INTERPROFESSIONAL HEALTHCARE PROVIDER EDUCATION ON NEONATAL ABSTINENCE SYNDROME

by

Mary L. Puchalski, MS, RNC-NIC, APN, CNS, NNP-BC

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Signature Faculty Reader	Date
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Signature Program Director	Date

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Abstract

The rapidly increasing incidence of Neonatal Abstinence Syndrome (NAS) in the U.S. has been identified as a national healthcare crisis. An evidence-based practice change project, "Interprofessional Healthcare Provider Education on NAS" (IHPEN) was designed to implement a protocol to increase consistency in treatment for infants with NAS and provision of healthcare provider education to increase knowledge regarding NAS, as well as sensitivity to the signs and symptoms of withdrawal. The target population included all healthcare providers in the Neonatal Intensive Care Unit and Mother/Baby Unit of a large, urban, not-for-profit perinatal center. The project was developed in response to a need for an organized, structured, systematic, and collaborative approach to assessment and treatment. This need was based on the following observations: (a) increasing numbers of patients admitted to the NICU who were diagnosed with NAS, (b) long lengths of stay for infants with NAS, (c) an inconsistent approach to the pharmacologic treatment and weaning of medications because of a lack of a protocol for infants with NAS, (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS.

141 healthcare providers participated in the educational intervention. 32% of the participants reached the benchmarked level of improvement of 10% from pretest to posttest, and 53% percent of the participants improved their pretest to posttest score. A paired-sample *t*-test was conducted to compare the differences in pretest and posttest score and found to be significant pretest ($p = 0.000164$). Thus, the outcomes of this evidence-based educational intervention supported the importance of providing comprehensive, interprofessional training on the assessment and treatment of infants with NAS in order to enhance healthcare provider knowledge.

Table of Contents

Interprofessional Healthcare Provider Education on Neonatal Abstinence Syndrome

Chapter One: Overview of the Problem of Interest

Neonatal Abstinence Syndrome (NAS) is a collection of abnormal physiologic and neurobehavioral clinical findings resulting from a newborn infant's physiological dependency on placentally transferred opioids due to maternal opioid use or abuse during pregnancy (Behnke & Smith, 2013; Hudak & Tan, 2012). Caring for the infant with NAS can be distressing to a bedside nurse as well as challenging for the medical provider. The American Academy of Pediatrics (AAP) (Hudak & Tan, 2012), along with number of experts, recommend a structured, systematic, and collaborative approach to the assessment and treatment of infants with NAS to prevent or minimize the exacerbation of symptoms, prolonged lengths of stay, and adverse outcomes (Fraser, Barnes, Biggs, & Kain, 2007; Hall et al., 2014; Lucas & Knobel, 2012; Maguire, Webb, Passmore, & Cline, 2012; Oei & Lui, 2007; Pritham, 2013; Rogers, Babgi, & Gomez, 2008).

This chapter will provide background information on the problem of NAS including a historical perspective and current challenges. It will introduce an evidence-based practice (EBP) change project that addressed the challenges of caring for and treating the newborn infant with NAS in the Neonatal Intensive Care (NICU) and Mother-Baby Units (MBU) of a large, urban, not-for-profit university-based level IV perinatal center in the State of Illinois: the *"Interprofessional Healthcare Provider Education on NAS"* (IHPEN). The project was designed to increase healthcare provider knowledge about NAS and implement a protocol for the assessment and treatment of infants with or at risk for NAS. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for

infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Background Information

Opioids are a class of drugs with the potential for both physical and psychological dependency. In adults, prolonged use or abuse of opioids, e.g., opium, heroin, methadone, buprenorphine, oxycodone, or hydromorphone, can result in both physical and psychological dependency including addiction, a disease characterized by dependency along with drug seeking behavior and the resultant "brain reward" (American Society of Addiction Medicine [ASAM], 2011). Classic research (Gerdin, Rane, & Lindberg, 1990) has proven opioids readily cross the placenta into the fetal blood stream resulting in rapid mother-fetus drug equilibrium. It is important to note that newborn infants do not have a capacity for addiction because they cannot engage in drug seeking behavior. However newborn infants do develop a clinically significant physiologic dependency to the opioid to which they were prenatally exposed. The resultant signs and symptoms of withdrawal, termed NAS, commence shortly after the placental supply of the drug is terminated (Hudak & Tan, 2012).

Perlstein (1947) published the earliest indexed report of neonatal withdrawal due to maternal drug abuse, although historians (Burosch, 1974) have identified earlier documentation of concern by medical practitioners surrounding infants born to opioid addicted women. Finnegan, Connaughton, Kron, and Emich (1975) were the first to describe the collective signs and symptoms of drug withdrawal in the newborn infant as a withdrawal syndrome. Current experts (Behnke & Smith, 2013; Hudak & Tan, 2012) provide a deeper understanding of the signs and symptoms of withdrawal in the newborn infant with NAS. These signs and symptoms present in 48 to 94% (Behnke & Smith, 2013) of in-utero opioid exposed newborn infants and

encompass nearly every body system, including central nervous, autonomic nervous, gastrointestinal, and respiratory. The most common symptoms include wakefulness, irritability, inconsolability, sweating, increased muscle tone, hyperreactivity, feeding problems, and diarrhea, (Behnke & Smith, 2013). The most serious complication of untreated or inadequately treated NAS is seizures, which may be life threatening.

After birth, identification of an infant's risk for NAS should be performed based on maternal risk factor screening then confirmed by a quantitative method such as testing urine, meconium, hair, cord blood, or umbilical cord tissue (American Congress of Obstetrics and Gynecology, 2012; Behnke & Smith, 2013; Hudak & Tan, 2012). Any newborn infant with prolonged intrauterine exposure to opioids, whether prescribed or illicit, should be assessed for signs and symptoms of NAS as severe withdrawal can impair the newborn's transition to extrauterine life (Behnke & Smith, 2013). These signs and symptoms should be assessed at regular intervals utilizing a valid and reliable NAS scoring tool to assist in identifying and evaluating their collective severity, as well as guide pharmacologic management (Bhatt-Mehta, Ng, & Schumacher, 2013; Hudak & Tan, 2012; Logan, Brown, & Hayes, 2013; Osborn, Jeffery & Cole, 2010). After pharmacologic treatment has begun and the withdrawal symptoms have resolved, weaning the infant off pharmacologic treatment must commence, requiring a systematic approach and routine assessment, utilizing the same NAS scoring tool in order to identify reemergence of symptomatology.

A number of NAS scoring tools have been developed to guide the treatment and pharmacologic interventions for infants with NAS (Finnegan, 1990; Finnegan, et al., 1975; Green & Suffet, 1981; Jansson, Velez, & Harrow, 2009; Lipsitz, 1975; Ostrea, Chavez, & Strauss, 1976; Zahorodny et al., 1998). However, some tools contain over 20 indicators making

them cumbersome, complicated, and challenging for the bedside nurse to use in the busy clinical setting (Zahorodny et al., 1998). Education and training on the assessment of withdrawal symptoms and proper application of the scoring tool is needed to ensure accuracy and consistency (D'Apolito, 2014; Lucas & Knobel, 2012; Orlando, 2014).

Caring for infants with NAS can be extremely stressful and time consuming for bedside nurses as these infants may awaken frequently, be irritable, difficult to console, feed poorly, vomit frequently, and have tremors, diarrhea, and diaper rashes (Jansson & Velez, 2012). Frustration when caring for these difficult infants can lead to moral distress in the nurses providing care (Fraser et al., 2007; Maguire et al., 2012). A nurse may feel ill-prepared to address the infant's needs and unable to communicate the severity of the infant's symptoms to medical providers if no specialized training pertaining to withdrawal in the infant and the NAS scoring tool has been provided. Inclusion of all healthcare providers in training has the potential to improve communication regarding symptomatology and in the development of individualized plans of care, as well as enhancing the efficacy in evaluation of the pharmacologic regime for treatment/weaning (Fraser et al., 2007; Lucas & Knobel, 2012; Maguire et al., 2012; Oei & Lui, 2007; Orlando, 2014; Pritham, 2013; Rogers et al., 2008).

Protocols and practice guidelines enable healthcare providers to work as a team and reduce the impact of individual variation and bias through the standardization of practice, potentially resulting in decreased hospital length of stay, thereby reducing hospital costs (Horbar, et al., 2001; Rogowski et al., 2001; Woolf, Grol, Hutchinson, Eccles, & Grimshaw, 1999). Research findings are more easily translated into clinical practice by incorporating protocols and practice guidelines (Melnyk & Fineout-Overholt, 2011). Protocols for the assessment and treatment of NAS also have the potential to support early intervention for withdrawal symptoms

(Murphy-Oikonen, Montelpare, Bertoldo, Southon, Persinchino, 2012). In a U.S. national survey of 102 neonatal division chiefs with a 73.5% response rate, Sakar and Donn (2006) found only 55% of respondents had a written protocol in place for management of NAS. Improvement in this rate is noted in a more recent national survey of 383 U.S. neonatal units with a 47% response rate by Mehta, Forbes, and Kuppala (2013), finding 72.5% of respondents had a written protocol in place. In contrast, a survey in the United Kingdom of 235 neonatal units with a 90% response rate (O'Grady, Hopewell, & White, 2009), found formal guidelines in place for 96% of the respondents. There is a need for all neonatal units in the U.S. to develop formalized protocols to meet the directive by the AAP (Hudak & Tan, 2012) that every neonatal unit develop and utilize a protocol to guide and standardize assessment and pharmacologic treatment of the newborn infant at risk for or with NAS.

Significance of the Clinical Problem

The incidence of NAS is on the rise nationally and is currently characterized as a healthcare crisis or even epidemic (Hayes & Brown, 2012). The 2012 National Survey on Drug Use and Health reported 5.9% of pregnant women used illicit drugs during their pregnancy during 2011 to 2012 (Substance Abuse and Mental Health Services Administration, 2013). Although this rate change is statistically insignificant from the 2009 to 2010 rate of 4.9%, Pan and Yi (2013), in an analysis of trends of hospitalized newborns in the United States from 1995 to 2008, identified a statistically significant rise in births at risk for NAS accompanied by a 63.3% increase in the diagnosis of neonatal drug withdrawal (clinically known as NAS). The abuse of prescription pain medication may increase this incidence even further (Azadi & Dildy, 2008). In a national, retrospective, serial, cross-sectional analysis of infants born between 2000 and 2009 with NAS, Patrick et al. (2012), identified a significant increase in maternal opiate use

and infants with NAS. Furthermore, the average hospitalization cost for an infant with NAS increased from $39,400 in 2000 to $53,400 in 2009 (Patrick et al., 2012). These increased costs were the result of prolonged hospitalization and complications. Medicaid is impacted disproportionately due to patient demographics.

The healthcare providers in the NICU and MBU of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois identified the need to address the problem of NAS at their organization. This need was based on the following concerns: (a) increasing numbers of patients admitted to the NICU who were diagnosed with NAS, (b) long lengths of stay for infants with NAS, (c) an inconsistent approach to the pharmacologic treatment and weaning of medications because of a lack of a protocol for infants with NAS, (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS (NICU medical director, personal communication, August 6, 2013). Although an exact number of infants diagnosed with NAS at this perinatal center was not available at that time, a perceived rise in the rate of the diagnosis, along with the apparent directive by the AAP (Hudak & Tan, 2012), heightened the concern regarding the lack of a standardized protocol for the assessment and treatment of infants with NAS. These findings prompted the development of the IHPEN project.

Question Guiding Inquiry (PICO)

Within the hospital setting, evidence-based practice (EBP) enables healthcare providers to address specific clinical needs, resulting in the "highest quality of care and best patient outcomes" (Melnyk & Fineout-Overholdt, 2011, p. 7). Driving the EBP process is the spirit of inquiry, leading to formulation of a question that can be researched efficiently and effectively. This question is formatted utilizing the "PICO" approach: (P) identifying the patient *population*,

(I) articulating the *intervention or issue* of interest, (C) determining the *comparison* group or intervention, and (O) identifying how the *outcome* will be measured (Melnyk & Fineout-Overholdt, 2011).

The PICO question which guided the IHPEN project asked: *Does interprofessional education, including implementation of a protocol for infants with NAS, increase healthcare provider knowledge and ultimately improve consistency in assessment and treatment of these infants, as well as decrease individual infant composite withdrawal scores and hospital length of stay*?

Population. The target population included nurses and medical providers employed by or privileged in the NICU and MBU of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois. This included 178 staff nurses, 11 neonatal nurse practitioners (NNPs), 47 pediatric and med-peds resident physicians, and 25 attending physicians (pediatricians and neonatologists). These healthcare providers were 18 years of age or older regardless of gender, religion, ethnicity, or years of service.

Intervention. The planned IHPEN project intervention was a comprehensive interprofessional educational program on NAS which included a protocol for assessment and treatment of infants with NAS. The education was inclusive of the following: the problem of substance abuse in pregnancy, symptoms of NAS in the newborn infant, assessment and scoring of infants with NAS using a valid and reliable NAS scoring tool, nonpharmacologic interventions, threshold for pharmacologic treatment, pharmacological algorithm (protocol), care of the family, discharge criteria, and long-term outcomes for infants with NAS. All neonatal healthcare providers (nurses, attending physicians, residents, and NNPs) who worked in the NICU and MBU were included in the training. The training was mandatory education for nurses

in these units. Attending physician, resident, and NNP participation was encouraged but voluntary.

Comparison. There were no comparison groups. Comparison was made between the pretest and posttest scores of participants surrounding the educational content. Knowledge gain was measured using a classic paired pretest-posttest methodology.

Outcomes. The anticipated outcome selected for measurement of the IHPEN project was increased healthcare provider knowledge regarding NAS, including withdrawal symptoms, assessment, and the treatment of the infant. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Conclusion

NAS is a significant clinical issue and a current national healthcare concern. A need to address the issue of NAS was identified by the healthcare providers of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois which did not have a standardized protocol in place. In order to address this concern, an EBP change project was designed: the IHPEN. The project, targeting all healthcare providers employed by or privileged in the NICU and MBU, included a comprehensive education program on NAS, including implementation of a protocol for the assessment and treatment of the infant with or at risk for NAS. The ultimate goal was to improve the care and comfort of infants with NAS, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of

stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Chapter Two: Review of the Literature/Evidence

Maternal opioid abuse and/or prolonged use during pregnancy exposes the fetus to drugs with the potential for physiologic dependency in the newborn infant. Signs and symptoms of withdrawal, which present in 48-94% of in utero opioid-exposed newborns, involve nearly every body system and are collectively are termed Neonatal Abstinence Syndrome (NAS) (Behnke & Smith, 2013; Hudak & Tan, 2012; Osborn, Jeffery, & Cole, 2010). The American Academy of Pediatrics (AAP) (Hudak & Tan, 2012), along with other researchers, recommend a structured, systematic, and collaborative approach to the assessment and treatment of infants with NAS to prevent or minimize the exacerbation of symptoms, prolonged lengths of stay, and adverse outcomes (Fraser, Barnes, Biggs, & Kain, 2007; Hall et al., 2014; Lucas & Knobel, 2012; Maguire, Webb, Passmore, & Cline, 2012; Oei & Lui, 2007; Pritham, 2013; Rogers, Babgi, & Gomez, 2008). Lack of knowledge regarding infants with NAS can lead to in an inconsistent approach to assessing and treating symptoms, potentially contributing to high withdrawal scores as well as prolonged lengths of hospital stay (Hudak & Tan, 2012).

Within the hospital setting, an evidence-based practice (EBP) approach enables healthcare providers to address specific clinical needs, resulting in the "highest quality of care and best patient outcomes" (Melnyk & Fineout-Overholdt, 2011, p. 7). Protocols and practice guidelines also enable healthcare providers to work as a team to reduce individual variation and bias through the standardization of practice. They have the potential to improve patient outcomes through a decrease in hospital length of stay, thereby also reducing hospital costs (Horbar, et al., 2001; Rogowski et al., 2001; Woolf, Grol, Hutchinson, Eccles, & Grimshaw, 1999).

The purpose of this chapter is to review the literature guiding and supporting an EBP change project, the *"Interprofessional Healthcare Provider Education on NAS"* (IHPEN), designed to improve outcomes for infants with NAS. The project's intervention consisted of comprehensive interprofessional education on NAS, including the introduction of a protocol for the assessment and treatment of infants with or at risk for NAS. The target population for the education was all healthcare providers who were employed or privileged to work in the Neonatal Intensive Care (NICU) and Mother/Baby Units (MBU) of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois. The anticipated outcome selected for measurement of the IHPEN project was a gain in knowledge regarding NAS by the healthcare provider. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

An in-depth literature review was conducted, guided by the clinical question, *Does interprofessional education, including implementation of a protocol for infants with NAS, increase healthcare provider knowledge and ultimately improve consistency in assessment and treatment of these infants, as well as decrease individual infant composite withdrawal scores and hospital length of stay*? The process, summary, and synthesis of those interventions that were identified to support the IHPEN project are presented.

Methodology

Sampling strategies. An electronic search of the relevant literature was conducted utilizing the PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and Cochrane databases. Search terms used to find relevant research on the incidence, assessment,

and management of opiate dependent infants included neonatal abstinence syndrome, NAS, opiate withdrawal, withdrawal, and management. The search was limited to English language sources and population (birth to 23 months). It was focused on peer reviewed publications, preferentially seeking high levels of evidence, including randomized controlled trials, systematic review, and meta-analysis. Recent review articles (within the last 5 years) were included to provide global information on the topic of NAS. Initially, 803 results meeting these criteria were retrieved.

Data evaluation. In order to further narrow the large volume of results, studies pertaining to maternal use of selective serotonin reuptake inhibitors and other non-opioid medications (46 studies) and animal studies (7 studies) were excluded. Of the remaining studies, 134 pertained to maternal treatment protocols and were selectively reviewed. All randomized controlled, retrospective, and prospective trials found in peer-reviewed journals reporting implications for opioid exposed infants with NAS were included. Also included were systematic reviews and guidelines, including those published by the AAP and American Congress of Obstetrics and Gynecologists (ACOG). Additional sources were identified by examining the reference lists of retrieved articles. Publications ultimately chosen for review were those which focused on evaluation of education on NAS or on implementation of a protocol for NAS.

Findings

No randomized-controlled trials, systematic reviews, or meta-analyses were identified pertaining to the efficacy of education or implementation of a protocol for NAS. Four recent studies evaluated the impact of the implementation of a protocol for infants with NAS (Bhatt-Mehta, Ng, & Schumacher, 2014; Hall, et al., 2014; Murphy-Oikonen, Montelpare, Bertoldo, Southon, & Persichino, 2012; Napolitano, Theophilopoulos, Seng, & Calhoun, 2013). These

studies found improved outcomes for infants with NAS when protocols were used to guide assessment and treatment.

