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The effects of perinatal methamphetamine use on maternal and child outcomes: implications for education among BSN nursing students

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The Effects of Perinatal Methamphetamine Use on Maternal and Child Outcomes:
Implications for Education Among BSN Nursing Students

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Departmental Honors Thesis
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Dedication

To my father Thanh V. Nguyen and my mother Sunnie T. Nguyen, who surpassed a number of life-altering milestones and immigrated to the United States of America in order to establish a new foundation upon which their children could pursue a lifestyle that they were not given the chance to live, one with opportunities for academic and personal success.

Abstract

The implications of methamphetamine use are vast and prevalent in the U.S. This epidemic is also well recognized in Tennessee and in Hamilton County. The number of men and women that continue to use methamphetamine speaks to the importance of this issue. Among these individuals, pregnant women comprise a significant portion of female methamphetamine users across the United States. The potential complications that can arise for not only a mother but also her child due to maternal methamphetamine use pose a much more significant issue. The detrimental effects that a child can experience as a result of maternal methamphetamine use during pregnancy can potentially lead to ramifications that remain with the child throughout the duration of its life. A methamphetamine using woman should be aware of the negative complications that methamphetamine use may have on her and her child, both in utero and long term.

The purpose of this study was to provide educational content on methamphetamine, the general effects of methamphetamine use, and the effects of perinatal methamphetamine use on maternal and child outcomes. Since limited knowledge on this topic is currently made available to nursing students, this project took a unique approach to enhancing the practice of nurses by educating nursing students so that they are better equipped to recognize methamphetamine users in the clinical arena and to increase awareness and knowledge through education in order to increase prevention and reduce the rate of disease. PRE/POST surveys were used to assess level of knowledge prior to and following an educational presentation of methamphetamine content. Teaching was performed through the use of a standardized patient role scenario and electronic Prezi presentation.

At the conclusion of the study, a comparison of the PRE/POST data illustrated an apparent knowledge deficit regarding the effects of perinatal methamphetamine on maternal and child outcomes among the third level nursing students enrolled in the maternal-childbearing course. Results from the quantitative data indicated a significant increase in student knowledge from PRE to POST test ($t(33) = -16.94, p < .001, d = 3.66$). Qualitative data reflected in the students' written responses showed that information acquired from the study is anticipated to be used in future clinical practice. Four major themes emerged from the qualitative data: (1) teaching others, (2) identification of drug use, (3) patient care, and (4) overall presentation benefit. The increased ability to demonstrate these major themes as a result of increased knowledge will subsequently enhance the students' practices as nurses. This was expressed through the student's reflection statements. From the data, it is evident that the students displayed a statistically significant increase in knowledge and awareness that has the potential to positively influence their professional nursing practices. This project is the first of many steps that will hopefully be taken in the future to combat the problem surrounding methamphetamine use. Continuous education through the use of additional teaching strategies may continue to enhance student knowledge in other settings outside the medical arena and among larger populations. Continued education can potentially reduce the incidence and prevalence of methamphetamine.

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Tennessee Meth & Pharmaceutical Task Force

Chapter 1

Introduction

Like many other illicit drugs, such as cocaine, heroin, and marijuana, methamphetamine use continues to be a popular trend among drug users. Within the United States, current methamphetamine use has been well established and prevalence of use continues to escalate. Methamphetamine is especially notable due to the fact that, in contrast to other substances, it is a non-naturally occurring product that is synthetically derived from a combination of store-bought chemicals. Aside from the ease of accessibility of these products, the effects produced by consumption of methamphetamine pose an even greater threat and lend to the detrimental nature of this drug.

Methamphetamine produces a number of effects which are deemed desirable to the user and serve as a primary motive for methamphetamine-seeking users. The duration of these effects in the body vary as methamphetamine produces both short-term and long-term effects. However, there are also a number of unfavorable effects that occur as a result of methamphetamine consumption. There are a multitude of short-term effects as well as long-term effects. In addition to the multitude of short-term acute effects, there is an even greater number of long-term chronic effects that occur as result of methamphetamine use. A lack of treatment for drug use or cessation of use altogether can often lead to irreversible damages that could further result in death. The detrimental effects of methamphetamine significantly influence not only the primary user of the drug but, consequently, all individuals that are also

secondarily exposed to the drug and its associated toxins. In addition to the overall destructive nature that methamphetamine has on a pregnant woman, for example, methamphetamine also leaves a profound impact on the fetus or neonate that is unintentionally exposed to the drug.

Recognizing the growing prevalence of methamphetamine use, particularly among pregnant mothers as well as women of childbearing age, The American Congress of Obstetricians and Gynecologists (ACOG) has formulated and implemented a protocol as a means to combat this issue through establishing methods for identification and assessment of methamphetamine use (The American Congress of Obstetricians and Gynecologists, 2011). The Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN) has also implemented recommendations regarding identification of methamphetamine users. However, despite their best efforts, the number of maternal methamphetamine users and secondarily exposed children continues to rise as many are not adequately identified and assessed so that sufficient treatment strategies can be developed and implemented. For this reason, increased knowledge of the effects of methamphetamine use is necessary. Education as a means of health promotion and disease prevention may be a potentially beneficial approach to combatting the issue surrounding perinatal methamphetamine before the implementation of treatment interventions becomes necessary.

Statement of the Problem

The prevalence of methamphetamine use continues to be an escalating concern. In contrast to other illicit drugs, methamphetamine is unique in that it is the

only substance that can be manufactured from accessible store bought chemicals. Methamphetamine use produces numerous acute and short-term effects. The acute and short-term effects of methamphetamine include increased attention, decreased fatigue, increased physical activity and wakefulness, decreased appetite, heightened euphoria and rush, increased respiration, rapid or irregular heartbeat, and hyperthermia (National Institute on Drug Abuse, 2012). The chronic and long-term effects of methamphetamine are comprised of but are not limited to anxiety, depression, confusion, insomnia, paranoia, aggressions, mood disturbances, delusion, skin problems, severe weight loss, dental problems, problems with thinking, emotion, and memory, progressive social and occupational deterioration, verbal learning impairment, motor slowing, suicidal ideation, and visual and auditory hallucinations (National Institute on Drug Abuse, 2012). The accumulation of these effects can contribute to further complications that include a series of cardiovascular, respiratory, neurologic, and psychological related issues which, if not treated, can ultimately lead to death.

In addition to its highly addictive nature, methamphetamine also induces immediate drug tolerance. Frequent use of the drug produces an increased tolerance to the effects of the drug. Therefore, the user is led to seek out the drug more often and in greater quantities. Additionally, the severe negative effects of methamphetamine do not always conclude at the point of withdrawal. Withdrawal from methamphetamine use often leads to additional physical and psychological disturbances. Therefore, increased drug consumption in frequency and amount is

often a result because continuous use of the drug allows the user to continue to experience the so-called desired effects of the drug while simultaneously avoiding the negative effects that can occur as a result of drug withdrawal. On the other hand, this only serves as a temporary solution, and in actuality, is no solution at all because more frequent and increased use also leads to a greater potential for increased and more severe negative effects. The implications of methamphetamine use are profound and the aforementioned qualities of methamphetamine are indicative of its unfavorable nature and dangerous impact on both secondary and primary users.

Worldwide, methamphetamine is second only to marijuana as the most widely used illegal drug among 15- to 64-year olds, with a prevalence of 14 to 57 million, or 0.3% to 1.3% (Gorman et al., 2014). One estimate is that 35 million people worldwide regularly use methamphetamine (McGuinness and Pollack, 2008). Nationally, while methamphetamine use was once considered an illicit drug use phenomenon prevalent in the West and Midwest regions of the United States, the geographical divide no longer holds true. The areas in which methamphetamine use continues to be the highest include the western states where methamphetamine is the third most commonly abused substance after alcohol and marijuana. However, methamphetamine use has expanded across the country (Gorman et al., 2014). Most recently, the trend has spread east and has established a strong foundation in both the Southern and Eastern regions of the United States. According to the United States Drug Enforcement Administration's National Clandestine Laboratory Register (2014), there are known methamphetamine laboratories in all 50 states, which implies

that the production, use, and sale of this drug is a nationwide trend. The United States Drug Enforcement Agency reports that seizure of clandestine methamphetamine laboratory sites grew from 7,439 in 1999 to 17,170 in 2004 (U.S. Department of Justice, 2006).

Since 2002, the number of new users of methamphetamine has remained steady at about 300,000 per year, doubling the rate of new initiates in the 1990s (McGuinness & Pollack, 2008). The lifetime prevalence rate had grown to 12 million Americans by 2004 (McGuinness & Pollack, 2008). In 2009, 12.8 million individuals aged 12 and older reported using methamphetamine at least once in their lifetime (Twomey et al., 2013).

In 2014, the estimated 1.6 million people aged 12 or older who were current nonmedical users of stimulants included 569,000 people who were current methamphetamine users. This statistic represents 0.2 percent of the population aged 12 or older who were current users of methamphetamine in 2014 within the past month, while 4.9% of individuals aged 12 and older were reported to have used methamphetamine at least once in their lifetime in 2014 (National Institute on Drug Abuse, 2012). To date, almost 11 million Americans have tried methamphetamine at least once. Of those 10.3 million, 1.3 million used methamphetamine in the last year (2015); and 512,000 used it within the last 30 days (Drug Policy Alliance, 2016).

The number of emergency department (ED) visits also rose as cases related to methamphetamine consumption became more prevalent. The number of methamphetamine-related visits to emergency departments increased from 67,954 in

2007 to 102,961 in 2011, with similar patterns seen for males and females. As reported by the Drug Abuse Warning Network in 2011, of the 102,961 total emergency department visits involving methamphetamine, methamphetamine was documented as the sole and primary substance of abuse among 39,434 cases (Substance Abuse and Mental Health Services Administration, 2014). There was an increase in emergency department visits from 44,008 in 2007 to 63,092 in 2011 among males and an increase from 23,942 in 2007 to 39,869 in 2011 for females (Substance Abuse and Mental Health Services Administration, 2014). Based on these statistics, it is clear that the national incidence of methamphetamine use continues to be an issue, though some states are involved with greater incidences of methamphetamine use than others. Among these states, Tennessee is considered one of the top methamphetamine states in the country.

Local manufacturing of methamphetamine is second only to cocaine trafficking in the state of Tennessee. Clandestine methamphetamine labs in central and southeastern Tennessee have reached epidemic proportions. It has been estimated that there is at least one methamphetamine lab either located or seized somewhere in the state every day (National Substance Abuse Index, n.d.). According to the Tennessee Meth & Pharmaceutical Task Force (2016), there have been 11,149 methamphetamine lab seizures in Tennessee since 1999. In 2015, there were 582 meth lab sites reported by law enforcement officers in Tennessee. A record amount of 2,082 methamphetamine lab seizures was recorded in Tennessee in 2010. In 2013, Tennessee led the nation in methamphetamine use. Since then, Tennessee has ranked

among the top three states for methamphetamine use, even ranking second for the highest incidence of methamphetamine use in 2015 (Phillips-Jones, 2015).

In Hamilton County alone, the Tennessee Meth & Pharmaceutical Task Force reported 104 methamphetamine laboratory seizures out of the 2,082 total seizures in 2010 (Tennessee Dangerous Drugs Task Force, 2016). Hamilton County was ranked 4th out of the 95 total counties for the most methamphetamine lab seizures in 2010 (Tennessee Dangerous Drugs Task Force, 2016). In 2015, five methamphetamine lab seizures were reported in Hamilton County. A combined total of 21 seizures were reported in the counties surrounding Hamilton County (Tennessee Dangerous Drugs Task Force, 2016). Due to the high prevalence of methamphetamine use in Hamilton County and its surrounding counties, the city of Chattanooga and Hamilton County are currently the home of the Tennessee Dangerous Drugs Task Force, previously known as the Tennessee Meth and Pharmaceutical Task Force. The establishment of this task force in Chattanooga is a direct response to the fact that methamphetamine is a significant concern that has spread far beyond the western region of the United States and has established a home in Tennessee, in Hamilton County, and other areas surrounding the Chattanooga area.

