

NAS Management Trends in TN

Study Report

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Study Team:

Karen D’Apolito, PI

Beth Donaghey, Technical support

Mary Dietrich, Co-Investigator, Statistician

Barbara Engelhardt, MD – Consultant

Carla Saunders, NNP, Consultant

Sheri Smith, BSN, Consultant

Terry King, Pharm.D. – Consultant

Erin Fish, Pre-Specialty Student Psychiatric NP Program at Vanderbilt – Research Assistant

Study Aims:

The aims of this study were to:

- 1) Develop a data base of the most common practices used among TN hospitals that are caring for infants with NAS.
- 2) Compare and contrast the different treatment practices used in TN hospitals for infants with NAS.

Research Questions:

- 1) What practices (screening methods, assessment tools, pharmacologic and environmental treatments, place of treatment) are used in TN hospitals that care for infants with NAS?
- 2) What is the length of stay and re-admission rate for infants treated for NAS in TN hospitals?
- 3) What are the most and least frequent treatment practices in TN hospitals caring for infants with NAS?

Methods:

This was a descriptive study using a survey to collect data related to the study questions (Appendix A). Surveys were sent out to hospitals in TN who care for infants with NAS. The list of hospitals reporting cases of infants with NAS was obtained from the TN Department of Health Division of Family Wellness. The list of TN hospitals listed with the American Hospital Association was also used to identify appropriate hospitals for participation. The survey was sent to Neonatologists or Pediatricians at delivering hospitals with > 100 deliveries per year as well as Children's Hospitals.

Procedure:

The study team gathered to generate survey questions (Appendix A). The survey, once developed, was placed on REDCap (Research Electronic Data Capture) and pilot tested with 10 physicians/nurse practitioners at Vanderbilt Children's Hospital. The feedback received from the pilot study was used to finalize the survey questions. The final survey was sent to the Vanderbilt IRB for approval. Once IRB approval was received the Chief Neonatologist or designate, at each hospital, was called by the study research assistant and asked if they would be willing to participate in the study. If interested, a survey was emailed to them using REDCap. Two reminders, at weekly intervals, were sent out by email if no responses were received after the survey was sent out. Participants were given a \$25 gift card when the survey was completed and submitted. All study participants were given ID numbers and a person not involved in the study was responsible for receiving gift card information from the participant and mailing out the gift cards to maintain anonymity of study participants.

Results:**Response Rate and Hospital Demographics (Table 1):**

Out of 70 potential hospitals 67 meet the inclusion criteria of having > 100 deliveries and caring for infants with NAS. A total of 27 hospitals completed and submitted the survey for a response rate of 40.3%. Five of the 27 surveys submitted were incomplete (18.5%). In looking at the demographic information for each of the participating hospitals a greater percentage of respondents were from East TN. A majority of the hospitals were classified as a Level I (Newborn Nursery) or Level II NICU or Special Care Nursery. Only 23% (n=6) of the respondents were from a free standing Children's Hospital. The median number of deliveries for participating hospitals was 775 (160-4500) within the last year. The average number of NICU admissions in the last year was 248 (range 0-1384) and of the 24 (89%) hospitals that reported the ability to care for infants with NAS the average number of infants admitted with NAS within the last year was 59 (1-260).

Hospitals were asked to identify the location within the hospital where infants with NAS are cared for before maternal discharge from the hospital. In order of frequency, infants with a diagnosis of NAS were cared for in the Normal Newborn Nursery; the Level II NICU; the Newborn Nursery and Mother's room and the Level III NICU. One site reported that infants were cared for in the newborn nursery/mother's room unless the infant needed treatment for NAS. In that case the infant was transferred to the NICU.

Once mothers of infants being treated for NAS were discharged from the hospital their continued care remained similar. Forty two percent of the infants resided in the normal newborn nursery (n=10) and those infants who were cared for in Level II or Level III non-private or private room remained in those rooms. One hospital (Table 8) reported that they have 7 individual rooms that are used for infants with NAS; however, "many of the infants also stay in an open bay unit since there typically are more than 7 patients at a time."

In 2013 the TN Department of Health made NAS a reportable disease within the state. This survey revealed that of the 24 hospitals that responded to this question on the survey 96% (n=23) are currently reporting cases of NAS to the health department NAS registry. One of the hospitals reported they do not currently report to the state NAS registry because they do not have enough babies admitted to their nursery.

Assessment and Biological Screening of NAS (Table 2):

Out of the 24 hospitals responding to the survey question regarding biological screening, 11 (45%) identified urine and meconium screening as the predominant screening tests used to confirm a diagnosis of NAS. Five of the hospitals used urine, meconium and umbilical cord testing (21%); 4 used umbilical cord testing only (17%); 3 used urine and umbilical cords (13%) and 1 used meconium and umbilical cords (4.1%).

All of the hospitals reported using a scoring tool to assess infants for NAS. The Finnegan scoring tool was used 96% (n=23) of the time and one hospital reported using the Neonatal Narcotic Withdrawal Index (4.2%). It was reported that the bedside nurse was the person completing the scoring (96%) and in one site the nurse practitioner was the healthcare provider who did the scoring (4.2%). Fifty percent of the hospitals scored infants for signs of NAS Q3 hours (n=12); 38% scored Q 4 hours (n=9), and 13% scored Q 12 hours (n=3).

Observation Days for Short-Acting; Long-Acting and Poly-Substance Exposure (Table 3):

Twenty three of the hospitals indicated the following results regarding the numbers of day's infants are initially observed for signs of NAS from short-acting opioids (e.g. codeine, oxycodone, hydrocodone, buprenorphine.) and SSRI's (e.g. citalopram, fluoxetine, paroxetine, sertraline, etc.); long-acting opioids (e.g. methadone) and poly-drug exposure. Forty three

percent (n=10) of the hospitals observed infants exposed to short-acting opioids for 3 days; 22% (n=5) observed them for 5 days; 17% (n=4) observed them for 3-5 days; 9% (n=2) observed them for 5 days and 4% (n=1) observed infants for 2-3 days and 4% (n=1) for 3-4 days.

The number of days hospitals initially observed infants prenatally exposed to long-acting opioids was quite varied. Thirty one percent (n=7) of the hospitals observed infants for 3 days; 31% (n=7) 3-5 days; 13% (n=3) 5 days; 9% (n=2) 2 days; 4.3% (n=1) 4 days; 13% (n=3) 5 days; 4.3% (n=1) 7-10 days and in one case infants were transferred to another institution (4.3%). The same question was asked related to the infants with poly-drug exposure. In this case 30.3% (n=7) observed infants for 3 days; 26% (n=6) 3-5 days; 17.4% (n=4) 5 days; 13% (n=3) 2 days; 4.3% (n=1) 4 days; 4.3% (n=1) 3-7 days and 4.3% (n=1) transferred the baby to another facility.

When looking across the participating hospitals regarding the number of days infants are initially observed for signs of NAS prior to treatment there is no pattern of hospitals observing infants for a shorter period of time when exposed to short-acting opioids compared to long-acting or poly-drug use. It appears that observing infants for 3 days prior to treatment is most common for infants prenatally exposed to all types of drugs. The second most common observation time across all drug types is 3-5 days.

Non-Pharmacologic Management: (Table 4)

A number of non-pharmacologic or comfort measures were used by responding hospitals to manage infants with NAS. Twenty three hospitals identified comfort measures used to help manage infants with NAS. The most common comfort measures included swaddling and sucking on a pacifier; followed by providing a quiet room, dim lighting and being held by nursed; encouraging nurses to hold the baby; placing the infant in a swing and holding by a care partner and finally providing boundaries for the baby while lying in the bassinette. In eight of the hospitals all of the mentioned comfort measures were used (35%). Five of the hospitals used all of the comfort measures excluding the use of boundaries and a variety of hospitals included a variety of comfort measures without much consistency among them.

Pharmacologic Management: (Table 5)

Most of the hospitals reported using medications to treat infant with NAS. In order of frequency oral morphine was reported to be used most frequently as the primary treatment medication (56%); followed by oral sucrose (19%); methadone, phenobarbital and acetaminophen (all 7%) and simethicone (4%). If the primary medication was not successful in controlling signs of NAS phenobarbital was most frequently added (46%) followed by clonidine (31%). In some cases when a third medication was required clonidine was also used most frequently (60%) when not used as a second line drug. More than 50% of the hospitals added the second line drug when the maximum dose of the primary drug was reached and the infant continued to have

increasing withdrawal scores. Twenty percent of the hospitals also used methadone as a third drug to add if the combination of the first two were not successful in controlling signs of NAS. In those hospitals using oral morphine to treat NAS 62% used the 0.04mg/ml solution (n=8) and 67% (n=11) of the hospitals followed a specific treatment protocol for drug administration. Second line medications were added to treatment when the maximum dose of the primary medication was reached and the infant's score NAS was increasing (62%) or when it was not possible to taper the primary treatment medication (31%). One site indicated that they do not use drugs other than the primary drug used to treat NAS (8%). In terms of weaning the opioid was weaned first (73%) followed by clonidine (18%) then phenobarbital (9%).

