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**IMPACT OF STATE-LED SURVEILLANCE PROGRAMS ON NEONATAL
ABSTINENCE SYNDROME**

ABSTRACT

Introduction: Neonatal Abstinence Syndrome (NAS) has been costly for the healthcare system, for every 24 minutes a baby was diagnosed in 2020. Uniform programs to diagnosis, track and prevent NAS have not been implemented previously. The NCBDDD worked with 6 states to implement a uniform surveillance program. By tracking the NAS incidence rate, the Apgar scores of infants with NAS, the length of stay for those infants, the cost of care for those infants and the percentage of mothers of infants with NAS were participating in Medication Assisted Treatment the effectiveness of the surveillance programs may be assessed.

Methodology: This study utilized a literature review and a semi-structured interview. Three databases were used to collect 347 total sources. These sources were reviewed and reduced to 30 total sources that were used in the written research. Of these, 10 sources were used in the results section.

Purpose of the Study: The purpose of this research was to identify the impact of NCBDDD surveillance programs on Neonatal Abstinence Syndrome incidence rates, Apgar scores reported for infants with NAS, length of stay, cost of care and the percentages of mothers who were treated with Medication Assisted Treatment while pregnant.

Results: The research showed that NCBDDD surveillance programs were not associated with decreases in NAS incidence rates, length of stay, cost of care, or an increase in Apgar scores or the percentage of mothers who were treated with Medicare Assisted Treatment while pregnant.

Key Words: 'Neonatal Abstinence Syndrome,' 'NAS,' 'NCBDDD surveillance programs,' 'Surveillance,' 'length of stay,' 'Apgar score,' 'cost,' 'MAT,' 'Medication Assisted Treatment'

INTRODUCTION

In 2020, a newborn was diagnosed with Neonatal Abstinence Syndrome (NAS) every 24 minutes in the United States (U.S.), totaling a sobering 59 newly diagnosed newborns per day (CDC, 2023). While the 2020 numbers demonstrated a decrease from 2017 levels, the shocking numbers highlighted a staggering issue that needed to be addressed (Hirai et al., 2021). The high of NAS was a result of the increase in opioid use disorder in pregnant women, which had more than quadrupled in the previous 20 years, but also reflected the increased knowledge and efforts of healthcare providers and public health departments to identify and report NAS (Haight et al., 2018). It has been reported that there were remarkable differences in incidence rates by state, with Hawaii reporting only one diagnosis of NAS per 1,000 newborns and West Virginia reporting a high of 43 infants with NAS per 1,000 births (CDC, 2023).

NAS has been defined as a condition in which infants have demonstrated a wide variety of symptoms as a result of in-utero exposure to certain substances, including benzodiazepines, barbiturates, alcohol, and opioids (CSTE, 2019). Infants with NAS have experienced various multi-system symptoms due to withdrawal from intrauterine exposure to drugs, often with symptoms not being identified until several days after birth (Tran et al., 2020). The broadness of symptoms of NAS has resulted in infants who have been sicker than the typical newborn, with increased length of stay and increased costs of care (CSTE, 2019).

Due to the presentation of symptoms varying widely depending on the specifics of the pregnant individual's Substance Use Disorder (SUD), NAS diagnosis and research have been hampered due to a lack of a standardized clinical definition (APHL, 2022). Similarly, the U.S. has lacked consistent reporting and tracking laws, with NAS surveillance performed reliant on the ICD-9 and ICD-10 diagnosis codes reported in hospital discharge data, without validation of codes or confirmation of case data (Lind et al., 2019).

To collect data that could better inform policymaking, clinical decision-making, and prevention efforts, the National Center on Birth Defects and Developmental Disabilities (NCBDDD), in cooperation with the Council of State and Territorial Epidemiologists (CSTE), has partnered with the health departments in six states to implement surveillance programs utilizing a standardized definition of NAS. These health department included the Arizona Department of Health Services, the Florida Department of Health, the Georgia Department of Public Health, the Massachusetts Department of Public Health, the Tennessee Department of Health, and Pennsylvania via the Philadelphia Department of Public Health (CDC, 2021).