Among methamphetamine users, both worldwide and across the United States, women continue to make up a large portion of this population. In contrast to other drugs of abuse, more women than men are first-time users and comprise one-half of those seeking treatment for methamphetamine use (LaGasse et al., 2012). Data obtained from treatment centers across the United States in 2003 showed that 45% of

patients treated for methamphetamine abuse were women. The continued use of methamphetamine among women is especially worrisome because the potentially adverse health risks may be greater for women than men.

The results of a study by Maxwell and Rawson (2014) also revealed that women became dependent on methamphetamine sooner than men, initiated methamphetamine use in an attempt to alleviate depression, and had higher rates of childhood sexual abuse in comparison to men. Similarly, Rawson, Gonzales, Obert, McCann, and Brethen (2005) found that young women reported more methamphetamine use, became dependent on methamphetamine within a shorter period of time, and suffered more adverse effects than did young men. After controlling for age and race, more women than men were dependent on methamphetamine and identified methamphetamine as their primary drug of choice.

Overall, methamphetamine use continues to be prevalent among female illicit drug users. Maxwell and Rawson (2014) illustrate how methamphetamine appears to affect women more greatly than men. This raises alarming concern due to the fact that increased incidence of methamphetamine use in women can lead to the potential for more severe implications for not only the women but also the children she may bear. According to the Center for Disease Control (2012), the childbearing age is considered to range from 15-44 years of age, though reports have confirmed the possibility of bearing a child as young as 12 years old, with the average age of menstruating onset being 12.5 years old (Reference, n.d.).

The significance behind the prevalence of methamphetamine use among women is due largely in part to the fact that the female population is also inclusive of both adolescents of childbearing age as well as women who are already pregnant. Women who are pregnant and using methamphetamine are placing their children in danger. Increased primary methamphetamine use by the mother leads to increased secondary methamphetamine use by her unborn child. Similarly, adolescents who could potentially become pregnant are not only harming themselves, but they are also putting their future children at risk of secondary exposure. As women and adolescents continue to use methamphetamine, their children are ultimately influenced by their choice to use methamphetamine.

In contrast to alcohol, smoking, and marijuana, the amount of literature related to methamphetamine use, particularly in pregnancy and among women of childbearing age is limited. In addition to the limited amount of literature on the effects of methamphetamine use, determining the effects of isolated methamphetamine use can be complicated because women who use methamphetamine frequently use tobacco, alcohol, and other drugs (The American College of Obstetricians and Gynecologists, 2011). The combination of these drugs may confound birth outcomes, and therefore, lead to varying results regarding the specific effects of methamphetamine. However, while limited, the current available literature illustrates a small but, nonetheless, noteworthy number of studies that are significant for outlining the isolated effects of prenatal methamphetamine use on maternal and neonatal complications during and after pregnancy.

The maternal complications that can ensue due to methamphetamine use include pregnancy-associated hypertension, preeclampsia, eclampsia, and placental abruption. In regards to child outcomes, methamphetamine has been shown to increase the risk of birth by cesarean section, premature birth, low birth weight, growth restriction, and both fetal and neonatal death. Though limited, current research has also shown that these deviations can lead to long term deficits that affect the cognitive, motor, physical, and neurobehavioral development of the child.

Given the potential risks to maternal, fetal, and infant health and well-being with methamphetamine use in pregnancy, identification of use is important, according to the American College of Obstetricians and Gynecologists (ACOG) as well as The Association of Women's Health, Obstetrics, and Neonatal Nurses (AWHONN), which states that "early identification...of women with substance use disorders and/or dependence is a critical component of preconception and prenatal care and is important for supporting healthy birth outcomes" (The Association of Women's Health, Obstetric and Neonatal Nurses, 2015). In addition to identification of methamphetamine use, adequate assessment is vital guiding the appropriate method of treatment and, thus, ensuring that sufficient patient care is being provided.

The multitude and severity of the outcomes due to primary and secondary methamphetamine use and exposure indicate a heightened demand for the provision of education and awareness among current and future health care professionals regarding this pertinent topic. Considering the fact that methamphetamine use in pregnancy continues to be a significant problem, the focus of educational awareness

relating to maternal methamphetamine use in pregnancy must be centralized on the deleterious effects of primary and secondary methamphetamine exposure. Increased knowledge of the effects of methamphetamine allows health care professionals to more successfully recognize and assess methamphetamine users.

Statement of the Purpose

The purpose of this project is to educate and prepare baccalaureate nursing students regarding the effects of methamphetamine on maternal and child outcomes. They will be educated on how to identify individuals who are using methamphetamine or exposed secondarily. Since the amount of knowledge made available on this particular topic to nursing students is very limited, increasing familiarity and understanding on specific information regarding methamphetamine will increase their awareness of methamphetamine use and the effects of use on their patients. Although nursing students may pursue different paths within the nursing profession, they will be aware, in any case, of the detrimental effects of methamphetamine on a mother and her child and will therefore be prepared to properly identify methamphetamine use and to disseminate this information to others.

Thus far, the recommendations set forth by ACOG and AWHONN serve as the sole standard for identification relating to methamphetamine use. While they are effective, they, alone, have not been successful in treating the continued prevalence of methamphetamine use. A proactive approach to addressing this problem is increasing education that is directed towards the negative effects of methamphetamine on

maternal and child outcomes and the signs and symptoms that are manifested in primary and secondary methamphetamine users.

Due to the danger that methamphetamine use and exposure poses, particularly during pregnancy, the focus of education should be directed at educating nurses on the effects of methamphetamine use as well as signs and symptoms that are indicative of methamphetamine use. Nurses are on the frontline of resistance to methamphetamine abuse in the United States and, through the education and knowledge they possess regarding various health-related clinical and nonclinical functions, assume key roles in protecting families and children from this drug within the health care setting.

In the perinatal setting, nurses carry the responsibility of providing holistic patient-centered care and taking into consideration what is best for both the expecting mother and child through every clinical decision and action. By educating and empowering nurses on avenues for identification through increased knowledge of methamphetamine abuse, nurses can continue to succeed in providing patients with the optimal care they deserve by educating them. Nurses who are keenly aware of the adverse maternal, fetal, and neonatal effects of methamphetamine will be able to identify qualities characteristic of methamphetamine use and exposure and utilize this knowledge to identify methamphetamine use. Nurses can, in turn, spread their knowledge by educating other health care professionals, and especially, the patients that they encounter. As a result, they are not only enhancing their practice as nurses, but also contributing to the cause to cease methamphetamine use.

Conceptual Framework

Due to the heightened prevalence of methamphetamine use among pregnant women and the associated detrimental maternal, fetal, and neonatal complications, there is a greater demand for the development of strategies in order to combat methamphetamine use altogether. A possible approach to reducing this issue is through the use of teaching and education. The issue surrounding the prevalence of methamphetamine and methamphetamine-related complications can be examined through Dorothea Orem's theoretical framework of nursing. Orem, a nursing theorist, developed the Self-Care Deficit Nursing Theory, which rests upon the ideas that people innately desire self-care agency; there is a need for nursing based on the health deviations of a person at any given time; the needs of the patient mold the responsibilities of the nurse in order for the nurse to adequately and effectively address the person's needs; and the nurse has a role to help the person to overcome or adapt to the self-care deficit ("Theory-Based Nursing Practice", n.d.).

The basis of Orem's model is centered on the theory of self-care, which explains and develops the reason why individuals require nursing care. Self-care, which is defined as a "human regulatory function that persons must perform for themselves in order to maintain life", is a concept that must be learned and deliberately performed ("Theory-Based Nursing Practice", n.d.). The ability to engage in self-care dependent-care is affected by a person's limitations in knowing what to do, when to do it, and how to do it, according to Orem. The ability of a person to successfully perform self-care is influenced by individualized self-care

requisites, or the “requirements necessary for maintaining functional integrity, health, and well-being” (“Theory-Based Nursing Practice”, n.d.). Self-care requisites are based on the assumptions that human beings have common needs for the intake of materials necessary to sustain and maintain life; human development from in utero to mature adult requires action to maintain conditions to promote growth and development at each period of the life cycle; and deviation from normal structure and function and well-being requires action to prevent occurrences and action to control the effects of the deviation (“Theory-Based Nursing Practice”, n.d.). If a person lacks the capacity or is unable to meet his or her self-care requisites at any point in time, nursing care is needed.

Nursing is not only a public declaration of commitment to care for individuals, groups, and communities, but is also comprised of both teaching and learning. Nursing consists of responsibilities and obligations that are vast and vary greatly depending on the patient’s circumstance. Along with being contingent upon the patients’ self-care deficits, two components that are essential to the nature of the helping service provided by nurses are nursing systems and nursing agency.

According to Orem, nursing systems are “series and sequences of deliberate practical actions of nurses performed at times in coordination with actions of their patients to know and meet components of their patients’ therapeutic self-care demands and to protect and regulate the exercise or development of patients’ self-care agency” (“Theory-Based Nursing Practice”, n.d.). The idea of nursing systems is carried out through the exercise of nursing agency. The concept of nursing agency, or “the skills

and life experiences that nurses have gained through years of education and practice that they use to effectively treat patients,” arises when there is a need for nursing (“Theory-Based Nursing Practice”, n.d.). In considering the concepts of nursing systems and nursing agency, the nurse possesses the personal qualities and skills to address a person’s self-care needs while doing so effectively, prudently, and professionally.

In order for nurses to address a person’s self-care deficits and provide safe, effective, and quality care, the nurse must be competent in various areas. The nurse must possess the knowledge to identify and analyze a particular situation, determine what interventions must be implemented and develop a plan of care while concomitantly adhering to the facility policies and standards of care. To do so, the nurse must have acquired optimum knowledge and information of the nursing process so that these functions can be carried out. A lack of knowledge can negatively affect the nurse’s ability to adhere to, carry out, and maintain the nursing agency and system that patients deserve and that are relevant to the patient’s self-care needs. Since self-care requisites are highly individualized and specific to each patient, optimal knowledge can assist the nurse in how to approach the nursing care for the maternal methamphetamine user, and therefore, properly carry out the appropriate nursing systems and nursing agency. Acquisition of education allows the nurse to provide optimal care for the patient. Optimal care includes possessing the knowledge of the overall negative ramifications of methamphetamine use and the severe implications of

maternal methamphetamine use on both the mother and her child and relaying this information to patients.

The effects of methamphetamine can significantly interfere with an individual's ability to adequately meet his or her self-care requisites or comprehend that self-care requisites need to be met. As a result, nursing becomes an essential factor so that the self-care requisites of a methamphetamine user are addressed. The conclusion that a person has self-care needs or is unable to carry out his or her self-care requisites is determined by a systematic assessment. The assessment confirms the presence of a therapeutic demand and establishes the needs for an appropriate plan of care. Greater proficiency of assessment skills allows the nurse to carry out his or her clinical responsibilities more optimally and successfully.

Nurses must should be knowledgeable of the effects of methamphetamine and identify the signs and symptoms of methamphetamine use because proper identification guides the nurse's mode of response to the patient. Possession of this knowledge nurses also enables the nurse to further educate methamphetamine using patients with current or potential pregnancies. In turn, patients will be better equipped to care for themselves with the best knowledge possible, which includes making more informed choices and understanding the consequences of their current choices.

Therefore, in Orem's view, lack of knowledge relating to the effects of methamphetamine and identification of the methamphetamine user would be identified as serious obstacles, resulting in the hindrance of the nurse's capacity to

perform and provide adequate nursing care and address an individual's self-care needs.

Significance of the Study

Current resources targeted to identifying and assessing maternal methamphetamine use in pregnancy have not been sufficient to treat the cause and lead to long term reductions in incidence. Due to its highly addictive nature, the high prevalence of methamphetamine use continues to exist. Because methamphetamine use negatively affects not only the primary consumer but also secondarily exposed individuals, additional efforts must be established to more adequately identify maternal methamphetamine users who are currently pregnant or may potentially become pregnant so that the appropriate intervention and treatment methods can be implemented as well as the proper teaching.

The objective of this project is to provide specific information on the effects of general methamphetamine use and the detrimental impacts of methamphetamine on both a mother and her child in pregnancy. An examination of the literature illustrating the acute and chronic effects of maternal methamphetamine use on a woman and her child demonstrates that the complications that can arise as a result of methamphetamine use can last beyond the period of pregnancy and can affect a mother and her child indefinitely.