Hospitals were asked to identify the Finnegan score used to begin pharmacologic treatment. Fifty percent (n=9) of the hospitals required a score of 8-11 twice; one hospital (6%) began treatment with one score that was between 8-11; 17% began treatment with a score of 12 or greater and 28% (n=5) used other criteria (28%) such the physician determines whether treatment is needed then the baby is transferred to another site; begin treatment when the Finnegan score is 9 or greater on 2 consecutive scores; scores of 8 twice or greater than 12 once and one site transferred all babies to a referring hospital if treatment is needed. If not using the Finnegan scoring tool for beginning pharmacologic management each of the following signs were selected with a frequency of one each (4%); vomiting, diarrhea, poor weight gain, dehydration, consistently irritable and seizures.

To gather some insight into how infants were being weaned from treatment medications half of the responding hospitals weaned by 10% of the stabilizing dose (n=6) while other weaned by 20% (n=2). Thirty three percent of the hospitals (n=4) used methods such as weaning the morphine by 10% of the initial dose (n=1) and clonidine by 25% (n=1); 4% wean by 0.01 mg/kg/dose enterally (n=1) and 4% weaned by 0.04mg/kg/dose (n=1). If the Finnegan scoring tool was not being used to assess for signs of NAS pharmacologic management was discontinued when the baby received a score of 7-8 on the tool they were using (4%, n=1). When looking at how often treatment medications were weaned, 50% (n=7) of responding hospitals weaned every 48 hours while 25% (n= 3) weaned every 24 hours (25%). Other strategies for weaning included weaning between 24-48 hours depending on the patient (4%) or every 24 hours based on infant signs of withdrawal (4%). In 43% (n=6) of the hospitals treatment medications were discontinued when Finnegan scores were 5-6. Other hospitals (22%; n=3) discontinued treatment with scores of 3-4; 22% (n=3) when scores were 7-8; one waited until the score was 1-2 (7%, n=1) or when the score was zero (7%, n=1). At the time when treatment was discontinued 36% (n=4) infants were receiving 20% of their initial treatment dose (n=4), and 27% (n=3) were receiving 10% of their original dose (n=3). In 4 individual cases pharmacologic treatment was discontinued when the infant's medication dose

was 0.25 mg/kg/dose (4%, n=1); 0.05 mg/kg/dose (4%, n=1); 0.01 mg/kg/dose and scores are less than or equal to 9 (4%, n=1).

Once pharmacologic treatment was discontinued 64% (n=9) of the time infants were observed for 48 hours prior to discharge. Other hospitals observed the infant for 24 hours (14%, n=2); 72 hours (14%, n=2) or were observed for the length of time determined by the physician (7%, n=1). All of the responding hospitals indicated that they would not send the baby home on the same day as the treatment was discontinued (100%, n=14). Forty one percent (n=11) of the hospitals did not send infants home on medication and 11% (n=3) did. Phenobarbital was the drug of choice when infants were sent home on medication for continued treatment. These infants were followed by the infant's pediatrician (100%, n=3).

To gain insight into the length of hospital stay for infants treated for NAS hospitals were asked to identify how long infants were in the hospitals when treated for NAS with opioids, opioids plus other drugs such as phenobarbital or clonidine and for treatment with drugs other than opioids. It was reported that infants treated with opioids alone (n=12) had a length of stay from 8 to 35 days with a median length of stay of 21 days (15-17). Infants who were treated with opioids plus other drugs such as phenobarbital or clonidine (n=8) remained hospitalized from 7 to 68 days with a median length of 26 days (16-42) and infants remained in the hospital from 0-15 days with a median of 10 days (10-25) when treated with other drugs other than opioids (n=3).

General Care of Infants with NAS: (Table 6)

Questions related to the general care of infants with NAS involved breast feeding practices, reporting to DCS (Division of Children's Services) and the accuracy of nurses scoring infants for signs of NAS. In terms of breastfeeding 74% (n=14) of the responding hospitals allow women to breast feed their babies who have a diagnosis of NAS and 26% (n=6) do not. Twenty six percent of the hospitals report allowing women to breast feed if they are in a drug treatment program (n=7). Other criteria include random drug maternal drug screening (7%; n=2) or the testing of breast milk for drugs (7%, n=2). Three different hospitals reported other criteria which included the mother's dose of treatment medication (4%, n=1); checking the literature to determine if breastfeeding is appropriate (4%, n=1) and allowing breast feeding if there is DCS monitoring (4%, n=1). One hospital reported not having any criteria which would allow breast feeding (4%, n=1). In 63% of the hospitals (n=12) women were not allowed to breast feed if they were a poly-substance user while 37% (n=7) did allow this practice. Sometimes infants receiving breast milk require supplemental feeding with formula and 14% (n=2) did not. Eighty six percent (n=12) of the hospitals allowed breast feeding to be supplemented with formula. In most cases a 20 calorie formula was used as a supplement (58%, n=7); 25% of the hospitals used a soy based formula (n=3) and others used Enfamil Gentle Ease (4%, n=1) or Similac Sensitive

formula if the infant requires more volume (4%, n=1). In 82% (n=14) formula or pumped breast milk was not fortified. The only time a fortifier was added to the formula was if the baby was losing weight (100%, n=3).

It is not uncommon for infants with a diagnosis of NAS to be reported to DCS. Based on the survey results 94% (n=18) of reporting hospitals reported infants with a diagnosis of NAS. This referral was most frequently made prior to the infants discharge from the hospital (94%, n=16). Fifty five percent of the infants (n=15) were reported when the infant has a positive drug screen; 52% reported if the mother had other children in DCS custody (n=14) and 41% made the referral if the mother was not in a drug treatment program (n=11). Some of the other reasons why infants were reported to DCS include a maternal history of drug use and a positive infant drug screen using an umbilical cord sample (4%, n=1); the mother has a positive drug screen (4%, n=1); the infant has a positive drug screen (4%, n=1) and in one case all infants with intrauterine drug exposure have a DCS consult (4%, n=1).

Since infants with NAS can be challenging to care for hospitals were asked if they have a core number of nurses who care for infants with a diagnosis of NAS. Sixty eight percent (n=13) of responding hospitals reported not having a core group of nurses caring for infants with NAS and 32% (n=6) did have a core group of nurses.

To determine whether an infant with a diagnosis of NAS requires pharmacologic management the decision to treat is many times based on the abstinence score infants receive. Hospitals were asked if the nurses in their unit were trained in the use of the scoring tool used to assess infants for signs of NAS. Ninety four percent (n=16) of the hospitals reported that the nurses at their hospital were trained in the use of the NAS and 16% (n=3) were not trained. If the nurses were not trained 67% (n=2) of the hospitals reported that the nurses should be trained compared to 33% (n=1) who did not believe training was necessary. When nurses report the NAS score to the physician or nurse practitioner who will be determining whether treatment is required 95% (n=17) of the hospitals reported that the physician/nurse practitioner believes the score given to the baby and 6% (n=1) did not believe the score. One hospital reported (3.7%) that the scores were not believed because they felt the scores were unreliable.

Parents are encouraged to visit and participate in the care of their infants with a diagnosis of NAS. Ninety five percent (n=18) of the hospitals reported that the parents were involved with their infants care while hospitalized and 68% (n=13) of the hospitals gave parents written information about NAS.

After Discharge: (Table 7)

One question health care providers often ask is whether infants are re-admitted to the hospitals for signs of NAS after discharge. Ninety percent of the hospitals responding to the

survey did not know (n=17). Additionally 94% of the hospitals (n=17) are not aware if their emergency room (ER) screens for NAS when an infant is brought to the ER. In one case it was reported that their ER will use a urine dip stick as a screening method to identify drug exposure (3.7%). Hospitals were also asked if there were any infants who were at risk for NAS but did not show signs of withdrawal while in the hospital. Fifty six percent (n=15) of the hospitals reported that they did have infants who were at risk for NAS but did not develop signs. There were 4 hospitals that reported 3-5 infants; 3 hospitals 10-25 infants; 1 hospital 40-50 and 1 hospital reported 100 infants.

General Comments: (Table 8)

Hospitals were given the opportunity to make additional comment at the end of the survey. These comments are related to length of hospital stay, reporting to DCS, the location of infants within the hospital nursery, education of health care professionals and drug screening.

Discussion

Over the last decade the incidence of infants in Tennessee diagnosed with NAS has increased fifteen-fold (Miller & Warren, 2013). In an attempt to quantify the actual number of NAS case within the state the TN Department of Health identified NAS as a reportable condition in January of 2013. This initiative has allowed the state to establish a NAS registry for the state of TN (Warren, 2014). To gather information about the common practices used in TN hospitals caring for infants with NAS this survey was conducted. The goals of the study were to 1) identify the type practices (screening methods, assessment tools, pharmacologic and non-pharmacologic management; place of treatment and environmental methods) used by hospitals in TN who care for infants with NAS and 2) compare these practices across participants.

The survey was sent via email using REDCap to 67 hospitals identified as institutions that care for infants with NAS within the state of TN. REDCap (Research Electronic Data Capture) is a methodology and software program that allows data to be collected, stored and disseminated. It is a tool that is used for web-based data collection that is secure and diminishes data entry error because data entered into the program can easily be downloaded for statistical analysis (Harris, et al., 2009). The list of hospitals with contact people and email addresses was gathered by a research assistant. An invitation was generated and sent to hospital contact people with a link to complete the survey on line. No specific identifying information was obtained to maintain hospital anonymity. On line surveys are economical, allow for complete anonymity and remove interviewer bias. Response rates with on line surveys are reported to be less than 50% compared to face-to-face interviews where an 80-90% response rate can be achieved. The overall response rate for this study was 40% (27/67) which is adequate (Polit & Beck, 2012). The

overall completion rate (surveys that were complete to the end) was 81.2% (22/27) however not every question was answered for some of the items by all of the sites that completed the questionnaire (Penwarden,2014).