These programs were designed to provide uniform criteria with which states could accurately record the incidence rate of NAS and use that data to inform actions aimed at prevention and treatment for mother-baby dyads at risk for SUD and NAS (CDC, 2021). The majority of states recorded that 75% of their total NAS cases were identified by medical professionals, while Arizona's data revealed only 50%-75% of cases were reported by clinicians (Jilani et al., 2019). The states utilized the data to report on the incidence rate of NAS, the patterns of NAS related to geography and demographics, and program development (Jilani et al., 2019).

As a result of the delayed onset of NAS symptoms, infants who experienced suspected in-utero exposure to substances that could cause withdrawal symptoms have been kept in hospital longer than healthy infants (Wachman & Schiff, 2019). The normal expected length of stay for a healthy newborn was two days (CDC, 2023). The overall average length of stay for patients with NAS in 2016 was 16.45 days (Ramphul et al., 2020).

Prior to the implementation of the NCBDDD surveillance program, the cost of NAS on the American healthcare system had been immense, with the cost in 2012 estimated to have reached nearly \$316 million and \$572.7 million in 2016 (Corr & Hollenbeak, 2017; Strahan et al., 2020).

The average cost of care per NAS patient was \$22,552 compared to \$1,100 per stay for non-NAS infants (Strahan et al., 2020; Moore et al., 2019).

An additional measure to assess the health of infants has been the Apgar score, which provides a standardized tool to assess the infants condition immediately following birth (ACOG & AAP, 2015). If a neonate's Apgar score at 5 minutes is 7 or greater, the clinical condition of the infant has been considered reassuring, while a score from 4-6 is moderately abnormal, and a low score of 0-3 is an indicator of potential health conditions that should be assessed and addressed (ACOG & AAP, 2015).

A further indicator that surveillance has been effective would have been an increase in the number of pregnant people who are in treatment for substance use disorder. Medication Assisted Treatment (MAT) is the recommended treatment for women with substance use disorder (SUD), in which physicians prescribe methadone or buprenorphine in place of the previously used substance, lessening the effects on the mother and fetus (Ko et al., 2017). Although MAT can cause NAS, it has lessened the severity of the condition (Ko et al., 2017). According to 65.8% of pregnant people with SUD seeking MAT was complicated by pregnancy, which was seen as a barrier (ASTHO, 2020). As a result, 44.1% of those respondents did not receive MAT (ASTHO, 2020).

The purpose of this research was to identify the impact of NCBDDD surveillance programs on Neonatal Abstinence Syndrome incidence rates, Apgar scores reported for infants with NAS, length of stay, cost of care and the percentages of mothers who were treated with Medication Assisted Treatment while pregnant.

METHODOLOGY

The hypothesis was that states that have implemented NCBDDD surveillance programs would

have lower incidences of reported Neonatal Abstinence Syndrome, lower NAS scores, higher Apgar scores, shorter lengths of stay, lower costs of care, and higher percentage of mothers who were treated with Medication Assisted Treatment while pregnant.

The methodology for this qualitative study was a literature review following a systematic review approach complemented by a semi-structured interview. IRB approval and written consent were obtained, with the interview of an epidemiologist working in a state surveillance program completed via Teams, recorded, and transcribed, and relevant answers utilized to further expand on the impact's surveillance programs have on NAS.

A conceptual framework was adopted from the Florida Perinatal Quality Collaborative report that provided a framework for diagnosing NAS based on the maternal history, the clinical signs and the severity of signs requiring treatment beyond the recommended observation period of the facility (Florida Perinatal Quality Collaborative, 2019). This framework delineates the diagnostic differences between suspected NAS and confirmed NAS. This conceptual framework was adopted to identify the complexity of diagnosing, tracking and surveilling NAS as examined in this research and its connection to the flow of the purpose of this research (See Figure 1).

The databases for this research included: PubMed, ProQuest, Access Medicine and Medline. When information could not be found using these databases, Google Scholar was used to identify additional scholarly articles. Additional government websites, including the Centers for Disease Control and Prevention, Healthcare Cost and Utilization (HCUP), and state health department webpages, were also utilized. These searches were limited to articles and other resources written in the English language that were published between 2013 and 2023, to include the most recent data. Searches were limited to critical keywords including: 'Neonatal Abstinence Syndrome' OR 'NAS' AND 'NCBDDD surveillance programs' OR 'Surveillance' AND 'length of stay' OR 'Apgar score' OR 'cost' OR 'MAT' OR 'Medication Assisted Treatment'.