Because nurses play a vital role as health care professionals when caring for mothers and children in the perinatal setting, it is essential to educate nurses on the issue surrounding maternal methamphetamine use in pregnancy and on avenues for

proper identification and teaching. Increasing provision of education among nurses enhances the overall practice of nurses by preparing them to adequately identify methamphetamine use and, ultimately, to engage in opportunities for teaching more frequently.

In this project, information will be presented to the nursing students in the third level of study within the School of Nursing at the University of Tennessee at Chattanooga (UTC). These students are studying the role of the nurse when caring for families expecting children. The objective of this project is to educate baccalaureate nursing students, who will later become registered nurses, so that they are well equipped to apply this knowledge through identification of use and patient teaching. Furthermore, they will be able to use this knowledge to educate their colleagues, and most importantly, patients on the negative implications of methamphetamine use in pregnancy.

Chapter 2

Review of the Literature

Methamphetamine is a highly addictive central nervous system stimulant drug whose chemical structure is similar to that of amphetamine. Stimulants comprise a class of drugs that are known to enhance mood, increase feelings of well-being, increase energy levels, and stimulate alertness (National Institute on Drug Abuse, 2016). Methamphetamine comes in several forms, including powder, crystal, rocks, and tablets. Regular methamphetamine is a pill or white, odorless, bitter-tasting powder that easily dissolves in water or alcohol. Crystal methamphetamine takes the form of glass fragments or shiny blue-white “rocks” of various sizes (Substance Abuse and Mental Health Services Administration, 2014).

Otherwise known as “meth” or by various street names such as “Crank”, “Chalk”, “Crystal”, “Fire”, “Glass”, “Go Fast”, “Ice”, “Tina”, or “Speed”, methamphetamine is classified as a Schedule II drug, meaning it has a high potential for abuse and limited medical use (National Institute on Drug Abuse, 2016). It is legally available through a prescription that cannot be refilled. Methamphetamine, which was developed in the early 20th century from its parent drug, amphetamine, was originally used in nasal decongestants and bronchial inhalers (National Institute on Drug Abuse, 2012). It was also widely available to treat a range of disorders, including attention deficit hyperactivity disorder (ADHD), obesity, narcolepsy, depression, obesity, and alcoholism (Drug Policy Alliance, 2016). Pharmaceutical methamphetamine is still available legally to solely treat obesity, narcolepsy, and

ADHD, but is infrequently prescribed due to the high potential for abuse and addiction. In these cases, the prescribed dose is far lower than those typically abused.

Production and Manufacture of Methamphetamine

Unlike drugs such as marijuana, cocaine, and heroin, which are derived from plants, methamphetamine is the only illicit drug that can be manufactured easily from store bought chemicals. The most common ingredient in methamphetamine is pseudoephedrine or ephedrine, commonly found in cold medicine. Through a cooking process, the pseudoephedrine or ephedrine is chemically converted into methamphetamine. Additional ingredients that are essential for the process of making methamphetamine can include: ether, paint thinner, Freon ®, acetone, anhydrous ammonia, iodine crystals, red phosphorus, drain cleaner, battery acid, and lithium (United States Drug Enforcement Administration, 2014).

Methamphetamine is often manufactured or “cooked” in laboratories. Most of the methamphetamine manufactured in the United States come from “super labs”, or large illegal laboratories that produce the drug in large quantities (United States Department of Justice Archive, n.d.). Many of these laboratories are not sophisticated operations and do not require elaborate chemistry equipment. Those who produce methamphetamine usually do not possess any chemistry training. While cooking methamphetamine is relatively simple, it is a highly dangerous and toxic process.

Physiological Mechanism of Methamphetamine

Methamphetamine is a central nervous system stimulant of the sympathetic nervous system. Methamphetamine belongs to a class of drugs referred to as

amphetamines. Amphetamines enhance the release of catecholamines, increasing intrasynaptic concentration levels of norepinephrine, dopamine, and serotonin. Methamphetamine may enhance synaptic catecholamine levels by inhibiting monoamine oxidase, the enzyme responsible for the oxidation of norepinephrine and serotonin. The psychoactive and potential neurotoxic effects from prolonged or high doses of methamphetamine may occur due to the following mechanisms that increase the synaptic or extracellular levels of these monoamines, primarily dopamine: 1) displacement of monoamines from synaptic vesicles to the cytosol; 2) reverse transport of neurotransmitters through plasma membrane transporters and through blocking the activity of dopamine transporters as well as decreasing the expression of these transporters at the cell surface; 3) increased activity and expression of tyrosine hydroxylase; and 4) inhibition of monoamine oxidase (Wouldes et al., 2014).

According to the National Institute on Drug Abuse (2012), methamphetamine's mechanism of action is to block reuptake of both dopamine and norepinephrine, as well as promote the release of dopamine into the synaptic cleft leading to high levels of the chemical in the brain, a common mechanism of action for most drugs of abuse. Dopamine is involved in reward, motivation, the experience of pleasure, and motor function. Methamphetamine's ability to rapidly release dopamine in reward regions of the brain produces a sense of increased alertness and intense euphoria.

The result of methamphetamine use is general excitation of the central nervous system, which accounts for the "desired" effects of increased alertness,

euphoria, and anorexia. However, higher concentrations of dopamine in the synapse may be toxic to nerve terminals. Therefore, the chronic use of methamphetamine may lead to long lasting functional impairments in the monoamine systems in the brain, particularly at sites involving dopamine (McGuinness & Pollack, 2008).

Effects of Methamphetamine Use

Methamphetamine has a longer half-life than a majority of other drugs, such as cocaine, and has additional mechanisms of action in the central nervous system. The half-life (or time required for half the quantity of the drug to be metabolized or eliminated by normal biological processes) of methamphetamine is approximately twelve hours, whereas the approximated half-life of cocaine is one hour (American Congress of Obstetricians and Gynecologists, 2011). Due to its prolonged half-life, methamphetamine continues to be a commonly sought out drug. On the other hand, while an extended half-life is a desirable quality to the individual abusing it, the length of time that the drug is present in the body also equates to the significant implications that it can have on the user and those exposed to it.

Methamphetamine can be taken by a variety of methods, including smoking, snorting, injecting, ingestion, or by the anal route. When methamphetamine is smoked or injected, the user experiences an intense rush that lasts only a few minutes. Snorting or oral use of the drug produces euphoria but not the intense high that is experienced if it is smoked or injected. The effects of snorting are felt within three to five minutes and within fifteen to twenty minutes when ingested orally.

The effects of methamphetamine on the user are well-established. Like amphetamine, methamphetamine causes increased activity and talkativeness, decreased appetite, and a heightened sense of well-being or euphoria. However, what differentiates methamphetamine from amphetamine is that, in comparable doses, much greater amounts of methamphetamine enter the brain, making it a more potent stimulant. When taken, methamphetamine results in the development of both short-term and long-term effects.

Methamphetamine use can produce rapid effects as a result of the release of dopamine, norepinephrine, and serotonin. The immediate and short-term effects of methamphetamine may include: increased attention, increased energy and decreased fatigue, increased physical activity and wakefulness, decreased appetite, heightened euphoria and rush, increased respiration, rapid or irregular heartbeat, and hyperthermia (National Institute on Drug Abuse, 2012). Methamphetamine use is also associated with increased libido and sexual pleasure as well as high-risk sexual behavior. Prolonged sleep and mild dysphoria occur as the drug's effects wear off (Winslow, Voorhees, & Pehl, 2007). Additional adverse effects due to acute methamphetamine exposure may also include: anorexia, anxiety, hypertension, psychosis, renal failure, rhabdomyolysis, seizures, sexually and parenterally transmitted infections, stroke, and trauma (Winslow, Voorhees, & Pehl, 2007).

In addition to the immediate and short-term impact of methamphetamine, long-term use of methamphetamine also has a multitude of damaging effects. Chronic methamphetamine abusers experience anxiety, depression, confusion, insomnia,

paranoia, aggressions, mood disturbances, delusions, skin sores (due to scratching), severe weight loss, dental problems, problems with thinking, emotion, and memory, progressive social and occupational deterioration, verbal learning impairment, motor slowing, suicidal ideation, visual and auditory hallucinations (Substance Abuse and Mental Health Services Administration, 2014).

Distinctive changes also occur in the physical appearance of long-term methamphetamine users, producing an aging effect. A common hallucination experienced by meth users is the so-called crank bug. The user gets the sensation that there are insects creeping on top of, or underneath, the skin. The user will pick at or scratch the skin, attempting to get rid of the imaginary bugs. This scratching can create open sores that may then become infected. Furthermore, methamphetamine reduces the amount of protective saliva around the teeth. Methamphetamine users also consume carbonated soft drinks in excessive number, they tend to neglect personal hygiene, and grind their teeth and clench their jaws. The combination of such actions lead to what is commonly called “meth mouth” (National Institute on Drug Abuse, 2016). “Meth mouth” refers to the physical changes that can occur as a result of methamphetamine use and consists of significant tooth decay and periodontal loss.

Without complete cessation, successful treatment, and recovery, the adverse effects of methamphetamine on the brain cannot be diminished or reversed, which can result in potentially irreversible neuronal changes (Winslow, Voorhees, & Pehl, 2007). These changes can produce neurologic and psychiatric symptoms which are

most likely caused by dopamine depletion. Methamphetamine can also cause a variety of cardiovascular related issues including elevated heart rate, irregular heart rhythms, and increased blood pressure. High doses can elevate body temperature to dangerous, and sometimes lethal, levels and can cause convulsions and death (U.S. Department of Justice Drug Enforcement Administration, n.d.).

One of methamphetamine's most devastating effects is addiction. Addiction to methamphetamine can occur quickly, as repeated use lowers the brain's ability to manufacture dopamine, leading to increased cravings for the drug (Hohman, Oliver, & Wright, 2004). Despite the desire to withdraw from using the drug, withdrawal from methamphetamine can cause additional adverse effects such as depression and apathy. These are symptoms that most users wish to avoid, thus leading the already addicted individual to continuously seek out the drug.

Methamphetamine also induces tolerance, which leads to consumption of increased doses in order to produce the same effect. To increase its effects, users may take higher doses of the drug, take it more frequently, or change their method of intake, such as snorting or injecting it. Because the effects produced by methamphetamine do not last long, users of the drug often take the drug repeatedly, in a "binge and crash" pattern (National Institute on Drug Abuse, 2016).

Continued methamphetamine use can cause effects that persist even after cessation of drug usage. Because methamphetamine has a significantly longer half-life in the body than other stimulants, such as cocaine, it leads to prolonged stimulant effects as well as a more intense and protracted withdrawal experience (National

Institute on Drug Abuse, 2013). As previously mentioned, dopamine and serotonin are neurotransmitters associated with feelings of well-being, key components in the reward center of the brain. Ingesting methamphetamine boosts both dopamine and serotonin levels, producing temporary feelings of well-being (White, 2002). When the effect of the methamphetamine ends, levels of these neurotransmitters drop precipitously causing two distinct phases of methamphetamine withdrawal: acute withdrawal and subacute withdrawal (McGregor et al., 2005). The acute phase is marked by increases in sleeping and appetite as well as depression-related symptoms. However, anxiety, irritability, and craving of methamphetamine also may occur. After about three days of the acute phase, a “crash” period has been described that involves sleeping excessively (McGregor et al., 2005). Withdrawal is further complicated by insomnia on the sixth day that lasts until the twentieth day of methamphetamine abstinence. Other signs and symptoms of withdrawal include somnolence, trouble sleeping, anger, nervousness, depression, anxiety, irritability, inability to concentrate, psychomotor slowing, paranoia, increased appetite, and a continuous strong craving for methamphetamine (National Institute on Drug Abuse, 2016).

As a powerful stimulant, methamphetamine can also cause death, which can ensue from cardiovascular collapse, a heart attack, or stroke that results from the drug's effects on norepinephrine, a neurotransmitter that raises heart rate and blood pressure and constricts blood vessels. Myocardial infarction, respiratory failure, stroke, cardiomyopathy, and hepatitis have also been reported as a result of chronic methamphetamine exposure (Winslow, Voorhees, & Pehl, 2007). Due to the

tolerance, reverse-tolerance, or redistribution, the fatal concentration of methamphetamine in the blood varies among reports and ranges from 0.5 to 41 mg/L (Sakai, Iwadate, Maebashi, Matsumoto, & Takasu, 2015). The fact that the fatal concentration of methamphetamine is not concretely defined and that methamphetamine abusers are not aware if the amount they consume is substantial enough to produce death lends to the drug's dangerous nature.