Demographics

Although infants with a diagnosis of NAS are cared for in all regions of the state there is a greater number of cases reported from East Tennessee (Warren, 2014). When looking at the number of hospitals completing the survey from East, Middle and West TN a greater percentage of hospitals from East TN completed the survey when compared to the other regions (51.9%, 37%, and 11.1% respectively). The greatest numbers of hospitals responding were reported as local hospitals of which some have a newborn nursery, Level II or Special Care Nursery or a Level III nursery. There is a growing concern regarding where infants with NAS are cared for in the hospital. It has been established that these infants require an environment that is quiet with dim lighting and minimal stimulation (Velez & Jansson, 2008). In looking at the survey results infants seem to be cared for in the newborn nursery and/or mother's room and the NICU while the mother remains hospitalized. After the mother is discharged from the hospital many of the infants remain in the nursery while others reside in the NICU either in a private or non-private room. Given the high cost of NICU care (about \$3,000 per day) it may be more appropriate to think of an alternative lower cost location to care for these infants rather than the NICU (Kornhauser & Schneiderman, 2010). One study compared the length of stay and duration of treatment in two groups of infants; one group remained on the postnatal ward with their mother and the other was transferred to the neonatal unit. Results suggest that infants who remain with their mothers required less treatment (45% vs 11%, $p=0.012$); had a shorter duration of treatment (12.7 vs 7.3 days, $p=0.05$) and had a shorter hospital stay (19.8 vs 15.9 days, $p=0.012$) (Saiki, et al, 2010). Many of our NICU's in the US have gone from having one large room to single bed rooms in pods to care for high risk infants in the NICU. This will help to provide the quiet, dim, low stimulating environment these infants require if costs are reduced however we may need to think about a new model that will allow mom and baby to stay together while the infant requires treatment for NAS.

Assessment and Screening

All of the hospitals used infant urine, meconium or umbilical cord screening to confirm the diagnosis of NAS. A few of the sites (16%) are just using umbilical cord sampling to confirm or identify intrauterine drug exposure. Urine testing is relatively easy however the drugs in the infant's urine represent recent drug use by the mother and may test negative if the mother is an inconsistent user. The incidence of false-negative results can range from 32% to 63% (Ostrea, 1999). Meconium can provide more specific results because it will contain the metabolites of all drugs the infant was exposed to during gestation. The limitations of

meconium analysis involve the long process of drug identification. The sample requires preliminary processing before drug analysis can be conducted. Meconium that is allowed to stand at room temperature for 24 hours can result in a 25% decrease cocaine and cannabinoid concentrations. Therefore, meconium needs to be sampled and processed as soon as possible after it has been excreted by the infant (Ostrea, 1999). Additionally false-positive results in meconium have been reported for amphetamines and when the meconium is contaminated with urine and when soap or alcohols have been used for cleaning before collection (Cotton, 2012). In 2005 the use of umbilical cords was presented in the literature as an alternative to meconium testing. When comparing umbilical cord tissue samples with meconium samples the results were comparable. The agreement of drug screening between umbilical cord and meconium testing was 90% for the same drugs (Montgomery, et al, 2005). It has been reported that umbilical cord analysis has even been able to detect even minor and remote exposures (Murphy-Oikonen, et al, 2010). Therefore, umbilical cords may be a good alternative to meconium and urine testing. Four hospitals within our state are only using umbilical cord tissue for screening.

There are two abstinence scoring tools that are being used by hospitals who responded to the study. These include the Finnegan Scoring Tool and the Neonatal Withdrawal Scoring System or Inventory. The majority of hospitals (96%) are using the Finnegan Scoring Tool which has been recommended by the American Academy of Pediatrics (AAP) as the predominant tool used in the United States to assess for signs of NAS (Hudak, & Tan, 2012). Infants are being scored every 3 or 4 hours which is customary and scoring is most frequently completed by the bedside nurse.

In a publication by the AAP it is recommended that infants exposed to short-acting opioids (average half-life of drug 4 hours) can be safely discharged after 3 days of hospital observation and infants exposed to long-acting opioids should be observed for 5-7 days (Hudak & Tan, 2012). A majority of the survey participants (43%) comply with the AAP's recommendations to observe infants in the hospital for 3 days when they have been exposed to short-acting opioids. When looking at the survey data there were a variety of responses to There was some variability among the survey data a few of the hospitals are observing infants for a shorter period of time (2 days) which may be problematic if infants are at home when signs of withdrawal appear. Other hospitals observed infants for 3-5 days which may be adequate however given the increased cost of infants hospitalized for NAS gaining knowledge of the most accurate observation period required for infants prenatally exposed only to short-acting opioids may be warranted.

The AAP additionally recommends that infants be observed for a minimum of 5-7 days if they have been prenatally exposed to long-acting opioids such as methadone. When looking at the

number of days infants are observed in the hospital when exposed to long-acting opioids 61% of the hospitals observed infants from 3 to 3-5 days. This can be problematic if infants are experiencing signs of withdrawal after discharge. Similar results were reported for infants exposed to poly-drugs. There is no data to recommend the length of time infants should be observed when exposed to poly-drugs however it would seem that at least a minimum of 5-7 days of observation would be needed given the recommended observation period for long-acting opioids.

Non-Pharmacologic Management

All infants with a diagnosis of NAS should routinely receive non-pharmacologic or comfort care. Non-pharmacologic care is not a substitute for pharmacologic treatment but an adjunct therapy. A number of comfort measures have been reported in the literature that can be used to support infants with a diagnosis of NAS. These comfort measures include reducing ambient light (Hamdan, 2008; Lauridsen-Hoegh, 1991; Finnegan & Kaltenbach, 1992; Torrence & Horns, 1989; Gosse, 1992; D’Apolito & Hepworth, 2001); minimize excessive noise (quiet environment) (Lauridsen-Hoegh, 1991; Finnegan & Kaltenbach, 1992; Torrence & Horns, 1989; Hamdan, 2008); swaddle the infant in a blanket to provide containment (Hamdan, 2008; Finnegan & Kaltenbach, 1992; American Academy of Pediatrics, 1998; D’Apolito & Hepworth, 2001); Offer the infant a pacifier (Weiner & Finnegan, 2006; Hamdan, 2008); Provide boundaries around the infant when in the bed (Jorgensen, 1992). There is no scientific data to suggest that using swings to calm infants with NAS is appropriate. There is evidence to suggest that placing infants in a rocking bed may be overstimulating (D’Apolito, 1999) and swaying or rocking may be helpful (Hill & Desmond, 1963). Vertical rocking has also been reported to quiet crying and or irritable infants (Lauridsen-Hoegh, 1991). However nurseries have used rocking beds as well as cuddlers to hold infants with NAS (East TN Children’s Hospital, 2015). Survey results revealed that the top four comfort measures used by respondents were swaddling, placing the infant in a quiet and dim room and allowing the infant to suck on a pacifier. Placing the infant in a swing or parent/cuddler/nurse holding was used less frequently and the least frequent comfort measure used was providing boundaries around the infant. None of the responding hospital mentioned the use of vertical rocking. In general, all of the hospitals are providing documented comfort measures when caring for infants with NAS.

Pharmacologic Management

Pharmacologic management of NAS is quite varied within the US. Many comprehensive reviews have concluded that there is lack of strong evidence to suggest the most effective pharmacologic treatment for NAS (Theis, et al, 1997; Johnson, et al, 2005). There is documented evidence to suggest that infants exposed to multiple illicit or licit drugs in utero may benefit from the use of more than one treatment drug. Poly-drug withdrawal is typically treated with opioids alone. If control of withdrawal signs cannot be achieved with the opioid, adding a drug such as Phenobarbital or Clonidine may be helpful (Johnson, et al, 2005; Sarkar & Donn, 2006). An opiate such as morphine should be used as initial treatment for infant withdrawal signs due to maternal opioid use in pregnancy (Osborn, Jeffery, Cole, 2005).

Phenobarbital should not be the first-choice of treatment in infants experiencing opioid withdrawal however it is appropriate as first-line treatment for non-opioid related signs of withdrawal (American Academy of Pediatrics, 1998). In the event that infants are experiencing NAS from poly-substances an opioid should be the first choice for treatment of NAS. However, if control signs of withdrawal cannot be achieved with the opioid alone, adding a drug such as phenobarbital or clonidine may be helpful (Johnson, et al, 2005; Sarkar & Donn, 2006).

There is limited data available regarding which opioid is favorable for the treatment of NAS in infants exposed to opioids during pregnancy. In a recent retrospective study 10,327 infants admitted to 299 NICU's in the US and Puerto Rico, with a diagnosis of NAS, morphine was most commonly used to treat NAS in 2013? This is an increase of 23% from 2004 to 2013 (49% vs 72%, $p < 0.001$). In 2013, clonidine was used to treat 9% of infants and 15% of infants were treated with methadone. This represents an increase from 2004 for clonidine and a decrease from 2011 for methadone (Tolia, et al., 2015). In comparison a few small studies have reported that both clonidine and methadone have been associated with a shorter length of stay (4 days sooner) when compared to morphine (Patrick, et al, 2014; Agthe, et al, 2009; Surran, et al., 2013. An increase in the use of phenobarbital as a primary drug of choice for NAS from opioids was reported (increase from 8% to 36%) (Patrick, et al, 2014) despite AAP recommendations that phenobarbital should not be a first line treatment for infants experiencing opioid withdrawal (American Academy of Pediatrics, 1998; Hudak & Tan, 2012).

