitals. This made aggregating NOWS symptom severity measures impracticable.

Additionally, there are several limitations related to the ascertainment of opioid exposure during pregnancy. Measuring substance use based on medical record documentation limited our ability to identify the timing and severity of pre-incarceration substance use relative to incarceration and delivery. We also note that the average time between prison intake and hospital delivery was much longer than the typical course of oxycodone, suggesting that some in the oxycodone exposure group may have completed that taper well in advance of delivery. We were not able to measure this interval at the individual level, however.

Despite these limitations, our findings suggest that delivery hospitalization outcomes following birth during an episode of incarceration for neonates exposed to opioids are similar to outcomes for infants born outside of an episode of incarceration, apart from

hospital LOS.[5,9,25] Given the tremendous benefits of MOUD to the birthing parent-infant dyad, the risks even in the setting of incarceration are likely outweighed, although additional interventions may be needed to decrease hospital LOS for infants born during incarceration. The finding that the majority of infants required intervention after separation from their birthing parent is a powerful reminder of the effects of incarceration. This separation may greatly impact an infant's access to vital non-pharmacologic treatment for NOWS, including consoling and breastfeeding, and prior research has identified separation as a critical source of neonatal toxic stress, affecting long-term cognitive and behavioral outcomes of children.[27,28] Interventions to improve infant outcomes should prioritize evidence-based treatment of OUD during pregnancy and minimizing parental-infant separation through longer postpartum hospital stays for birthing parents, supportive interventions for non-birthing parent caregivers to be present in the hospital, innovative programs to keep dyads together during incarceration, and community-based alternatives to incarceration.

Acknowledgements:

The authors would like to thank Athena Samaras for her input on the clinical guidelines and protocols for infants with opioid exposure during the study period. This work was supported by a Cefalo Bowes Young Researcher Award from the Collaborative for Maternal and Infant Health at the University of North Carolina at Chapel Hill (Knittel, Zarnick), the Department of Obstetrics and Gynecology at the University of North Carolina at Chapel Hill, the National Institute of Child Health and Human Development (NICHD) (Knittel, K12HD103085), and the National Center for Advancing Translational Sciences (Lin, Tsujimoto, UL1TR002489).

Disclosure of funding:

This work was funded in part by the National Institutes of Health (NIH).

References

1. Hirai AH, Ko JY, Owens PL, Stocks C, Patrick SW. Neonatal Abstinence Syndrome and Maternal Opioid-Related Diagnoses in the US, 2010–2017. JAMA. 2021;325(2):146–155. [PubMed: 33433576]
2. Reddy UM, Davis JM, Ren Z, Greene MF. Opioid Use in Pregnancy, Neonatal Abstinence Syndrome, and Childhood Outcomes: Executive Summary of a Joint Workshop by the Eunice Kennedy Shriver National Institute of Child Health and Human Development, American College of Obstetricians and Gynecologists, American Academy of Pediatrics, Society for Maternal-Fetal Medicine, Centers for Disease Control and Prevention, and the March of Dimes Foundation. Obstet Gynecol. 2017;130(1):10–28. [PubMed: 28594753]
3. Jones HE, Martin PR, Heil SH, et al. Treatment of opioid-dependent pregnant women: clinical and research issues. J Subst Abuse Treat. 2008;35(3):245–259. [PubMed: 18248941]
4. Schiff DM, Nielsen T, Terplan M, et al. Fatal and Nonfatal Overdose Among Pregnant and Postpartum Women in Massachusetts. Obstet Gynecol. 2018;132(2):466–474. [PubMed: 29995730]
5. Jones HE, Kaltenbach K, Heil SH, et al. Neonatal Abstinence Syndrome after Methadone or Buprenorphine Exposure. N Engl J Med. 2010;363(24):2320–2331. [PubMed: 21142534]
6. Substance Abuse and Mental Health Services Administration. Clinical Guidance for Treating Pregnant and Parenting Women with Opioid Use Disorder and Their Infants. In. Rockville: Substance Abuse and Mental Health Services Administration; 2018.
7. Grossman MR, Lipshaw MJ, Osborn RR, Berkwitt AK. A novel approach to assessing infants with neonatal abstinence syndrome. Hospital Pediatrics. 2018;8(1):1–6. [PubMed: 29263121]
8. Achilles JS, Castaneda-Lovato J. A quality improvement initiative to improve the care of infants born exposed to opioids by implementing the eat, sleep, console assessment tool. Hospital pediatrics. 2019;9(8):624–631. [PubMed: 31358546]