A total of 332 articles were identified through database searching and were categorized using a PRISMA diagram. Articles were excluded when they did not meet the inclusion criteria (N=312). Articles were included if they related to the costs of care, length of stay, Apgar scores, or MAT with a breakdown by state for patients with Neonatal Abstinence Syndrome. Articles from relevant government and medical organization webpages (N=15) were included, as well. These 30 articles were subject to full text review, and these 30 references were included in the analysis. Of these 30 references, 10 were used in the results section (See Figure 2, PRISMA, 2020). The literature search was conducted by PL and validated by AC who acted as a second reviewer and determined if the references met inclusion criteria.

RESULTS

Impact of Surveillance Programs on Neonatal Abstinence Syndrome Incidence Rates

While studies prior to 2018 showed a slight decrease in national NAS incidence rates, there was a significant lack of relevant studies in academic journals published for years following 2018, reporting the impact that the NCBDDD surveillance program and other programs. One study showed the national NAS rate decreased 18% from 2016-2020, with more than half of states assessed reporting a decline (West et al., 2023). The same report identified a state-level increase in NAS cases from 2016-2020 per 1,000 births of 39.7% for Arizona, an 18.3% decrease for Florida, a 16.3% decrease for Georgia, a 22.7% decrease for Massachusetts, and a 17% decrease for Pennsylvania. Of the 20 states (and Washington D.C.) that experienced an increase in NAS incidences between 2016-2020, only one state was enrolled in the NCBDDD surveillance program, Arizona (see Figure 1) (West et al., 2023).

The national rate of NAS declined from 30.1 per 1,000 Medicaid births in 2018 to 28.4 per 1,000 Medicaid births in 2020 (West et al., 2023). Massachusetts reported a decrease in NAS

incidence rates from 11.7 per 1,000 births in 2018 to 9.9 per 1,000 births in 2019 (MDPH, 2023). Tennessee reported a decrease in NAS incidence rates from 11.7 per 1,000 births in 2018 to 10.2 per 1,000 births in 2020 (Nyakeriga & McDonald, 2020).

Impact of Surveillance Programs on Apgar Scores for NAS Patients

The state of Pennsylvania's Department of Health 2018 annual report did not include the average 1-minute and 5-minute Apgar scores for infants diagnosed with NAS (PDH, 2019). Their data for 2019 identified that 87% of infants with NAS had an Apgar score ≥ 7 , a normal value, 1-minute after birth and 93% had a normal value Apgar score 5-minutes after birth (PDH, 2021). The 2020 numbers showed Apgar score for patients with NAS was ≥ 7 , a normal value, in 66.08% of cases 1-minute after birth and 72.71% of cases 5-minutes after birth, compared to 97.29% of total live births in Pennsylvania in 2020 who had a normal value Apgar score 5-minutes after birth (PDH, 2022).

Impact of Surveillance Programs on Length of Stay for NAS Patients

The Healthcare Cost and Utilization Program (HCUP) has identified the national average LOS for NAS patients as 11 days in 2018 and 9 days in 2020, a two-day decrease (HCUP, 2022). For states that participated in the NCBDDD surveillance programs, the difference between the average Length of Stay for NAS patients in 2018 to 2020 was a decrease of one day for Tennessee, two days for Arizona, Georgia, and Massachusetts, three days for Florida, and four days for Pennsylvania (HCUP, 2022).

Impact of Surveillance Programs on Cost of Care (Inflation Adjusted) for NAS Patients

The median cost of care associated with patients with NAS for the U.S. decreased by 2.5%, from \$8,000 in 2018 to \$7,800 in 2020, when adjusted for inflation (HCUP, 2022). For states that

participated in the NCBDDD surveillance program the median cost of care from 2018 to 2020 decreased by 2.9% for Arizona, 4.3% for Massachusetts, 13.2% for Florida, and 25.8% for Pennsylvania, when adjusted for inflation (HCUP, 2022). The median cost of care for NAS patients from 2018 to 2020 increased for Georgia by 12% and 52.7% for Tennessee, when adjusted for inflation, despite their participation in the NCBDDD surveillance program.