In looking at the drugs of choice for treating NAS in hospitals participating in this study oral morphine was the first or primary drug of choice which is consistent with national trends. This was followed by phenobarbital as the second line drug and clonidine as the third drug to be added to the treatment if the infant's signs of NAS are not captured with the other drugs. These choices are also consistent with reports found in the literature, particularly for withdrawal from poly-drug exposure (AAP, 1998; Osborn et al., 2005; Finnegan, et al., 1984). When determining whether phenobarbital vs clonidine is should be selected as the second drug of choice in addition to morphine one study concluded that infants ($n=34$ each group) in the morphine/phenobarbital group had shorter inpatient treatment days however the overall length of treatment was shorter because no continued outpatient treatment was needed with clonidine (Surran et al., (2013).

A few of the hospitals (19%) used oral sucrose as a treatment for NAS. Oral sucrose is effective in relieving minor procedural pain in infants. In order for it to work the infant's endogenous opioid system must be functioning normally. Oral sucrose is not recommended for use with NAS because these infants have a poorly functioning endogenous opioid system so it is ineffective in calming opioid-exposed infants suffering from NAS (Blass, & Ciaramataro, 1994).

When determining the concentration of oral morphine most responding hospitals use the 0.04mg/ml solution, they treat using the infant's weight and/or signs of withdrawal and a secondary drug is added to the treatment plan if the maximum dose of the primary drug has been reached and is not controlling the withdrawal signs the infant is experiencing. There was some variability among the responding hospitals regarding when pharmacologic treatment should begin. Half of the hospitals, who use the Finnegan scoring tool, began treatment when the infant has a score of 8-11 on two consecutive scorings

every 4 hours (Table 2). The recommended schema for beginning pharmacologic management is a score of 8 or greater on 3 consecutive scorings or the average of any 3 consecutive scores is 8 or greater (Kaltenbach & Finnegan, 1992). It is possible that infants are beginning on treatment too soon; however if the score is reliable, beginning treatment earlier may be warranted.

When it is time to wean the treatment medication morphine is typically weaned first if the infant is receiving multiple drugs. The process for weaning morphine is to maintain the infant on a stabilizing dose for 72 hours then decrease the dose by 10% once a day. When dose levels reach 0.5 mg/kg per day morphine can be discontinued (Finnegan, 1990; in original work paregoric was used). Phenobarbital can be weaned after 72 hours of steady state maintenance (verified by serum levels and total scores of < 8). The goal is to decline phenobarbital levels at a rate of 10-20% per day, ideally by 15%, by administering phenobarbital 2 mg/kg/day. Once the phenobarbital is discontinued the infant should be observed for 72 hours before discharge (Finnegan, 1990). Fifty percent of the hospitals participating in this survey (n=6) used a 10% wean each day (58%) which is the recommended procedure for weaning treatment with an opioid. After a period of weaning all of the hospitals (n=14) discontinued the treatment medication when Finnegan scores were < 8. Forty three hospitals (n=6) discontinued pharmacologic treatment when the Finnegan score was between 5-6 (n=6); 21% (n=3) when scores were between 7-8; 21% between 3-4; 7% (n=1) between 1-2 and 7% (n=1) when the score was zero. There is no need to identify a specific Finnegan score to discontinue the treatment medication. It is important that the score is <8 and the infant has not had an increase in scores of 8 or greater during the observation period after weaning (Finnegan & Kaltenbach, 1992). After being weaned from the treatment medication the infant can be discharged after 72 hours (Finnegan, 1990). In the sample of hospitals responding to this survey only 14% (n=2) of them observed infants for 72 hours after discontinuation of the treatment medication. In comparison, 64% (n=9) sent infants home after a 48 hour observation period and two hospitals (n=14%) sent infants home after 24 hours of observation.

Some hospitals throughout the US are considering sending infants home with continued treatment on methadone. This to some is an enticing thought because the length of hospital stay (LOS) for infants requiring treatment for NAS can be anywhere between 8-79 days with an average of 30 days (Langenfeld, 2005; Lainwala, 2005). The median LOS for hospitals in this survey reported a median of 21 days for infants exposed to short-acting opioids (range 8-35 days); 28 days for exposure to long-acting opioids (range 7-68 days) and a median LOS of 10 days for infants exposed to poly-drugs (10-25). Given these long treatment periods in the hospital it is easy to understand why healthcare facilities are considering discharging infants from inpatient units to continuing care as an outpatient. A majority of the hospitals participating in this survey do not send infants home on continued treatment for NAS (79%, n=11). However, in three cases (21%) infants were sent home on phenobarbital that required follow-up with a pediatrician. In one retrospective study there were 121 infants who received inpatient methadone treatment for signs of NAS. Of those, 75 infants remained in the hospital for their treatment (traditional group) and 46 began treatment in the hospital but completed their treatment as an outpatient (combined group). When looking at the overall length of stay for both groups, those infants in the combined group had a shorter length of stay than infants in the traditional group (13 days vs 25 days). All of the infants in the combined group were seen by a pediatrician within 72 hours of discharge

and required more primary care visits for prescription refills than those in the traditional group. Emergency room visits and readmission to the reference hospital were the same between the two groups. Infants in both groups were lost to follow –up at one year of age (52% traditional; 80% combined). Those lost to follow-up were families who lived furthest from the reference hospital. There was an in-hospital cost savings of \$13,817 per infants in the combined group which resulted in a total cost saving of \$636,000 over a 2 year period. It is possible that treating infants at home with methadone may be an alternative to inpatient treatment once infants are stabilized provided there is a healthcare provider who can follow these infants and families attend follow-up appointments (Backes, et al, 2012).

General Care

Breastfeeding is the recommended feeding for infants. The American Academy of Pediatrics (AAP) reaffirmed in their 2012 policy statement that breastfeeding and consumption of human milk is the standard for infant feeding and nutrition. The decision to allow women to breastfeed postpartum while consuming alcohol and other drugs presents a problem for the health care provider. Hospitals who responded to the survey indicated that 73% (n=14) allow women to breast feed their infants if they are in a methadone treatment program (26%, n=7). Other considerations for allowing women to breastfeed their infant include having a random negative urine (7.4%, n=2)) and breastmilk drug screen (7.4%, n=2). In other cases hospitals looked into the literature to determine if breastfeeding was appropriate (3.7%, n=1); if the mother was going to have DCS monitoring (3.7%, n=1); physician preference (3.7%, n=1) and one site had no criteria to make this determination (3.7%). Thirty seven percent (n=7) of the hospitals allowed women to breastfeed if they are a poly-substances user. All of the others (63%, n=12) did not follow this practice. The determination of whether breastfeeding is acceptable for women with substance abuse dependence is very controversial. In 2013 the AAP updated their statement on the use of medications during breastfeeding. The AAP previously stated that the effects of psychoactive drugs (antianxiety, antidepressants and mood stabilizers) on the breastfeeding infant were unknown therefore should be of concern. It is now known that for some of these drugs very little of drug metabolites are transferred into breastmilk (< 2% of weighted-adjusted maternal dose and/or milk-plasma ratios of <1) (Fortinguerra, et al., 2009). Those drugs that at maternal doses that secrete 10% or more metabolites into breastmilk are not recommended with breastfeeding (bupropion, diazepam, fluoxetine, citalopram, lithium, lamotrigine and venlafaxine). It is important to remember that information about drug excretion in human milk is not available for up to one-third of psychoactive drugs (Fortinguerra, et al., 2009; Sachs, H., 2013).

Methadone, buprenorphine and naltrexone are drugs approved by the FDA for treatment of opioid dependence. Since methadone levels in breast milk are low (infant exposure < 3% of maternal weighted-adjusted dose) plasma concentrations in the infant are also low during the neonatal period and up to 6 months postpartum. As a result the Academy of Breastfeeding Medicine encourages breastfeeding for women in methadone-maintenance programs Jansson, 2009). PCP and cocaine are present in human milk in high concentrations and can cause infant intoxication (Chasnoff, 1987). THC (Tetrahydrocannabinol) is present in human milk and metabolites not found in the milk are found in infant feces indicating that it is absorbed and

metabolized by the infant. We are not sure if there are any long-term effects of exposure on infant development (Perez-Reyes, 1982; Astley & Little, 1990).

Methadone maintenance is the treatment of choice for opioid addiction in pregnancy.

Concentrations of methadone in human milk are low; therefore, women stable on methadone maintenance should be permitted to breastfeed if desired (Geraghty, 1997). Buprenorphine (Subutex) and Buprenorphine plus naloxone (Suboxone) are excreted into human milk and achieves a level similar to levels in maternal plasma. Infant exposure appears to be up to 2.4% of the maternal-weight adjusted dose. Labeling indicates that breastfeeding is not advised with these drugs because animal studies have shown decreased milk production and viability of the offspring (Jansson, et al, 2008; Jansson, et al., (2008; Chan, et al., (2004). Pain medications such as oxycodone, pentazocine (Talwin), propoxyphene (Darvon) and meperidine Demerol) are not compatible with breastfeeding. Pain relievers that are approved are butorphanol (Stadol), morphine or hydromorphone (Dilaudid) (Seaton, et al., 2007).