In addition to the introduction of a protocol, education on the protocol, including comprehensive information on the general topic of NAS, can improve the ability of healthcare providers to detect symptoms and effectively care for and treat infants with NAS. Furthermore, since utilization of a withdrawal score can be complex (Jansson, Velez, & Harrow, 2009; Kuschel, 2007; Orlando, 2014), education focused on the scoring tool can improve withdrawal scoring and interpretation of the score. Three studies (Bhatt-Mehta et al., 2014; Lucas & Knobel, 2012; Napolitano et al., 2013) and one unpublished report (Keels, 2010) support the importance of education for healthcare providers in improving outcomes for infants with NAS.

Compare and contrast findings.

Evidence supporting protocols for NAS. Although some included studies did not report statistical significance in terms of *p* value, they all found improvement in outcomes after implementation of a pharmacologic protocol for treatment of infants with NAS, generally measured as lower composite withdrawal scores and/or decreased length of stay. In a retrospective chart review, Bhatt-Mehta et al. (2014) evaluated 60 infants diagnosed and treated for NAS after implementation of a clinical protocol, which included staff education, to address a perceived need for consistency in the approach to care and pharmacologic treatment of infants with NAS. They evaluated outcomes approximately 2.5 years after implementation of the protocol to ensure "nursing and medical staff were comfortable with institution of the screening and nonpharmacologic as well as pharmacologic measures" (p. 166). They found initial high compliance with the protocol, with 93% of infants on the recommended dose of methadone, but significant deviation after 48 and 72 hours, with approximately 59% and 61% of the infants

respectively requiring a higher methadone dose than recommended in the protocol. The authors attributed this to inadequate methadone dosing recommendations in the protocol and changed their protocol based on this finding.

Hall et al. (2014) performed a cohort analysis of 20 hospitals encompassing six Ohio regions and including six regional strategies for the assessment and treatment of NAS over an eighteen month period of time. Three of the six regions had a formal protocol for pharmacologic treatment and subsequent weaning and three did not. Their sample included 547 infants, 34 weeks of gestation and greater and diagnosed with NAS. They compared 417 infants treated with a formal protocol driven strategy, to 130 infants who were treated without a protocol driven strategy. They found infants who were managed under a protocol driven strategy, regardless of the specifics of the protocol, had a significantly ($p = .0004$) shorter length of hospitalization (22.7 days versus 32.1 days). Furthermore, they found infants who were treated with a protocol driven strategy had a significantly ($p < .0001$) shorter duration of pharmacologic treatment with an opioid (17.7 days versus 32.1 days). A comparison of opioid treatment strategies found use of morphine in a treatment/weaning strategy to be superior ($p \leq .002$) in terms of length of treatment over methadone; however, utilization of a strict protocol had the most significant impact on decreasing length of stay. They concluded that their findings "reemphasize the importance of protocols that minimize ambiguity and limit dependence on subjective measures" (p. e532).

Murphy-Oikonen et al. (2012) employed a retrospective cohort design to compare the outcomes of 20 infants with NAS during the 6 months pre-implementation of a clinical practice guideline to the outcomes of 70 infants 6 months post-implementation. They reported a lack of consistency in the evaluation and treatment of the 20 NAS infants, along with a prolonged length

of stay, as the impetus for developing the guideline. Their evaluation found that although the average absolute dose of morphine increased in treated infants, the average number of doses per patient decreased from 141 pre-implementation to 79 post implementation, and the overall NAS score decreased from 5.6 to 4.14 ($p < .0001$), implying improved control of NAS symptomology, resulting in decreased nursing time. Furthermore, the average length of stay decreased from 20.24 days to 14.35 days ($p < .0001$). Thus, implementation of the protocol resulted in a significant reduction in both hospital length of stay and overall average NAS scores for infants with NAS.

Napolitano et al. (2013) evaluated neonatal length of stay after implementation of a protocol for treating NAS. They defined the success of their program by: "(1) an increased percentage of intact mother-infant dyad discharges; (2) improved nursing staff satisfaction; and (3) a decreased LOS" (p. 199). Although no statistical analysis was performed to evaluate the above indicators of success, they reported a reduction in length of stay for infants with NAS, from 29 days pre-implementation of the protocol to 18 days post implementation.

Evidence supporting education and training on NAS. Utilization of a NAS scoring tool is critical to the assessment of withdrawal in infants with NAS, but it can be complex to apply and interpret, and may be complicated by bias and subjectivity (Grim, Harrison, &Wilder, 2013; Zahorodny et al., 1998). Education on signs and symptoms of withdrawal and the use of a NAS scoring tool has been recommended to ensure consistency and accuracy in scoring (D'Apolito, 2014; Jansson et al., 2009; Kuschel, 2007; Oei & Lui, 2007; Orlando, 2014). In addition, it is reasonable to assume that education on the general topic of NAS can improve a healthcare provider's knowledge and thus improve their ability to effectively care for and treat infants with NAS. Although some included studies did not report significance in terms of *p* values, three

studies (Bhatt-Mehta et al., 2014; Lucas & Knobel, 2012; Napolitano et al., 2013) and one unpublished report (Keels, 2010) emphasized the significance of adequate training for healthcare providers in improving outcomes for infants with NAS.

Education on a protocol is frequently the first step in protocol or practice guideline implementation as a method for disseminating detailed information about a protocol and its use to the target healthcare providers. However this step is not consistently reported in the discussion nor measured when the outcomes of a protocol are reported. For example, Hall et al. (2014) reported training as a "first step at standardized treatment" (p.e529) in their evaluation of the outcomes of six regional strategies for treatment of NAS in the State of Ohio, but did not include an analysis of the impact of this training. A report of unpublished data from one of those organizations (Keels, 2010), a large children's hospital with a high incidence of infants with NAS, found significantly improved pretest to posttest workshop scores after implementation of a standardized educational training program on NAS ($p = 0.000$).

Lucas and Knobel (2012), in a non-experimental, pretest/posttest study design, evaluated 68 nurses for changes in their knowledge of NAS after implementation of education on EBP clinical guidelines which included formal classroom didactic, interactive DVDs, and printed materials. Utilizing a paired-sample *t*-test, a 10% or greater increase in total score from pretest to posttest was determined to indicate "improved knowledge" (p. 43). No participant scored 100% on the pretest, and three of the 68 participants scored 100% on the posttest. All of the participants were found to have some improvement in knowledge from pre- to posttest, ranging from 2% to 44%, with 90% improving by 10% or more. The study concluded that not only did knowledge increase, but sustainability of the NAS clinical guidelines education project was

supported by high post-education evaluation scores, indicating nurses found the education to be valuable to clinical practice.

Napolitano et al. (2013) evaluated neonatal length of stay after implementation of a protocol for treating NAS which also included staff education, family outreach, and supportive care strategies. In addition to the result of their protocol implementation, described previously in the section *Evidence supporting protocols for NAS,* they identified staff education and training as key elements impacting the successful outcome. Although no metrics were employed to evaluate or measure knowledge gained from the education (which was provided by national speakers), they reported a substantial reduction in length of stay for infants with NAS, from 29 days pre-implementation to 18 days post-implementation of the education and protocol.

In a retrospective chart review, Bhatt-Mehta et al. (2014) evaluated 60 infants diagnosed and treated for NAS after implementation of a clinical protocol, also previously described in the section *Evidence supporting protocols for NAS*. Their implementation strategy included staff education. Although the investigators attributed the identified deviation from the clinical guideline at the 48 and 72 hour mark after initiation to an inadequacy in the recommended dosing regimen for methadone, it may be posited that the education for caregivers during the implementation phase increased their sensitivity to withdrawal and need for amelioration of symptoms of NAS with pharmacologic treatment.

Evidence supporting education and training on a protocol improves outcomes. The importance of educating neonatal healthcare providers in order to improve compliance with a protocol is further supported by the works of Deindl et al. (2013), Gilkey et al. (2014), and Warren (2011). Deindl et al. (2013) evaluated the implementation of a neonatal pain and sedation protocol by using a pre/post intervention survey and a pre/post comparison of neonatal

outcomes. Nurses and physicians responded to survey questions on documentation, interventions, and effectiveness of therapy for neonatal pain. After implementation of the protocol they found significant improvement ($p < .001$) in nursing and physician satisfaction with neonatal pain and sedation interventions as well as a high level of compliance with the protocol.

Warren (2011), in an EBP improvement project for management of extravasation injuries in the newborn infant, evaluated documentation of intravenous sites pre versus post education on and implementation of a protocol, including assessment of previous education on the management of extravasation injuries. They found "marked improvement" in compliance with the protocol after the education-based implementation. Although this project focused specifically on improvement of extravasation as a result of an educational program, positive patient outcomes were also noted as the result of consistent employment of the protocol.

Literature identifying the most effective pedagogy for the EBP project was also reviewed. Gilkey et al. (2014) evaluated an education program designed to improve healthcare provider compliance with adolescent vaccination that utilized two modes of education delivery: in-person and webinar. They found significant improvement in provider ($p < 0.05$) "confidence to use reminder/recall systems" (p. 5) after the educational intervention, with webinars demonstrating a significant cost savings over in-person program delivery. This study, although not performed in the neonatal intensive care environment, provides further support for the positive impact of healthcare provider education on protocol compliance, potentially improving patient outcomes. It also provides support for the utilization of web-based technology as cost-effective strategy for program delivery.

Limitations of the literature review. Although the AAP has published a recommendation that every neonatal unit develop a protocol to assess and treat NAS (Hudak & Tan, 2012), it did not identify a specific protocol as the most effective. No systematic reviews were found to support the evaluation or implementation of a specific pharmacologic protocol. In additon, as detailed above, only a few recently published studies have evaluated specific protocols. Hall et al. (2014) provided a unique insight into the perspective that the specifics of the protocol were not as important as the consistent application of a protocol driven approach in improving outcomes for infants with NAS. Furthermore, other studies in neonatal care protocols (Deindl et al., 2013; Gilkey et al., 2014) have provided support for the importance of education in implementation of a protocol as well as knowledge gain as a result of the educational component.

An additional exploration was performed on the internet using the Google search engine to identify pharmacologic protocols for assessment and treatment of NAS available to be downloaded. The search terms used to find relevant protocols—neonatal abstinence syndrome protocol and neonatal abstinence syndrome guideline—resulted in more than 21 hospital, perinatal region, or healthcare regional guidelines. None reported any formal evaluation of their guideline or protocol. All varied in their approach to the pharmacologic management of NAS in terms of treatment, dosing, and weaning strategies. These findings confirmed the need for further research to identify the most effective pharmacology strategy for the treatment of infants with NAS.

Discussion

Conclusions from findings. Implementation of an EBP protocol has the potential to standardize the approach to the evaluation and treatment of infants with NAS and improve their

outcomes, most often measured either by improved NAS scores and/or decreased length of hospitalization. Education enhances the knowledge base for healthcare providers and increases consistency in treatment (e.g., with a protocol), with the potential to positively impact the infant. In addition to supporting the need for the implementation of a protocol for NAS (Hudak & Tan, 2012), the literature reports improved outcomes for infants with NAS after implementation of a protocol. Furthermore, the literature also supports that education for healthcare providers not only results in knowledge gain, but also increases compliance with a protocol and results in improved in outcomes for infants with NAS as well as in other neonatal and pediatric populations.

Advantages and disadvantages. The advantage of implementing a protocol for the treatment of NAS is in the standardization of approach, increasing the potential that all healthcare providers will utilize the same criteria for assessment and treatment. Universal education has the potential to increase the consistency in application of the NAS tool, as well as reduce the potential for bias in the interpretation of withdrawal symptomology (D'Apolito, 2014; Grim et al., 2013; Jansson et al., 2009; Kuschel, 2007; Oei & Lui, 2007; Orlando, 2014). Furthermore, education may increase the healthcare provider's awareness of and sensitivity to the signs and symptoms of withdrawal, resulting in a more expedient identification of an infant with NAS who may previously have gone unnoticed until symptoms were exaggerated and difficult to get under control.

Although a specific pharmacologic protocol for the treatment of NAS has not been tested or validated as best practice, it is clear that (a) standardization through implementation of protocol increases consistency in treatment and (b) healthcare provider education has the potential to increase knowledge and compliance with any given protocol. In addition, AAP's

strong recommendation (Hudak & Tan, 2012) to adopt a NAS protocol in every neonatal unit is a significant imperative. While length of stay is commonly utilized as an outcome measurement, it must be noted that length of stay may also be complicated by other concurrent medical conditions common in the newborn infant population, e.g., prematurity, sepsis, and respiratory distress. Furthermore, non-medical conditions, such as determining safe discharge of the infant when a parent has a history of the use of illicit drugs, may also be a factor in length of stay (Mactier, McGlone, Hamilton, & MacKinnon, 2012).

Utilization in practice. The goal of treatment for NAS is the identification and amelioration of the symptoms of withdrawal. In order to accomplish this, caregivers must have knowledge of both the symptomatology and appropriate interventions to employ. Providing education on NAS has the potential to increase the caregiver's awareness of symptoms of withdrawal and expedite treatment in order to prevent adverse outcomes for the infant (Oei & Lui, 2007). It is imperative to provide education when a new protocol is introduced to ensure compliance, especially when dealing with the challenging population of infants with NAS (Fraser et al., 2007). Education has the potential not only to increase healthcare provider knowledge regarding the assessment and treatment of infants with NAS, but also to deepen their understanding of opioid abuse as a chronic, treatable disease and dispel myths which may lead to bias in care (Center for Substance Abuse Treatment, 2009). Early identification of NAS and implementation of appropriate intervention strategies to prevent exacerbation of withdrawal has the potential to improve sleep-wake cycles, growth, and feeding tolerance, all considerable developmental concerns in the infant experiencing withdrawal (Hudak & Tan, 2012; Osborn et al., 2010; Sublett, 2013; Velez & Jansson, 2008; Welle-Strand et al., 2013).

Conclusion

NAS is a serious and complex medical issue faced by neonatal healthcare providers with increasing frequency. Caring for infants with NAS requires a structured, standardized, and collaborative approach to assessment and treatment by all healthcare providers. This can be achieved through (a) implementation of a protocol to increase consistency in treatment for infants with NAS and (b) provision of healthcare provider education to increase knowledge regarding NAS, as well as sensitivity to the signs and symptoms of withdrawal. As supported by the cited literature, the approach of the IHPEN project has the potential to lead to more successful outcomes for infants with NAS.

Chapter Three: Theory and Conceptual Model for the Evidenced-Based Practice Change

The Conceptual-Theoretical-Empirical structure (C-T-E) (Fawcett & DeSanto-Madeya, 2013) provides a structure to examine and address the definition of abstract concepts utilized, theoretical conceptualization of relationships between concepts, and testing of the relationships. It provides a framework and methodology for the doctor of nursing practice (DNP) to ground practice with scholarly work, translating knowledge regarding theories, research, and philosophical thought into practice. Thus the C-T-E structure supports the science of nursing and culminates in translation of research findings to bedside care through implementation of evidence-based practice (EBP) change. This process meets Essential I of the American Association of Colleges of Nursing (AACN) Essentials of Doctoral Education for Advanced Nursing Practice (2006): "Scientific Underpinnings for Practice" (p. 8).

This chapter will employ the C-T-E structure to support an EBP change to improve outcomes for infants with neonatal abstinence syndrome (NAS) utilizing an educational approach: the "*Interprofessional Healthcare Provider Education on NAS*" (IHPEN). A conceptual definition for "threshold for treatment" will be presented, along with the theoretical basis for implementing the practice change. Finally, an empirical indicator to effectively identify and measure the threshold for treatment, along with the EBP change theory enabling translation of the evidence into practice for the IHPEN, will be described.

Concept Definition

NAS is a term describing the symptoms of opioid withdrawal in the newborn infant that result from a physiologic dependency after prolonged exposure to an opioid during prenatal life, often due to maternal drug abuse (Behnke & Smith, 2013; Hudak & Tan, 2012). Because withdrawal in infants with NAS can result in prolonged hospitalization, a structured, systematic,

and collaborative approach is required to optimize assessment and treatment in order to prevent or minimize exacerbation of symptoms which result in prolonged length of stay (Logan, Brown, & Hayes, 2013; Patrick et al., 2012). The perceived increased incidence of infants with NAS has propelled a desire to unite the neonatal healthcare providers of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois in an EBP approach to improve outcomes for these infants. The threshold for pharmacologic treatment is a critical concept in the management of withdrawal symptoms in infants with NAS in order to determine the point or degree of symptomatology that will indicate the need for pharmacologic intervention.

The practice of medicine uses the concept of "threshold" to define critical limits, often a cut off value which indicates an above or below normal score. In the assessment and treatment of infants with NAS, however, the answer is not simple as a single point in time or a specific symptom constituting the threshold for treatment. Further complicating the threshold for treatment is the clinical decision point: if it is too low, treatment will be indicated earlier, potentially leading to medically unnecessary treatment; if the decision point is too high, treatment will be indicated later, and those who should have been treated might suffer. In the infant with NAS, it is a clustering of a critical group of symptoms or series of assessments indicating the condition is worsening which necessitates implementation of a pharmacologic intervention to prevent an adverse outcome (e.g., seizure from withdrawal) (Hudak & Tan, 2012). Thus, a specialized assessment scale for NAS is needed in order to organize assessment of symptomatology into a measureable entity, a number or score, which then becomes the key driver in medical decision making and determination if the threshold for treatment has been met.

Therefore, the salient issue in the treatment of infants with NAS is the routine assessment with a valid and reliable NAS scoring tool to quantify the symptomatology of withdrawal. This

allows for identification of exacerbation of withdrawal by assigning a score to the observed symptom and then comparing these scores over time. The need for pharmacologic treatment is indicated when a series of scores exceed the threshold (most commonly two or three consecutive scores).

The concept of threshold for treatment is critical in the protocol development for assessment and treatment of infants with NAS. Without a shared operational definition of the concept of threshold, there is a risk of either undertreating or overtreating the infant. This definition is especially important during the introduction and implementation of a protocol for infants with NAS. In designing the structure for the EBP change of the IHPEN project, a shared conceptual framework propels the journey through the process of change, keeping it on track and moving forward.

Change Theory

Lewin's Change Theory (1947) is a model which supports implementation of the IHPEN project from a theoretical perspective (Shirely, 2013). Lewin, a social psychologist, developed the "Change Theory" based on his "Field Theory," which theorized that a group is different than the simple sum of its parts. It involves three steps: unfreezing, moving, and re-freezing. The theory proposes that behavior is related to both personal characteristics and the social situation. Thus, in order to change the way something is done, it must act on both the person and the situation. This fits well with the concept of threshold for the treatment and implementation of a protocol for NAS as the situation (emergence of symptoms of NAS) is what drives the initiation of treatment.

