Title Page

**Neonatal Abstinence Syndrome: Magee Womens Hospital**

by

**Jennifer Shin Zank**

BSFS, Georgetown University, 1998

MD, Loyola University, 2010

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Committee Membership Page

UNIVERSITY OF PITTSBURGH

Graduate School of Public Health

This essay is submitted

**Jennifer Shin Zank**

on

April 8, 2019

and approved by

Committee Member: Jennifer Kloesz, MD, Associate Professor, Department of Pediatrics, School of Medicine, University of Pittsburgh

**Essay Advisor:** Marian Jarlenski, PhD, Assistant Professor, Department of Health Policy and Management, Graduate School of Public Health, University of Pittsburgh

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Abstract

Marian Jarlenski, PhD

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Jennifer Shin Zank, MHA

University of Pittsburgh, 2019

**Abstract**

Opioid use disorder among pregnant women and women of reproductive age has quadrupled in the U.S. Given this there is a concurrent growth in the incidence of neonatal abstinence syndrome. Clinically a baby is observed for withdrawal symptoms if a mother is known to have used opioids during pregnancy and the baby can undergo treatment themselves for drug dependence. These babies are typically admitted to the Neonatal Intensive Care Unit (NICU) when treatment is required. There is wide variation across the country on how these babies are managed from the non-pharmacologic to pharmacologic methods. To understand individual hospital performance these patients need to be identified through hospital administrative data. The public health significance lies in identification of these patients to understand areas of improvement for treatment and long term outcomes. This essay aims to determine if a hospital administrative database can identify these patients by ICD-10 codes. Coupled with chart review we will also describe the patient population and benchmark Magee Womens Hospital compared to the national trends based on length of stay and number of patients requiring pharmacologic therapy.

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Preface

As a resident physician I met my first patient dependent on opioids and did not understand NAS and the power of addiction. These little patients and their families have taught me so much over the years and my hope is that by reducing variation of NAS treatment and understanding the powerful role of non-pharmacological treatment we can make changes in the outcomes of these babies and their families. I would like to thank Professor Marian Jarlenski for her patience and her guidance in preparing this essay without her input this essay may not have made it “over the finish line.” I would also like to thank my family for their support as I completed my graduate degree during a tough few years. Finally, I would like to thank the patients and their families who have shared their stories with me so I can understand more about the challenges they face for it has made me a better physician and person.

# Background

The diagnosis of NAS increased over 300% from 1.20 per 1,000 hospital births in 2000 to 3.39 per 1,000 hospital births in 2009.(1) From 2004 to 2013, Neonatal Intensive Care Unit (NICU) admissions for infants with NAS increased from 7 cases per 1,000 admissions to 27 cases per 1,000 admissions.(2) When comparing state-wide data, in 2013, for example, the incidence ranges from 0.7 cases (Hawaii) to 33.4 cases (West Virginia) per 1,000 hospital births. (3) The overall cost of NAS-related hospital charges in 2012 is estimated to be $1.5 billion of which 80% was paid by Medicaid programs.(3)

In the past decade, the prevalence of opioid use disorder among pregnant women and women of reproductive age has quadrupled in the U.S., leading to a parallel increase in the incidence of neonatal abstinence syndrome (NAS). NAS is identified by symptoms including how well a baby eats, sleeps, and can be consoled. Clinically a baby is observed for drug dependence symptoms if a mother is known to have used opioids during pregnancy. By 2009, one infant per hour was born in the United States with NAS.(1) Best practices involving infant screening and managing their symptoms continues to improve however identification of these patients to understand the magnitude of the epidemic remains challenging for hospitals.

NAS itself refers to the constellation of symptoms that newborns exhibit soon after delivery. Symptoms usually manifest as neurological excitability, gastrointestinal dysfunction, and autonomic over reactivity. If untreated withdrawal in a newborn can lead to poor weight gain, seizure, and even death. In utero exposure to opioids can cause neonatal withdrawal after birth; an estimated 60% of neonates with in-utero opioid exposure will be identified as having NAS.(4) Not all babies go through withdrawal but those who have been exposed require a period of observation to determine if treatment with medication is required. During the observation period most babies are assessed using the Finnegan Neonatal Abstinence Scoring Tool.(5) The NAS scoring tool lists 21 symptoms that are observed in the opiate-exposed neonate (see Appendix) and the score will determine whether a baby is started on medication. In all cases non-pharmacologic care is the first line treatment for NAS. If pharmacologic treatment is required morphine has been the most commonly used medication to treat opioid dependence in a neonate(6) however centers continue to explore other treatment options like buprenorphine(7) and methadone.