Most infants receive supplementation of breastfeeding with formula (86%, n=14). The most common formula is a 20 cal/oz formula (58%, n=7) and 25% of the hospitals use a soy based formula (n=3). Enfamil Gentle Ease and Similac Sensitive formula are infrequently used 3ach 3.7%). In most cases breast milk fortifiers are not being used (82%, n=14). The only time a fortifier was added to the breast milk was when an infant was not gaining weight (n=3, 100%). None of the hospitals use a 24 calorie infant formula for infants who were not gaining weight. It has been recommended that infants with NAS receive 150-250 kcal/kg/day for growth (Hamdan, 2014). To achieve this amount a higher calorie formula or breast milk fortifier may be needed.

It is not uncommon for the Department of Child Protection Services (DCS) to be involved with the family prior to the infants discharge from the hospital. This practice occurred in 94% of the participating hospitals. Ninety four percent (n=16) made this referral before the infant was discharged from the hospital. Reasons for reporting infants to DCS included the infant having a positive drug screen (56%, n=15; the mother has other children in custody (52%, n=14) and the mother is not in drug treatment (41%, n=11). In one hospital all infants with intrauterine drug exposure get referred to DCS (3.7%). Another hospital reported infants if the mother had a history of drug use and the infant has a positive drug screen (3.7%) or if the mother just had a positive drug screen (3.7). In the general comments (Table 8) one hospital reported that a drug screen is sent on all babies. If that drug screen is presumed positive an umbilical cord sample is sent. If that comes back positive DCS is notified. According to the TN Department of Children's Services the following infant must be reported to DCS: 1) children under 2 years of age that have been exposed to a drug or chemical as verified by a positive drug screen by mother or baby; 2) infants born dependent on legally prescribed or illegally obtained drugs used by the mother during pregnancy and/or 3) has parents/caretakers who have a positive drug screen manufacture drugs or chemical substances; have admitted to the use of an illegal drug or non-prescribed medication or misuses prescribed medication or chemical substances (State of Tennessee Department of Children's Services, 2013).

Since infants with NAS require specialized care hospitals were asked if they had a core group of nurses who care for infants with NAS. Sixty eight (n=13) of the hospitals did not have a core group of nurses caring for these infants and 32% (n=6) did. Sixty seven percent (n= 2) felt that the nurses should be trained in scoring infant for signs of NAS and 33% (n=1) said no. Ninety four percent (n=17) of the hospitals reported that they believe the abstinence scores given to the infant and 5.6% (n=1) said they did not believe the scores. The reason for not believing the scores was because the nurses were not trained in the scoring (33%, n=9). There is a program available that will train nurses to reliability in the use of the Finnegan scoring tool. This program has been used in studies to assure the reliability of the nurses when testing a standardized pharmacologic treatment protocol across sites in Ohio (Hall, et al., 2014). When looking at parent involvement in their infant's care and parents being given information about NAS, 68% (n=13) of the hospitals reported both of these were occurring.

After Discharge

Many healthcare providers are concerned about whether infants discharged after being treated, in the hospital for NAS, return to the emergency department (ER) with sub-acute signs of NAS. Ninety percent of the hospitals (n=17) had no knowledge of ER visits and 94% (n=17) had no knowledge about whether the ER screened infants for NAS. Seventy nine percent (n=15) of the hospitals had knowledge of infants admitted to their nursery who were at risk for developing NAS but did not show signs and the numbers ranged from 3-100 per year. If more infants will be discharged on pharmacologic management over time it will be important for ER's to be on the look-out for infants who may be experiencing signs of NAS whether they are still weaning from their treatment medication or not. Emergency room physicians should be educated to look for signs of NAS and have the necessary screening tests to confirm any suspicions. This will become more and more important because of the increase incidence of NAS within our state. In looking at the general comments submitted all it is the opinion of some that all medical professionals need education in the area of NAS and women prenatally should also be educated so they can be prepared if their infants is hospitalized for signs of NAS.

General Comments

One hospital reported that they have seen a decrease in their length of stay (LOS) by using a written protocol. This is a very significant comment because it has recently been documented that it does not matter what medication is used to treat NAS the important this is that you have a written protocol that is followed. This can help to decrease LOS (Lindsey, et al, 2015; Hall, et al.,2014).

Protocols (Appendix B)

Five hospitals submitted their NAS treatment protocol. One of the protocols was a link to a website that could not be accessed. In observing the submitted treatment protocols there are several differences among them. As all of the protocols are reviewed there are inconsistencies regarding when treatment should begin, the frequency of scoring, the frequency of treatment,

not all of the protocols address the procedure for weaning treatment medications or guidelines for discharge. One site uses a protocol that was developed by Dr. Gary Snyder of the Pediatrix Medical Group of Ohio. This protocol has been used in a study to determine whether having a standardized treatment protocol would decrease LOS for infants with NAS (Hall, et al., 2014). Length of stay in our state may benefit by having an evidence based treatment protocol that specifically addresses all aspects of the care required for infants with NAS including the requirement for staff nurses to be trained to reliability in the use of the Finnegan scoring tool.

Recommendations

The following are some recommendations for improving the care of infants in our state with NAS:

- 1) Gather more specific information about the re-admission rate of infants discharged from the hospital after being treated for NAS. This would involve the education of health care professionals in the ER about the signs of NAS and how to assess for it in the ER. The development of a registry or state reporting mechanism for ER visits and/or re-hospitalizations of infants who were discharged after being treated inpatient for NAS.
- 2) Test the efficacy of using umbilical cord sampling vs meconium and urine for NAS screening so there is consistency within our state. Increasing the consistency will assure that infants receive an accurate diagnosis of NAS in a timely fashion.
- 3) Determine the best practice for observing infants exposed to short and long-acting opioids and infants exposed to poly-substances. Addressing this issue will provide evidence for the best practice and may reduce hospital costs by preventing a prolonged observation period especially for infants exposed to short-acting opioids and possibly prevent ER visits for infants discharged too soon when exposed to poly-substances.
- 4) Develop a study to study to specifically test the effectiveness of using oral morphine, methadone, clonidine and oral sucrose to treat infants with NAS to determine the best practice . A part of this study may also determine how long infants should be observed after treatment and before discharge to home. It could be that hospital length of stay can be reduced if infants can be discharged before the recommended 72 hour observation period.
- 5) Evaluate which comfort measures will significantly comfort infants with NAS. The establishment of the most effective measures may help to decrease the number of infants that may require pharmacologic management.
- 6) Develop a study to determine the efficacy of discharging infants to home while continuing to be treated for NAS (methadone, morphine, phenobarbital and/or clonidine).

7) Develop a demonstration project that would care for infants with NAS in a “home like” facility rather than a hospital.

8) Develop a study to determine the most effective frequency for pharmacologic management. It has been documented that when treating infants for NAS the dosing interval should not be more than 4 hours because longer dosing intervals are associated with longer hospital stays (Jones, 1999). This study did not address this issue in the questionnaire.

9) Design a study to determine the milk to plasma ratio and infant exposure for drugs such as Subutex since this drug is being used to treat opioid addiction in pregnancy women.

10) Design a study to determine the best feeding practices: ad lib feeding vs programed feedings (cc/kg/day; kcal/kg/day); the use of breast milk fortifiers; the best formula to use to promote linear growth and weight gain.

These recommendations will help to determine best practices for the care of infants with NAS. A final goal would be the development of an evidence based protocol that could be distributed to all hospitals. If the protocol is followed we can test its efficacy in decreasing hospital LOS, Treatment days and weight gain.

Table 1: Hospital Demographics (n=27)

	N	N (%)	Median (IQR)	Mean	MIN, MAX
Hospital Region	27				
East TN		14 (51.9)			
Middle TN		10 (37.0)			
West TN		3 (11.1)			
Free Standing Children's Hospital	26				
Yes		6 (23.1)			
No		20 (76.9)			
Not a Free Standing Children's Hospital	20				
Medical Center		4 (14.8)			
Local Hospital		14 (51.9)			
Regional Hospital		2 (7.4)			
Number of Deliveries (last year)	24		774.5 (322-2017)	1,256	160, 4500
Number of Nursery Types	27				
Level I (Newborn Nursery)		14 (51.9)			
Level II NICU or Special Care Unit		10 (37.0)			
Level III NICU		5 (18.5)			
Level III Plus NICU		3 (11.1)			
Number of NICU Admissions (last year)	22		27.5 (0-594)	248	0, 1384
NAS Admissions (last year)	27				
Yes		24 (88.9)			
No		3 (11.1)			
Number of NAS Admissions (last year)	21		20.0 (2-260)	59	1, 260
NAS Infant Care Location Before Maternal Discharge	24				
Newborn Nursery		6(25)			
Level II NICU		3 (12.5)			
Level III NICU		5 (20.8)			
Mother's Room		4 (16.7)			
Newborn Nursery and Mother's Room		5 (20.8)			
Other		1 (4.2)			
NAS Infant Care Location After Maternal discharge	24				