First, "unfreezing" must occur in order to enable the letting go of an old pattern of behavior. The target population must recognize or become convinced that change is needed; the

"old" must be seen as problematic. In the case of the IHPEN project, the NICU leadership and staff had previously identified a problem needing change which led to strong support for the educational intervention and protocol development.

Next, the "moving" stage involves the implementation of the new process. In the IHPEN project it encompassed the process of agreement on the threshold for treatment, development of standardized order sets and a protocol, and educational materials. The education program provided the background, context, and evidence for the treatment of the infant with NAS, including the implementation of the pharmacologic protocol.

Finally the "re-freezing" stage emerges when the new process becomes the norm and the process is "hardwired." This stage occurs when there is evidence that knowledge has been gained through the education provided and the protocol is imbedded in practice. It is substantiated by improved outcomes for infants with NAS.

Empirical Indicator

In addition to developing an understanding of the symptomatology, a common language for communicating the severity of symptoms through the application and use of a specialized, valid, and reliable assessment tool (a scale) for NAS is needed. The NAS scoring tool would organize assessment data into a measureable entity—a number—which then would become the key driver in medical decision making through the determination of a threshold for treatment. After pharmacologic treatment has begun and the withdrawal symptoms have resolved, weaning the infant off of medication must commence, again requiring a systematic approach with routine assessment utilizing the NAS scoring tool to identify reemergence of symptomatology. Consistency in the application of the NAS scoring tool and utilization of the score to determine

the need for pharmacologic treatment provides confirmation of protocol penetrating clinical practice.

Although the threshold for treatment might be purely defined as the value above or below which treatment is indicated, when a scale is utilized for assessment, assurance of its psychometric properties is critical (Bannigan & Watson, 2009). Since a valid tool must measure what it is intended to measure, the chosen tool for evaluation of NAS must include valid indicators of opiate withdrawal in the newborn infant. Furthermore, although 100% accuracy is not possible, establishing reliability of the tool by confirming consistency in measurement each time it is used decreases the potential for individual interpretation (Heavy, 2011; Melynk & Fineout Overholt, 2011).

In addition to established psychometric properties, the tool's use in other studies supports its value. Furthermore, feasibility, how easy the tool is to apply in the clinical setting, and clinical utility, how useful the results are to clinical application, improves the compliance with its use and value in determining treatment (Keszei, Novak, & Streiner, 2010). None of the currently available scoring tools for NAS fulfill all of these requirements.

The Finnegan Neonatal Abstinence Scoring System (FNASS) (Finnegan, Connaughton, Kron, & Emich, 1975) was the first tool developed and published which organized the symptoms of NAS into a scoring system to enable measurement of threshold for treatment. Indicators included in the tool were chosen by the authors and ranked by "pathological significance" with "arbitrary" scores assigned of one through five (p. 27). Despite the fact that it is the most widely used tool for assessment of NAS, no measure of validity or specificity for the indicators was performed, which may create the potential for "bias and subjectivity" (Grim, Harrison, & Wilder, 2013, pp. 512). In addition to the lack of validation of the indicators, the FNASS can be

cumbersome to apply at the bedside due to the large number of indicators included in the tool, thus potentially limiting its clinical utility.

Another empirical instrument for evaluation of the "threshold for treatment" for infants with NAS is the Neonatal Withdrawal Inventory (NWI) (Zahorodny, et al., 1998). The NWI is an 8-item scale, with a weighted score for each item. Evaluated through a carefully designed methodological study, the tool was found to have a high sensitivity and specificity in detecting signs and symptoms of withdrawal when compared to the FNASS with kappa statistic = 1.0, standard error = 0.23 (FNASS Kappa = 1.0, standard error = 0.14). Although this could be considered a measure of validity, there is no established validity for the FNASS, which it is being compared against. Interrater reliability was established by simultaneous application of the NWI and FNASS and comparing the scores, finding a Pearson's correlation of (X = 0.93 versus 0.80) and Cronbach's alpha of 0.98 versus 0.93. One of the objectives in the development of the NWI was feasibility of use at the bedside. The researchers determined that scoring with the NWI takes only 10 minutes to complete (p. 90) making it highly feasible when compared to other tools.

Suresh & Anand (2001), prominent researchers in neonatal pain management, justify use of the NWI in their clinical practice based on the "simplicity and clinical utility" of the tool (p. 515). Subsequent research identified the NWI as one of the "potentially better practices to improve pain management" in newborn infants when used for weaning them from opioid exposure (Dunbar et al., 2006). More recently, a withdrawal tool for critically ill children was developed based on the NWI's structure, clinical utility, and reduction in bias in scoring methodology (Franck, Harris, Soetenga, Amling, & Curley, 2008). However, there has been limited use of the NWI in clinical studies which evaluated interventions for infants with NAS (Anand et al., 2004; D'Apolito, 1999).

When compared to other scoring tools, including the FNASS, the NWI has the best established psychometrics, least number of indicators, and demonstrated feasibility, which make it the preferred choice for inclusion in the IHPEN project to evaluate severity of withdrawal symptoms and determination of the threshold for pharmacologic treatment in infants with NAS. Instruction on the NWI tool was included in the educational component to transition staff from the more clinically complex NAS scoring tool that was currently in use at the bedside.

Although the NWI was introduced during the IHPEN project, the outcome measure for improvement in outcomes for infants with NAS was confirmed through the surrogate measure of a pretest/posttest assessment of knowledge gain by healthcare providers, using multiple choice questions developed by content experts (Hakkennes & Green, 2006). Outcomes at the patient level were beyond the timeframe for this project. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care. The process of the development of the IHPEN project, including the implementation of the educational intervention, introduction of a protocol for pharmacologic management, and the evaluation of healthcare provider knowledge gain was guided by the methodology utilized at the clinical implementation site called the “Rush Way” (education and quality coordinator, personal communication, March 26, 2014).

Evidence-Based Practice Change Theory

Many methodologies have been developed and evaluated for guiding practice change, however, there are many commonalities in them. First, the process of inquiry and establishment of the current process (data collection) is needed, along with emphasis on the need for high

levels of published evidence to support the practice change. Next, some methodologic approach is employed to evaluate and disseminate findings. Models differ in the manner in which they proceed once the practice change and evidence to support the change have been identified.

The "Rush Way" is the model for organizational change and clinical practice improvement at the site where the IHPEN project was implemented. The "Rush Way" borrows elements from three current quality improvement methodologies: Plan-Do-Check-Act (W. Edwards Deming Institute, 2014), Lean (Ohno, 1988), and Six Sigma (Harry & Schroeder, 2000). It includes four phases: ready, understand, solve, and hold.

The "Ready" phase involves describing the problem from different perspectives, then identifies the objectives, goals, scope, team, and metrics for the project. As previously noted, the neonatal healthcare providers of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois identified the need for a unified approach to assessment and treatment of infants with NAS, which represents the commencement of the "Ready" phase. The need emerged from the following observations regarding infants with NAS: (a) increasing numbers of patients diagnosed with NAS admitted to the NICU, (b) long lengths of stay for infants with NAS, (c) a varied and inconsistent approach to pharmacologic treatment and weaning of infants with NAS (lack of a protocol), (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS. The question formulated to drive the evaluation of the evidence and development of the intervention was: *Does interprofessional education which includes implementation of a protocol for infants with NAS increase healthcare provider knowledge and ultimately improve consistency in the assessment and treatment of these infants, as well as decrease individual infant composite withdrawal scores and hospital length of stay*? The metric

chosen was a surrogate measure for direct evaluation of improvement in outcomes for infants: healthcare provider knowledge gain from education, evaluated by a classic pretest-posttest methodology.

During the second phase, "Understand," baseline data on the incidence, current practice, and treatment methodology surrounding infants with NAS was collected and utilized to identify root causes, key drivers, and detailed definition of the problem. The third phase, "Solve," involved development of the protocol for NAS, identification of the educational methodology, and conduction of a cost-benefit analysis. In the final phase, "Hold," the focus was on sustaining the improvement through an identified maintenance plan. Ongoing data tracking and analysis was initiated to ensure continued success. Additional elements were developed, including NICU and MBU Handbook materials on NAS, a reference NAS scoring tool, a parent handout on NAS, and a forum for clinical questions to further support sustainability of the practice change.

Conclusion

This chapter described the C-T-E structure used to identify, design, implement, and evaluate an EBP practice change for assessment and treatment of NAS. Critical to understanding the treatment of infants with NAS and the basis of the protocol is defining the concept of "threshold for treatment." Identification of a valid and reliable tool, the NWI, to evaluate withdrawal symptomatology and guide pharmacologic treatment was described. Lewin's Change Theory (1947) was applied to facilitate the understanding of the process of the introduction and implementation of the practice change. Empiric evaluation of the success of the IHPEN project through comparison of pretest/posttest scores was described. Guiding the entire practice change process was the Rush Way methodology for EBP practice change. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent

approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Chapter Four: Pre-implementation Planning

Neonatal Abstinence Syndrome (NAS) is a collection of abnormal physiologic and neurobehavioral clinical findings resulting from an infant's physiological dependency on placentally transferred opioids due to maternal opioid use or abuse during pregnancy (Behnke & Smith, 2013; Hudak & Tan, 2012). It is a complex and serious medical issue faced by neonatal care providers increasing in incidence and a current national health care crisis (Azadi & Dildy, 2008; Hayes & Brown, 2012; Pan & Yi, 2013; Patrick et al., 2012). Caring for the infant with NAS can be distressing to a bedside nurse, as well as challenging for the medical provider. The American Academy of Pediatrics (AAP) (Hudak & Tan, 2012) and numerous researchers (Fraser, Barnes, Biggs, & Kain, 2007; Lucas & Knobel, 2012; Maguire, Webb, Passmore, & Cline, 2012; Oei & Lui, 2007; Pritham, 2013; Rogers, Babgi, & Gomez, 2008) recommend a structured, systematic, and collaborative approach to the assessment and treatment of infants with NAS to prevent or minimize exacerbation of symptoms, prolonged lengths of stay, and adverse outcomes. Furthermore, standardization of practice through both the implementation of a treatment protocol and provision of healthcare provider education has the potential to reduce bias in assessment and treatment and enable a more accurate interpretation of symptomatology, thus improving outcomes for infants with NAS (Bhatt-Mehta, Ng, & Schumacher, 2014; Hall et al., 2014; Lucas, & Knobel, 2012; Keels, 2010; Murphy-Oikonen, Montelpare, Bertoldo, Southon, & Perishino., 2012; Napolitano, Theophilopoulos, Seng, & Calhoun, 2013).

This chapter will describe the preparation for an evidence-based practice (EBP) change project, the "*Interprofessional Healthcare Provider Education on NAS*" (IHPEN), including the organization's readiness for change, interprofessional team development, risk management assessment, strategies to overcome barriers, and organization approval process. The role of

information technology will be detailed along with the materials used and the plan presented to the institutional review board (IRB) for approval. Finally, the plan used to evaluate the project will be outlined including participant demographics, the measurement tool, metrics for outcome measurement, and the data management plan.

Purpose of the Project

In order to provide comprehensive, interprofessional education on NAS along with implementation of a protocol for the assessment and treatment of infants with or at risk for NAS, an interprofessional educational program was designed—the IHPEN project—which was grounded in an EBP approach. As supported by the literature, the IHPEN project had the potential to improve outcomes for infants with NAS by: (a) guiding and standardizing care for infants with NAS, (b) reducing individual healthcare provider variation in the approach and treatment, (c) enhancing communication and collaboration between healthcare providers, and (d) relieving caregiver distress. Ultimately, the goal was to decrease overall and/or individual infant composite withdrawal scores and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Project overview. A comprehensive interprofessional educational program to address the assessment and treatment of infants with NAS for healthcare providers in the Neonatal Intensive Care Unit (NICU) and Mother/Baby Unit (MBU) of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois was developed to ensure that every healthcare provider utilized the same information to assess, intervene, and plan care for the infant with or at risk for NAS. The educational program was inclusive of the problem of substance abuse in pregnancy, signs and symptoms of NAS in the newborn infant, assessment

and scoring of infants with NAS using a valid and reliable NAS scoring tool, nonpharmacologic interventions, threshold for pharmacologic treatment, a pharmacological algorithm (protocol), care of the family, discharge criteria, and long-term outcomes for infants with NAS.

A project team was assembled to ensure all aspects of the project were clear and in line with organizational priorities, as to well as evaluated for any threats to success. The education program was distributed through the organization's online learning system (OLMS) to all nursing and medical healthcare providers in the NICU and MBU. It was a required learning module for the 178 nurses, who also received continuing education credits for attending the program if they completed an evaluation. Medical providers (pediatric and med-peds resident physicians, attending pediatricians and neonatologists, and neonatal nurse practitioners [NNPs]) were invited and encouraged to participate. The project was evaluated utilizing a classic paired pretest-posttest methodology for measurement of knowledge gain.

Project Management

Careful, intentional planning for an EBP change project is crucial to successful implementation. Harris, Roussel, Walters, and Dearman (2011) describe the elements of project implementation which enable anticipation of issues that may arise and implementation of plans for interventions. The environment in which practice change occurs must be carefully evaluated in order to identify the need for and employ key strategies to promote sustainability of the practice change (Ogrinc et al., 2012). Harris et al. (2011) emphasize that planning for outcomes and mitigating risk are elements which can facilitate a successful implementation. The following sections will discuss the process and plan used to implement the IHPEN project's educational intervention, designed to improve the healthcare provider's knowledge surrounding assessment and management of infants with NAS.

Organizational/environmental readiness for change.

Gap analysis. As suggested by Harris et al. (2011), a gap analysis was performed which identified the need for a standard protocol and healthcare provider education on NAS. Findings which drove this need included the following: (a) increasing numbers of patients admitted to the NICU who were diagnosed with NAS, (b) long lengths of stay for infants with NAS, (c) an inconsistent approach to the pharmacologic treatment and weaning of medications because of a lack of a protocol for infants with NAS, (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS. Standardization of care with a protocol, along with education on NAS, were identified as the critical missing elements contributing to the frustration of healthcare providers (NICU clinical nurse specialist, personal communication, August 5, 2013). Since the facility was a Magnet® organization (American Nurses Credentialing Center, 2014), an EBP approach was a well-accepted methodology for implementing practice change in order to improve patient outcomes.

SWOT methodology analysis. After the need for the education was identified, a risk management analysis was performed utilizing the "strengths, weaknesses, opportunities, threats" (SWOT) methodology (Harris et al., 2011, p. 53). This approach enabled a clear identification of strengths and opportunities to be capitalized on. Threats and weaknesses were identified in order to employ strategies to minimize their impact on the success of the IHPEN project.

Strengths included support from hospital administration, nursing administration, and the medical director of the NICU. Clinical nurse specialists (CNSs) from the units involved not only supported the program, but were resources in implementing the online educational component. Lastly, utilization of the current OLMS was an efficient method to roll out education to a large

number of staff and ensure that all healthcare providers were presented with exactly the same information.

Weaknesses primarily revolved around the short time frame for implementation to roll out the education to 261 healthcare providers. This was managed through regular reminders to complete the education utilizing email and personal contact. A team of nurses with a special interest in the project were identified from the NICU. They participated in encouragement of staff nurses to complete the education within the identified timeframe. Weekly newsletters from the resident chiefs functioned to promote resident participation along with approval from the Pediatric Residency Program Director to "count it as fulfilling one goal of their yearly required Individualized Learning Plans" (pediatric residency program director, personal communication, July 28, 2014). The education was also discussed in the weekly NICU interprofessional staff meetings.

Opportunities included the need to improve the approach to infants with NAS had been identified by the medical providers and nursing staff for more than a year (NICU CNS, personal communication, August 5, 2013; NICU medical director, personal communication, August 6, 2013). In addition, there was strong national interest in this topic (Association of State and Territorial Health Officials, 2014) and pressure to improve the clinical site's approach to meet the perceived national mandate from the AAP (Hudak & Tan, 2012) that every neonatal unit implement a protocol for the assessment and treatment of NAS. The interest of bedside nurses to understand how they could improve their care of infants with NAS was communicated verbally to the program manager.

Threats included the possibility that presenting education using an online platform would allow staff to skip the presentation of the educational content and go right to taking the test. To

mitigate this liability, the online educational modules were designed to be accessed by the user sequentially. A pretest was required to be completed before part one of the presentation was made available to the user. Subsequently, the user was required to open and view part two of the presentation before the posttest became available in the OLMS.

In a busy NICU, there was also the threat that the census could surge, and all available time would be utilized for patient care. However, because the IHPEN project was strongly supported by unit administration, the negative consequences of a census surge thought to be negligible. Nursing management supported the education module and made participation mandatory for all staff nurses. To further encourage nursing participation, continuing education units (CEUs) were offered to nurses for completing the education and a program evaluation (approved for 1.5 CEUs, Department of Interprofessional Continuing Education, personal communication, July 28, 2014).

Because the education and testing were not required of medical providers, there was the possibility that the attending physicians, residents, and NNPs would feel they already knew enough about the subject, so would not value the education enough to complete it. Participation by attending physicians and NNPs was encouraged by support from the medical directors of the NICU (personal communication, July 16, 2014) and MBU (personal communication, July 25, 2014) and the section chief of neonatology (personal communication, July 25, 2014). NNPs were also eligible to receive nursing CEUs if they participated and completed a program evaluation. Resident physician participation was approved by the pediatric residency program director to "count it as fulfilling one goal of their yearly required Individualized Learning Plans" (personal communication, July 28, 2014). The IHPEN project completion rates were reported during weekly interprofessional staff meetings in NICU and globally by email to all healthcare

providers as an additional reminder to participate. Thus, intentional encouragement to participate through frequent communication, along with support from the medical directors, was employed to minimize the threat of non-participation.

Interprofessional collaboration/implementation team development. The planning for and implementation of an EBP change project, such the IHPEN, required interprofessional collaboration between nursing, medicine, and pharmacy to bring consensus to the approach. In evaluation of the infant's entry into the system, it was determined that the prenatal identification of maternal risk factors were addressed in a comprehensive fashion, as every mother was screened for illicit drug use. The primary issues ensued with the assessment of the newborn infant once their risk for withdrawal was identified prenatally, as well as need for consistency in approach and pharmacologic intervention if symptoms of withdrawal presented.