NAS can be attributed to both illicit and licit drug use. There has been a 33% increase in the use of opioid pain relievers among pregnant women in the past decade. During pregnancy improved universal screening efforts have identified mothers who can benefit from medication assisted therapy (MAT). Methadone, a synthetic complete mu-opioid receptor agonist, and buprenorphine, a semi-synthetic partial mu-opioid receptor agonist, are both considered standard of care treatment for pregnant women with opioid use disorders. A large prospective randomized study found buprenorphine as superior to methadone for a shorter hospital stay and less withdrawal for NAS patients. However, the study did not find that the incidence or severity of NAS changed.(8)

In response to the growing opioid epidemic and the resultant increase in NAS states have made it a reportable condition to improve the public health surveillance. Current states include Florida, Kentucky, and Tennessee.(9) Pennsylvania hospitals now report NAS cases to the Department of Health. Magee Womens Hospital has been gathering data for the state for over 2 years now. Individual hospital surveillance for NAS however remains difficult given inconsistent coding patterns. A recent paper looked at a large cohort of Medicaid claims data compared to hospital administrative data in Tennessee demonstrating a 91% positive predictive value using ICD-9 and ICD-10 diagnostic codes.(10) However, another study of different states found positive predictive values ranging from 50% to 80% by state. (11)

To understand individual hospital performance, the primary objective for this study was to perform a medical record review based on administrative database coding to understand if the NAS population can be accurately identified by diagnostic code alone. Then, to use this initial dataset to perform a comprehensive chart review to understand baseline characteristics of the Magee Womens Hospital NAS population.

# Methods

## Study Design and Setting

The study setting was Magee Womens Hospital in Pittsburgh, PA. There are over 11,000 deliveries at Magee Womens Hospital a year which accounts for 45% of all births in Allegheny County, PA.(12) The hospital’s Neonatal Intensive Care Unit admits approximately 1,500 babies per year.(12) The NAS population made up 16% of the NICU admissions in 2016.

The 2016 data for this retrospective cohort was obtained from the Cognos database at the University of Pittsburgh Medical Center (UPMC). The Cognos database is a business intelligence and performance management tool utilized across UPMC. The Cognos database can generate a report identifying patients with the specific diagnosis codes. The diagnostic codes used for NAS were from the International Classification of Disease, Tenth Revision, Clinical Modification (ICD-10-CM). The diagnostic codes identified the patients for analysis and individual chart review was performed. We only identified patients from their birth hospitalization. Historically readmission rates within 28 days of birth for NAS will end up getting admitted to the Children’s hospital versus Magee. This study was reviewed and approved by the University of Pittsburgh Medical Center quality improvement board.

## Cohort Assembly

The cohort included: (1) infants admitted or transferred to Magee Womens Hospital January 1, 2016 through December 31, 2016. (2) A Cognos query of code P96.1, which is the ICD-10 diagnosis code indicating “neonatal withdrawal symptoms from maternal use of drugs of addiction”. At the time of the analysis this was the main code being used to identify NAS patients. (3) Patients who spent greater than 5 days in the Magee Womens Hospital Newborn Nursery. The 5 days was selected since all opioid exposed patients are monitored 5-7 days before being discharged home. Patients were excluded even if they were exposed to opioids in utero if they were admitted to the NICU for major medical issues and were medically unstable or if they were less than 34 weeks gestational age.

After the retrospective chart review was performed the Commonwealth of Pennsylvania added in addition to P96.1 the ICD-10 code P04.49, “newborn affected by maternal use of other drugs of addiction”. This expanded the list of patients that would have been captured by our original query of the database.

The retrospective chart review provided information on gestational age, sex, and the in-utero illicit and licit drug exposure found on both urine drug screen and chart review. The length of stay and whether the patient was transferred to another institution was also captured. The primary diagnosis code was captured on each cohort patient. The chart review included information on admission to the NICU and whether morphine treatment was initiated, or the patient was transferred back to the newborn nursery. Maternal exposures were determined by urine drug screen or by information documented in the chart. Tobacco is not tested and was determined based on chart maternal history documentation. Infants were categorized based on admission to the NICU and whether they received treatment for their NAS symptoms. Descriptive statistics were performed to analyze this cohort of patients identified by the diagnostic code query and length of stay.