Newborn Nursery		10 (41.7)			
Level II NICU Private Room		1 (4.2)			
Level II NICU Non-Private Room		2 (8.3)			
Level III NICU Private Room		4 (16.7)			
Level III NICU Non-Private Room		5 (20.8)			
Other (Mothers room; Transferred to Level III)		2 (8.3)			
NAS Cases Reported to TN Depart. Of Health NAS State Registry					
Yes		23 (95.8)			
No		1 (8.3)			
Not enough babies		1 (100.0)			

Table 2: Assessment and Screening

	N	N (%)
Biological NAS Diagnostic Tests Used	24	
Urine + Meconium		11 (45.8)
Urine + Umbilical Cord		3 (12.5)
Meconium + Umbilical Cord		1 (4.1)
Urine + Meconium + Umbilical Cord		5(20.8)
Umbilical Cord Only		4 (16.6)
Clinical Scoring Tool Used to Assess NAS	24	
Yes		24 (100.0)
Finnegan Scoring Tool		23 (95.8)
Neonatal Drug Withdrawal Scoring System		1 (4.2)
Neonatal Narcotic Withdrawal Index		-----
Lipsitz Tool		-----
No		-----
Scoring Frequency for NAS (each day)	24	
Q 3 hours		12 (50.0)
Q 4 hours		9 (37.5)
Q 6 hours		3 (12.5)
Q 12 hours		-----
Once a day		-----
Who Completed NAS Scoring	24	
Bedside Nurse		23 (95.8%)
Nurse Practitioner		1 (4.2)
Physician		-----
Number of Days Infant is Observed if Exposed to Short Acting Opioids and SSRI	23	
2 days		5 (21.7)
3 days		10 (43.4)
5 days		2 (8.6)
3-5 days		4 (17.4)
2-3 days		1 (4.3)
3-4 days		1 (4.3)
Number of Days Infant is Observed if Exposed to Long-Acting Opioids	23	
2 days		2 (8.6)
3 days		7 (30.4)
4 days		1 (4.3)
5 days		3 (13)
3-4 days		1 (4.3)
3-5 days		7 (30.4)

7-10 days		1 (4.3)
Transfer		1 (4.3)
Number of Days Infant is Observed if Exposed to Poly-Substance Exposure		
2 days		3 (13)
3 days		7 (30.4)
4 days		1 (4.3)
5 days		4 (17.4)
3-5 days		6 (26)
3-7 days		1 (4.3)
Transfer		1 (4.3)

Table 3: Numbers of Days Infants are Initially Observed for Signs of NAS

Observation Time	Short-Acting Opioid (n=23)	Long- Acting Opioid (n=23)	Poly-Drug Use (n=23)
	N (%)	N (%)	N (%)
2 days	5 (21.7)	2 (8.6)	3 (13)
3 days	10 (43.4)	7 (30.4)	7 (30.4)
4 days		1 (4.3)	1 (4.3)
5 days	2 (8.6)	3 (13)	4 (17.4)
3-5 days	4 (17.4)	7 (30.4)	6 (26)
2-3 days	1 (4.3)		
3-4 days	1 (4.3)	1 (4.3)	
3-7 days			1(4.3)
7-10 days		1 (4.3)	
Transfer		1 (4.3)	1 (4.3)

Table 4: Non-Pharmacologic Management (comfort measures)

	N	N (%)
Non-Pharmacologic Methods	23	
Swaddling		23(100.0)
Quiet room		20 (86.9)
Dim lighting in room		21(91.3)
Provide boundaries around infant		13(56.5)
Sucking on a pacifier		23(100.0)
Rocking infant in swing		17(73.9)
Encourage parent holding		19 (82.6)
Holding by care partner		17 (73.9)
Holding by nurses		20 (86.9)
Other		1 (4.3)
Rocking crib		1 (3.7)
Combinations of Non-Pharmacologic Methods	23	
All above		8 (34.8)
All without boundaries		5 (21.7)
All without boundaries & parent holding		1 (4.3)
All without dim lighting, boundaries, care partner		1 (4.3)
All without boundaries, rocking in swing, parents holding, care partner		1 (4.3)
All without Quiet room, dim lighting, rocking, care partners		1 (4.3)
All without rocking in swing		1 (4.3)
All without parent holding and care partner		1 (4.3)
All without boundaries, rocking in swing & care partner		1 (4.3)
All without quiet room & boundaries		1 (4.3)
All without parents holding		1 (4.3)
All without boundaries & rocking in swing		1 (4.3)

Table 5: Pharmacologic Management

	N	N (%)
Medications used to treat NAS	21	
Yes		18 (85.7)
No		3 (14.3)
Primary medication to treat NAS	27	
Oral Morphine		15 (55.6)
Methadone		2 (7.4)
Tincture of Opium		0 (0.0)
Phenobarbital		2 (7.4)
Clonidine		0 (0.0)
Sucrose Water		5 (18.5)
Acetaminophen		2 (7.4)
Simethicone		1 (3.7)
Other		0 (0.0)
Second medication added in addition to first choice	13	
Methadone		1 (7.7)
Phenobarbital		6 (46.2)
Clonidine		4 (30.7)
Sucrose Water		1 (7.7)
Other		1 (7.7)
Third medication added in addition to first and second choice	10	
Methadone		2 (20.0)
Phenobarbital		1 (10.0)
Clonidine		6 (60.0)
Simethicone		1 (10.0)
Oral Morphine dosing method	16	
Weight based		7 (43.8)
Symptom based		1 (6.2)
Weight & symptom based		8 (50.0)
Oral morphine concentration used	13	
0.04 mg/ml solution		8 (61.5)
0.02 mg/ml solution		5 (38.5)
Specific treatment protocol to manage infants with NAS	17	
Yes		11 (64.7)
No		6 (35.3)
Criteria for ordering additional drugs to control NAS	13	
Reached maximum dose of primary drug and scores still		8 (61.5)

increasing		
Failure to taper primary drug		4 (30.8)
Other		1 (7.7)
Do not use another drug		1 (7.7)
Frist weaning drug choice	11	
Opioid		8 (72.7)
Phenobarbital		1 (9.1)
Clonidine		2 (18.2)
Finnegan scoring tool pharmacologic management trigger	18	
Finnegan score of 8-11 one time		1 (5.6)
Finnegan score 8-11 two times		9 (50.0)
Finnegan score 12 or greater		3 (16.6)
Other		5 (27.8)
Depends on physician		1 (3.7)
If med needed baby is transferred to an NICU		2 (11)
Score of 9 or greater on 2 consecutive scores		1 (3.7)
Scores of 8 X 2 or > 12 X 1		1 (3.7)
Trigger for pharmacologic management if not using the Finnegan scoring tool	27	
Vomiting		1 (3.7)
Diarrhea		1 (3.7)
Poor weight gain		1 (3.7)
Dehydration		1 (3.7)
Consistently irritable		1 (3.7)
Seizures		1 (3.7)
Other		0 (0.0)
Percentage when treatment meds are weaned	12	
5%		0 (0.0)
10%		6 (50.0)
20%		2 (16.7)
Other		4 (33.3)
Morphine by 10% initial dose and clonidine by 25%		1 (3.7)
Transfer baby		1 (3.7)
Wean by 0.01 mg/kg/dose enterally		1 (3.7)
Wean by decreasing dose 0.04mg/kg/dose		1 (3.7)
Weaning frequency	12	
Every 24 hours		3 (25)
Every 48 hours		7 (58.3)
Other		2 (16.7)
Finnegan score when meds are discontinued	14	
Zero		1 (7.1)
1-2		1 (7.1)
3-4		3 (21.4)
5-6		6 (42.9)

7-8		3 (21.4)
Other scoring tool (not Finnegan) treatment discontinuation trigger	1	
7-8		1 (100)
Percentage of treatment dose when pharmacologic treatment is discontinued	11	
10%		3 (27.3)
20%		4 (36.4)
Other		4 (36.4)
Observation of infant when treatment is discontinued prior to discharge	14	
24 hours		2 (14.3)
48 hours		9 (64.3)
72 hours		2 (14.3)
Other		1 (7.1)
Depends on physician		1 (3.7)
Infant sent home same day as treatment discontinuation	14	
Yes		0 (0.0)
No		14 (100)
Meds sent home for infant NAS treatment	14	
Yes		3 (21.4)
Phenobarbital		3 (21.4)
No		11 (78.6)
Who follows infant at home on meds	3	
Pediatrician		3 (100)
Neonatologist in Neonatal Follow Clinic		0 (0.0)
	Median (IQR)	Min, MAX
Average length of stay for opioid treatment of NAS (days) (n=12)	20.5 (15-27)	8,35
Average length of stay for infants being treated with opioids plus other drugs such as phenobarbital or clonidine (n=8)	27.5 (16-42)	7.68
Average length of stay for infants being treated with drugs other than opioids (n=3)	10 (10,25)	0.25

Table 6: General Care for Infants with NAS (n=27)