Stakeholders. The NICU and MBU CNSs provided support and consideration for implementation of the IHPEN project in their respective units. The medical director for the NICU and MBU, along with the pediatric chief residents and the pediatric/neonatal pharmacist provided support for the considerations of implementation for medical providers. Staff nurses from NICU provided insight from the bedside perspective. Administration support was provided by section chief for neonatology (personal communication, July 25, 2014); the assistant vice president of hospital operations and director of the children's hospital (personal communication, July 9, 2014); the NICU medical director (personal communication, July 16, 2014); MBU medical director (personal communication, July, 25, 2014); NICU nursing director (personal communication, July, 16, 2014); and MBU nursing director (personal communication, June 27, 2014). Globally, the project underwent review and approval by the Professional Nursing Practice Committee (education and quality coordinator, personal communication, June 27, 2014).

Collaboration and communication with these key stakeholders ensured support for the EBP practice change project, confirming its alignment with the goals and priorities of the organization, as well as of the individual units (Ogrinc et al., 2012).

In the 6 months prior to the implementation of the IHPEN project, the key stakeholders, as identified above, met both formally and informally to provide comment and direction to the project. Questions and concerns were encouraged to be brought forward, as the goal was to improve outcomes for the increasing population of infants with NAS admitted to the NICU. A neonatal specific morphine preparation was obtained and approved through the Pharmacy and Therapeutics Committee to enable appropriate pharmacologic treatments and weaning. A pharmacologic algorithm for treatment and weaning was agreed upon and approved by the section of neonatology. A change in the NAS scoring tool to the Neonatal Withdrawal Inventory (Zahorodny et al., 1998) was agreed to by nursing and neonatology. Permission was obtained from the author to have the new tool entered into the electronic medical record for ease of access by all healthcare providers (W. Zahorodny, Ph.D. personal communication, September 8, 2014).

Components to be included in the educational program of the IHPEN project were discussed at length with the CNSs who were in charge of education for the NICU and MBU. It was decided that the education would be split into two 30 minute sessions to maximize the opportunity to complete the learning activity without undue stress on the individual nurse, attending physician, resident, or NNP. Nursing CEUs were obtained and offered to nurses who completed the program. Financial support for continuing medical education (CME) credits for medical providers was unable to be secured.

Risk management assessment and strategy to overcome barriers. The organization in which the IHPEN project was implemented frequently brings together interprofessional teams

when implementing changes in patient care protocols. Potential team challenges which can result in barriers to implementation include not fully understanding the need for the project (i.e., unclear goals), unstructured communication methods, and lack of time commitment to meeting attendance (Ogrinc, et al., 2012). According to Lencinoi (as cited by Harris et al., 2011) other barriers to successful teamwork include "inability to trust or have reliance on others, fear of conflict …accountability, [and]…inattention" (p. 45). Although none of these barriers emerged, it was important to remain sensitive to them and identify any potential threats or barriers which could have impeded the IHPEN project in order to address and minimize their impact on moving the project forward. Ogrinc et al. (2012) identifies communication as the "key to building commitment" (p. 132).

Since the aim of the IHPEN project was to improve healthcare provider's knowledge on NAS, along with implementation of a protocol for assessment and treatment of NAS, through an educational intervention, effective communication regarding the planned approach was critical. All team members were kept apprised of ongoing progress of the project through both formal and informal meetings. Feedback was elicited by the project manager on all aspects of the plan, including the protocol, pre/posttests, educational program content, and method of delivery.

Although no overt barriers or objections to implementation of the IHPEN project were identified in the planning phase, open, frequent communication was the key to early detection of any issues or problems. This communication occurred through both formal and informal methods, including presentations at regular meetings, email communication, and one-on-one discussions. Key stakeholders were also regularly updated on the project plan. Email was the primary method of communication as the majority of the healthcare providers involved were

staff nurses (178 nurses). The NICU also published a monthly newsletter in which announcements about the IHPEN project education and updates were presented.

The IHPEN project was an educational intervention, so no risk to patients was involved. No participant identifiers related to the tests were available to the project manager. Clear communication regarding the process for the education was sent through email by the project manager. Only basic demographics on participants were collected. Time spent on education for nurses was accounted for in their hourly pay. Medical provider's (attending physicians, residents, and NNPs) participation was voluntary. They were informed in writing that their refusal or non-participation was in no way related to their employment or credentialing.

Organizational approval process. The project was initially presented to and approved by the medical and nursing unit directors of the NICU. A clinical site agreement between the organization and Chatham University was obtained and approved. The educational plan was presented, refined, and approved by the NICU and MBU CNSs, as well as unit directors, and incorporated into the overall educational plan for the year. The educational component was presented, reviewed, and approved by the Professional Nursing Practice Committee (education/quality coordinator, personal communication, June 27, 2014).

Role of information technology. The use of information technology was critical to the successful implementation of the IHPEN project. A narrated slide presentation was developed using computer software technology (PowerPoint, Microsoft, 2014b) and saved as movies (MP4 file) to deliver the educational component. This presentation was then distributed through the password protected internal OLMS, along with the pretests and posttests. Test results were exported from the OLMS by the clinicians responsible for tracking education (unit based CNSs). The data was de-identified by removal of participant name and employee number before sending

to the IHPEN project manager. The project manager then manually entered the individual test results into an Excel (Microsoft, 2014a) database which was then utilized for analysis of the test results. The participants were only identified by job title, unit employed on, and years in practice.

Materials needed for the project. A presentation was created with Microsoft PowerPoint (Microsoft, 2014b) software. Narration was recorded and sound files embedded in each slide. The file was then converted to a video (MP4 file) for participant ease in viewing and listening. The IHPEN project manager's personal computer and software were utilized for development of the education materials. The pretest and posttest, along with the video presentation, were uploaded to the clinical site's OLMS by the IHPEN project manager with assistance from the organization's OLMS staff. Data from completed pretests and posttests was downloaded from the OLMS by the unit-based CNSs and manually entered into a spreadsheet and analyzed using Microsoft Excel (Microsoft, 2014a) data analysis tool kit (see *Data Management Plan*).

The only equipment participants required was a computer (with audio) and access to the organization's OLMS. Computer work stations were available in multiple locations in the NICU and MBU. Healthcare providers with a home computer and internet access were also able to access the password protected OLMS remotely. This strategy for distribution of the educational program and tests provided maximum flexibility and created ease of access for participants with a 24-hour per day availability of the material. It also ensured that all participants were presented with exactly the same educational material presented in an identical format.

Institutional Review Board (IRB) Approval

Application for approval of the IHPEN project was submitted to the IRB of the organization at which the project was implemented, requesting an expedited review. The preliminary requirements for IRB application were completed in June 2014, including The National Institutes of Health (NIH) Office of Extramural Research training course "Protecting Human Research Participants" on June 6, 2014 and the elements of the Collaborative Institutional Training Initiative Program (2012) (human subjects research, responsible conduct of research, one-time biosafety training, and good clinical practice course) required by the IRB organization to which the application was submitted on June 12, 2014. Coverage analysis was issued July 20, 2014. The completed IRB application was submitted July 21, 2014. Approval for an expedited review was received on August 5, 2014 and final approval for the project was granted on August 26, 2014.

Plan for Project Evaluation

Demographic information. Three demographic elements for the providers involved in the IHPEN project were collected: the type of provider, unit employed on, and years in practice. The first three questions of the pretest delineated this data. Participants chose a category of provider from a list that included: (a) MBU nurse, (b) NICU nurse, (c) MCFP nurse, (d) advanced practice nurse, (e) resident, and (f) attending physician. The choices of unit employed on were: (a) NICU, (b) MBU, or (c) both. The years in practice choices included: (a) less than 1, (b) 1 to 5, (c) 6 to 10, (d) 11 to 15, or (e) more than 15. The demographics for the participant group are reported graphically in charts (frequency distributions) and reported in Chapter Six.

Measurement tool. Before and after the educational intervention, participants were given a 20 question multiple choice knowledge assessment test. Although there was not

published validity or reliability for the knowledge assessment questions, they were derived from questions developed for the quality improvement collaborative webinars sponsored by the Vermont Oxford Network (VON, 2014). This collaborative was developed to "measure, learn, improve, and share potentially better practices in the care of infants and families affected by maternal substance abuse disorder (SAD) and neonatal abstinence syndrome (NAS)" (para. 1). The questions were developed by the international researchers and experts in NAS, including nurses, physicians, and pharmacists who led the webinars and discussions for the collaborative thus providing content validity (Twycross & Shields, 2004). Permission was obtained from VON to use the 20 multiple choice knowledge assessment questions.

The clinical site's OLMS allowed sequential access to the material. Completion of the pretest was required before access to part one of the presentation was enabled. The participants were then required to open part two of the presentation before access to the posttest was enabled. Test score data was extracted from the OLMS as previously described in *Role of Information Technology* section. This data is reported graphically in charts and tables as described below in "Outcome measurement and metrics" and reported in Chapter Six.

Outcome measurement and metrics. The outcome measured for the IHPEN project was knowledge gain by healthcare providers as represented by improvement from pretest to posttest scores for the 20 multiple choice knowledge assessment questions which reflect the material presented. Due to the short time frame to complete the education (8 weeks) and large number of staff (261 healthcare providers), a goal of 50% of the nursing staff and 25% of the medical staff (attending physicians, residents, and NNPs) completing the program was set. Frequency, percentage, mean, range, and standard deviation of scores were calculated separately

for pretests and posttests, as well as for each participant provider category. This information is graphically displayed in bar charts and tables and reported in Chapter Six.

Evaluation of change in knowledge from pretest to posttest was measured by a paired-sample *t*-test to compare both composite pretest to posttest scores (Heavey, 2011) and for each category (group) of healthcare provider. A significance of $p < 0.05$ and a benchmark of a 10% increase from pretest to posttest score was selected as representing "improvement" in knowledge. The 10% benchmark mirrors that utilized in a supporting study on an educational intervention for infants with NAS (Lucas & Knobel, 2012). Results of the analysis of the pretest and posttest scores are graphically displayed in a bar charts and tables to enable a visual representation of the change from pre to post education and reported in Chapter Six.

Data management plan. Test results were exported from the OLMS by the clinicians responsible for tracking education (unit based CNSs). The information for each participant was de-identified by removal of participant name and employee number, then assigned a participant number prior to sending the data to the project manager. The individual test results were then manually entered into an Excel (Microsoft, 2014a) database by the project manager.

The de-identified data file utilized for analysis was saved on a limited-access, password protected drive on the medical center's secure network. This drive was backed up by the clinical site's information systems department per organizational policy. A back up copy of the data was also made to a password protected jump drive and stored in a locked, fireproof cabinet in the NICU unit management office. Data files will be maintained for a minimum of five years in order to facilitate publication of results. All data is the property of the organization at which the IHPEN project was performed.

Analysis of the data for the IHPEN project was completed using the Excel (Microsoft, 2014a) data analysis tool kit and two web-based tools. An Excel database was designed with columns formatted for each question. Descriptive statistics, including frequency, percent, mean, standard deviation, and range were calculated for composite test scores, as well as for each groups of provider types. The data was entered into a web-based tool (Lowry, 2012) which enabled comparison of composite score for the pretest to posttest and for each group of provider type using a paired-sample *t*-test. An additional web based tool was utilized to calculate confidence intervals (McCallum Layton, 2014).

Conclusion

This chapter has described the process of an EBP practice change project, the IHPEN project, to address the problem of infants with or at risk for NAS in the NICU and MBU of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois. The IHPEN project was comprised of comprehensive education on the subject of NAS, including the introduction of a pharmacologic protocol, for all healthcare providers. The knowledge gain as a result of the education provided was evaluated by a classic pretest-posttest design methodology. The management, materials needed, IRB approval process, and evaluation plan for the project were described. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Chapter Five: Project Implementation

Neonatal Abstinence Syndrome (NAS) is a collection of abnormal physiologic and neurobehavioral clinical findings resulting from an infant's physiologic dependence to opioids. Maternal use and/or abuse of opioids during pregnancy are the primary of causes of this complex and challenging medical issue in newborn infants which is growing at an alarming rate (Azadi & Dildy, 2008; Behnke & Smith , 2013; Hayes & Brown, 2012; Hudak & Tan, 2012; Pan & Yi, 2013). Infants with NAS are commonly admitted to neonatal intensive care units (NICU) and inconsistently treated which leads to inadequate control of withdrawal symptoms, resulting in prolonged and costly hospitalizations (Behnke & Smith, 2013; Hudak & Tan, 2012; Patrick et al., 2012). Bedside nurses often find caring for these infants to be extremely stressful and time consuming (Fraser, Barnes, Biggs, & Kain, 2007; Jansson & Velez, 2012; Maguire et al., 2012).

Protocols and practice guidelines enable healthcare providers to work as a team and reduce individual variation and bias through the standardization of practice, resulting in the potential for decreasing hospital length of stay, thereby reducing hospital costs (Horbar, et al., 2001; Rogowski et al., 2001; Woolf, Grol, Hutchinson, Eccles, & Grimshaw, 1999). The American Academy of Pediatrics (AAP) has recommended that every hospital neonatal unit develop a protocol to address the assessment and treatment of NAS (Hudak & Tan, 2012). Published evidence supports the importance of standardization of practice through implementation of a protocol in improving outcomes for infants with NAS (Bhatt-Mehta, Ng, & Schumacher 2014; Hall, et al., 2014; Murphy-Oikonen, Montelpare, Bertoldo, Southon, & Persichino, 2012; Napolitano, Theophilopoulos, Seng, & Calhoun, 2013). Furthermore, evidence supports the importance of education in enhancing a healthcare provider's knowledge and ability to accurately identify and interpret neonatal withdrawal symptoms, along with

providing detailed information regarding a treatment protocol (Bhatt-Mehta et al., 2014; Lucas & Knobel, 2012; Napolitano et al., 2013; Keels, 2010). Thus, an organized, structured, systematic, and collaborative approach to the assessment and treatment of infants with NAS is needed to prevent or minimize the exacerbation of withdrawal symptoms and prolonged lengths of hospitalization, thus improving their outcomes.

This chapter will describe the implementation process of an evidence-based practice (EBP) change project that addressed the challenges of caring for and treating the newborn infant with NAS: the "*Interprofessional Healthcare Provider Education on NAS*" (IHPEN). The project was designed to increase healthcare provider knowledge about NAS and implement a protocol for the assessment and treatment of infants with or at risk for NAS. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Setting and Population

The IHPEN project was conducted in the 60-bed NICU and 34-bed Mother-Baby Unit (MBU) of a large, urban, not-for-profit university-based level IV perinatal center in the State of Illinois. The target population included nurses and medical providers employed by or privileged in the NICU and MBU. This included 178 staff nurses, 11 neonatal nurse practitioners (NNPs), 47 residents (pediatric and med-peds), and 25 attending physicians (neonatologists and pediatricians). These healthcare providers were 18 years of age or older regardless of gender, religion, ethnicity, or years of service.

Nursing participants. Staff nurses from the NICU, MBU, and maternal-child float pool (MCFP) participated in the IHPEN as part of their required, unit-based, ongoing education. They were assigned the module (pretest, videos, and posttest) in the organization's online learning management system (OLMS) in the usual fashion by the clinical nurse specialists (CNS) of the NICU and MBU. Notification of the education availability and the timeframe required for completion was distributed by email, as this is the usual method by which required information is communicated to the staff due to its large size. In addition, the email communication included information regarding the data collection from the OLMS, including the fact that de-identified pretest and posttest data would be collected from the OLMS and analyzed as part of an IRB approved project. Nurses who complete the educational module and submitted a program evaluation received 1.5 continuing education units (CEUs) (the organization is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation and has designated this educational presentation activity for 1.5 CEU credits (Department of Interprofessional Continuing Education, personal communication, July 28, 2014).

Medical provider participants. Attending physicians (neonatologists and pediatricians) in the NICU and MBU, residents (pediatric and med-peds specialties), and NNPs were assigned the module in the OLMS by the project manager. Participation by these providers was voluntary and elicited through email communication, the weekly resident newsletter (which also was distributed to attending physicians and NNPs), and announcements at weekly departmental staff meetings. They were informed in the email announcements that their refusal or non-participation was in no way related to their employment or credentialing, and that de-identified test data would be collected from the OLMS and analyzed as part of an IRB approved project. Residents were

able to use the completed education as fulfilling a goal for their yearly required individualized learning plans (pediatric residency program director, personal communication, July 28, 2014). NNPs were eligible to received nursing CEUs for completion of the program if they submitted a program evaluation.

Implementation Steps

Educational program design. Prior to the opening of the IHPEN project, institutional review board (IRB) approval for an expedited review for the project was requested with final approval granted on August 26, 2014. Administrative letters of support were provided by the nursing and medical directors for the NICU. Verbal support for the project was provided by the assistant vice president of hospital operations, the section chief for neonatology, and the MBU nursing and medical directors. The project also underwent review and approval by the Professional Nursing Practice Committee. CEUs for nursing were also applied for and approval granted for 1.5 CEUs. An application for continuing medical education (CME) units was also completed, however the program manager was unable to secure funding to support the application.

The program design was discussed with the organization's primary point person for the OLMS. It was confirmed that dividing the materials into two modules, part one containing a pretest and 30-minute video, and part two containing a 30-minute video and a posttest would be compatible with the OLMS's capabilities. Furthermore, the project manager was informed that test data could be downloaded directly from the OLMS into an Excel (Microsoft 2014a) spreadsheet for further analysis.

Program components. The IHPEN project's intervention included a multiple choice pretest with 3 demographic questions and 20 knowledge questions, two 30-minute video

presentations, and a 20 question multiple choice posttest, identical to the pretest. The intervention was delivered through the organization's OLMS, a password-protected, web-based program, which is accessible by all employees both internally and remotely (e.g., from a home computer). This method of educational program delivery was chosen as it provided maximum flexibility and ease of access, thus enabling participation by the large number of healthcare providers, as well as 24-hour availability to the materials. It also ensured that all participants were presented with exactly the same educational content in an identical format. Another benefit of using the OLMS was that it allowed sequential access to material: completion of the pretest was required before access to part one of the presentation was enabled; viewing of part two of the presentation was required before access to the posttest was enabled. The organization's OLMS staff with access to create modules assisted with building the modules in the OLMS.

Educational component. The videos used for the educational portion of the project were derived from a PowerPoint (Microsoft, 2014b) presentation created by the program manager. Sound files containing recorded narration were embedded in each slide. The presentation was then divided into two 30-minute segments and saved as two separate video files (MP4).

The educational presentation was inclusive of the problem of substance abuse in pregnancy, signs and symptoms of NAS in the newborn infant, the assessment and scoring of infants with NAS using a valid and reliable NAS scoring tool, nonpharmacologic interventions, the threshold for pharmacologic treatment, a pharmacological algorithm (protocol), care of the family, discharge criteria, and long-term outcomes for infants with NAS. Appendix A outlines the educational program content and learning objectives.