Effects of Secondary Methamphetamine Exposure

In addition to the direct effects that methamphetamine can have on the user, there are also significant secondary effects on an individual who is not using methamphetamine, but is exposed to methamphetamine. Manufacturing of methamphetamine can expose both primary and secondary users to toxic chemicals and fumes through absorption, inhalation, or ingestion. Methamphetamine laboratories generate highly explosive gases that place all individuals at an increased risk of injury or death.

Fumes generated by the production of methamphetamine are breathed in during production both day and night. Residue that is present in food is consumed and the byproducts of methamphetamine are absorbed from every surface within the home (Hohman, Oliver, & Wright, 2004). The acute health effects of exposure to methamphetamine production can include burning of the eyes and skin, headaches, dizziness, nausea, and respiratory distress (Hohman, Oliver, & Wright, 2004). The long-term chronic effects of inhalation or contact with the chemicals used in manufacturing methamphetamine are not known, although there have been reports of

severe lung disease in police officers involved in methamphetamine laboratory seizures (Hohman, Oliver, & Wright, 2004). Such disease is a function of the toxic effect on the lungs of the acid chemicals used in the process of producing methamphetamine. Some of the catalysts used in the making of methamphetamine also include toxic heavy metals that can cause severe kidney and neurologic damage if ingested in sufficient quantities (Hohman, Oliver, & Wright, 2004). Other reported side effects from the precursor chemicals utilized to manufacture methamphetamine include liver and kidney disease, cancers such as lymphomas and leukemias, bone marrow suppression resulting in anemia, and increased risks of infection (Hohman, Oliver, & Wright, 2004). It is clear, based on these established findings, that methamphetamine is equivalently harmful for both the primary and secondary methamphetamine user.

Prevalence of Methamphetamine Use Among Pregnant Women/Adolescents

As evidence confirms, there continues to be a large number of pregnant women and adolescents who use methamphetamine. Current research and statistics illustrate that substance use by pregnant women continues to be a serious public problem. Colliver, Kroutil, Dai, and Gfroerer (2006) report that roughly 19,000 pregnant women across the United States use methamphetamine annually. Among 29,494 women giving birth in California, the Infant Development, Environment, and Lifestyle (IDEAL) study found that 206, or 0.7%, of the total number of women reported using an amphetamine during pregnancy (Liles et al., 2012). Liles et al. (2012) also found that among 1,632 mothers giving birth in areas known for high

methamphetamine use, 5.2% of mothers were documented to have used methamphetamine during pregnancy (Liles et al., 2012). This percentage equates to 84 women who used methamphetamine during pregnancy. Similarly, a large-scale study on methamphetamine use in pregnancies across the United States indicated that at some point during their pregnancy, 5.2% of these women used methamphetamine (Arria et al., 2006).

In addition to the previously mentioned data, which delineates the prevalence of methamphetamine use among pregnant women in the United States, additional studies display statistics regarding the prevalence of treatment admissions among pregnant women. This data is comparably significant for it illustrates the continued occurrence of methamphetamine use among this particular demographic. According to additional studies regarding maternal methamphetamine use, in 1994, methamphetamine accounted for 8% of pregnant women who were admitted for substance abuse. This percentage rose significantly by 2006, when methamphetamine accounted for 24% of admissions by pregnant women to federally funded substance abuse treatment centers the United States (Terplan, Smith, Kozloski, & Pollack, 2009). In 2010, the percentage of pregnant women seeking treatment for methamphetamine abuse increased yet again, doubling to 46%, according to the 2010 National Survey on Substance Abuse and Health.

According to the Substance Abuse and Mental Health Services Administration (SAMHSA), pregnant teenage admissions for methamphetamine abuse had more than quadrupled from 4.3% of admissions in 1992 to 18.8% in 2007. The Substance Abuse

and Mental Health Services Administration also found that not only had treatment facilities across the U.S. seen the highest number of pregnant teenage admissions in a decade, but the largest increase in the type of substance abuse being treated was caused by methamphetamine use (Good et al., 2010). A large fraction of this statistic is divided among some of the highest methamphetamine using states in the United States, including Tennessee.

Tennessee's population of pregnant women comprise a significant portion of the methamphetamine using women across the United States. Statistics provided by the National Substance Abuse Index for the state of Tennessee, which is currently one of the highest ranked states in methamphetamine use, illustrated that out of 14,627 drug users identified in the state, 84.3% of drug individuals between the ages of 12 and 45 were methamphetamine users (National Substance Abuse Index, n.d.). In addition, 25.2% of the 14,627 individuals were female methamphetamine users (National Substance Abuse Index, n.d.). In 2014, 44.8% of people in Tennessee who were admitted for methamphetamine abuse treatment were women. This corresponds to 478 of 1069 total individuals (Center for Behavioral Health Statistics and Quality, Substance Abuse, and Mental Health Services Administration, 2015). For the 14th year in a row, state figures show that Tennessee is on pace for more drug-dependent births than the year before — approaching 1,000 out of the state's 80,000 annual births (Gonzalez and Boucher, 2015). This conclusion is highly significant for it further confirms that the prevalence of methamphetamine use in pregnancy continues to burden the United States, the incidence of methamphetamine use is well

recognized far beyond the western United States, and relevant for the purpose of this paper, has become a local concern.

Demographic and Psychosocial Characteristics of Mothers Using Methamphetamine During Pregnancy

Just as the clinical effects of methamphetamine are well-known, the demographic characteristics that exist among methamphetamine using mothers have also been recognized and are consistent among maternal methamphetamine users.

Research suggests that methamphetamine using mothers are more likely to receive fewer prenatal care visits than non-methamphetamine using mothers (Liles et al., 2012). A study by Gorman et al. (2010) displayed results that support these claims, for more than two-thirds of methamphetamine-abusing mothers reported having fewer than five prenatal appointments during their pregnancies, compared to 10% of mothers from the control group (Good et al., 2010). Gorman et al. (2014), Nguyen et al. (2010), and Smith et al. (2008) also found that methamphetamine users are also more likely to have fewer prenatal care visits and begin prenatal care at a later gestational age when compared with mothers unexposed to methamphetamine. Equally, the demographic characteristics of the sample population in the study by Wouldes et al. (2015) displayed that the methamphetamine-exposed group had mothers with no partner at birth and who presented later in gestation for prenatal care. In addition to the claim that methamphetamine using mothers receive delayed prenatal care, the population of methamphetamine using mothers in a study by Shah et al. (2011) were found to be less likely to receive prenatal care at all. Likewise,

Smith et al. (2010) found that the women in the methamphetamine exposed group of their study were less likely to have attended prenatal care visits than the comparison group. Based on these studies, it is evident that methamphetamine use during pregnancy often affects the timing during which mothers seek out prenatal care. In some cases, mothers fail to seek prenatal care at all. This, as a result, can negatively affect the child as well as the mother using methamphetamine.

In addition to receiving delayed or no prenatal care at all, methamphetamine using mothers are more likely to be younger, poorer, single, and less educated than non-methamphetamine using mothers at their child's birth. Mothers in the methamphetamine group of a study by Nguyen et al. (2010) were younger and more likely to have low socioeconomic status, no partner, and have fewer than twelve years of education as compared to the unexposed group. These findings are reinforced by Gorman et al. (2014), whose population sample included 12% of methamphetamine using mothers who were married versus 46% of the control group's mothers who were married. A higher percentage of methamphetamine using mothers were also unemployed in comparison to the control group.

Smith et al. (2008) and LaGasse et al. (2012) also found, in their studies, that relative to the comparison group, the methamphetamine-exposed group was more likely to have a lower socioeconomic status and to be without a partner (Smith et al., 2008). Similarly, demographics collected at birth and 36 months of age in the study by Liles et al. (2012) showed that the comparison mothers had a higher income at their child's birth and were more likely to be married or living with a partner than

methamphetamine using mothers at both visits.

Grant and her associates (2010) screened a cohort of 84 women exposed to methamphetamine use during pregnancy and enrolled 92 women to serve as controls. Compared with the control group, women in the methamphetamine group were of lower socioeconomic status and lacked a partner (57% vs. 36%). This finding is also supported by Diaz et al. (2014), though they found no differences in educational level or maternal age. Good et al. (2010), who aimed to report the demographic characteristics of methamphetamine-exposed pregnancies compared with control patients, confirmed the findings of previously mentioned studies, showing that methamphetamine users were more likely to be unmarried and unemployed. They also had an 11th grade education or less, and were less likely to receive prenatal care, a characteristic confirmed by Gorman et al. (2014), Liles et al. (2012), Shah et al. (2011), Smith et al. (2008), and Nguyen et al. (2010).

Methamphetamine using mothers have also been found to be more likely to have ongoing legal difficulties and be involved in domestic violence than a non-methamphetamine using group (Liles et al., 2012). Liles and colleagues enrolled 212 mother-child dyads as a subset of the participants in the Infant Development, Environment, and Lifestyle (IDEAL) Study, an ongoing longitudinal study. The mother-child pairs were followed from birth until 36 months. Of the 412 participants in the study, only 212 biological mothers maintained continuous custody of their children from birth to 36 months (137 comparison mothers and 75 prenatally methamphetamine using mothers). The primary reason was due in large part to

physician's mandatory reporting of the mother's illicit drug use during pregnancy, resulting in the involvement of Child Protective Services. The comparison group was found to be larger since this group was more likely to have continuous custody of their child at 36 months than the methamphetamine using group. This is an additional characteristic that often differentiates methamphetamine using mothers from non-methamphetamine using mothers and is further supported by Smith et al. (2008), whose study showed that 40% of methamphetamine using mothers lost custody of their babies who were then placed in foster care, Child Protective Services, adoption, or were receiving care from another individual.

Similarly, Shah et al. (2011) concluded from their study that methamphetamine-exposed infants were more likely to be referred to Child Protective Services. Comparable to the three aforementioned groups of researchers, Brunk (2004) also demonstrated, as a result of his study, that maternal methamphetamine use in pregnancy was correlated with more referrals to Child Protective Services at discharge (51% vs. 6%) with 26% (vs. 3%) of newborns not placed with their mothers. Based on these findings, maternal methamphetamine use is a common predictor of disruption in custody and placement of children into out-of-home settings (McGuinness and Pollack, 2008).

Building upon the claims made by Liles et al. (2012), Twomey et al. (2013) also illustrated, through their study, that the psychological adversities identified among methamphetamine using pregnant women include involvement in the legal system. In addition, Twomey et al. (2013) also found that maternal drug use is in

general associated with a number of adverse environmental risk factors that include domestic violence, other forms of abuse and violence, and limited social support. Likewise, Good et al. (2010) and Gorman et al. (2014) reported that methamphetamine using women were likely to experience increased incidences of domestic violence compared to the control group. In the study by Good et al. (2010), almost one-fourth of methamphetamine using mothers reported domestic violence.

Additional evidence supports the claim that maternal methamphetamine use is correlated to various psychological implications. Psychiatric disorders are prevalent among methamphetamine pregnant women and have been reported to be even more common than among women who use other drugs such as cocaine, marijuana, opiates, tobacco, or alcohol (Oei, Abdel-Latif, Clark, Craig, & Lui, 2010). Coexisting substance abuse and psychiatric disorders, such as major depression, can interfere with competent parenting capacities, which can in turn adversely impact child behavior (Hans, 1999).

Liles et al. (2012) conducted a study to examine the association between methamphetamine use during pregnancy and maternal parenting stress, maternal depression, and perceived child behavior problems. From their results, Liles et al. (2012) found that both at birth and at the child's 36-month visit, methamphetamine mothers reported significantly higher parenting stress scores and lower quality of life perceptions than comparison mothers. Further, a comparison of depression scores between the methamphetamine using mothers and comparison mothers showed that methamphetamine using mothers reported statistically significant higher levels of

depressive symptoms than comparison mothers, a finding that supports that of Heiss, Goldberg, and Dion (2010), who also concluded that pregnant methamphetamine using mothers are often at risk for depression.