Impact of Surveillance Programs on Medication Assisted Treatment for Pregnant Persons

There have been numerous policies implemented in states with NCBDDD surveillance programs, demonstrating the impact this surveillance program has had on access to care. As of 2023, Arizona, Georgia and Florida had laws that considered substance use during pregnancy child abuse (Gutmacher Institute, 2023). Arizona and Tennessee also have provided pregnant people priority access to drug treatment programs. Tennessee, Georgia, Massachusetts, Pennsylvania, and Florida created a targeted drug treatment program for pregnant persons. Tennessee was the only state of the six participating in NCBDDD's surveillance program to protect pregnant people from discrimination in publicly funded drug treatment programs (Gutmacher Institute, 2023).

Pennsylvania reported that in 2020 56.58% of people who gave birth to infants with NAS received MAT during their pregnancy, down from 68% in 2018 (PDH, 2022; PDH, 2019). Tennessee reported that 65% of NAS cases were related to MAT in 2019 and reported a decrease to 62% in 2020 (Nyakeriga & McDonald, 2020).

DISCUSSION

The purpose of this research was to analyze the impact of NCBDDD surveillance programs on incidence rates of Neonatal Abstinence Syndrome (NAS), Apgar scores, length of stay, cost of care and the rates of Medication Assisted Treatment (MAT) for mothers of patients born with NAS.

The results of the literature review and the interview with an expert in the field have demonstrated

a mixed correlation between the outcomes explored and the NCBDDD surveillance programs.

There was not substantial research available at a state level nor did the Expert interviewed detailed information about the effects of NCBDDD surveillance in other states. The Expert was highly informative on the topic of the barriers to surveillance programs for NAS.

According to the Expert, states that are not using a standardized surveillance program are collecting some of this data through their own processes, like West Virginia's Project Watch program. The Expert expressed concern that the data that is collected, because it isn't specifically looking at only NAS patients, is not being utilized in a way that would prevent or lessen the severity of NAS. The Expert asserted that the complex nature of SUD for pregnant people makes identifying the population who will be affected before they are pregnant very difficult, which means focusing efforts on getting women off of substances prior to getting pregnant, although there is often less motivation prior to pregnancy. The Expert also identified the issues preventing a uniform surveillance program may be largely technical – getting the correct technology working well across multiple health systems and states, with appropriate staffing to support it – as well as frequent changes in the definition of NAS and its severity.

This research was not without its limitations. The literature review was limited by the available research found with key words largely predated the timeframe that would demonstrate an impact from NCBDDD surveillance programs. Other limitations included lack of research available for infants that did not display NAS symptoms requiring treatment until after the initial hospital stay. There was also the possibility of bias within the publishers of the articles utilized. Moreover, researcher and Expert bias could have also played a role.

CONCLUSION

As a result of this research, the NCBDDD surveillance systems instituted by states showed mixed results in decreasing the reported incidence rate of NAS, with decreases in all participating

states, except Arizona. The length of stay decreased in states utilizing NCBDDD surveillance programs, but others saw increases in the length of care. The cost of care showed mixed results, as some states saw decreases in cost after the implementation of NCBDDD, while others demonstrated increased. The Apgar scores of infants with NAS after 5 minutes were higher after the implementation of NCBDDD surveillance programs than prior to implementation but were not improved at 1-minute after birth. Our hypothesis that the percentage of mothers of patients with NAS who were receiving MAT was proven invalid, as the two states reporting that data demonstrated a decrease in the rates of MAT for those mothers.

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Figure 1

Conceptual Framework

(Adapted from Florida Perinatal Quality Collaborative, 2019)