# Results

Magee Womens Hospital admits approximately 300 NAS patients per year. In 2016, among the 303 infants reviewed for this analysis 17 patients were excluded and a total of 286 patients were either monitored or treated for NAS (Figure 1). 50 patients (17%) were not coded as NAS in the administrative data set and were identified due to their length of stay and by chart review. These 50 patients were never admitted to the NICU and remained on the newborn service during their period of monitoring and did not require pharmacotherapy.

The initial database query did not identify several patients who were subsequently identified on chart review based on their length of stay in the newborn nursery. Most patients who were missed in the initially query was coded as P04.49 “newborn affected by maternal use of other drugs of addiction”. Two neonate patients were coded O99.320, drug use complicating pregnancy, which is applicable to maternity patients and is not an appropriate code for a neonate. The rest of the patients were coded based on their birth and type of delivery (e.g., vaginal or c-section) with a Z code and were unable to be identified as NAS patients.

86% of patients were born term defined as greater than 37 weeks and 14% of patients were born late preterm (Table 1). Most patients’ mothers tested positive for either subutex (51%) or methadone (37%) with 12% of mothers on other opioids both prescription and illicit at delivery. 60% of observed patients received morphine therapy to treat their dependence. The average length of stay for non-transferred patients was 17 days. More than 50% of patients were transferred to be either closer to home to complete their treatment with over 80% of patients going to The Children’s Home to complete their treatment for NAS. The Children’s Home is a Pediatric Specialty Hospital that creates a home like environment where parents and siblings can stay while a baby is undergoing treatment for NAS.

At Magee, the screening tool utilized is the Finnegan Neonatal Abstinence Scoring System which assigns a numerical score to subjective clinical signs of NAS (Appendix A). All newborns who are exposed to opioids are monitored for 5-7 days before discharge is considered. Newborns are initially monitored on the newborn service and only transferred to the NICU when Finnegan scores suggest therapy should be initiated. At Magee when the average of three consecutive scores are > 8 then therapy with morphine is initiated. Nursing staff scores the patients and they are trained on the Finnegan scoring system. All babies in this cohort who were admitted to the NICU for NAS had an initial Finnegan score. For this cohort of patients, the overall mean Finnegan score on admission was 10. Those patients who were exposed to multiple illicit or licit substances had a higher mean Finnegan score.

# Discussion

Our objective for this study was to identify NAS patients by diagnosis code. Using a hospital administrative database, we were able to identify 87% of patients who were admitted to Magee Womens Hospital for observation or treatment of NAS. We found that using ICD-10 code 96.1 coupled with P04.49 and by adding in patients with greater than 5-day stay in the nursery would capture 93%of NAS patients. The administrative data set also provided information regarding length of stay and whether they were admitted to the NICU. This review demonstrates that hospital administrative data set can serve as an initial starting point to identify patients and when coupled with chart review can inform improvements in care for these patients.

At this time NAS data reported to the Commonwealth of Pennsylvania is not easily accessible and at this time is not a useful tool for individual hospitals for surveillance of their local population. The Commonwealth does not provide routine reports back to sites regarding their NAS population and length of stay. Nor is the information they currently provide site specific when data is shared. Using the Cognos database is a useful initial first step in understanding the NAS cohort for Magee Womens Hospital. Coupled with a comprehensive chart review we were able to understand the baseline characteristics of NAS patients, number treated, and number transferred to another institution.

In a recent cross-sectional analysis looking at 299 NICUs across the country found that that certain centers had more than 20% of their NICU days attributed to NAS patients. In addition, 87% required treatment with pharmacotherapy with most centers using morphine. The median length of stay was also 19 days.(2) When comparing the national statistics to Magee the NICU is on par with the national trends. The average length of stay is 17 days with 60% of patients requiring treatment. Although the length of stay is on part with national trends 50% of NAS patients were transferred to another facility and did not complete therapy at Magee. It is not clear how long these patients would stay admitted thereby adding to the Magee length of stay and if they required additional medication besides morphine to control symptoms.

In line with the American Academy of Pediatrics policy statement the Magee NICU in partnership with the newborn service developed a standardized plan for ‘the evaluation and comprehensive treatment of infants at risk for or showing signs of withdrawl.’(13) The Magee protocol includes information on how to up titrate morphine therapy and when to add a second or third line agent. Limitation of our review is understanding adherence to the standardized plan of care for NAS patients. Our retrospective chart review did not include this level of analysis.