In their study, Heiss, Goldberg, and Dion (2010) found that twenty-three percent of the sample exhibited clinically significant depressive symptoms, with methamphetamine mothers (30.7%) more likely than comparison mothers (19%) to exhibit clinical depressive symptoms (Liles et al., 2012). In summary, the study by Liles et al. (2012) confirmed the presence of increased depressive symptoms and parenting stress among mothers who used methamphetamine during pregnancy than mothers who did not use methamphetamine during pregnancy.

To further support the findings of the study by Liles et al. (2012), Shah et al. (2011), found that methamphetamine using mothers were also more like to have a psychiatric disorder or illness. Twomey et al. (2013) also determined that maternal methamphetamine use was associated to maternal childhood trauma psychiatric disorders, though specific conditions were not outlined. Nevertheless, Twomey et al. (2013), Liles et al. (2012), and Shah et al. (2011) confirmed that mothers who use methamphetamine during pregnancy have an increased chance of developing certain psychiatric symptoms.

In addition to the relationship that exists between methamphetamine use and an increased risk of developing psychological deficits, there is also a confirmed relationship between methamphetamine use and increased substance abuse. Current research shows that many mothers who use methamphetamine during pregnancy are

more at risk of having more substance-using family and friends, using other illicit drugs, as well as tobacco and alcohol, and developing substance use disorders. In a study by Nguyen et al. (2010), 3705 mother/infant pairs consented for participation. Among the consented, 204 were exposed to methamphetamine and 3501 were unexposed to methamphetamine. Mothers in the methamphetamine group used more tobacco, alcohol, and marijuana during pregnancy than the unexposed mothers (Nguyen et al., 2010).

Similarly, the methamphetamine-exposed group in a study by Wouldes et al. (2015) had a higher percentage of mothers reporting the use of tobacco and marijuana than comparison mothers and a higher daily use of alcohol, cigarettes and marijuana across pregnancy. Smith et al. (2008) also determined that more mothers in the methamphetamine-exposed group used tobacco, alcohol, and marijuana during pregnancy than in the comparison group and were more likely to be heavy users of these substances than mothers in the comparison group.

In their IDEAL study, which included a total sample population of 49 methamphetamine using mothers and 81 non-methamphetamine using mothers, Derauf et al. (2007) found that significantly more women in the methamphetamine using group used tobacco (n=35 [71%] versus n=20 [25%]), alcohol (n=24 [49%] versus 13 [16%]), and marijuana (n=22 [43%] versus 6 [8%]). Furthermore, 90% of the methamphetamine using group reported using methamphetamine in conjunction with 1 to 5 other licit and illicit drugs. According to the same study, 74% of the methamphetamine using women were determined to have a high probability of

developing a substance dependence disorder, compared to 11% of the non-methamphetamine using women.

Building upon previous studies, LaGasse et al. (2012), who conducted an Infant Development, Environment, and Lifestyle (IDEAL) study, a longitudinal study, reported results that not only further supports those produced in their prior works but also those illustrated by others. Relative to the comparison group, LaGasse et al (2012) found that the methamphetamine-exposed group was more likely to use alcohol, tobacco, and marijuana during pregnancy. According to Brunk (2004), methamphetamine using mothers consumed more alcohol (43% vs. 17%), tobacco (79% vs. 26%), and marijuana (39% vs. 8%) during pregnancy. These results verify those previously mentioned, and thus, lend further validity to the argument that methamphetamine use is associated with additional substance abuse.

In addition to the already mentioned demographic characteristics and their correlations to methamphetamine use, Brecht and Herbeck (2014) also concluded that methamphetamine using women are also more inclined to display increased sexual behaviors, and thus, have more pregnancies. In their study, 153 women who reported methamphetamine use during pregnancy were enrolled. While 1996 national statistics showed an overall lifetime pregnancy rate of 3.2 per woman, the methamphetamine sample showed a significantly higher overall average of 4.6. The methamphetamine sample also had a higher than usual average number of pregnancies that ended without a live birth: 2.1 per woman versus a national lifetime average of 1.2. The methamphetamine group displayed higher levels of sexual risky behaviors than the

comparison group at the time they were interviewed. In conclusion, Brecht and Herbeck (2014) provide data that provides a strong and effective argument that maternal methamphetamine users engage in more sexual behaviors. As a result of these behaviors, they are more likely to experience a greater number of pregnancies.

Based on the current available research, it is evident that demographic characteristics among mothers who use methamphetamine drastically differ from those who do not. Mothers who use methamphetamine during their pregnancies show remarkable differences from mothers in the control group. These differences unfortunately work against methamphetamine using mothers and their inevitably exposed children and lead to increasingly more severe complications.

Maternal Complications of Methamphetamine Use

Substance abuse by pregnant women continues to be a significant public health problem (Gorman, Orme, Nguyen, Kent 3rd, & Caughey, 2014). Perinatal methamphetamine use is a concern because it can lead to a variety of maternal complications. These complications have the potential to subsequently affect a fetus and neonate.

Gorman and colleagues (2014) sought to examine the effects of methamphetamine use on maternal and neonatal outcomes. Within their study, 8542 pregnancies (0.4%) that were linked to a diagnosis of methamphetamine use were identified and compared with 2,031,328 control pregnancies. Based on the results of the study, Gorman, Orme, Nguyen, Kent 3rd, and Caughey (2014) concluded that there was a statistically significant increase in hypertensive diseases of pregnancy

associated with methamphetamine use. Compared with control pregnancies, methamphetamine users had a greater frequency of pregnancy-associated hypertension (11.6% vs. 5.8%), gestational hypertension (5.6% vs. 3.2%), preeclampsia (6.8% vs. 2.9%), severe preeclampsia (2.5% vs. 0.8%), and eclampsia (0.3% vs. 0.1%) (Gorman, Orme, Nguyen, Kent 3rd, & Caughey, 2014).

To further support the conclusion made by Gorman and his colleagues regarding maternal complications of methamphetamine abuse, additional current studies report that methamphetamine use during pregnancy can significantly impact the mother by leading to conditions such as pregnancy-related hypertension, preeclampsia, severe preeclampsia, and eclampsia. According to Stewart and Meeker (1997), increased maternal blood pressure can result in premature separation of the placenta from the uterine wall, also referred to as abruptio placenta. The danger associated with this complication is that this usually results in spontaneous abortion or premature delivery of the fetus (Stewart and Meeker, 1997).

Similar to Stewart and Meeker (1997), a study by Good et al. (2010) revealed that methamphetamine-abusing mothers showed the common characteristic of uncontrolled high blood pressure during their pregnancies, therefore supporting the findings by Gorman and his colleagues. Almost 20% of pregnant methamphetamine users had uncontrolled blood pressure, and another 10% had experienced placental abruption—two exceptionally rare but potential complications during pregnancy that affect less than 1% of the general population.

In a study by Scott, Fleming, Bennett, and Graves (2005), a retrospective chart review of all pregnancies associated with substance abuse from 1998 until present at a tertiary care center was undertaken. Thirty-two records were identified as presumptive positive for methamphetamine and/or metabolites. Maternal complications comprised 68.75% (23/32) of the total. Preterm labor affected 21.9% (7/32). Hypertensive complications affected 25% (8/32) of patients: 15.6% (5/32) experienced preeclampsia, 6.25% (2/32) experienced post-partum preeclampsia 6.25% (2/32), and 3.1% (1/32) experienced a hypertensive emergency. Antepartum hemorrhage complicated 12.5% (4/32). Two maternal deaths occurred in their cohort (Scott, Fleming, Bennett, & Graves, 2005).

From the aforementioned studies, it can be determined that methamphetamine greatly affects the general user and produces significant effects on the woman during pregnancy. Equally significant and maybe even more importantly, maternal methamphetamine use also impacts the process of fetal development throughout pregnancy. The manner in which maternal methamphetamine use interferes with the normal fetal development process can also lead to negative implications that hinder normal neonatal development.

Effects of Methamphetamine on Placental Transport During Pregnancy

Case reports and retrospective analyses have suggested that maternal methamphetamine use may be associated with a possible increase in defects of the fetal central nervous system, cardiovascular system, gastrointestinal system, oral cleft and limb defects. However, while case-control and prospective studies have not

confirmed these results, the current findings are consistent for illustrating the high likelihood that perinatal or neonatal death can occur as a result of the serious defects. This is particularly significant due to the fact that these problems arise as a result of maternal methamphetamine use. Therefore, the extent to which women engage in methamphetamine use during pregnancy determines the severity of the complications that reflect fetal and neonatal outcomes as a result of the drug's teratogenic effects.

A potential risk of illicit drug use is teratogenicity. In exploring the effects of maternal use of methamphetamine on the fetus and neonate in more detail, there is increasing evidence in recent years that drugs of abuse such as cocaine, amphetamines, cannabinoids, and nicotine can interfere with the transport function of the placenta, and thus, lead to complications in the fetus, and later, the neonate (Gorman, Orme, Nguyen, Kent 3rd, & Caughey, 2014).

Methamphetamine transfers from maternal blood to fetal blood via the placenta because of its low molecular weight and lipid solubility. It appears that the blood concentration of methamphetamine in a fetus is maintained longer than in the mother due to the immaturity of fetal metabolic abilities (Sakai, Iwadate, Maebashi, Matusumoto, & Takasu, 2015). Under this condition, infants are likely more vulnerable to methamphetamine intoxication than adults. Because methamphetamine can cross the placenta, many of the clinical effects of maternal methamphetamine use are not only also experienced by the fetus, including fetal tachycardia and hypertension, but they are more likely to lead to more serious complications (Shah et al., 2011).

The placenta is the means of metabolic and nutrient exchange between the embryonic and maternal circulations (Ganapathy, Prasad, Ganapathy, & Leibach, 1998). The function of the placenta as a transport organ is obligatory for fetal development because this process, mediated by a variety of transport systems, is responsible for the delivery of nutrients from the mother to the fetus. Some of the transport systems in the placenta also play a role in the clearance of vasoactive compounds, thus maintaining optimal blood flow to this organ (Ganapathy, Prasad, Ganapathy, & Leibach, 1998). There is strong supporting evidence to indicate that several of these placental transport systems are either direct or indirect targets for certain drugs of abuse, including cocaine, amphetamines, nicotine, and cannabinoids. These drugs of abuse compromise normal placental transport function and cause the systemic release of catecholamines, which therefore leads to vasoconstriction and a restriction of nutrients and oxygen to the fetus. In combination, these alterations consequently produce detrimental effects on the developing fetus (Ganapathy, Prasad, Ganapathy, & Leibach, 1998).

Simultaneous with the clinical effects of maternal methamphetamine on the mother, there are also a variety of effects that can occur in the fetus, all of which result due to a decreased blood supply and ultimately a decreased amount of available oxygen to the placenta and fetus. The impaired blood/oxygen supply can retard fetal development and, as a result, can potentially lead to additional long-term implications. These changes can be reflected as both deviations in physical appearance as well as impairments in normal physiological processes.

In their study, Sakai, Iwadate, Maebashi, Matusumoto, and Takasu (2015) examined the case of an infant whose source of death was acute intoxication by methamphetamine caused by maternal abuse during pregnancy and delivery. The umbilical cord was pearly white, dry with 3 vessels and did not present with any knots or excessive torsion. The parenchyma of the placenta was red, beefy, and spongy without any abnormality including infarction or hematoma. However, upon internal examination, a number of ecchymoses were found under the scalp, and a few petechiae were visible in the visceral pleura and renal pelvis—all findings that are typically not expected. The lungs were dark red and poorly aerated, indicating impaired gas exchange. The alveoli were uniformly collapsed and a significant amount of squamous epithelia and a small amount of mucus were found within the alveoli. Accumulation of substances within the alveoli can result in inadequate oxygen and carbon dioxide exchange.

Furthermore, the findings obtained from aspirated amniotic fluid were consistent with the fetal hypoxemia that was likely caused by the vasoconstrictive effects of methamphetamine (Sakai, Iwadate, Maebashi, Matusumoto, & Takasu (2015). Overall, the results of the study by Sakai et al. (2015) are significant for illustrating the significant effects of methamphetamine use on respiratory function in the neonate which can result from a profound impact of methamphetamine on normal placental transport of oxygen during pregnancy that compromises the fetus from the beginning stages of development.