Pretest/posttest component. The 20 question pretest and 20 question posttest were identical. The multiple choice questions were derived from questions developed for the Vermont

Oxford Network (VON) quality improvement collaborative webinars on NAS (VON, 2014) for which approval was granted for use. The questions were developed by international researchers and experts in NAS, including nurses, physicians, and pharmacists who led the webinars and discussions for the collaborative.

Continuing education units for nursing. Nurses were eligible to receive the 1.5 CEUs offered for completion of the modules if they also completed a program evaluation. They were instructed to print the evaluation tool and place it in an envelope outside the program manager's office, or attach the completed document to an email to the program manager. These evaluations were then utilized to develop a roster which was forwarded to the organization's Interprofessional Continuing Education department who granted the CEUs.

Educational program distribution. For two weeks prior to the education becoming available (August 25 through September 7, 2014) information about upcoming education was disseminated though email communication. The module, including pretest, two 30-minute videos, and posttest, was then opened up for 8 weeks, September 8 through November 2, 2014. Reminder emails were sent out weekly, including the number of participants who had completed each part of the IHPEN program to date. The number of participants who completed the educational module were initially obtained from a summary report in the OLMS accessed by the project director. However, as noted below, this data was skewed by multiple attempts by individual users and vastly overestimated the participation in the module. The medical directors of the NICU and MBU who supported the project encouraged participation by the medical providers.

Issues encountered. Initially, the plan discussed and approved by the OLMS staff included conversion of the PowerPoint slides into a flash video files utilizing an add-in element

that the program manager owned and then uploading these files into the OLMS. However, after the flash video files were created, the OLMS staff determined that this file type was not compatible with the OLMS. The program manager then copied the audio files into the PowerPoint (Microsoft, 2014b) slides, divided the presentation into two 30-minute segments, and saved the files as MPEG-4 videos, a format which was compatible with the OLMS.

Another issue was encountered when participants contacted the program manager with difficulty in playing the videos on computers within in the organization. The organization's information systems (IS) staff was consulted and it was determined that the problem was due to two issues: (a) the OLMS was hosted off-site and (b) the streaming of video over the internet was set to the lowest bandwidth priority by the IS department of the organization. These issues were remedied by uploading the videos to an onsite system and server which the OLMS was able to link directly to. All participants were notified by email of the issue, progress on the issue identification, and then again with the resolution of the issue. The participants were encouraged to contact the program manager if additional issues were encountered in playing the videos. One complaint was received regarding audio issues with the video, but this was determined to be a user error. Two complaints were received regarding difficulty accessing the videos remotely using Mac (Apple®) computers, which was rectified by utilization of an alternate internet browser to access the OLMS. No further issues were communicated regarding accessing and playing of the videos.

An additional issue surfaced approximately half-way through implementation when participants contacted the program manager regarding complaints of inability to "pass" the pretest or posttest. The participants were all emailed and reassured that the score was not relevant and it should be ignored. However, dissatisfaction with this resolution was

communicated to the program manager as the module would not be cleared from their queue in the OLMS until they had "passed" the tests. Upon further inquiry with the OLMS it was discovered that although questions were coded as having any answer as correct (i.e., a or b or c or d), the system interpreted that as the participants having to mark all answers correct (i.e., a and b and c and d). This issue could not be rectified directly. All participants were notified that all tests would be marked completed in the OLMS after the data collection was completed.

Also, unbeknown to the program manager, the OLMS defaulted to a passing score of 80%. This was rectified with the passing score changed to 0% going forward, but would require those who had already taken the tests to retake them in order to receive a passing score. It was decided that this could also be rectified after the data collection was completed. All participants were again emailed regarding this issue with the OLMS.

These issues with scoring brought to light another issue in utilizing the OLMS for test analysis: participants were able to take tests multiple times. This finding skewed all aggregate data the OLMS collected making it unusable for analysis as it collected and collated *each attempt* by every user. However, it was determined that the system did collect the details of each test attempt. The program director worked with the unit based CNSs to retrieve the individual test data for each participant and remove all identifiers before sending to the program director. The program director then manually entered all test data for each participant into an Excel (Microsoft, 2014a) database for analysis.

Activities to Support the Project

During the eight weeks the learning module was open, the project manager performed additional activities and developed supplementary educational materials to support the project. These included: development of NICU and MBU Handbook materials on NAS, a reference NAS

scoring tool, a parent handout, intentional rounding on NAS infants in the NICU, and collecting 12 months of baseline pre-intervention patient data for infants in the NICU diagnosed with NAS. These activities and materials not only provided value to the educational intervention, but also promoted the sustainability of the practice change.

Handbook materials. A detailed description of the protocol for the assessment and treatment of infants with NAS was written for publication in the NICU Handbook. This information included brief, general information about NAS, the NAS screening tool, the protocol for assessment and treatment, and an algorithm for pharmacologic treatment. Additional information included brief detail regarding the medications used for treatment of NAS, discharge criteria, and follow-up recommendations.

Bedside reference cards. Laminated cards that describe the NAS tool, indicators of withdrawal in the infant, and how to score them using the NAS scoring tool, and the algorithm for treatment were designed. The flip side of this card listed targeted interventions for infants with NAS and infant stability/stress signals. These cards were posted at the unit workstations and placed in the infant's chart upon admission to provide rapid bedside access to the scoring criteria and effective interventions to employ. Nurses were encouraged to utilize the reference for parent communication and teaching regarding the signs and symptoms of withdrawal in their infant.

Parent guide. A parent handout was designed and reviewed by neonatology and NICU nursing leadership. It was then sent to the parent advisory committee of the NICU for review. The final document will be sent to the house wide committee on patient education for approval. Once approved, the parent guide will be converted into a PDF formatted document and uploaded

to the central resources for pediatric patients on the organization's intranet to maximize availability to nurses caring for infants with NAS to present to the parents of the infants.

Intentional rounding. The program director performed intentional rounding on infants with NAS currently admitted to the NICU. This was done to encourage staff to complete the NAS education, as well as elicit questions which could be addressed. It additionally provided the opportunity to reinforce the education regarding use of the NAS scoring tool, as well as effective interventions to employ with infants. Questions regarding assessment and treatment of infants with NAS were also solicited by email. A question and answer format email was then developed and sent to all staff at the conclusion of the learning activity.

Preintervention patient data collection. Preintervention data was collected on the infants with NAS over the 12 months prior to the intervention to establish baseline data on the outcomes of infants with NAS prior to the IHPEN project implementation. Postintervention data collection will commence one month after the educational module has been completed. The preintervention and postintervention data will be utilized as a quality measure for prospective comparison of outcomes in infants with NAS as a result of the implementation of the education and the protocol. This data collection falls under quality improvement initiative and does not require IRB approval (NICU medical director, personal communication, June 10, 2014). However, the data results will not be published without IRB approval.

Conclusion

This chapter has described the implementation procedure utilized for an EBP change to improve outcomes for infants with NAS utilizing an educational approach: the IHPEN project. The project was propelled by an identified need to unite the healthcare providers in the NICU and MBU of a large, urban, not-for-profit, university-based, level IV perinatal center in the State

of Illinois in an EBP approach to improve outcomes for infants with NAS. The project was comprised of an education intervention, introduction of a protocol for the assessment and pharmacologic management, and the evaluation of healthcare provider knowledge gain. It was delivered and managed through the organization's OLMS. The issues encountered utilizing this technology for distribution were described. The primary intention of the IPHEN project was to increase healthcare provider knowledge regarding the assessment and treatment of infants with NAS. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Chapter Six: Evaluation and Outcomes of the Practice Change Initiative

Neonatal Abstinence Syndrome (NAS) is a collection of abnormal physiologic and neurobehavioral clinical findings resulting from an infant's physiological dependence to opioids. Maternal use and/or abuse of opioids during pregnancy are the primary cause of this complex and challenging medical issue in newborn infants, which is growing at an alarming rate (Azadi & Dildy, 2008; Behnke & Smith, 2013; Hayes & Brown, 2012; Hudak & Tan, 2012; Pan & Yi, 2013). Infants with NAS are commonly admitted to neonatal intensive care units (NICU) and inconsistently treated which leads to inadequate control of withdrawal symptoms, resulting in prolonged and costly hospitalizations (Behnke & Smith, 2013; Hudak & Tan, 2012; Patrick et al., 2012). Bedside nurses also find caring for these infants to be extremely stressful and time consuming (Fraser, Barnes, Biggs, & Kain, 2007; Jansson & Velez, 2012; Maguire et al., 2012).

This chapter will describe the evaluation of an evidence-based practice (EBP) change project that addressed the challenges of caring for and treating the newborn infant with NAS: the "*Interprofessional Healthcare Provider Education on NAS*" (IHPEN). The need for the project emerged from the following observations: (a) increasing numbers of patients admitted to the NICU who were diagnosed with NAS, (b) long lengths of stay for infants with NAS, (c) an inconsistent approach to the pharmacologic treatment and weaning of medications because of a lack of a protocol for infants with NAS, (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS. The question formulated to drive the evaluation of the evidence and development of the intervention was: *Does interprofessional education which includes implementation of a protocol for infants with NAS increase healthcare provider knowledge, ultimately improve consistency in assessment and treatment of these infants, as well as decrease individual infant*

composite withdrawal scores and hospital length of stay? The metric chosen to evaluate the intervention was a surrogate measure for direct evaluation of improvement in outcomes for infants: knowledge gain from education evaluated by a classic paired pretest-posttest methodology. The project was designed to increase healthcare provider knowledge about NAS and implement a protocol for the assessment and treatment of infants with or at risk for NAS. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Participants

The target population included nurses and medical providers employed by or privileged in the NICU and mother-baby unit (MBU) of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois. This included 178 staff nurses, 11 neonatal nurse practitioners (NNPs), 47 residents (pediatric and med-peds), and 25 attending physicians (neonatologists and pediatricians). These healthcare providers were 18 years of age or older regardless of gender, religion, ethnicity, or years of service. Program participation was mandatory for staff nurses in these units. Attending physician, resident, and NNP participation was voluntary.

Ultimately, 141 healthcare providers (54% of those eligible) participated in the IHPEN within the 8 weeks the program was available in the organization's online learning system (OLMS). Of these, 133 (94% of participants) completed both the pretest and the posttest, enabling comparison data (see Figure 6.1). Posttest data was missing for 8 participants: 6 NICU nurses and 2 MCFP nurses.

Demographics

The primary type of participant was the staff nurse, with 131 participants, representing 93% of the total number of participants. The majority of the staff nurses were employed in the NICU (84 participants) which represented 74% of total participants and 64% of nursing participants. The lowest number of staff nurse participants were from the MCFP, which was expected as they are the smallest group of staff nurses (see Figure 6.2).

Figure 6.1. Numbers of participants eligible for participation, actually participated, and completed the IHPEN project by healthcare provider type.

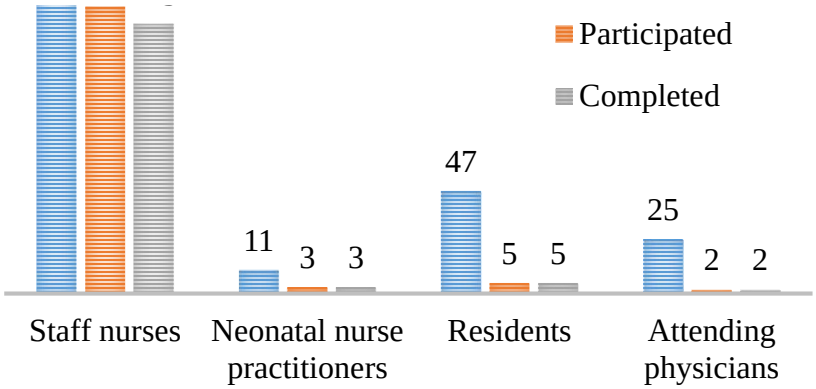

Figure 6.1. Numbers of participants eligible for participation, actually participated, and completed the IHPEN project by healthcare provider type.

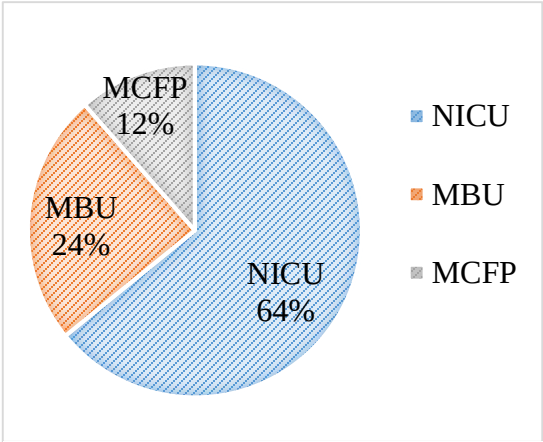

Figure 6.2. Percent of total nurses who participated in the IHPEN project by unit employed on (*n*=131).

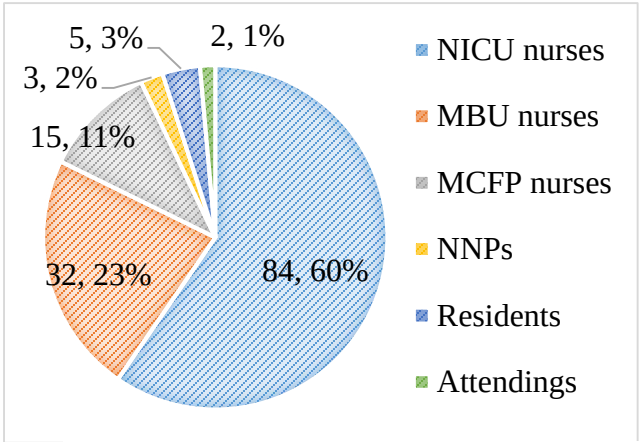

Figure 6.3. Number of participants in the IHPEN project by provider type (*n*=141).

Medical provider participation (NNPs, pediatric and med-peds residents, and attending neonatologists and pediatricians) was 7% of total participants and 12% of total medical

providers. Only 2 attending pediatricians completed the modules in the OLMS. Resident participation was also low at 5 participants (10% of residents included in the target population), as was NNP participation at 3 participants (27% of the NNPs) (see Figure 6.3). See Table 6.1 for descriptive statistics of the participants by provider type and units employed.

Table 6.1

Participant Type and Unit Employed

Participant Type	Count	Unit Employed			
		NICU	MBU	Both	Percent
Nurses	131	84	32	15	93%
NNPs	3	3	0	0	2%
Resident	5	0	0	5	3.5%
Attending physician	2	0	2	0	1.4%

N = 141

Figure 6.4 graphically illustrates the experience of participants in terms of years in practice. The lowest percentage of participants were in the 11 to 15 years of experience range (12%), with the highest percentage (26%) in the most experienced (greater than 15 years). See Table 6.2 for descriptive statistics of the participants by provider type and years in practice.

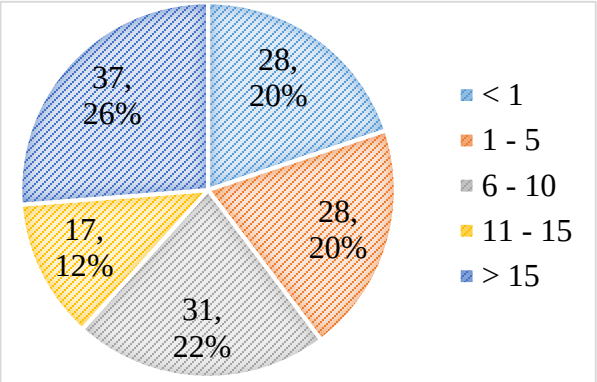

Figure 6.4. Number and percentage of total participants by provider type and years in practice for the IHPEN project (*n*=141).

Table 6.2

Participant Years in Practice by Provider Type

Participant Type	*n*	Years in Practice				
		< 1	1 – 5	6 – 10	11 – 15	> 15
Nurses	131	26	24	30	16	35
NICU	84	19	17	17	9	22
MBU	32	7	4	8	3	10
MCFP	15	0	3	5	4	3
Medical providers	10	2	4	1	1	2
NNPs	3	0	1	0	0	2
Residents	5	2	3	0	0	0
Attending physicians	2	0	0	1	1	0

N = 141

Intended Outcomes

Identified benchmark. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care. However, because the average LOS was more than 30 days for infants with NAS in the NICU in which the IHPEN project was conducted, outcomes at the patient level were beyond the timeframe for this project. The outcome measure identified for the IHPEN project was to increase healthcare provider knowledge regarding NAS, including withdrawal symptoms, assessment, and treatment of the infant. Due to the short timeframe to complete the education (8

weeks) and the large number of staff (261 healthcare providers), a participation goal of 50% of the nursing staff and 25% of the medical staff completing the program was set. Evaluation of change in knowledge pretest to posttest was measured by comparing pretest to posttest mean scores, along with performing a paired-sample *t*-test (Heavey, 2011). Results were reported for all providers, by categories, and also for each type of healthcare provider. A significance of $p < 0.05$ and a benchmark of a 10% increase from pretest to posttest scores was selected as representing "improvement" in knowledge. This benchmark mirrors that utilized in a supporting study on an educational intervention for infants with NAS (Lucas & Knobel, 2012).

Measurement tool. A NAS withdrawal scoring tool, the Neonatal Withdrawal Inventory (Zahorodny, et al., 1998), was introduced during the IHPEN project implementation. However, the outcome measure for improvement in outcomes for infants with NAS was confirmed through the surrogate measure (Hakkennes & Green, 2006) using a pretest/posttest methodology. Prior to the educational intervention (previously described in Chapters 4 and 5) which consisted of two 30-minute videos, a 20 question multiple choice pretest was administered. Completion of the pretest then enabled access to the educational intervention. Although there was not published validity or reliability for the knowledge assessment questions, they were developed by experts in the field, thus providing content validity (Twycross & Shields, 2004). Following viewing of the two videos, a 20 question multiple choice posttest, identical to the pretest was administered. The pretest, posttest, and videos were delivered through the organization's OLMS. Test score data was extracted from the OLMS by the unit personnel responsible for the OLMS, downloaded and de-identified of employee name and number before sending to the program manager for entry into an Excel (Microsoft 2014a) database for analysis.

Effectiveness of the Initiative

Although 141 healthcare providers (54% of those eligible) participated in the IHPEN program, matched pretest/posttest data was available for only 133 participants, primarily nurses in the NICU. Nursing participation at 74% (131 out of 178 nurses) exceeded the goal of 50%. Of the 83 medical providers (NNPs, residents, and attending physicians) only 12% (10) participated, which did not meet the goal of 25% of the medical staff completing the education. The higher staff nurse participation rate was most likely influenced by the mandatory education requirement for staff nurses as opposed to medical providers who were offered the opportunity, but not required to participate. The predominance of participation by NICU nurses versus those employed in MBU or the MCFP also was anticipated, as there are 114 NICU nurses, 42 MBU nurses, and 22 MCFP nurses employed in their respective units.