	N	N (%)
NAS Infants allowed to breast feed	19	
Yes		14 (73.7)
No		5 (26.3)
Criteria to assure breastfeeding appropriateness	27	
Mother in drug treatment program		7 (25.9)
Random maternal urine drug screening		2 (7.4)
Testing of breast milk		2 (7.4)
Other		5 (18.5)
Check evidence base literature to determine if OK to breastfeed		1 (3.7)
DCS monitoring		1 (3.7)
Depends on mother's dose		1 (3.7)
Depends on physician		1 (3.7)
We have no criteria		1 (3.7)
Women with poly-substance abuse allowed to breast feed	19	
Yes		7 (36.8)
No		12 (63.2)
Supplemental breastfeeding with formula	14	
Yes		12 (85.7)
Regular 20 calorie formula	12	7 (58.3)
Soy based formula		3 (25.0)
24 calorie formula		-----
Other		2 (16.7)
Enfamil Gentle Ease		1 (3.7)
Sensitive formula – only used if needed for volume		1 (3.7)
No		2 (14.3)
Breast milk fortifiers used when bottle feeding	17	
Yes		3 (17.6)
No		14 (82.4)
Criteria for adding fortifier		
No criteria all babies get it		-----
When baby is losing weight		3 (100.0)
Babies with NAS reported to DCS	19	
Yes		18 (94.7)
Before discharge		16 (94.1)
At discharge		1 (5.9)
No		1 (5.3)

Criteria for DCS reporting	27	
Baby has positive drug screen		15 (55.6)
Mother has other children in DCS custody		14 (51.9)
Mother not in drug treatment		11 (40.7)
Other		4 (14.8)
All intrauterine exposed infants have a DCS consult		1 (3.7)
If mother has history and a positive umbilical cord stat		1 (3.7)
Mother has positive screen		1 (3.7)
We use umbilical cord testing, if positive, they are reported		1 (3.7)
Core of nurses caring for babies with NAS	19	
Yes		6 (31.6)
No		13 (68.4)
Nurses trained in NAS scoring	19	
Yes		16 (94.2)
No		3 (15.8)
Should nurse be trained in NAS scoring	3	
Yes		2 (66.7)
No		1 (33.3)
Belief in NAS scores	18	
Yes		17 (94.4)
No		1(5.6)
Scores are unreliable	27	1 (3.7)
Nurses not trained to score		9 (33.3)
Baby does not exhibit signs indicated by scores		1 (3.7)
Other		-----
Parents of infants with NAS involved in their care	19	
Yes		13 (68.4)
No		6 (31.6)
Parents given written information about NAS	19	
Yes		13 (68.4)
No		6 (31.6)

Table 7: After Discharge

	N	N (%)
Knowledge of Infants re-admitted for signs of NAS after discharge	19	
Yes		2 (10.5)
How many re-admitted in last year?		2 (7.4)
No		17 (89.5)
Emergency Room Screening for NAS	18	
Yes		1 (5.6)
Urine dip stick for screening	27	1 (3.7)
No		17 (94.4)
Knowledge of infants at risk for NAS but didn't show signs while in hospital after birth	19	
Yes		15 (78.9)
How many in the last year?	27	
3		1 (3.7)
5		3 (11.0)
10		1 (3.7)
18		1 (3.7)
25		1 (3.7)
100		2 (7.4)
At least 40-50		1 (3.7)
Not sure of actual number		1 (3.7)
Unknown		2 (7.4)
No		4 (21.1)

Table 8: General Comments

Topic	Comment
Length of Stay	The ALOS has been decreasing in 2014 since we switched to using morphine rather than methadone. LOS has gone from 40 days down to 20-30 days. We use the Vanderbilt protocol.
Education	“Education for medical personnel is very much needed in this area!! Also this problem needs to be addressed with patients prenatally so the parents are prepared when they come to the hospital.”
Pharmacologic Treatment	If any baby needs medication for NAS, we give the first dose and then transfer the baby to a regional medical center. That facility does the reporting to NAS portal.
Emergency Room	“The ER does assess/screen when appropriate but not on every infant visit.”
Drug Screening/DCS	“We drug screen all patients. If the initial drug screen is presumed positive, we obtain a cord segment and send it for testing. If that comes back positive, our Social Services Department reports to DCS. As a level 1, we tend to transfer our NAS infants who need treatment, however, if we can treat them here, we do. Many of our patients are presumed positive, but the infants show no signs or symptoms during their hospitalization.”
Location of Infants with NAS	“We have 7 individual rooms that we try and place our NAS patients in, however, many of them also stay in our open bay unit since we typically have more than 7 patients at a time.”

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Appendix A
Survey

Appendix B

Protocols

Neonatal Abstinence Syndrome (NAS): Management Trends in TN

Directions: This survey is part of a study designed to identify the care practices of infants with a diagnosis of neonatal abstinence (drug withdrawal) in your institution. Some questions are related to general demographic information about your site. The rest of the questions are related to the care and management of infants with neonatal abstinence. Please answer the following questions related to infants that were given a diagnosis of neonatal abstinence or drug withdrawal and were cared for in your hospital within the last 12 months.

The person completing this survey will receive a \$25.00 gift certificate. Participation is voluntary and by completing you indicate your consent to participate in this study. No names will be associated with your responses and all data collected will be reported in aggregate.

Thank you!

Demographics

Name of Hospital:

In which region is your hospital?

- East TN
- West TN
- Middle TN

Is your hospital a Children's Hospital?

- No
- Yes

If no, how do you classify your hospital?

- Medical Center
- Local Hospital
- Regional Hospital
- Other

Please specify:

Number of deliveries in your hospital during the last year:

Type of nursery in your hospital:

- Newborn Nursery
- Level II NICU or Special Care Unit
- Level III Nursery
- Level II & Level III

Number of newborn nursery admissions last year:

Total number of NICU admissions last year:

Have you admitted infants to your nursery with NAS in the last year?

- No
- Yes

Number of infants admitted to your nursery with NAS in the last year:

Where are infants with NAS cared for in your hospital after delivery and before the mother is discharged from the hospital?

- Newborn Nursery
 Mother's room
 Newborn Nursery and Mother's room
 Level II NICU
 Level III NICU
 Other

Please specify: _____

Where are infants with NAS cared for in your hospital once mothers are discharged from the hospital?

- Newborn Nursery
 Level II NICU private room
 Level II NICU non-private room
 Level III NICU private room
 Level III NICU non-private room
 Other

Please specify: _____

Do you report your cases of NAS to the Tennessee Department of Health NAS State Registry?

- No
 Yes

If no, why not?

- Not enough babies
 No one to enter the information
 Other

Please specify _____

Assessment and Screening of NAS

Do you use any of the following drug screening tests to diagnose NAS? (select all that apply)

- Urine screening
 Meconium screening
 Umbilical cord screening
 Urine and meconium screening

Do you use a clinical scoring tool to assess the severity of NAS?

- No
 Yes

Which clinical NAS scoring tool do you use?

- Finnegan Scoring Tool
 Lipsitz Tool
 Neonatal Drug Withdrawal Scoring System
 Neonatal Narcotic Withdrawal Index
 Neonatal Withdrawal Inventory
 Other

Please specify: _____

Have you modified an existing NAS scoring tool?

- No
 Yes

If yes, which one?

- Finnegan Scoring Tool
 Lipsitz Tool
 Neonatal Drug Withdrawal Scoring System
 Neonatal Narcotic Withdrawal Index
 Neonatal Withdrawal Inventory
 Other

Please specify: _____

How often are infant's scored for signs of neonatal abstinence each day?

- Q 3 hrs
 Q 4 hrs
 Q 6 hrs
 Q 12 hrs
 Once a day

Who completes the neonatal abstinence clinical scoring tool?

- Bedside RN
- Nurse Practitioner
- Physician
- Other

Please specify: _____

How many days do you observe an at risk baby for signs of NAS?

(Number of Days)

Non-Pharmacologic Management of NAS

What non-pharmacologic measures do you use to comfort infants with NAS? (select all that apply)

- None
- Swaddling
- Quiet room
- Dim lighting in the room
- Providing boundaries around infant
- Sucking on a pacifier
- Rocking infant in a swing
- Encourage parent holding
- Holding by care partners
- Holding by nurses
- Other

Please specify _____

Pharmacologic Management to Treat NAS

Do you use medications to treat infants with NAS?

- No
- Yes

If yes, which medication would you use first (primary choice)?

- Oral Morphine
- Methadone
- Tincture of Opium
- Phenobarbital
- Clonidine
- Sucrose Water
- Acetaminophen
- Simethicone
- Other

Please specify _____

If you needed to add a second medication to control signs of NAS, which of the following medications would you add as your 2nd line of treatment (add this drug to the primary drug being given):

- Oral Morphine
- Methadone
- Tincture of Opium
- Phenobarbital
- Clonidine
- Sucrose Water
- Acetaminophen
- Simethicone
- Other

Please specify: _____

If you added a third medication, what would it be?

- Oral Morphine
- Methadone
- Tincture of Opium
- Phenobarbital
- Clonidine
- Sucrose Water
- Acetaminophen
- Simethicone
- Other

Please specify:

If you treat infants with oral morphine to manage signs of NAS is your dosing:

- Weight based
- Symptom based
- Weight and Symptom based

Do you follow a specific treatment protocol to manage infants with NAS?

- No
- Yes

If yes, please attach it here.

When do you add your second medication of choice for opioid withdrawal?

- Reached maximum dose of primary drug and scores still increasing
- Failed to taper primary drug
- Other

Please specify

When the baby is on a primary and secondary medication for treatment of NAS which drug do you wean first?

- Primary opioid
- Secondary (Phenobarbital or other)

What criteria do you use to begin pharmacological management?