9. Blount T, Painter A, Freeman E, Grossman M, Sutton AG. Reduction in Length of Stay and Morphine Use for NAS With the “Eat, Sleep, Console” Method. Hospital Pediatrics. 2019;9(8):615–623. [PubMed: 31285356]
10. Sufrin C, Jones RK, Mosher WD, Beal L. Pregnancy Prevalence and Outcomes in US Jails. Obstet Gynecol. 2020;135(5):1177–1183. [PubMed: 32282606]
11. Sufrin C, Beal L, Clarke J, Jones R, Mosher WD. Pregnancy Outcomes in US Prisons, 2016–2017. Am J Public Health. 2019;109(5):799–805. [PubMed: 30897003]
12. North Carolina Correctional Institution for Women. 2015–2018 Statistical Report for Pregnant Admissions at NCCIW. In: North Carolina Department of Public Safety Freedom of Information Act Response, ed. Raleigh, NC: North Carolina American Civil Liberties Union; 2019.
13. Sufrin C, Kramer CT, Terplan M, et al. Availability of Medications for the Treatment of Opioid Use Disorder Among Pregnant and Postpartum Individuals in US Jails. JAMA Network Open. 2022;5(1):e2144369–e2144369. [PubMed: 35050354]
14. Sufrin C, Sutherland L, Beal L, Terplan M, Latkin C, Clarke JG. Opioid Use Disorder Incidence and Treatment Among Incarcerated Pregnant People in the US: Results from a National Surveillance Study. Addiction. 2020;115(11):2057–2065. [PubMed: 32141128]
15. North Carolina Department of Public Safety. N.C. Correctional Institution for Women. North Carolina Department of Public Safety Web site. https://www.ncdps.gov/adult-corrections/prisons/prison-facilities/nc-correctional-institution-for-women. Updated October 2020. Accessed May 14, 2021.
16. Knittel AK, Swartzwelder RA, Zarnick S, et al. Medications for opioid use disorder during pregnancy: Access and continuity in a state women’s prison facility, 2016–2019. Drug Alcohol Depend. 2022;232:109308.
17. Jones HE, Johnson RE, Jasinski DR, et al. Buprenorphine versus methadone in the treatment of pregnant opioid-dependent patients: effects on the neonatal abstinence syndrome. Drug Alcohol Depend. 2005;79(1):1–10. [PubMed: 15943939]
18. Boucher A-M, Harris-Haman PA, Zukowsky K. Nonopioid management of neonatal abstinence syndrome. Adv Neonatal Care. 2017;17(2):84–90. [PubMed: 28002062]
19. Holmes AV, Atwood EC, Whalen B, et al. Rooming-in to treat neonatal abstinence syndrome: improved family-centered care at lower cost. Pediatrics. 2016;137(6).
20. Welle-Strand GK, Skurtveit S, Jansson LM, Bakstad B, Bjarkø L, Ravndal E. Breastfeeding reduces the need for withdrawal treatment in opioid-exposed infants. Acta Paediatr. 2013;102(11):1060–1066. [PubMed: 23909865]
21. Short VL, Gannon M, Abatemarco DJ. The Association Between Breastfeeding and Length of Hospital Stay Among Infants Diagnosed with Neonatal Abstinence Syndrome: A Population-Based Study of In-Hospital Births. Breastfeed Med. 2016;11(7):343–349. [PubMed: 27529500]
22. Asiodu IV, Beal L, Sufrin C. Breastfeeding in Incarcerated Settings in the United States: A National Survey of Frequency and Policies. Breastfeed Med. 2021.
23. Fritz S, Whiteacre K. Prison nurseries: Experiences of incarcerated women during pregnancy. Journal of Offender Rehabilitation. 2016;55(1):1–20.
24. Hotelling BA. Perinatal Needs of Pregnant, Incarcerated Women. Journal of Perinatal Education. 2008;17(2):37–44. [PubMed: 19252687]
25. Jones HE, Deppen K, Hudak ML, et al. Clinical care for opioid-using pregnant and postpartum women: the role of obstetric providers. Am J Obstet Gynecol. 2014;210(4):302–310. [PubMed: 24120973]
26. Drago MJ, Shabanova V, Hochreiter D, Grossman M, Mercurio M. Does Maternal Incarceration Impact Infants with Neonatal Abstinence Syndrome? Maternal and Child Health Journal. 2022;26(5):1095–1103. [PubMed: 35088297]
27. Bergman NJ. Birth practices: Maternal-neonate separation as a source of toxic stress. Birth defects research. 2019;111(15):1087–1109. [PubMed: 31157520]
28. Mooney-Leber SM, Brummelte S. Neonatal pain and reduced maternal care: early-life stressors interacting to impact brain and behavioral development. Neuroscience. 2017;342:21–36. [PubMed: 27167085]