Although the overall rate of participation at 54% of the healthcare providers targeted for participation in the IHPEN project was acceptable (see Figure 6.1), the low rate of medical provider participation was unexpected. Aside from the NNPs who work in the NICU routinely, only 6 to 8 residents work in the NICU or MBU during a 4-week period of time, as the rest of their time is spent covering other services and clinics. Thus their interest in a medical condition affecting exclusively newborn infants in the NICU may have been low during the time period the IHPEN was offered. Pediatricians also sporadically staff in the MBU and neonatologist staff in 2-week periods of time in the NICU. The additional clinical and organizational responsibilities of these attending physicians may have impacted their interest in this topic or time to participate. It is also possible that physicians did not feel they needed this education—felt they already knew enough about the subject. The inability to obtain funds to support continuing medical education (CME) units also may have impacted the incentive for voluntarily participation.

It was anticipated that if the census would surge during the implementation time, all level of providers might be consumed with direct patient care, potentially working additional shifts and limiting the time for additional activities (e.g., education). This indeed was the case for the first 5 weeks of implementation. In addition, there were numerous issues with the OLMS regarding playing the videos and pretest/posttest scoring as outlined in Chapter 5. These issues created a great deal of frustration for some participants, which may have been communicated to other potential participants, decreasing their willingness to participate. There was also a competing required educational program for all of the same providers, which may also have impacted participation.

Pretest scores and posttest scores both ranged from a minimum of 60% to a maximum of 100%. The composite mean for the pretest scores was 79% and the composite mean for the posttest scores was 82%. This represented an aggregate mean improvement from pretest to posttest of 3%. Figure 6.5 illustrates the mean pretest and posttest scored for all healthcare provider types and groups.

The mean score for the pretest to posttest demonstrated a small, but statistically significant improvement ($p = 0.000164$). Inspection of individual test scores revealed that 71 participants (53%) improved their scores from pretest to posttest with 73% scoring 80% or greater on the post test. On the pretest, 40% of the participants scored 75% or less, whereas only 27% of the participants scored 75% or less on the posttest. Table 6.3 summarizes pretest and post test scores by selected ranges. Of the 71 participants whose scores improved from pretest to posttest, 59% (32% of all participants) improved their score by 10% or more and 13 participants improved by 20% or more. The benchmark for knowledge increase was determined to be 10% which mirrored that of a supporting study on an educational intervention for infants with NAS

(Lucas & Knobel, 2012). Thus an increase from pretest to posttest of at least 10%, by 32% of the participants demonstrated the intervention was at least partially effective. Inspection of the questions answered incorrectly on both tests may be helpful to explain why 45% of the participants had no or a negative change in pretest to posttest score.

Table 6.3

Number of Pretest and Posttest Scores by Selected Ranges

	≤ 65%	70%	75%	80%	85%	90%	≥ 95%
Pretest	14	14	26	32	31	11	6
Posttest	8	13	15	31	29	19	18

N = 133

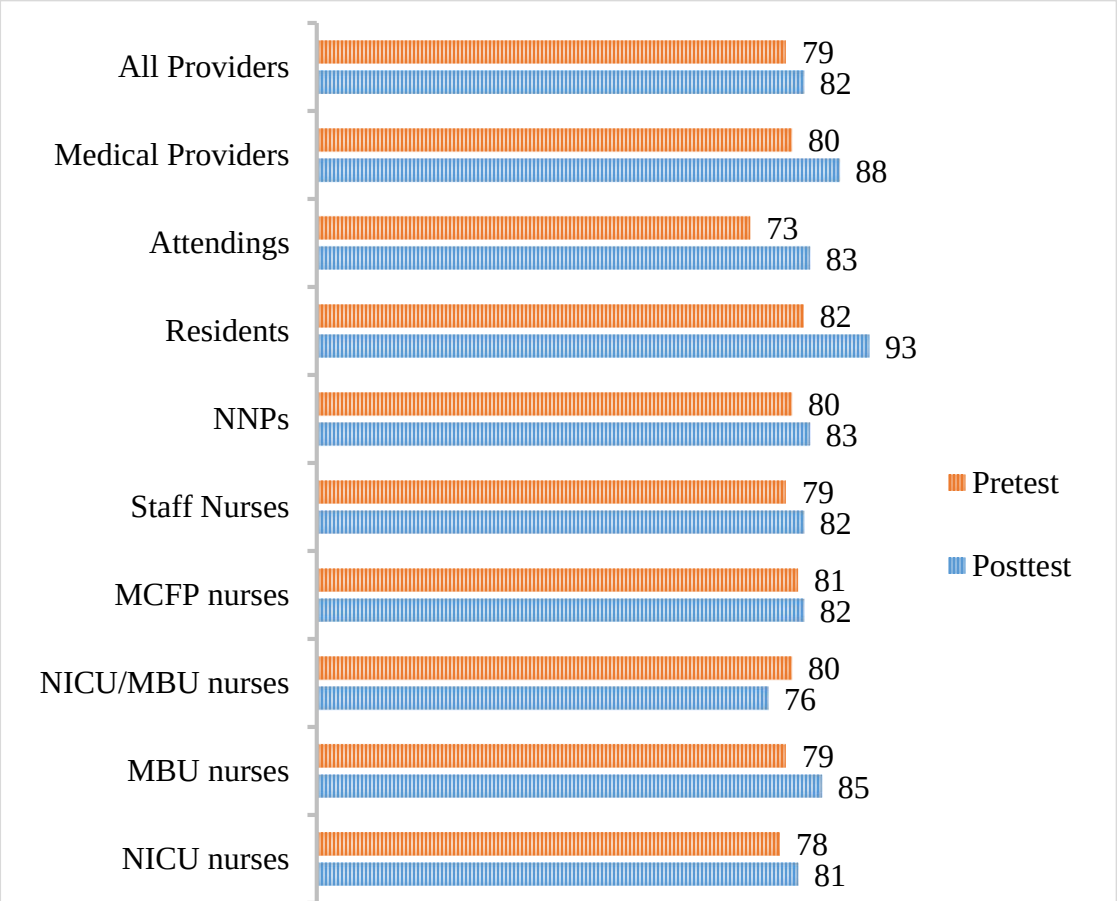

Figure 6.5. Healthcare participant pretest and posttest mean scores by provider type.

A paired-sample *t*-test was conducted to compare the difference in pretest and posttest scores. There was a significant difference in the scores for pretest (M = 79, SD = 8.1) and posttest (M = 82, SD = 8.8); conditions t(132) = 3.69, $p = 0.000164$. This finding indicated a statistically significant increase in knowledge following the educational intervention as the target significance was $p < 0.05$. Tables 6.4 and 6.5 detail test score results, means, standard deviation, and percent difference by provider type and years in practice. Table 6.6 presents data on the paired-sample *t*-test for all providers and by provider type.

Table 6.4

Pretest/Posttest Results by Participant Type

		Pretest			Posttest			Percent change
	n	*Min.*	*Max.*	*M (SD)*	*Min.*	*Max.*	*M (SD)*	
All participants	133	60%	100%	79% (8.1)	60%	100%	82% (8.8)	3%
Nurses	123	60%	100%	79% (8.14)	60%	100%	82% (8.7)	3%
NICU	78	65%	95%	78% (7.9)	60%	100%	81% (8.47)	3%
MBU	32	60%	100%	80% (8.84)	65%	100%	83% (8.87)	3%
MCFP	13	70%	90%	81% (6.5)	75%	95%	82% (6.6)	1%
Medical	100	65%	90%	80% (7.24)	70%	95%	84.5% (1.01)	4.5%
NNP	3	65%	90%	80% (13.2)	65%	100%	83% (16.0)	3%
Resident	5	75%	90%	82% (5.7)	90%	95%	93% (2.73)	11%

Attending physician	2	70%	75%	73% (3.53)	65%	100%	82% (2.47)	7%

Note. Min. = lowest score. Max. = highest score. M = Mean. SD = Standard Deviation.

Table 6.5

Pretest/Posttest Results by Participant Grouped by Years in Practice

Years in Practice		Pretest			Posttest			Percent change
	n	*Min.*	*Max.*	*M (SD)*	*Min.*	*Max.*	*M (SD)*	
< 1	28	60%	85%	76% (7.68)	60%	95%	80% (9.85)	4%
1 – 5	24	65%	100%	79% (9.25)	65%	100%	85% (8.53)	6%
6 – 10	31	65%	95%	80% (7.24)	70%	100%	83% (7.62)	3%
11 – 15	15	65%	90%	81% (6.23)	65%	95%	79% (0.110)	-2%
> 15	35	60%	95%	79% (8.77)	65%	100%	83% (0.101)	4%

N = 133
Note. Min. = lowest score. Max. = highest score. *M* = Mean. *SD* = Standard Deviation.

Table 6.6

Test Results Using Paired Sample t test for Equality of Means

Participant type	*n*	*M*	*SD*	95% CI of the Difference	*t*	df	*One-tailed p*
All participants	133	-3.1654	9.89	-4.85, -1.48	3.69	132	0.000164*
Nurses	123	-3.4309	11.6246	-5.49, -1.38	3.27	122	0.0006915*
NICU	78	-2.8205	9.8228	-5, -0.64	2.54	77	0.022508*
MBU	32	-3.9062	10.578	-7.57, -0.24	2.09	31	0.0068905*

MCFP	13	-1.1538	11.0215	-7.15, 4.84	1.15	12	0.356215
Medical	10	-8.5	11.068	-15.36, -1.64	2.43	9	0.019036*
NNP	3	-3.333	2.8868	-6.6, -0.07	2	2	0.091753
Resident	5	-11	6.5192	-16.71, -5.29	3.77	4	0.009777*
Attending physician	2	-10	28.2843	-49.2, 29.2	0.5	1	0.352

Note. *M* = Mean pretest – Mean posttest. *SD* = Standard Deviation of Difference of Means. CI = confidence interval. *t* = *t* test. df = degrees of freedom. Significant of $*p < 0.05$.

In addition to pretest and posttests, nurses were provided continuing education credit if they completed a program evaluation. Of the 53 program evaluations submitted, 95% stated they agreed or strongly agreed with the effectiveness of the teaching method, 100% agreed or strongly agreed with the program's applicability to their professional practice, and 100% agreed or strongly agreed that they would apply the knowledge and/or skills acquired from the activity to their practice (see Table 6.7). Thus it appeared that the program was very well received by those completing the program evaluations.

Table 6.7

Continuing Education Program Evaluation Responses

Evaluation Questions	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
This activity met my expectations based on the stated goals and objectives.	77%	23%	0%	0%	0%
The teaching method(s) used were effective for learning.	62%	33%	5%	0%	0%
The knowledge and/or skills I have acquired from this activity are directly applicable to my professional practice.	75%	25%	0%	0%	0%

I intend to apply the knowledge and/or skills I have acquired from this activity to my practice/area of work.	81%	19%	0%	0%	0%
I have a strategy/strategies to make change(s) in my professional practice based the knowledge and/or skills I have acquired from this activity	74%	24%	2%	0%	0%

N=53

Comments on the evaluations included:

> "*As a new NICU RN, the presentation was very informative and useful to my practice."*
>
> *"I thought the information was great and the module was wonderful learning tool. I congratulate Mary on this wonderful informative education resource. Thanks for doing it and presenting it to us."*
>
> *"The video and quizzes provided were very informative, especially for a new nurse who has limited experience caring for this particular population."*
>
> *"I learned a lot on how to care for infants going through withdrawal, and how to provide effective teaching to their family members."*
>
> *"I enjoyed learning about NAS as I have taken care of a number of patients with NAS. I thought it was very well presented, informative and worthwhile*!"
>
> *"Information very interesting and necessary for improving practice."*

These positive comments provided additional support for the efficacy and acceptability of the IHPEN educational intervention.

Conclusion

The IHPEN project was developed to address the following concerns regarding infants with NAS: (a) increasing numbers of patients admitted to the NICU who were diagnosed with NAS, (b) long lengths of stay for infants with NAS, (c) an inconsistent approach to the

pharmacologic treatment and weaning of medications because of a lack of a protocol for infants with NAS, (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS. The project included the implementation of a protocol to increase consistency in treatment for infants with NAS and provision of healthcare provider education to increase knowledge regarding NAS, as well as their sensitivity to the signs and symptoms of withdrawal.

Despite the overall good rate of participation in the program of 54%, there were significant issues in the OLMS delivery format, a prolonged surge in census, and a competing educational requirement which may have impacted participation. Nursing participation at 74% was higher than the expected 50%. Medical provider participation was low at 12% overall. The only group of medical providers who met the 25% expected participation rate were the residents at 11%.

The benchmark of 10% improvement from pretest to posttest score was partially met in that 32% of the participant's score improved by at least 10% from pretest to posttest. In addition, the improvement was statistically significant. A paired-sample *t*-test demonstrated the difference in the scores for pretest (M = 79, SD = 8.1) and posttest (M = 82, SD = 8.8); conditions $t(132) = 3.69$, $p = 0.000164$. Furthermore, the project was well received by nursing, as demonstrated by high program evaluations ratings providing additional support for the efficacy and acceptability of the IHPEN educational intervention.

Chapter Seven: Implications for Nursing Practice and Limitations of the Project

In 2011, the Institute of Medicine (IOM) with the support of the Robert Wood Johnson Foundation, published a report on the future of nursing. It detailed specific recommendations and strategies in four themes: (1) scope of practice, (2) education and training, (3) partnership with all levels of healthcare providers, and (4) information systems infrastructure. Although all of these are important in order to advance nursing practice and promote health outcomes in the 21st century, education may be the key factor in the power of nursing's voice over all other aspects by purposefully preparing them for leadership positions. Advanced education continues to surface as one of the crucial "competencies in such arenas as health policy and health care financing, community and public health, leadership, quality improvement, and systems thinking" (IOM, 2010, p. 3). It is this strategic initiative that the American Association of Colleges of Nursing's (AACN, 2006) *Essential of Doctoral Education for Advanced Nursing Practice* address. By meeting the eight "foundational competencies that are core to all advanced nursing practice roles" (AACN, 2006, p. 8) the advanced practice registered nurse (APRN) has the potential to impact nursing practice at its core.

This chapter will describe the implications for nursing practice and the limitations of an evidence-based practice (EBP) change project led by an APRN. This project addressed the challenges of caring for and treating the newborn infant with Neonatal Abstinence Syndrome (NAS): the "*Interprofessional Healthcare Provider Education on NAS*" (IHPEN). The project included education intended to increase healthcare provider knowledge regarding the assessment and treatment of infants with or at risk for NAS and the implementation of a protocol to increase consistency in treatment for infants NAS. The ultimate goal was to improve outcomes for infants with NAS. In evaluating the current and future implications for nursing practice of the

IHPEN project, consideration was given to the AACN (2006) foundational competencies for DNP education.

Implications for Nursing Practice

The AACN (2006) "foundational competencies" include a responsibility to improve patient outcomes through translation of the best available empiric evidence into bedside practice. The need for "requisite competencies to deliver high-quality care" (IOM, 2010, p. 2) cannot be understated considering the complexity of today's healthcare environment. Other aspects to be addressed include systems and organizational leadership, promotion of interprofessional collaboration, advocacy for healthcare policy, along with guidance and mentorship for other nurses. These opportunities are all accompanied by a fiscal responsibility to both the patient and the organization.

The IHPEN project was developed to address the following concerns regarding infants with NAS: (a) increasing numbers of patients admitted to the NICU who were diagnosed with NAS, (b) long lengths of stay for infants with NAS, (c) an inconsistent approach to the pharmacologic treatment and weaning of medications because of a lack of a protocol for infants with NAS, (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS. As supported by the literature, the IHPEN project had the potential to increase healthcare provider knowledge about NAS and lead to more successful outcomes for infants with NAS by: (a) guiding and standardizing the care for infants with NAS, (b) reducing individual healthcare provider variation in the approach and treatment, (c) enhancing communication and collaboration between healthcare providers, and (d) relieving caregiver distress (Bhatt-Mehta, Ng, & Schumacher,

2014; Hall, et al., 2014; Keels, 2010; Lucas & Knobel, 2012; Murphy-Oikonen, Montelpare, Bertoldo, Southon, & Persichino, 2012; Napolitano, Theophilopoulos, Seng, & Calhoun, 2013).

Leadership. According to the IOM's report on the *Future of Nursing* (2011), nurses are key stakeholders in the healthcare system. Additionally, nurses have the potential to have great influence in improving outcomes for patients. As leaders whose education has prepared them to translate research into practice, the APRN should proactively survey the landscape in which they work for opportunities to contribute to improvement in the healthcare system, whether it is a small, private practice or a large organization.

Ogrin et al. (2012) emphasized the importance of administrative leadership when changing a process in healthcare, as was needed in order to effectively design and implement the IHPEN project. The IHPEN project was conceived due to a perceived need by providers in the organization for a better strategy to improve the outcomes of infants with NAS and to meet the national mandate to specifically address this vulnerable population (Hudak & Tan, 2012). The leadership provided by the project manager, an APRN, enabled continuous forward movement in order for the medical providers to come to a consensus on a protocol, and nursing to understand best practice efforts in the direct care of infants with NAS.

The need to continue providing leadership to ensure sustainability of the practice change embodied in the IHPEN project is critical. Monitoring of metrics such as, compliance with the protocol by providers, interrater reliability in assessment by nurses, and patient length of stay will enable understanding of the measures needed going forward to promote permanence of the practice change. These measures would also assist in the identification of opportunities for further interventions to promote improvement to meet the goals of consistency in practice and improving patient outcomes.

Although the IHPEN addressed a specific population healthcare providers caring and treating infants with NAS in a single organization, this effort could be expanded to other organizations. The facility at which the project was implemented is a perinatal referral center for a large regional network of hospitals. The APRN leading the IHPEN project could use the implementation strategy for extrapolation of the project to the newborn nurseries within the perinatal region. Expanding the project to multiple hospitals would not only enable both a protocol-based approach in these facilities, but also the standardization of a regional approach to the assessment and treatment of infants with NAS. Furthermore, it would create the opportunity to pool the data across these hospitals, thus enabling additional evaluation of the effectiveness of the treatment strategy and improving the strength of any metrics employed.