- Finnegan score of 8-11 one time
- Finnegan score of 8-11 two times
- Finnegan score of 12 or greater

For the withdrawal tool used, what score do you begin pharmacological management?

By what percentage do you wean the treatment medication?

- 5%
- 10%
- 20%
- Other

Please specify

How often do you wean?

- every 24 hours
- every 48 hours
- other

Please specify

At what Finnegan withdrawal score so you discontinue treatment?

- 0
- 1-2
- 3-4
- 5-6
- 7-8

Do you send babies home on the second drug of choice used to treat NAS?

- No
- Yes

Who follows the baby after discharge from the hospital?

- Pediatrician
- Neurologist in Follow Up Clinic
- Other

Please specify

At what percentage of dose do you stop treatment?

- 10%
 20%
 Other

Please specify _____

After discontinuation of all treatment medications for NAS how long do you typically observe a baby before discharge from the hospital?

- 1 day (24 hours)
 2 days
 3 days

Do you send a baby home the same day treatment is discontinued?

- No
 Yes

What is your average length of stay in days for babies being treated for NAS in your unit?

(in days)

General Care for NAS Infants

Do you allow NAS infants to breast feed?

- No
 Yes

If yes, what criteria do you use to assure appropriateness of breast feeding? (select all that apply)

- Mother must be in a drug treatment program (methadone or buprenorphine)
 Random urine maternal screening
 Testing of breast milk
 Other

Please specify _____

Do you allow women with poly-substance abuse to breast feed?

- No
 Yes

Do you supplement breast feeding with formula?

- No
 Yes

If yes, what kind of formula do you use?

- Regular 20 calorie formula
 Soy based formula
 24 calorie formula
 Other

Please specify _____

Do you use breast milk fortifiers when bottle feeding infants with NAS?

- No
 Yes

If yes, what criteria do you use to add the fortifier?

- No criteria, all babies get it
 When baby is losing weight
 Other

Please specify _____

Do you report babies with NAS to the Division of Children Services (DCS)?

- No
 Yes

If yes, what criteria do you use to make that determination? (select all that apply)

- Baby has a positive drug screen
 Mother has other children in DCS custody
 Mother is not in a drug treatment program
 Other

Please specify _____

If yes, when do you contact DCS?

- Before discharge
 At the time of discharge

Do you have a core group of nurses who care for infants with NAS in your unit?

- No
- Yes

Are nurses specifically trained in the use of the NAS scoring tool?

- No
- Yes
- I don't know

If no or you don't know, do you think nurses should be specifically trained to be reliable in using the NAS scoring tool?

- No
- Yes

When making rounds on infants with NAS do you typically believe the NAS scores given to the baby?

- No
- Yes

If not, why?

- Scores are unreliable
- Nurses are not trained to score
- Baby does not exhibit signs indicated by scores
- Other

Please specify:

Are parents typically involved in the care of NAS infants?

- No
- Yes

Do you give parents any written information about NAS?

- No
- Yes

After Discharge

Do you know of any babies who have been re-admitted for signs of NAS after discharge?

- No
- Yes

If yes, about how many?

Please specify

Does your Emergency Room screen infants for drug withdrawal (neonatal abstinence syndrome)?

- No
- Yes

How do you screen?

Do you know of any babies who were at risk for drug withdrawal but did not show signs while in the hospital after birth?

- No
- Yes

If yes, about how many?

Please submit your survey in order to register for the gift card.

NEONATAL ABSTINENCE SYNDROME ORDERS

Page 1 of 1

Patient identification

Form No. EB-0501-E Date 9/16/2011

1. Diagnosis: Newborn (< 28 days of age) with positive drug screen
Positive maternal history of drug use
Infants with signs of withdrawal
2. Complete "Neonatal Abstinence Scoring" (record on Form MS-6961)
 - a. initiate screening at 4 hours of age or sooner if symptoms are present
 - b. complete screening every 4 hours for first 24 hours in conjunction with feeds
 - c. complete screening every 4 – 6 hours beginning at 24 hours until scores consistently less than 10, whether on replacement therapy or not
3. Regulate environment to reduce quantity / variety of sensory input for symptomatic patients
 - a. Cover isolette if applicable
 - b. Reduce ambient lighting
 - c. Minimal handling, coordination of handling
 - d. Routine vital signs, non – invasive monitoring if available
 - e. Developmentally appropriate care
 - i. Cue based
 - ii. Swaddling
4. Gastrointestinal treatment:
 - a. Cue based on – demand feedings Minimum feed ____ mL / kg / day
 - b. Accurately record intake and output
 - c. Insert # 5 French NG tube for gavage feeding PRN to meet caloric requirements
 - d. Provide pacifier PRN for consolation
 - e. Lactation consult, if applicable, regarding safety of breast milk use
5. Promote maternal infant attachment
 - a. Education for parent(s) regarding appropriate infant stimulation
 - b. Promote parent involvement in infant care
6. Pharmacologic treatment:

Initiate medication treatment if withdrawal score is greater than 10 for 2 consecutive evaluations

SWEET – EASE 24% solution 0.2 mL PO PRN consolably

morphine sulfate 0.1 mg / kg PO every 4 hours (dose: ____ mg)*

methadone 0.1 mg / kg PO every 24 hours (dose: ____ mg)*

methadone 0.1 mg / kg IV every 24 hours (dose: ____ mg)*

Notify house officer (HO) or pediatrician if NAS score continues to be greater than 10 for 2 consecutive evaluations after treatment is started

*Apply Cardio Respiratory monitor upon initiation of medication therapy
7. Laboratory:

Toxicology drug test: Umbilical cord Urine Meconium

Verify maternal prenatal screens
8. Support Services
Consult social work
Consult physical therapy, for symptomatic patients, for assistance with developmental appropriate care

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Physician's Signature _____ Date _____ Time _____

Preprinted physician orders – Scan orders to Pharmacy before placing in Medical Record

Nursing Interventions:

1. Reduce environmental stimuli at newborn's bedside:
 - a. Avoid talking at bedside
 - b. Decrease environmental lighting
 - c. Attempt to place newborn in a room with low activity/noise level
 - d. Present one stimulus at a time (i.e., voices, face, rocking)
 - e. Move newborn away from telephone, sink, and high traffic areas
2. Possible measure to console irritable newborn:
 - a. Nest with blanket rolls for containment and flexion
 - b. Offer pacifier
 - c. Try hear beat types
 - d. Decrease stimulation at first sign of distress
 - e. Try vertical rocking

Pharmacological Management:

1. Notify physician when Neonatal Abstinence Score (NAS) is 8 or higher for three consecutive scores, or when the average of any score is 12 or higher for two consecutive intervals; or the average is 12 or higher for two consecutive scores. Initiate therapy according to the physician's order using the appropriate detoxicant dose; this is usually done before more than four (4) hours elapse.
2. Consult pharmacist for dosing regime
3. Opiate withdrawal (Methadone, Heroin, Hydrocodone, Morphine, Oxycodone, etc.)

Methadone Protocols:

• **Methadone:**

Methadone can be used to treat neonatal opiate abstinence. Given the prolonged taper needed, it is not the drug of choice for withdrawal from short acting opiates but may be considered for infants of Methadone-maintained mothers or for infants dependent on Fentanyl for iatrogenic reasons. The average duration of treatment following prenatal Methadone exposure is significantly longer than treatment for infants exposed to short acting opiates.

- a. Give initial loading dose of 0.01 mg/kg/dose X 1
- b. Start a maintenance dose of 0.05 to 0.1 mg/kg/dose every 6 hours
- c. Give an additional 0.025 mg/kg/dose every 6 hours for continuing NAS scores >8 until symptoms are controlled or a maximum dose of 0.5 mg/kg/day is reached.
- d. The maintenance dose is determined by calculating the total Methadone dose given over the previous 24 hours
- e. Administer the maintenance dose in 2 divided doses every 12 hours
- f. Monitor respiratory and cardiac status closely
- g. Assess for abdominal distention, and a loss of bowel sounds.

• **Oral Morphine Preparations:**

- a. No loading dose

- b. Maintenance dose 0.05 mg/kg/dose every 4 hours
 - c. Increase dose by 0.03 mg/kg/dose every 4 hours for serial NAS scores >8 until symptoms are controlled
 - d. The maximum maintenance dose to control symptoms is administered every 4 hours
 - e. Monitor respiratory and cardiac status closely.
4. Non-Opiate withdrawal (Cocaine, Methamphetamine, Ecstasy, etc.)
- **Phenobarbital** 3 to 4 mg/kg per day in divided doses.

Note:

For both Methadone and Morphine the maximum maintenance dose required to control symptoms is given every 4 hours for 48-72 hours or until NAS scores decline. At this point the dose is weaned by 10% of the maximum dose every other day, as tolerated. Treatment is discontinued once the dose has been weaned to 10% of the maximum dose.

Before Discharge, Continue to Assess:

1. Newborn growth and development: a weight gain of 20-30 grams/day (may be lower if mother is breast feeding) is the ideal target.
2. Feeding: the newborn should be receiving high caloric formula for 3-5 days prior to discharge if the mother is not breastfeeding.
3. Assess handling and patterns – (sleeping, cry, behavioral).
4. Assess environmental adaptation – return to normal light conditions 2-5 days prior to discharge.
5. Assess for other medical concerns.

Any newborns testing positive for illegal controlled substances will have referrals made to Social Services who will in turn report to Child Protective Services.

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