Despite data to suggest methadone or buprenorphine treatment versus morphine treatment may decrease length of stay(7,14) patients at Magee continue to receive morphine therapy with phenobarbital and clonidine as second and third line treatment, respectively. Morphine is the current medication of choice given that the formulation of buprenorphine contains alcohol and appropriate methadone dosing is difficult to determine. Methadone is known to have a longer half-life leading to less dramatic swings in drug effect and it is dosed at longer intervals compare to the every 3-hour dosing with morphine. This can lead to fewer times infants may be experiencing an increase in symptoms leading to less escalation of therapy.(15) Our study was not able to identify if another agent was added to the treatment regimen nor if medications were increased or decreased according to protocol.

Another limitation to our study was identifying which patients were being given breastmilk versus formula. In our chart review it was not well documented in the daily patient notes. The American College of Obstetricians and Gynecologists and the American Academy of Pediatrics both recommend the use of breastmilk when mothers are in treatment programs and not using illicit drugs since the benefits outweigh the risks and can improve maternal-infant bonding.(16,17)

Our study is limited by using hospital administrative data and our study looks at data encompassing one year. Despite that hospital administrative data coupled with chart review allowed for a more comprehensive view of the total number of patients admitted and observed for NAS.

# Conclusion

Identifying NAS patients is a challenge within a hospital system however a good starting point would be to query using ICD-10 10 codes P04.49 and P96.1. By incorporating chart review data, a hospital system can understand current trends and how one compares to national benchmark data. Future initiatives should focus on standardizing coding for all NAS patients at the provider level to ensure accuracy in reporting. This would allow Magee’s NICU to understand current success and identify areas for improvement to serve this growing population of patients.

Appendix Tables and Figures

303 infants reviewed for this analysis

17 were excluded

5 prematurity

3 unable to identify

2 non-opiate observation

2 twins

2 hyperbilirubinemia

2 medically unstable

1 slow weight gain

286 infants diagnosed with NAS

236 coded P96.1

50 infants identified by > 5 days LOS

Figure 1 Screening and Identification of NAS Paients Identified During Birth Hospitalization

Table 1 Diagnosis Codes

|  |  |  |
| --- | --- | --- |
| Diagnosis Code | N (%) | Interpretation |
| O99.320 | 2 (0) | Drug use complicating pregnancy, unspecified trimester |
| P04.9 | 6 (0.02) | Newborn affected by maternal noxious substance, unspecified |
| P04.49 | 17 (6) | Newborn affected by maternal use of other drugs of addiction |
| P96.1 | 248 (87) | Neonatal withdrawal symptoms from maternal use of drugs of addiction |
| Z38.0 | 13 (5) | Single liveborn infant, born in hospital |

Table 2 Characteristics of Magee Womens Hospital Newborn Identified with NAS

|  |  |
| --- | --- |
| Variable | Result (n=286) |
| Infant CharacteristicsGestational Age, n (%)34 0/7 weeks to 34 6/7 weeks35 0/7 weeks to 35 6/7 weeks36 0/7 weeks to 36 6/7 weeks>=37 0/7 weeks Discharge Disposition, n (%) Transfer to another facilityMean Length of Stay, days (SD) (if not transferred)Median Length of Stay, days (IQR) (if not transferred) | 8 (3)13 (5)20 (7)245 (86)88 (51)17 (7.2)16 (6) |
| Maternal Drug Exposure, n (%)Buprenorphine only Buprenorphine + Other Antidepressant Benzodiazepines Cocaine Marijuana Methamphetamines Opioids (e.g., heroin, oxycodone) Phencyclidine TobaccoMethadone onlyMethadone + Other Antidepressant Benzodiazepines Cocaine Marijuana Methamphetamines Opioids (e.g., heroin, oxycodone) Phencyclidine TobaccoOpioids (e.g., vicodin, oxycodone, heroin) | 93 (33)51 (18)6 (12)4 (8)5 (10)10 (20)3 (6)26 (51)0 (0)16 (31)52 (18)55 (19)4 (7)6 (11)11 (20)8 (15)0 (0)25 (45)1 (2)21 (38)35 (12) |
| Number of patients requiring morphine therapy, n (%) | 172 (60) |
| Admission Finnegan ScoreOverall mean (SD)Overall median (IQR)Mean Finnegan Score (SD)Buprenorphine onlyBuprenorphine + OtherMethadone onlyMethadone + OtherOpiates | 10 (2.8)10 (3)10.3 (2.7)11.2 (2.2)9.5 (2.6)10.3 (3.3)9.4 (3.5) |



Figure 2 Finnegan NAS Scoring Tool (13)

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