Teamwork. In the patient care environment, communication and teamwork are essential elements for enhancing patient safety and outcomes (Clark, 2009; Ogrinc et al., 2012). The optimal methodology for practice change is through a team approach (AACN, 2006; Chism, 2013; Ogrinc et al., 2012). The most effective healthcare teams include members with a broad range of knowledge and experience enabling a global understanding of the process, multiple perspectives on challenges to be overcome through interprofessional collaboration and a comprehensive overview of possible intervention strategies (Interprofessional Education Collaborative Expert Panel, 2011; Mitchell et al., 2012),.

The IHPEN project brought together a multidisciplinary team, including medicine, nursing, and pharmacy, to address the problem of prolonged length of stay in infants with NAS. Working collaboratively, the team had the opportunity to facilitate the implementation of a protocol to standardize the assessment and treatment of infants with NAS. Going forward, the team could be expanded to include social services, lactation consultants and specialists, parents

of infants with NAS, as well as community organizations supporting women who are recovering from substance abuse. The expansion of the team would provide a broader, more comprehensive view of the needs of the families of infants with NAS. This process would create the additional opportunity to evaluate areas requiring improvement, including addressing stigmatization, discrimination, and stereotyping of the substance-abusing woman (Livingston, Milne, Fang, & Amari, 2012; Skinner, Feather, Freeman, & Roche, 2007). These views can lead to barriers to the creation and promotion of a culture of compassion and caring for the substance abusing mother and her infant (Skinner, Roche, Freeman, & Mckinnon, 2009). The inclusion of lactation consultants would facilitate encouragement of breastfeeding, which emerging evidence suggests may improve the long term health for both the opioid-dependent woman and her infant (Pritham, 2013).

Translating evidence into practice. EBP is the key to ensuring the highest quality of care and patient outcomes (Melnyk & Fineout-Overholt, 2011). It is grounded in a "spirit of inquiry" (p. 11), involving an integrative process of a systematic review and appraisal of current literature and other sources of evidence, which may then be translated into clinical practice. Protocols, or practice guidelines enable care providers to work as a team in addressing a specific clinical need, facilitating standardization of practice to reduce individual variation and bias. When developed from an EBP approach, protocols have the potential to improve patient outcomes and decrease lengths of stay, thus reducing hospital costs (Melnyk & Fineout-Overholt, 2011).

In evaluating the literature for evidence supporting a specific protocol it was discovered that no consensus existed. What was evident was support for the implementation of a protocol which unified healthcare providers in a distinct approach to assessing and treating the infant with

NAS. Additionally, the literature revealed that education about a protocol, accompanied by information on the general topic of NAS and nursing care, had the potential to improve outcomes for these infants. This protocol-based approach, accompanied by interprofessional education, has been demonstrated by the literature to improve outcomes for infants with NAS, as evidenced by a decrease in length of stay (Bhatt-Mehta et al., 2014; Hall et al., 2014; Keels, 2010; Lucas & Knobel, 2012; Murphy-Oikonen et al., 2012; Napolitano et al., 2013).

Expanding the scope of the protocol and education on NAS to other organizations through dissemination at local and national conferences in both lecture and poster format has the potential to broaden the impact and provide impetus for other organizations to develop protocols. Utilization of the advanced capabilities of software, such as PowerPoint (Microsoft, 2014b), to convert a presentation into a video and then distributing it via web-based technology as was done in the IHPEN project, has the potential to reach a greater number of participants and further improve provider knowledge. Publication of the project in a peer reviewed journal would also broaden the impact of the project and provide evidence to support others in similar efforts.

Education, guidance, and mentorship. The need to "facilitate optimal care and patient outcomes" (AACN, 2006, p. 17) not only involves identification of opportunities for improvement in patient outcomes through a team approach, but also through supporting and promoting the efforts of nursing through education, guidance, and mentorship (Melnyk & Finout-Overholt, 2011; Melnyk, Finout-Overholt, Stillwell & Williamson, 2010). This approach has the potential to enable the bedside nurse to effectively transition to a new method of care delivery. It involves cultivating a nurturing environment in which learning can occur.

Improving care for infants with NAS by educating the healthcare providers addressed a knowledge gap that existed in the organization in which the IHPEN project was conducted. The

vast majority of these providers were staff nurses who have experienced frustration in caring for these difficult infants. Due to the inherent nurturing nature of the nurse-patient and nurse-family relationship, nurses in general may have a high vulnerability to moral distress, especially those in critical care, when they are unable to provide the level of care they aspire to (Cavaliere, Daly, Dowling, & Montgomery, 2010; Corley, 2002; Cronqvist, Theorell, Burns, & Lutzen, 2004; Elpern, Covert, & Kleinpell, 2005; Hefferman & Heilig, 1999; Janvier, Nadeau, Deschenes, Couture, & Barrington, 2007). Improving the bedside nurse's knowledge regarding effective strategies to calm and comfort infants with NAS, addressed the potential sequelae of moral distress nurses may be experiencing by providing them with evidenced-based effective interventions and strategies for care of these difficult infants (Maguire, Webb, Passmore, & Cline, 2012). Encouraging nurses to express their questions and concerns enables clarification of issues in a timely fashion.

To further promote sustainability of the practice change, new nurses and residents coming into the organization will require education on NAS and the EBP approach to care of the infant experiencing withdrawal. Intentional rounding on patients in the unit by the APRN who managed the project should continue in order to reinforce the strategies taught and encourage verbalization of questions regarding the care of these infants. This approach will also enable a conversation regarding other topics or clinical dilemmas to be addressed in the future.

Offering mentorship to nurses who might be interested in participating in additional endeavors related to NAS should be explored. Mentors are critical to a nurse's success as this relationship can be "an important catalyst in the development of future leaders and enhancement of leadership skills" (McCloughen, O'Brien, & Jackson, 2009, p. 327). This relationship creates the opportunity to encourage and promote innovation in practice, inspiring the mentee to

accomplish or contribute to the future improvement of outcomes for infants and families with NAS (Porter-O'Grady, 2011).

Nursing also has the opportunity to partner with volunteers in the organization to promote the use of their services in the NICU as "cuddlers" for infants with NAS. This program would bring in and train volunteers to hold and interact with these infants in the NICU when parents cannot be present. Although this would require an expenditure of time in training of the volunteers in effective calming strategies for infants with NAS, this cost might be offset by a decreased nursing time spent in calming an agitated infant.

Fiscal responsibility and cost of care. As leaders in healthcare, the DNP prepared APRN is charged with fiscally responsible healthcare delivery (Reineck, 2013). This includes a responsibility to both the patient and organization to evaluate care from all perspectives: quality, costs, and outcomes. The IOM (2001) provides guidance for evaluation of clinical effectiveness of care from the perspectives of safety, timeliness, effectiveness, efficiency, equitability, and patient-centeredness. Based on these perspectives, costs can be reduced by the standardization of care through implementation of EBP initiatives, error identification and reduction through examination processes, direct cost evaluation and comparison, and EBP based management of chronic diseases.

A limited chart review was performed to develop a better understanding of the significance of the problem of NAS at the current organization. Although the actual number of admissions with NAS per year represents a small percentage of the total NICU census, the number of admissions with this diagnosis have been steadily increasing over the past several years. In 2012 there were five admissions. The admission rate nearly doubled in 2013 to 11 patients, with a mean LOS of 36 days. Through the third quarter of 2014, 14 patients with NAS

were admitted with a mean LOS of 34 days. This represents a nearly 30% increase in admission for this diagnosis over the previous year, with a minimal reduction in the LOS. According to Patrick et al, (2012), the national average LOS for infants with NAS is 16 days. The organization at which the IHPEN project was conducted has the opportunity to provide more effective, cost efficient care of newborn infants with NAS through standardization of treatment with the protocol agreed upon, potentially decreasing their LOS (Hall et al., 2014).

Patrick et al. (2012) estimated the mean cost of hospital charges for infants with NAS at $53,400 and a mean LOS of 16 days, resulting in an estimated daily charge of $3337.50 (p. 1937). If this charge is applied to the mean LOS of 34 days at the NICU in which the IHPEN project was conducted, the average cost of care would be $113,475.00 per infant with NAS—more than double the national average. Reducing the LOS by approximately 25%, to 25 days, could result in an average savings of $30,037.50 per infant in hospital charges alone (see Table 7.1 for an annualized cost comparison by LOS). In addition, since infants with NAS are generally otherwise healthy, term gestation newborns, decreasing the LOS not only decreases hospital expenditure and the cost of their care overall, but may also open up NICU beds for more critically ill newborn infants.

Table 7.1

Annualized Hospitalization Cost Saving for NAS with 25% Reduction in LOS

Admissions	Cost per day	LOS	Total Hospitalization Cost per Year	
14	$3337.50	34	$1,588,650.00	
14	$3337.50	25	$1,168.125.00	
			Net saving to reduce LOS by 25%	$420,525.00

This cost analysis reflects an opportunity to not only address cost containment from an organizational perspective, but also from a societal burden in relationship to cost of care for healthcare. Since Medicare is the primary payor for infants with NAS (Patrick et al., 2012), reduction in hospitalization costs has the potential to impact the societal burden of care for these infants on a national level. Furthermore, since the state bears the brunt of the financial cost of the Medicare program, reduction in costs also impacts state expenditures. Although the methodology of one organization cannot simply be imported to another, as there are often different organizational support services, resources, and priorities, there is opportunity to use this as an example to other organizations. In addition, future analysis is warranted to compare the actual cost of hospitalization (versus billing) and evaluate for true cost-benefit comparison with implementation of the IHPEN project. There is also a need for research to identify a specific pharmacologic protocol as the most effective in treating withdrawal in infants with NAS.

Healthcare policy advocacy. The leadership responsibility for nurses extends to the legislative level with regards to both governmental and public health policy. Not only is there a responsibility to bring scientific knowledge into practice through EBP programs, but also into policies and programs, "evidence-informed policies" (Fielding & Briss, 2006, p. 969). Because nursing is a highly respected profession it is in a position to be influential in facilitating this important priority, utilizing health impact assessments, systematic reviews and "assuring community fit and feasibility" (Fielding & Briss, 2006, p. 971). Paralleling medicine and nursing, creating of public policy also involves both art and science (Brownson, Chriqui, Stamakis, 2009). Like medical care, public policy has the potential to impact every part of our lives. Nursing leadership can be influential in "assist[ing] people and policy makers to

understand the relations among behaviors, our environment and our health" (Fielding, et al., 2002).

Although the IHPEN project addressed the need of a single organization, the healthcare crisis of NAS is gaining momentum as a national issue. Numerous webinars have been recently held and posted calling for a more unified, national approach to this issue (Association of State and Territorial Health officials, 2014; Office of National Drug Control Policy, 2014; National Institute for Healthcare Management Foundation, 2014). The American Academy of Pediatrics (AAP) (Hudak & Tan, 2012) has published a recommendation, which could be construed as a mandate, that all hospital neonatal units develop and implement a protocoled approach to the care and treatment of infants with NAS. Thus, there is a great opportunity to effect change and improve outcomes for infants with NAS on a national level.

This crisis can only be truly addressed through attention to the women who use and abuse drugs and those who supply those drugs (Hays & Brown, 2012; Spitznas, 2014). Collaborative efforts to publicize the significance of this healthcare crisis are needed for neonatal units in the U.S. as the most recent survey on practice revealed a significant opportunity to address this issue (Mehta, Forbes, & Kuppala, 2013). On a governmental level, elements of the prevention of NAS are directed, not at the infant who is an innocent, but at the women and families of these infants. There is an opportunity, beyond the confines of the organization, to educate other healthcare providers regarding the impact of maternal opioid use and/or abuse and its effects on the newborn infant (Spitznas, 2014). In addition, public policy must also be evaluated for a negative or discriminatory impact (Carpenter, 2012; Roberts & Nuru-Jeter, 2010; Roberts & Nuru-Jeter, 2011; Roberts & Nuru-Jeter, 2012).

In January 2014, the State of Illinois introduced House Bill (HB4255) TANF – Substance Abuse Testing, filed by Representative Dwight Kay (R), proposing an amendment to the Illinois Public Aid Code (IPAC, 1967). This bill would require substance abuse testing for all applicants for Temporary Assistance for Needy Families (TANF, 1997). The purpose of TANF is to provide temporary financial assistance for pregnant women and families with one or more dependent children, helping to pay for food, shelter, utilities and expenses (excluding medical) (Illinois Department of Human Services, n.d.). Denying benefits as a result of HB4255 may place an additional hardship on the children of struggling parent(s), potentially reducing access to healthcare because financial resources may need to be re-prioritized. The bill's strictly punitive approach does not appear to provide a truly sound policy for the prevention of illicit drug use or the subsequent birth of infants with NAS. Furthermore, the brunt of impact of this legislation would be on the most vulnerable populations of pregnant women and children.

Rather than simply denying the benefits, defining an approach which includes referral for treatment along with scheduled retesting while receiving benefits would help provide a financial incentive while addressing the drug problem as well. The efficacy of this bill might also be enhanced if it merely screened, as opposed to testing, all applicants for illicit substances, and only required testing when there was a positive result from the screening process. The APRN has the opportunity to advocate for amending this policy through lobbying by the Illinois Society for Advanced Practice Nursing (ISAPN, 2014) to further improve outcomes for infant with NAS and their families.

In addition to evaluating state policy, there is a need for a federal mandate for the development of a protocol for NAS in every organization that cares for newborn infants, as legislative mandates "have the potential to encourage protocol development and shape protocol

content" (Zellman, Fair, Hoube, & Wong, 2002). APRN's participation in the development of a legislative mandate has the potential to de-stigmatize substance abuse and improve detection of at risk infants who might be missed because their mothers do not fall into the popular "at risk" categories.

Interprofessional collaboration. The American Association of Critical Care Nurses (2005) calls nursing to be "relentless" in their pursuit of "true collaboration" (p. 20). Collaboration requires mutual respect between healthcare providers. An intentional effort is required to promote this attribute, which is linked to how one perceives their contribution to the process as valued by the group. The most effective healthcare teams include members with a broad range of knowledge and experience enabling a dialog for patient care concerns which can be further addressed through EBP process change (Mitchell et al., 2012). For infants with NAS, this might include facilitating organizational participation in a national collaborative, such as the Vermont Oxford Collaborative, thus addressing the issue from a multisystem perspective.

Limitations of the Project

The IHPEN project was conducted in a 60-bed NICU and a 34-bed Mother-Baby Unit (MBU) of a large, urban, not-for-profit university-based level IV perinatal center in the State of Illinois. The target population included nurses and medical providers (attending physicians, residents, and advanced practice nurses) employed by or privileged in the NICU and MBU of a large, urban, not-for-profit, university-based, level IV perinatal center in the State of Illinois. This included 178 staff nurses, 11 neonatal nurse practitioners (NNPs), 47 residents (pediatric and med-peds), and 25 attending physicians (neonatologists and pediatricians). These healthcare providers were 18 years of age or older regardless of gender, religion, ethnicity, or years of service. The project design included a 20 question multiple choice pretest, two 30-minute video

presentations, and a 20 question multiple choice posttest, identical to the pretest, delivered through the organization's password-protected, web-based online learning system (OLMS) which is accessible by all employees both internally and remotely (e.g., from a home computer). This method of educational program delivery was chosen to provide maximum flexibility and ease of access, enabling participation by the large number of healthcare providers through 24-hour per day access to the materials. It also ensured that all participants were presented with exactly the same educational material presented in an identical format. The OLMS also insured sequential access to material: completion of the pretest was required before access to part one of the presentation was enabled; viewing of the part two video was required before access to the posttest was enabled.

A number of issues were encountered with the program's content delivery utilizing the organization's OLMS. In addition, only 12% of the medical providers (APNs, residents, and attending physicians) participated. This participation rate was not only lower than the desired 25% rate, but was dramatically lower than the 74% participation by the staff nurses, which was higher than the anticipated 50% rate. These issues resulted in significant limitations in the assessment of effectiveness of the intervention.

Program delivery. Initially, the plan discussed and approved by the OLMS staff included conversion of the PowerPoint slides into a flash video utilizing an add-in element which the program manager owned. However, after the flash video was created, the OLMS staff determined that this file type was not compatible with the OLMS. The program manager then copied the audio files into the PowerPoint presentations (part one and part two) and saved the files as MPEG-4 videos which could be uploaded into the OLMS.

Another issue was encountered when participants contacted the program manager about difficulty in playing the videos from computers within in the organization. The organization's information systems (IS) staff was consulted and determined that the problem was due to two issues: (a) the OLMS was hosted off-site and (b) the streaming of video over the internet was set to the lowest bandwidth priority by the IS department of the organization. These issues were remedied by uploading the videos to an onsite system and server which the OLMS was then able to directly link to. All participants were notified by email of the issue, progress on issue identification, and then again with the resolution of the issue. The participants were encouraged to contact the program manager if further issues were encountered in playing the videos. One complaint was received regarding audio issues with the video, but this was determined to be a user error. No further issues were communicated regarding accessing or playing the videos.

An additional issue surfaced approximately half-way through implementation when participants contacted the program manager regarding complaints of inability to "pass" the pretest or posttest. The participants were all emailed and reassured that the score was not relevant and it should be ignored. However, dissatisfaction with this resolution was communicated to the program manager as the module would not be cleared from their required education queue in the OLMS until they had "passed" the tests. Upon further inquiry with the OLMS staff it was discovered that although questions were intended to be coded as having *any answer* correct (i.e., a or b or c or d), the system interpreted this coding as the participants having to mark *all answers* correct (i.e., a and b and c and d). Thus providing only one answer (e.g., b) would result in it being marked incorrect. This issue could not be rectified directly. All participants were notified that all tests would be marked completed after the data collection was completed.

In addition, unbeknownst to the program manager, the OLMS defaulted to a passing score of 80%, which rectified by changing the passing score to 0% for those yet to participate. However if this was applied to those who had already taken the tests, they would be required to retake them in order to receive a passing score. It was decided that this would be rectified after the data collection was complete. All participants were again emailed regarding this issue with the OLMS.

This issue with scoring brought to light another issue in utilizing the OLMS for test analysis: participants were able to take tests multiple times. This finding skewed all aggregate data the OLMS collected making it unusable for accurate analysis as the OLMS collected and collated *each attempt* by every user. However, it was determined that the system did collect the details of each test attempt. Unit based CNSs then retrieved the test data for each participant and removed all identifiers before sending to the program manager. The program manager then manually entered the test data for the 141 participants into an Excel (Microsoft, 2014a) database to facilitate analysis of the results.

Participant participation. Although participation in the program overall was good (54%), there was significant issues in the OLMS delivery format, a prolonged surge in census, as well as a competing educational requirement for all providers. The primary type of participant was the nurse, with 131 participants, representing 93% of total participants and 74% of nurses overall in the target population. The nurses were primarily employed in the NICU, representing 64% of total nurses. The lowest number of staff nurse participants were from the maternal-child float pool (MCFP), which was anticipated because they are the smallest group of staff nurses, however they also had the lowest participation rate at 68%.