Fetal Complications from Maternal Methamphetamine Use During Pregnancy

Mechanisms by which methamphetamine can compromise fetal development include fetal acidosis, hypoxemia, decreased uterine blood flow, changes in fetal blood gases, and an increase in fetal glucose levels (Stewart and Meeker, 1997). These alternations ultimately interfere with normal physiological processes that can lead to a variety of effects that range in severity, with death as the most serious outcome.

As the fetus develops throughout pregnancy, the nervous system is vulnerable to damage at any time because the brain and nervous system are developing throughout the pregnancy. While the fetus is susceptible to injury at any point throughout the course of pregnancy, the fetus is at greatest risk during the first trimester. This is the time when the cells differentiate and develop into limbs and organs. Drug use during this time poses a risk to organ development. The second and third trimesters involve maturation of the developing body parts. The risk of spontaneous abortion in the second trimester and of premature birth in the third are increased with drug use. Any one of these effects places the fetus at an increased risk of enduring more serious consequences.

As mentioned earlier, methamphetamine use can result in pregnancy-related hypertension in the mother. Increased maternal blood pressure can result in premature separation of the placenta from the uterine wall (abruptio placenta). This usually results in spontaneous abortion or premature delivery. This is supported by Gorman et al. (2014), whose results indicated that methamphetamine users were found to have a

higher incidence of abruption and intrauterine fetal death. According to Gorman et al. (2014), the odds of abruption were much greater in the methamphetamine using population compared with control subjects.

In addition to Gorman et al. (2014), there is one report in the forensic science institution in California, illustrating eight fetal and infant deaths that were associated with maternal methamphetamine use (Sakai et al., 2015). The average week of gestation at which fetal death occurred was week 30 with a range of 20 to 36 weeks. In their case report, titled “Fetal and Infant Deaths Associated with Maternal Abuse”, Stewart and Meeker (1997) also examined the six fetal and two infant death cases related to maternal methamphetamine abuse. The causes of death, ranging from intrauterine death, to asphyxia, to prematurity, to acute bronchopneumonia, and to chorioamnionitis, were all associated with maternal methamphetamine use during pregnancy. The case report presented by Stewart and Meeker (1997) illustrates the significant effects of maternal methamphetamine use during pregnancy on fetal morbidity. In summary, Stewart and Meeker (1997) and Sakai et al. (2015) are both sources that support the claim made by Gorman et al. (2014) who showed that fetal death is increased among methamphetamine users.

Neonatal Complications from Maternal Methamphetamine Use During Pregnancy

Neonatal complications are not an uncommon occurrence in children born to methamphetamine using mothers. Existing research has demonstrated an association between maternal methamphetamine use and an increased risk of physiological

complications in the neonate, such as being small for gestational age, low birth weight, intrauterine growth restriction, preterm birth, and many more (Gorman et al., 2014). In their study, Gorman et al. (2014) concluded that gestational age delivery was exponentially associated with the use of methamphetamine. Preterm birth, which is defined as delivery at <37 weeks 0 days of gestation, and very preterm birth, which is defined as delivery at <32 weeks 0 days gestation, were both increased significantly increased among maternal methamphetamine users when compared with control subjects. According to Gorman and colleagues, neonates had 2.9 times greater odds of being born prematurely (<37 weeks of gestation) and 4.5 times greater odds of being born very prematurely (<32 weeks of gestation) when compared with neonates of non-using mothers. These neonates also had increased odds of incidence of small-for-gestational-age neonates and birth weight <2500 grams when compared with control subjects (Gorman et al., 2014). Gorman et al. (2014) also revealed that other studies, which also evaluated the effects of methamphetamine use among pregnant women, found a statistically significant decrease in birth weight and head circumference among neonates who were born to methamphetamine-abusing mothers compared with control subjects.

Confirming the results of Gorman et al. (2014), Good et al. (2010) acquired results that showed that more than half (52%) of methamphetamine abusing mothers had delivered premature births, while only 17% of the control pregnancies were preterm. Good et al. (2010) also found that babies born from methamphetamine had

lower Apgar scores than those within the control group (6% compared with 1-2%) and 12% had intrauterine growth restriction (Good et al., 2010).

Similarly, Scott, Fleming, Bennett and Graves (2005) identified thirty-two records as presumptive positive for methamphetamine and/or metabolites. Among the thirty-two records, there were a total of 27 births, with neonatal complications occurring in 70.4% (19/27). Prematurity complicated 51.9% (12/27), admission to the Neonatal Intensive Care Unit occurred in 48.1% (13/37) with 84.6% (11/13) accounting for preterm neonates. Three of the 32 identified cases resulted in neonatal deaths (Scott, Fleming, Bennett, & Graves, 2005).

The results of study by Nguyen et al. (2010) demonstrated that infants in the methamphetamine-exposed group were born slightly earlier than the unexposed group. Eighteen of the methamphetamine exposed newborns (8.8% of the total exposed population) were less than 36 weeks' gestation and 130 were premature in the unexposed group (3.7% of the total unexposed population). In summary, maternal methamphetamine use leads to an increase in the likelihood of having a child earlier in pregnancy by about 50%. Nguyen et al. (2010) also found that the methamphetamine-exposed group had an increased likelihood of being born small for gestational age.

According to Heiss, Goldberg, and Dion (2010), infants exposed to methamphetamine tend to be premature, or if born at term, small for gestational age, including a small head circumference. Similarly, the results illustrated by Wright, Schuetter, Tellei, and Sauvage (2015), who collected data on methamphetamine use

and birth outcomes and compared methamphetamine-exposed pregnancies to non-methamphetamine exposed pregnancies, showed that shorter gestational age and decreased birth weight were prevalent among the methamphetamine-exposed infants than the non-exposed infants. Similarly, Shah et al. (2010) found that methamphetamine-exposed infants were more likely to have smaller head circumferences. Shah and his colleagues also found that methamphetamine-exposed infants were at an increased risk of being shorter in length, a finding that was also demonstrated a study by Diaz et al. (2014), who found that infants exposed to methamphetamine were more likely to be shorter and more likely to be born earlier.

Oro and Dixon (1987) examined 105 mother–infant pairs with positive results of urine toxicology screens at the time of delivery and found that in comparison to narcotic-exposed neonates, methamphetamine-exposed neonates were more likely to have decreased birth weight and head circumference and to be small for gestational age (SGA). These conclusions were also made by another study, in which 66 children born to mothers in Sweden who had abused amphetamines during their pregnancy were studied. The mean birth weight, height, and head circumference of these exposed children were below the means of their unexposed peers (Zabaneh et al., 2011).

Comparably, the methamphetamine-exposed group of children in the study by Smith et al. (2010) also had decreased gestational age, length and head circumference at birth, though no differences were found in birth weight or incidence of small for gestational age or low birth weight by the exposure group, a finding that contrasts that

of Heiss et al. (2010) and Shah et al. (2010). In their Infant Development, Environment, and Lifestyle Study, LaGasse et al. (2012) found similar results, in that methamphetamine exposed infants were on average 5 days younger in gestational age and 1.3 centimeters shorter at birth than infants in the comparison group (LaGasse et al., 2012).

In summary, maternal methamphetamine use leads to a variety of neonatal complications that include but are not limited to preterm birth, low birth weight, small for gestational age, intrauterine growth restriction, and possibly death. These implications are particularly significant because, aside from death, they are often predictors of more severe complications. Death is not an uncommon result of the complications that occur in fetuses and neonates from maternal methamphetamine use. From their study, Good et al. (2010) proved that neonates born to methamphetamine using mothers were more likely to experience a greater chance of mortality compared to the control group; 4% of methamphetamine-related births died shortly after birth whereas only 1% of births from the control group experienced neonatal deaths (Good et al., (2010). The complications that neonates must consequently face as a result of maternal methamphetamine use may interfere with all components of development, and thus, permanently affect the neonate as it progresses throughout the later stages of life into adolescence and adulthood.

Effects of Perinatal Methamphetamine Use on Complications in Child

Development

The general effects of methamphetamine use on the primary user are established. The effects of methamphetamine use on a secondarily exposed individual are also clearly demarcated. While the general effects of methamphetamine have been well studied, knowledge of the effects of perinatal methamphetamine on a child's development is more ambiguous. However, studies already conducted have produced results that not only validate the presence of negative implications on both parties of individuals, but the consistency of results acquired thus far creates a reliable trend for future researchers to follow.

In creating this project, an extensive review of the literature relating to the effects of methamphetamine on maternal, fetal, and neonatal outcomes was completed. This project is significant because it may not only lead to additional studies that focus on measures to treat methamphetamine use, but it may also lead to implications for future research that explore the effects of perinatal methamphetamine use on the outcomes of a child following the neonatal period, in its adolescent years, and through adulthood. Though more limited than the current available literature that outlines the effects of perinatal methamphetamine use on maternal, fetal, and neonatal outcomes, previous studies conducted for the purpose of examining the effects on all facets of a child's development following the neonatal period have been equally significant. Though future studies may be necessary in order to further validate the findings from previous researchers, the results that have been already confirmed are

truly significant for illustrating the effects of maternal methamphetamine use a child's cognitive, motor, neurobehavioral, and physical development.

Effects on Cognitive Development Increasing evidence indicates that prenatal exposure to methamphetamine results in severe morphological changes in the brain with associated cognitive deficits as the child matures in age (Good et al., 2010). At present, the only evidence of the long-term effects of prenatal exposure comes from a study in Sweden that followed the growth and development of 65 prenatally exposed children through age 15 years (Wouldes et al., 2014, Diaz et al., 2014). The results of the study determined that, by age 4 years, exposed children had lower IQ scores (103 versus 110) and were more likely to be “problem children” than a normative group of Swedish children (Diaz et al., 2014). At age 8 years, prenatal exposure was associated with problems among peers in addition to problems with aggressive behavior, social adjustment and psychometric assessments. By 14-15 years of age, prenatal exposure was associated with decreased school performance, particularly in math, language, and physical fitness activities when compared with their schoolmates (Lester & Lagasse, 2010). Furthermore, 15% of children were one year behind for their age (Wouldes et al., 2014). These findings are also supported by those delineated by Diaz et al. (2014).

In their study, Diaz et al. (2014) enrolled 412 mother–infant pairs (204 methamphetamine-exposed and 208 unexposed matched comparisons). One hundred fifty-one children exposed to methamphetamine and 147 unexposed comparisons of the original 208 who attended the 7.5-year visit were included in the study. Based on

the results of the study, children exposed to methamphetamine had significantly higher cognitive problems subscale scores than comparisons and were 2.8 times more likely to have cognitive problems scores that were above average. In summary, prenatal methamphetamine exposure was associated with increased cognitive problems, which may affect academic achievement and lead to increased negative behavioral outcomes (Diaz et al., 2014). Their IDEAL study also found that that heavy methamphetamine exposure is associated with subtle deficits in inhibitory control—a particularly important component for the development of social competence and emotional and cognitive control— at age 5.5 years (Diaz et al., 2014).

Similarly, Heiss, Goldberg, and Dion (2010) found similar cognitive abnormalities when studying a case report of a 5-year-old girl exposed to methamphetamine in utero. At 5 years of age, her overall standardized intelligence age score was 72 according to cognitive functioning tests, notably below the norm of 100. While analysis of speech and language samples were indicated as intelligible and speech production was appropriate, her language skills were below-average and vocabulary was limited (Heiss et al., 2010).

Effects on Motor Development In addition to the effects that maternal methamphetamine has on the cognitive development of a child, a study by Woules et al. (2014) showed that prenatal methamphetamine exposure was also found to be associated with poor motor performance at 1 and 2 years. In contrast to the aforementioned findings, Woules et al. (2014) found maternal methamphetamine

use did not affect cognitive development, but rather, resulted in delayed gross motor development and lower scores on composite measure of psychomotor performance over the first 3 years of life. However, no associations were found between methamphetamine exposure and fine motor development. The conclusions made by Wouldes et al. (2014) were also validated by Diaz et al. (2014), who reports, from their study, that methamphetamine exposed children were more likely to exhibit poor suck and poor grasping ability at 1 and 3 years.