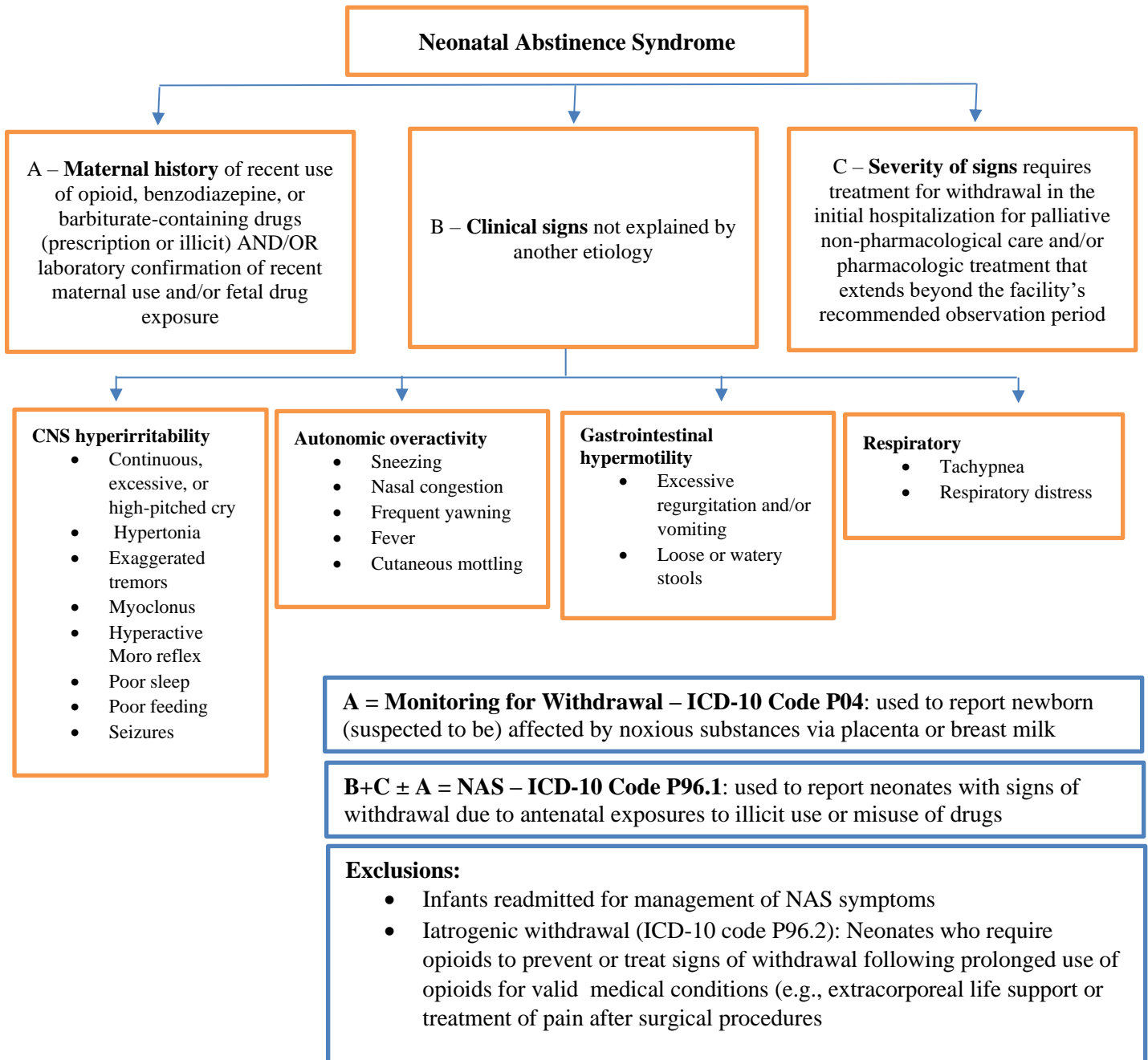
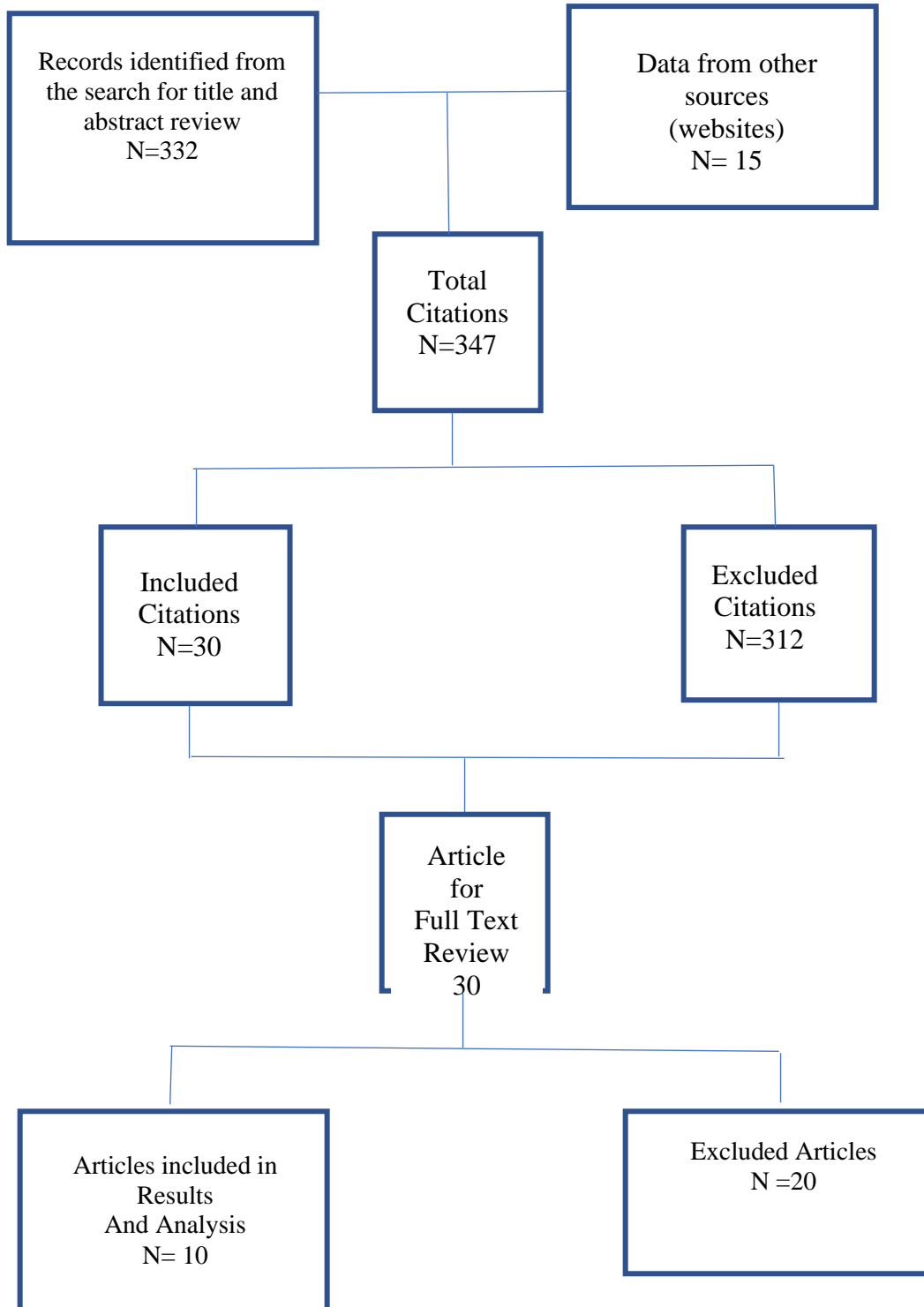


Figure 2

Overview of Literature Evaluation (PRISMA, 2020)



Interview Questions

1. Does your state participate in the NCBDDD Surveillance program? Why or why not?
2. Does your state participate in another surveillance program? If yes, please elaborate on the scope of the surveillance program. If not, why not?
3. Does your state use a standardized clinical definition of Neonatal Abstinence Syndrome (NAS) follows for diagnosis and reporting? If yes, why? Which one? If not, why not?
4. Has the incidence rate of NAS been impacted by the surveillance system currently in place? Why or why not?
5. Have the NAS scores reported by providers been impacted by the surveillance system currently in place in your state? Why or why not?
6. Have the APGAR scores for infants with NAS been impacted by the surveillance system currently in place in your state? Why or why not?
7. Has the surveillance program aided your state in preventing NAS? Why or why not?
8. What other outcomes have been impacted as a result of implementing a NAS surveillance program in your state? Why or why not?
9. What barriers prevent your state from implementing, improving, or expanding its NAS surveillance program? Why or why not?
10. Are there other measures could your state implement to reduce the impact of NAS on its residents? Why or why not? If yes, please elaborate.