Table 1.

Neonatal outcomes for infants with prenatal opioid exposures born during episodes of perinatal incarceration at a Southeastern women's prison, 2016–2019.

	Overall (n = 125)	None (n = 54)	Methadone (n = 34)	Buprenorphine (n = 15)	Oxycodone (n = 22)	p-value
Ever documented difficulty with ESC	54 (43%)	3 (5.6%)	33 (97%)	12 (80%)	6 (27%)	<0.001
Ever treated with medication for NOWS	27 (22%)	0 (0%)	20 (59%)	7 (47%)	0 (0%)	<0.001
Any NOWS intervention after parental discharge (Cesarean, POD#5–10)	10 (32%)	0 (0%)	9 (90%)	1 (33%)	0 (0%)	<0.001
Any NOWS intervention after parental discharge (Vaginal birth, PPD#3–10)	28 (31%)	0 (0%)	18 (75%)	7 (58%)	3 (23%)	<0.001
Total number of days documented difficulty with ESC	(n=54)	(n=3)	(n=33)	(n=12)	(n=6)	0.085
Mean (SD)	11 (10)	2 (2)	13 (10)	11 (9)	4 (5)	
Median (IQR)	8 (4, 15)	1 (1, 3)	9 (6, 19)	10 (4, 16)	3 (2, 4)	
Range	1, 36	1, 5	2, 36	1, 33	1, 14	
Total number of days treated with medication for NOWS	(n=27)	(n=0)	(n=20)	(n=7)	(n=0)	0.2
Mean (SD)	11 (10)	–	13 (11)	7 (7)	–	
Median (IQR)	9 (4, 16)	–	12 (6, 16)	5 (2, 10)	–	
Range	1, 38	–	1, 38	1, 19	–	
Hospital Length of Stay						<0.001
Mean (SD)	9 (9)	4 (2)	15 (11)	12 (10)	9 (10)	
Median (IQR)	5 (3, 10)	3 (2, 5)	14 (6, 22)	9 (4, 18)	5 (4, 7)	
Range	2, 43	2, 13	3, 40	3, 37	2, 43	
Discharge plans						0.3
Birthing parent (N, %)	5 (4.1%)	1 (1.9%)	4 (12%)	0 (0%)	0 (0%)	
Other parent (N, %)	11 (8.9%)	6 (11%)	3 (9.1%)	1 (6.7%)	1 (4.8%)	
Friends or other family (N, %)	74 (60%)	35 (65%)	19 (58%)	10 (67%)	10 (48%)	
Foster care (N, %)	32 (26%)	12 (22%)	7 (21%)	4 (27%)	9 (43%)	
Adoption (N, %)	1 (0.8%)	0 (0%)	0 (0%)	0 (0%)	1 (4.8%)	

Notes: ESC = Eat/Sleep/Console; NAS = Neonatal Abstinence Syndrome; POD = post-operative day; PPD = post-partum day. POD#5–10 and PPD#3–10 are after typical parental hospital discharge to the prison after cesarean and vaginal birth, respectively. P-values <0.007 are statistically significant after Bonferroni correction for multiple comparisons.