Smith et al. (2010) also found that prenatal methamphetamine exposure resulted in early motor disturbances at birth and 1 month. Smith et al. (2010) conducted a study in order to examine the effects of prenatal methamphetamine exposure on cognitive and motor development in children at 1, 2, and 3 years of age. At the completion of their study, they found that there was a subtle methamphetamine exposure effect on fine motor performance at 1 year with the poorest performance observed in the most heavily exposed children. Furthermore, from their study, Heiss et al. (2010) also documented that a 5-year old girl exposed to methamphetamine in utero had relatively low scores for gross and fine motor and visual development. At 5 years of age, her age equivalent score for gross and fine motor and visual development was 3 years and 6 months, notably low for what they should be (Heiss et al., 2010).

In conclusion, various studies are positive for confirming that maternal methamphetamine use is associated with deficits in motor development in addition to cognitive development delays. Further speaking, along with the significant impact on

cognitive and motor functioning, there is also evidence, though limited, that illustrates that maternal methamphetamine use also influences the neurobehavioral development of a child.

Effects on Neurobehavioral Development While limited research is present on the neurobehavioral effects of prenatal methamphetamine exposure in children, multiple previously conducted studies show promising results that illustrate profound effects. According to an IDEAL study conducted by Smith et al. (2007), methamphetamine exposure is associated with multiple maternal psychosocial risks, newborn neurobehavioral patterns of decreased arousal, increased lethargy, increased total stress/abstinence, physiological stress, and central nervous system stress.

In a later study, LaGasse et al. (2012) sought to evaluate behavior problems in children who were prenatally exposed to methamphetamine at ages 3 and 5 years. A total of 330 children (166 exposed and 164 comparison) were assessed for behavior problems by using the caregiver report on the Child Behavior Checklist (LaGasse et al., 2012). Their IDEAL study found that these children displayed increased emotional reactivity and anxious/depressed problems at 3 and 5 years of age, externalizing and attention-deficit hyperactivity disorder (ADHD) problems at age 5 years, and subtle differences in outcomes predictive of ADHD at 5.5 years of age. These findings are supported by Heiss et al. (2010), whose case report documented that at 5 years of age, a behavioral assessment revealed that methamphetamine exposure in utero leads to high scores in oppositional behavior, inattention, hyperactivity, social problems, psychomatic issues, and impulsivity, findings that are

all consistent with the criteria for ADHD diagnosis (Heiss et al., 2010). Similarly, Twomey et al. (2013) also reported clinically significant behavioral problems of children with prenatal methamphetamine exposure at 5 years of age. Twomey et al. (2013) also found that children with prenatal methamphetamine exposure were more than twice as likely to exceed the clinical cutoff for externalizing behavioral problems relative to comparison children (Twomey et al., 2013).

Further expanding on the relationship between maternal methamphetamine use and neurobehavioral development problems in children, Zapata et al. (2008), who performed a study for the purpose of examining the association between lifetime methamphetamine use and recent risky sexual behaviors and lifetime adolescent pregnancy, proved that adolescent methamphetamine use affects an individual's behaviors throughout his or her adolescent years. A population-based study of heterosexual male methamphetamine users in California reported a strong association between methamphetamine use, sex with anonymous and casual female partners, anal intercourse, and sex with an injection drug user. In another study of heterosexual encounters, methamphetamine use was associated with unprotected anal sex and unprotected sex with a new partner (Semple, Strathdee, Zians, & Patterson, 2010).

Like Semple and colleagues, Zapata et al. (2008) concluded that sexual behaviors were common among methamphetamine users. Whereas 31.4% of youth who had never used methamphetamine reported having sex during the past 3 months, 70.4% of ever-users reported recent sexual activity. Furthermore, 7.3% of never-users reported having at least 2 sex partners during the past 3 months, compared with

34.9% of ever-users, and 3.1% of never-users reported ever becoming pregnant or getting someone pregnant, compared with 18.0% of ever-users (Zapata et al., 2008). Zapata et al. (2008) also found that methamphetamine use was common among high school students, with nearly 1 out of 13 youth reporting lifetime use and that methamphetamine use was associated with increased recent sexual activity, having ≥ 2 sexual partners, and lifetime adolescent pregnancy.

Supporting the findings by Zapata et al. (2008) is another report by Springer, Peters, Shegog, White, and Kelder (2007) who documented a significant association between methamphetamine use and lifetime sexual intercourse, and lifetime sexual intercourse, initiation of sexual intercourse before age 13, lifetime multiple partners, lifetime adolescent pregnancy, and nonuse of condoms during last intercourse. The previously mentioned studies have confirmed a strong correlation between maternal methamphetamine use in pregnancy and limitations relating to neurobehavioral development.

Effects on Physical Development In addition to delays surrounding cognitive development, motor development, and neurobehavioral development, there is also evidence, though limited, that delineates an association between maternal methamphetamine use and its impact on the physical development of a child.

Zabeneh et al. (2011) conducted a study to examine the effects of prenatal methamphetamine exposure on growth parameters from birth to age 3 years. Aiming to assess the effects of prenatal methamphetamine exposure on childhood outcomes through examination of weight, head circumference, height and weight-for-length

growth trajectory, they enrolled 412 subjects, 204 who were exposed to methamphetamine during pregnancy. They found that height trajectory was lower in the exposed group versus the comparison children over the first 3 years of life. In term subjects, methamphetamine exposure was also associated with a lower height trajectory. However, there was no difference in weight, head circumference, or weight-for length growth trajectories. These findings of decreased height trajectory over the first three years of life are consistent with previous reports of height deficits in methamphetamine-exposed children at birth and at 1 and 4 years of age (Eriksson et al., 1994). However, as previously stated, there were no differences in head circumference, weight, or weight-for-length trajectories, suggesting that although exposed children demonstrate continued height growth restriction, the impaired growth is not placing them at an increased risk for developmental delay or later onset of cardiovascular morbidity (Zabaneh et al., 2011). Based on their study, long-term follow-up would be necessary to determine if the decreased height trajectories in methamphetamine-exposed children continues into later childhood and affects final adult height.

In their study, Wouldes et al. (2014), who also examined the growth of infants across the first 3 years of age, determined that methamphetamine exposure was associated with smaller head circumferences at 1 year, weighing less at 2 years, and being shorter at 3 years, when compared with the non-exposed group (Wouldes et al., 2014). From their studies, Wouldes et al. (2014), Zabaneh et al. (2011), and Eriksson et al. (n.d.) confirmed that maternal methamphetamine has an impact on the normal

process of physical development in the child. However, due to the fact that there were minor discrepancies in their findings, additional studies are indicated in order to verify consistency among these specific findings.

The previously mentioned findings regarding the relationship between methamphetamine use and alterations in child development are promising. This study in combination with the previous studies conducted lead to strong implications for further research. Future studies will hopefully not only validate the findings illustrated by previous researchers, but will also add to the field of knowledge surrounding this specific topic.

Identification of Maternal Methamphetamine Use

Given the previously mentioned effects of methamphetamine abuse on the maternal user and her child, it is essential that actions are taken to address the current issue of methamphetamine use among pregnant women. This can be achieved by enhancing measures to adequately assess primary and secondary users. Assessments of methamphetamine use may be made, first, through proper identification and recognition of several indicators.

Methamphetamine abusers tend to have an abundance of energy and may participate in repetitive activities. Mothers who are heavy methamphetamine users often neglect their personal appearances as well as the appearance and hygiene of their children. Additional behaviors that may be observed include anxiety, paranoia, mood swings, irritability, hyper-vigilance, confusion, violent threats or actions, and possibly psychosis (Hohman, Oliver, & Wright, 2004). Methamphetamine users also

have a diminished need to eat or sleep, and have been known to go for as many as three weeks without sleeping. Other indicators include pupil dilation, a general smell of ammonia, or stale urine (Hohman, Oliver, & Wright, 2004).

Skin manifestations may also be quite apparent: users may pick at their skin in search of crawling bugs, resulting in abrasions and excoriations that often lead to the development of polymicrobial infections (McGuinness and Pollack, 2008). Furthermore, chronic use can lead to the formation of skin abscesses, particularly on the face, and users can exhibit weight loss, poor hygiene, and dental problems (Hohman, Oliver, & Wright, 2004). A more chronic sign of methamphetamine abuse is “meth mouth”. However, many illicit substances cause xerostomia, which is the basis for poor oral health in substance abusers (Rhodus & Little, 2005). Periodontal bone loss can also give methamphetamine users an aged appearance.

If a mother demonstrates the aforementioned signs and symptoms, the nurse can begin by approaching the parent in a nonjudgmental manner. The nurse can inquire about the parent’s general health and suggest that skin conditions and poor oral health are related to a variety of health problems. The nurse can suggest that drug abuse sometimes causes these symptoms and that treatment for addiction works. Nurses should become familiar with local treatment options and how to refer patients with substance use disorders. If a parent admits to substance abuse, the child or children should be assessed for abuse and neglect. Nurses should be knowledgeable of and prepared to contact local child welfare authorities if abuse and neglect are evident (McGuinness & Pollack, 2008).

Currently, recommendations regarding identification and treatment of methamphetamine users during pregnancy have been made and implemented by the American Congress of Obstetricians and Gynecologists (ACOG) Given the potential risks to maternal, fetal, and infant health with methamphetamine use in pregnancy, identification of use is important and of priority, according to ACOG (2011).

Successful identification of methamphetamine through the various indicators previously mentioned can be obtained through a complete recount of the client's history. Aside from the more obvious signs that confirm methamphetamine use, all pregnant women should be asked about past and recent smoking, alcohol, and other drug use as part of the prenatal history, ACOG reports (ACOG, 2011). Asking about partner substance use may aid patient disclosure of personal drug use. Studies have shown that pregnant methamphetamine users are more likely to be white, young, and unmarried. Women using methamphetamine often seek prenatal care late in pregnancy and experience poor weight gain. Signs of methamphetamine use include "track marks from intravenous injection, malnutrition, severe dental decay, and skin abscesses from skin picking secondary to formication" (ACOG, 2011).

In collaboration with the Association of Women's Health, Obstetric and Neonatal Nurses, Amy McKeever (2015) further delineates specific measures relating to identification of substance users. According to McKeever, screening tools are appropriate for identifying substance abusers (McKeever, 2015). In addition to screening tools, health care providers can all also inquire about substance abuse by introducing the topic in conversation and asking direct questions. Most effective

antepartum care is care that begins in the first trimester of pregnancy and is consistent throughout the pregnancy, McKeever reports. Following recognition and identification of a substance abuser, collaborative care between health care professionals, including nurses, primary care providers, and obstetrical providers, and substance abuse treatment providers as well as social services is necessary in order to ensure that the patient's health demands are met (McKeever, 2015). Additional care cannot be implemented until adequate identification is carried out.

Summary

In summary, the implications of methamphetamine use are vast and prevalent in the U.S. This epidemic is also well recognized in Tennessee and Hamilton County. The number of men and women that continue to use methamphetamine speaks to the importance of this issue. Among these individuals, pregnant women comprise a significant portion of female methamphetamine users across the United States. The duration of effects that result from maternal methamphetamine use on a mother as well as the fetus and neonate far surpass the period of pregnancy. The overall effects of methamphetamine on an individual are alarming enough due to its highly addictive nature. However, the potential complications that can arise for not only a mother but also her child due to maternal methamphetamine use pose a much more significant issue.

The detrimental effects that a child can experience as a result of maternal methamphetamine use during pregnancy can potentially cause effects that remain with the child throughout the remainder of its life. These effects can weigh heavily on

the neonate both physiologically and psychologically and can ultimately lead to death. While the mother, who is partaking in methamphetamine use, may or may not be aware nor concerned about the implications that the drug is having on her physiological and psychological well-being, it is important to make her aware of the negative complications that methamphetamine use can have on her and her child, both in utero and long term. As health care professionals who may encounter these individuals in the clinical setting, nurses must be prepared carry out the clinical functions expected of nurses. These responsibilities include proper identification and health teaching. In order to accomplish this, they must be fully aware of the general implications of methamphetamine use, its impact on a mother and child in pregnancy, as well as signs and symptoms of methamphetamine use. Knowledge in these areas will not enhance their practice as nurses but to allow them to educate their patients and enhance the patients' knowledge so they can make more informed choices as well as understand their current ones.