The participation rate by medical providers was only 12%, much lower than the goal of 25% participation. Of the medical providers, NNP participation was the highest with 27% participation. Attending physician's participation was the lowest at 8%. Resident participation was also low at 10% participation.

Although the overall rate of participation at 54% of the healthcare providers targeted for participation in the IHPEN project was acceptable (see Figure 6.1), the low rate of medical provider participation was unexpected. Aside from the NNPs who work in the NICU routinely, only 6 to 8 residents work in the NICU or MBU during a 4-week period of time, as the rest of their time is spent covering other services and clinics. Thus their interest in a medical condition affecting exclusively newborn infants in the NICU may have been low during the time period the IHPEN was offered. Pediatricians also sporadically staff in the MBU and neonatologists staff in 2-week periods of time in the NICU. The additional clinical and organizational responsibilities of these attending physicians may have impacted their interest in this topic or time to participate. It is also possible that physicians did not feel they needed this education—felt they already knew enough about the subject. The inability to obtain funds to support continuing medical education (CME) units also may have impacted the incentive for voluntarily participation.

It was anticipated that if the census would surge during the implementation time, all level of providers might be consumed with direct patient care, potentially working additional shifts and limiting the time for additional activities (e.g., education). This indeed was the case for the first 5 weeks of implementation. In addition, there were numerous issues with the OLMS regarding playing the videos and pretest/posttest scoring as outlined in Chapter 5. These issues created a great deal of frustration for some participants, which may have been communicated to other potential participants, decreasing their willingness to participate. There was also a

competing required educational program for all of the same providers, which may also have impacted participation

Low posttest scores. While there was a trend toward improvement from mean pretest to posttest scores, composite mean for the pretest scores was 79% and the composite mean for the posttest scores was 82%. This represented a small (3%), but statistically significant improvement ($p = 0.000164$) from pretest to posttest. Inspection of individual test scores revealed that 71 participants (53%) improved their scores from pretest to posttest with 73% scoring 80% or greater on the post test. On the pretest, 40% of the participants scored 75% or less, whereas only 27% of the participants scored 75% or less on the posttest.

Of the 71 participants whose scores improved from pretest to posttest, 59% (32% of all participants) improved their score by at least 10% and 13 participants improved by 20% or more. The benchmark for knowledge increase was determined to be 10%, thus an increase from pretest to posttest of at least 10%, by 32% of the participants demonstrated the intervention was at least partially effective.

The low composite mean test score could be explained by a number of factors. First, the design of the education may not have strongly enough emphasized the items that were included in testing. Second, the test questions may not have been "good questions," as they were obtained from another source without established validity or reliability other than having been developed by experts in the field. Third, the questions and/or distractors might not have been clearly termed or there may have been too many questions (Considine, Botti, & Thomas, 2005; Cook, Thompson, & Thomas, 2014). Inspection of the questions answered incorrectly on both tests may be helpful to explain why 45% of the participants had no or a negative change in pretest to posttest score.

Another finding of concern was the *decrease* from pretest to posttest scores for a number of participants. This occurred in 35 participants (26%). Also the scores of 25 participants (19%) had no change from pretest to posttest. Again, although disappointing, these findings might be related to the global issues with utilizing the OLMS to conduct the testing. The program was created in two modules to provide flexibility in time management and participation. Because participants were not blinded to the results of the test, there was much anxiety about "passing," with many participants taking the pretest multiple times. When the announcement was received to only take each test once, they might not have made the same effort with the posttest as they may have with the pretest. In addition, in an attempt to encourage participation and decrease anxiety in the participants, they were instructed to "ignore" the test scores. This may have negatively impacted their motivation to even attempt to answer the question correctly.

Despite the low improvement rate from pretest to posttest, it was a statistically significant improvement. A paired-sample *t*-test was conducted to compare the difference in mean pretest and posttest scores. A significant difference in the scores from pretest to posttest, ($M = 79$, $SD = 8.1$) and posttest ($M = 82$, $SD = 8.8$); conditions $t(132) = 3.69$, $p = 0.000164$ was detected.

Plans for Future Projects

The IHPEN project represented an initial attempt to address the problem of NAS at a single organization. There is need for continued leadership, as well as monitoring of metrics, such as compliance with protocol by providers, interrater reliability in assessment by nurses, and evaluation of patient length of stay, to ensure the sustainability of the practice change. These measures will promote the understanding of the impact of the practice change while identifying further measures needed going forward to promote permanence or improvement.

In light of the low average posttest scores further education may be needed to expand upon concepts which were not clearly addressed in the initial IHPEN intervention. In addition, the OLMS proved to have significant limitations for program distribution and evaluation. Further initiatives could include more novel interactive formats, such as games, competitions, and simulation (Baid & Lambert, 2010) and utilization of new technologies, such as Prezi (2014), to engage learners in a non-linear lecture type format (Duffy, Guerandel, Casey, Malone, & Kelly, 2014).

There is a need to increase awareness of the significance of the problem of NAS and its impact on the healthcare system, the nurse, the infant, and on the families. In order to facilitate this, the IHPEN project could be presented in both podium and poster format at national forums, such as the National Association of Neonatal Nurses (NANN), Association for Women's Health, Obstetric, and Neonatal Nurses, Academy of Neonatal Nurses, and the Advanced Practice Forum (an annual conference for neonatal APRNs). In addition, a learning module could be developed for distribution by web or digital technology (e.g., DVD) to further enhance the opportunity for nursing education on NAS nationally.

Development of a "cuddler" program in which adult volunteers would be trained in comforting (holding and interacting) infants with NAS in the NICU could implemented. This program would have the potential to decrease the demand on nursing time by providing the calming interaction these infants so desperately need. It would require the development of a structured education for adult volunteers to hold and interact with infants with NAS in the NICU when their parents cannot be with them. Measurement of efficacy of such a program could be accomplished through both nursing and parent satisfaction surveys.

Conclusion

Caring for neonates with NAS can be extremely challenging. (Jansson & Velez, 2012; Logan, Brown, & Hayes, 2013; Osborn, Jeffery, & Cole, 2010). Their protracted hospitalization results in nurses caring for these difficult, time consuming patients for prolonged periods of time. Promoting EPB at the bedside is challenging (Ogrinc et al, 2012) as there are many competing requirements for nursing is time, along with a need for balance with respect to their personal life. Because a thoughtful, intentional, and organized approach to optimize outcomes is required, change should not be expected as an immediate result. Change takes time and the DNP prepared nurse should be the conduit for EBP change, not the instrument (Melnyk & Fineout-Overholt, 2011).

The outcome of the IHPEN project as designed, was measured as an immediate change in knowledge as the result of an educational intervention. The benchmark of 10% improvement from pretest to posttest score was partially met in that 32% of the participant's score improved by at least 10% from pretest to posttest. In addition, the improvement was statistically significant at $p = 0.000164$. The small, but statistically significant improvement from pretest to posttest scores could be viewed a requisite need to address the knowledge deficits in a more comprehensive fashion. From the same perspective, although the low physician participation was disappointing, this also may be an indication of a need for change at an organizational level with an emphasis on the importance and significance of interprofessional education.

Going forward, there are multiple opportunities to expand on the IHPEN project and impact nursing practice, as well as improve the care for infants with NAS and their families. Partnering with social services, lactation, substance-abuse programs, parents, and volunteers has the potential to improve outcomes for infants and improve nursing care. Prospectively

evaluating the length of stay for infants with NAS will enable further understanding of the effectiveness of the protocol implementation at this organization. Dissemination of the results through podium and poster presentations has the potential to increase awareness of this issue and the need for effective strategies to address it at a national level.

Chapter Eight: Summary and Conclusion

Neonatal Abstinence Syndrome (NAS) is serious national healthcare crisis and significant clinical issue which neonatal healthcare providers are facing with increasing frequency (Hays & Brown, 2012; Pan & Yi, 2013; Substance Abuse and Mental Health Services Administration, 2013). Prolonged prenatal exposure to opioids, illicit substances and prescription pain killers, leads to withdrawal in newborn infants (Behnke & Smith, 2013), who are then commonly admitted to neonatal intensive care units (NICU). Inadequate understanding of the most effective treatment strategies may lead to inconsistent treatment, resulting in insufficient control of withdrawal symptoms and prolonged, costly hospitalizations (Behnke & Smith, 2013; Hudak & Tan, 2012; Patrick et al., 2012). In order to improve outcome for infants with NAS, a coordinated, intentional approach to care by both nursing and medicine is needed. The American Academy of Pediatrics (AAP) has published a recommendation, which could be construed as a mandate, that all neonatal units develop and implement a protocol-based approach for the care of infants with NAS (Hudak & Tan, 2012).

Problem

An evidence-based practice (EBP) change project was designed to address the challenges in caring for and treating the newborn infant with NAS: the "*Interprofessional Healthcare Provider Education on NAS*" (IHPEN). The need for the project emerged from the following observations: (a) increasing numbers of patients admitted to the NICU who were diagnosed with NAS, (b) long lengths of stay for infants with NAS, (c) an inconsistent approach to the pharmacologic treatment and weaning of medications because of a lack of a protocol for infants with NAS, (d) frustration expressed by all neonatal healthcare providers as how to "best" handle infants with NAS, and (e) a need for staff education on the topic of NAS. The project was

designed to increase healthcare provider knowledge about NAS and implement a protocol for the assessment and treatment of infants with or at risk for NAS. The ultimate goals were to improve the care and comfort of infants with NAS through a more consistent approach, decrease overall and/or individual infant composite withdrawal scores, and reduce the hospital length of stay for infants with NAS, thus improving outcomes for these infants as well as decreasing the societal burden of the cost of their care.

Evidence Base

An in-depth literature review was conducted, guided by the clinical question, "*Does interprofessional education including implementation of a protocol for infants with NAS increase healthcare provider knowledge, ultimately improve consistency in assessment and treatment of these infants, as well as decrease individual infant composite withdrawal scores length and of hospital length of stay*?" This review resulted in a dearth of evidence to support the efficacy of any single specific treatment strategy as superior to another. However there was strong evidence to support implementation of a protocol to standardize the approach to the evaluation and treatment of infants with NAS in improving the infants' outcomes (Bhatt-Mehta, Ng, & Schumacher 2014; Hall et al., 2014; Murphy-Oikonen, Montelpare, Bertoldo, Southon, & Persichino, 2012; Napolitano, Theophilopoulos, Seng, & Calhoun, 2013).

Despite the fact that education on a protocol is frequently the first step in dissemination of information regarding protocol or practice guideline implementation, this step is not consistently reported nor measured as an outcome. The literature supported the role of education for healthcare providers not only in knowledge gain and increased compliance with a protocol by the providers, but also in heightened awareness of and sensitivity to the signs and symptoms of withdrawal in the infant with NAS (Bhatt-Mehta et al., 2014; Lucas & Knobel, 2012; Keels,

2010; Napolitano et al., 2013). Furthermore, education has the potential to deepen the understanding of opioid abuse as a chronic, treatable disease and dispel myths which may lead to bias in care (Center for Substance Abuse Treatment, 2009).

Planning/Preparation

Lewin's Change Theory (1947) was the model which supported implementation of the IHPEN project from a theoretical perspective (Shirely, 2013). This theory facilitated understanding of the process of introduction and implementation of a practice change. The "Rush Way" model for organizational change and clinical practice improvement guided the implementation of the IHPEN project practice change. The metric chosen to evaluate the practice change was a surrogate measure for the direct evaluation of improvement in outcomes for infants: knowledge gain resulting from education evaluated using a classic pretest-posttest methodology.

A project team was assembled to ensure all aspects of the project were clear and in line with organizational priorities, as well as to evaluate for threats to the success of the project. It was determined that all neonatal healthcare providers (staff nurses, neonatal nurse practitioners, residents, and attending physicians) who worked in the NICU and mother-baby units (MBU) would be included in the training. Approval of the IHPEN project was granted by the institutional review board of the organization at which the project was implemented.

Implementation

The educational component was delivered through a narrated slide presentation developed using PowerPoint (Microsoft, 2014b) which was then converted to two 30-minute movies (MP4 files). A 20-question multiple choice pretest and posttest was designed utilizing questions developed by international researchers and experts in NAS (Vermont Oxford Network,

2014). The presentation and test were distributed through the organization's password protected online learning management system (OLMS), ensuring all participants were presented with exactly the same educational content presented in an identical manner, with 24-hour per day availability. It was a required learning module for nurses, who also received continuing education credits (CEUs) for attending the program if they completed a program evaluation. Attending physicians (neonatologists and pediatricians), residents (pediatric and med-peds), and neonatal nurse practitioners were invited and encouraged to participate. Data from the pretests and posttests was de-identified by removal of participant name and employee number before sending to the project manager for statistical analysis. The tests were then evaluated utilizing a classic paired pretest-posttest methodology for knowledge gain.

Findings

Within the 8 weeks the IHPEN program was available in the OLMS, 141 healthcare providers participated. Of these, 133 (94%) completed both the pretest and the posttest, enabling comparison data. The primary participant type was nursing, with 131 participants, 93% of total participants and 74% of possible staff nurses, exceeding the goal of 50% participation by nursing. Although attending physicians were asked to participate, only two completed the modules in the OLMS (8% of attending physicians). Resident participation was also low at 5 participants (10% of residents). NNPs with 3 participants exceeded the expected 25% participation rate at 27%. The combined medical provider participation (physicians, residents, and NNPs) was 10 participants representing 7% of total participants and 12% of medical providers, significantly less than the goal of 25% participation.

Both pretest and posttest scores ranged from a maximum of 100% to minimum of 60%. Seventy participants (53%) improved their scores from pre- to posttest. The benchmark for

knowledge increase was determined to be 10% which mirrored that of a supporting study on an educational intervention for infants with NAS (Lucas & Knobel, 2012). Thus an increase from pretest to posttest of at least 10%, by 32% of the participants demonstrated the intervention was at least partially effective.

Evaluation of change in knowledge pretest to posttest was also measured by a paired-sample *t*-test for pretest to posttest scores and for each category (group) of healthcare provider. A significance of $p < 0.05$ in difference between pretest and posttest score was selected as representing "improvement" in knowledge. The results from the paired-sample *t*-test indicated a significant difference in the scores for pretest (M = 79, SD = 8.1) and posttest (M = 82, SD = 8.8); conditions $t(132) = 3.69$, $p = 0.000164$. Thus the identified goal for a significant increase in knowledge related to the educational intervention of the IHPEN project was met.

Implications

The outcome of the IHPEN project as designed, was measured as an immediate change in knowledge as the result of an education intervention. Although only 32% of the participants reached the benchmarked level of improvement of 10% from pretest to posttest, 53% percent of the participants improved their pretest to posttest score. Although the increase in score from pretest to posttest was statistically significant ($p = 0.000164$), comparison of the answer responses between pretest and posttest may be helpful to identify any improvements needed in the education intervention as well as any poorly constructed test items.

Nurses were also provided CEUs if they completed a program evaluation. Of the 53 program evaluations submitted, it could be concluded that the program was very well received as the 95% stated they agreed or strongly agreed with the effectiveness of the teaching method. In addition, 100% indicated that they acquired knowledge and or skills from the program and would

apply that knowledge to their professional practice. Thus, it was perceived to be a significant learning opportunity by nursing.

Going forward, there are multiple opportunities to expand on the IHPEN project. Improving medical staff participation by emphasizing the importance and significance of interprofessional education will help ensure sustainability and effectiveness of this NAS protocol. Partnering with social service, lactation, substance-abuse programs, parents, and volunteers has the potential to enhance outcomes for these infants and to improve nursing care. Prospectively evaluating the length of stay for infants with NAS will provide further understanding of the effectiveness of the protocol implementation at this organization. Dissemination of the results through podium and poster presentations at local and national forums has the potential to increase awareness of this issue and effective strategies to address it on a national level.

Final Conclusions

The IHPEN project was developed to address a the following concerns regarding infants with NAS: (a) increasing numbers of patients diagnosed with NAS admitted to the NICU, (b) long lengths of stay for infants with NAS, (c) a varied and inconsistent approach to pharmacologic treatment and weaning of infants with NAS (lack of a protocol), (d) frustration expressed by all neonatal healthcare providers as how to “best” handle infants with NAS, and (e) a need for staff education on the topic of NAS. The project included the implementation of a protocol to increase the consistency of treatment for infants with NAS and the provision of healthcare provider education intended to increase knowledge regarding NAS, as well as sensitivity to the signs and symptoms of withdrawal.

The project was not only well received, as demonstrated by high nursing program evaluations, but there was a statistically significant trend toward improved pretest to posttest scores ($p = 0.000164$). Although participation in the program by the physicians was lower than expected this could be attributed to the significant issues in the OLMS delivery format, the fact that participation was voluntary, a prolonged surge in census, and a competing educational requirement. Ultimately, comparing the length of stay for infants with NAS before and after implementation of the intervention will provide validation of any improvement in the outcomes for these infants.

The fact that NAS is a national healthcare crisis is clear (Hays & Brown, 2012; Pan & Yi, 2013; Substance Abuse and Mental Health Services Administration, 2013). The escalation of the incidence of NAS along with the cost of the prolonged hospitalization of these infants is a strong indication of a need for an effective intervention (Patrick et al., 2012). The outcome of the IHPEN project supported the importance of providing comprehensive, interprofessional education on the introduction of protocol, along with assessment and treatment of infants. This approach has the potential to enhance communication and collaboration between nurses and medical staff, relieve caregiver distress, and improve outcomes for infants with NAS at a large, urban, not-for-profit university-based level IV perinatal center in the State of Illinois from an EPB perspective.

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Appendix A

Educational Program Content

- Definition of the problem of substance abuse in pregnancy and prevalence.
- Effects of maternal substance abuse on the fetus and newborn.
- Identification of the signs and symptoms of withdrawal.
- Application and use of a valid and reliable NAS scoring tool.
- Nonpharmacologic interventions to be employed for infants with withdrawal.
- Definition of the threshold for pharmacologic treatment and weaning.
- The pharmacological algorithm for treatment of NAS.
- Discharge criteria and follow-up needs for infants with NAS.
- The impact of NAS on the family of the infant.

Educational Learning Objectives:

Upon completion of this program, the learner will:

1. Define the problem of substance abuse in pregnancy, prevalence, and its effects on the fetus and newborn infant.
2. Identify the signs and symptoms of withdrawal in the newborn infant and scoring with the NAS assessment tool.
3. Develop an understanding of pharmacologic and non-pharmacologic management strategies for the infant withdrawing from prenatal exposure to opioids.
4. Describe the criteria for discharge and follow-up needs of the infant after hospitalization.F