Chapter 3

Methodology

Purpose of the Study

The purpose of this study was to provide educational content on methamphetamine, the general effects of methamphetamine use, and the effects of methamphetamine use on maternal and child outcomes during and following pregnancy. In light of what is currently known about methamphetamine including its associated effects and complications, this project took a unique approach to enhancing the practice of nurses by educating nursing students so that they are better equipped to not only identify and recognize signs and symptoms of methamphetamine users in the clinical arena but also to increase awareness and knowledge through education.

Education as a means of disease prevention and health promotion served as the methodological component of this project. The substantial and significant amount of knowledge acquired in all areas related to methamphetamine including the production of methamphetamine, effects of methamphetamine use, characteristics of methamphetamine users, the general complications of methamphetamine use, and the complications of maternal methamphetamine use on a mother and her child was compiled and integrated into a standardized patient education program as a method of teaching among the third level baccalaureate nursing students.

Since limited knowledge on this topic is currently made available to the students, this project provided them with specific information on the definition of

methamphetamine, the general effects of methamphetamine use, and signs and symptoms that are indicative of methamphetamine use. Knowledge of this information was anticipated to enhance the students' practices as future nurses by improving their abilities to better identify methamphetamine users within the clinical care setting as a result of an increase in knowledge. Acquisition of this knowledge will, in addition, enable them to relay this information to their patients and educate them on the detrimental effects of methamphetamine so that they are more aware, can make more informed choices regarding initiation of drug use, and can understand the implications of their current choices to use methamphetamine.

This information was presented through the use of various teaching strategies, participant questions were answered, and activities that reinforced learning were incorporated. In addition to the methamphetamine educational program, PRE/POST testing was included in order to serve as a measurement of the learning received during the educational program by comparing what the individual knew before in a PRE survey and after the educational experience in a POST survey. PRE/POST testing allows one to quantify the knowledge gained from a group of students with diverse learning styles and educational backgrounds. More specifically, the tests indicate how the students are learning. In this case, the PRE/POST surveys incorporated content that was included in the educational program that was directly related to the learning objectives and outcomes. The PRE/POST assessments were developed and distributed electronically using Qualtrics software.

Participants

The participants of this study were selected by a method of convenience sampling based on those currently enrolled in the NURS 3350 Care of the Childbearing Family course at the University of Tennessee at Chattanooga (UTC) School of Nursing. During the 3rd semester of nursing school, the academic curriculum is focused on nursing care of a mother and her child before, during, and following pregnancy. For this reason, targeting the population of students who were enrolled in the third level of study and who were undergoing a course regarding childbearing families was ideal. The number of students included in this study was based on the number of individuals enrolled in the NURS 3350 course. The total number of students that were listed as enrolled in the NURS 3350 course was 39, with seven of the students being male and 32 students being female. The participants of this study were not minors, involuntarily institutionalized, nor mentally handicapped.

Project Setting

It was necessary to obtain consent from the study participants in order to proceed with the project. The consent was provided by the participants in this study. Consent for participation was requested prior to completion of the PRE survey (see Appendix A). Participants certified their consent by affirming that they agree with the terms of participation. Informed consent was reflected as a written document at the beginning of the PRE survey that was distributed on September 6, 2016. The students were provided with contact information should they wish to contact the principal

investigator or the UTC Institutional Review Board (IRB). Following affirmation of consent, the participants proceeded to complete the electronic PRE survey.

Approval was also obtained by the Institutional Review Board (IRB) at the University of Tennessee at Chattanooga because the implementation of the proposed educational teaching intervention required participation of human subjects, though no new research was conducted. No person was put in a dangerous situation nor harmed in any way and patient rights were protected during this study.

The participants of this project were also assured and reminded that participation in this study would affect the outcome of his or her grade within his or her academic courses. However, the students were made aware that knowledge of information provided in this program would be assessed as part of the course learning outcomes; therefore, assessment of knowledge was reflected on course examinations.

While the educational teaching program was anticipated to benefit the author and contributing members of this project, the targeted population of this project were the participants and ultimately, those that they may encounter in clinical practice and the work arena as nursing students and registered nurses. Increasing awareness and knowledge of the prevalence of methamphetamine drug use among BSN nursing students was expected to enhance the practice of these students within the clinical setting as both student nurses and future registered nurses, and, thus, increase holistic and patient-centered care, which is directly related to positive patient outcomes.

Inclusion/Exclusion Criteria

Inclusion criteria for this project consisted of several items. The participants of this study were third level baccalaureate nursing students who were enrolled in NURS 3350 Care of the Childbearing course at the University of Tennessee at Chattanooga. Exclusion criteria included individuals who were not enrolled in the NURS 3350 course in the Fall 2016 semester, individuals who were minors, involuntarily institutionalized, and mentally handicapped. Although students were allowed to withdraw from the study at any point in time, it was anticipated that every student would participate throughout the entire course of the study. Exclusion criteria also consisted of those who chose to withdraw at any point while the study was in effect.

Risks/Benefits to Participants

There were no foreseeable risks to the individuals participating in this study. There were, on the other hand, many notable benefits anticipated from this study. The specific information provided in this study projected to benefit nursing students by enhancing their knowledge about methamphetamine. Furthermore, this study was also expected to benefit the students themselves by contributing to their field of knowledge, thereby enhancing their practices as nurses and benefitting society as a whole. It was hypothesized that by the end of the study, the sample population would be more knowledgeable about methamphetamine and thus able to use this information to further educate their patients on this particular topic as well.

Incentives

No incentives were offered for participation in the study and students were not penalized for choosing not to participate in the PRE/POST surveys. Students choosing not to participate in the PRE/POST surveys were still expected to participate in the class during which the methamphetamine-related content was presented to the students as they would already be present for course lecture. They were also expected to participate in the subsequent assignments and examinations at the discretion of the course instructor as part of the course structure and outline. However, their reflections/observations were omitted from data analysis and/or inclusion in any presentation of the results.

Limitations

There were a couple of limitations to this study. One limitation to this study pertained to the sample size. The sample population consisted of 39 baccalaureate students. A second limitation to this study was that the study was implemented at only one southeastern university school of nursing. The combination of these factors could potentially affect generalization of the study and results.

Project Instrument

The PRE/POST survey instruments utilized in this study were self-constructed with the guidance of faculty within the School of Nursing at UTC. A test blueprint was constructed prior and served as a tool to guide the development of the PRE/POST surveys. The PRE/POST surveys consisted of 25 content-based questions. The PRE survey also contained 5 questions that were used in order to elicit demographic data.

The POST survey contained a reflection question that enabled the students to provide reflection statements (see Appendix B).

The content presented in the PRE/POST surveys addressed topics relating to the history, origin, and prevalence of methamphetamine, the definition of methamphetamine, the overall effects of methamphetamine, the impact of maternal methamphetamine use in pregnancy on maternal and child outcomes, and signs and symptoms of methamphetamine. The content provided in the PRE/POST surveys and educational presentation were reviewed by nursing faculty who are knowledgeable and well experienced in the areas of content structure.

The reliability of the various components of this study, inclusive of the PRE/POST assessments, educational content, and method of data analysis, were considered in terms of face validity. The instrument was verified for accuracy by nursing faculty prepared at the doctoral level and who possess content-structure expertise. Thus, face validity for the instrument was established.

Methods/Procedures

The research questions for this study were:

1. Is there a significant difference in the knowledge of third level BSN nursing students regarding methamphetamine after the presentation on methamphetamine content?
2. How does the presentation on methamphetamine impact the anticipated future clinical practice of the student?

These research questions were measured by the data acquired from the PRE/POST assessments and were expected to be fully addressed by the completion of the study.

In developing the educational program and PRE/POST assessments, there were a series of learning objectives and outcomes that the students were anticipated to address. By the end of the presentation, it was expected that the participants would be able to:

1. Define what methamphetamine is.
2. Describe the effects of methamphetamine use.
3. Recognize signs and characteristics that are indicative of methamphetamine use during pregnancy.
4. Discuss how to identify methamphetamine use.
5. Explain the maternal, fetal, and neonatal complications that can occur as a result of maternal methamphetamine use during pregnancy.

At the conclusion of this study, it was anticipated that the students would meet the previously listed learning objectives and in conjunction, the preceding research questions would be answered.

This study incorporated components that were significant to both quantitative and qualitative methods of research as well a cross sectional model. A quantitative approach was applicable to this study due in large part to the fact that enhancement of learning was assessed using PRE/POST surveys. This study also incorporated qualitative characteristics, for student perceptions regarding integration of information learned into future practice was evaluated through a reflection

component. The PRE/POST surveys not only focused on measurement of knowledge gain, but also on feelings, ideas, and insights. A cross-sectional model was chosen for the reason that the study took place in a short period of time and the participants would not be followed long-term. They would only be followed for the duration of time from the implementation of the PRE survey to the implementation of the POST survey.

Before the educational content was presented, a PRE survey was distributed to the participants of the study on the agreed “entry point” of the study. In this case, the study commenced in the first week of September when the students completed the PRE survey. The PRE survey, a formative evaluation, was intended to serve several purposes: knowledge of the current status of a group would guide for future activities as well as the basis of comparison for a POST survey results; administering a test of entry knowledge helped to determine whether assumed prerequisites were achieved. The process of creating the PRE/POST surveys involved constructing 25 questions that effectively tested the participant’s knowledge prior to the implementation of the educational program and after the concepts of the educational program were presented. The PRE survey also contained 5 questions that inquired about the student’s current knowledge, attitudes, and personal experience regarding methamphetamine. This content was based on the learning outcomes and objectives that were established for the program. Completion of the PRE survey was expected to take no more than 45-60 minutes and was distributed electronically via Qualtrics software. The PRE survey was distributed and completed on September 6, 2016.

The methamphetamine education program was presented during the time the antepartum content was being introduced. The educational program consisted of a standard patient role play scenario as well as a presentation via Prezi software. The educational content was provided on October 4, 2016. This was the optimal time to present the methamphetamine content. The length of the methamphetamine education program was limited to no more than 1 hour. The educational program was intended to provide 30-45 minutes for the presentation and 15 minutes for questions.

Immediately following the presentation of educational content, a POST survey was distributed to the participants. The POST survey, in addition to the PRE survey, was a valuable methodology to measure the learning acquired as a result of the educational program, to analyze the appropriateness of learning objectives and outcomes, to recognize individuals who needed additional help, and to target any instructional needs to improve the program. The POST survey measured application and impact of learning. Mirroring the PRE survey, the POST survey consisted of 25 questions that pertained to the learning objectives as well as the content of the educational program. Completion of the POST survey was done electronically via Qualtrics software and took no more than 45-60 minutes.

Following completion of the PRE/POST surveys, the tests were collected and the item-by-item answer data was analyzed using SPSS Statistics software. This software allowed for management of data acquired from the PRE/POST assessments and calculation of the statistics. The information compiled from this software provided a clear picture of whether there was significant POST survey data.

In addition to the 25-item PRE/POST assessments, which provided a quantitative approach of methodology, a reflection component was included which provided a qualitative approach. In contrast to the PRE/POST assessments, which included questions using factual content and provide answer options that have already been generated, the reflection component encouraged the participant to provide his or her own self-assessment to a question regarding the impact of the teaching presentation on future clinical practice. The purpose of the reflection component was to acquire insight and perspective on the participant's thoughts, feelings, opinions, and insight regarding the topic content. This was an effective method to determining how the information presented was anticipated to impact and be applied to the student's clinical setting and work arena in the future.

Chapter 4

Results

The purpose of this project was to provide specific information regarding the effects of perinatal methamphetamine use on maternal and child outcomes to baccalaureate nursing students studying childbearing families in the third level of study at the University of Tennessee at Chattanooga. By educating nursing students through defining methamphetamine, describing the general effects of methamphetamine use, and outlining the effects of perinatal methamphetamine use on a mother and child, it was predicted that the study participants would be more prepared, as nursing students and future registered nurses, to recognize signs and symptoms indicative of methamphetamine use, especially in pregnancy, and subsequently increase awareness on the detrimental nature of this drug.

The research questions that guided this study were:

1. Is there a significant difference in the knowledge of third level BSN nursing students regarding methamphetamine after the presentation on methamphetamine content?
2. How does the presentation on methamphetamine impact the anticipated future clinical practice of the student?

At the conclusion of the study, the quantitative results of the PRE/POST surveys were compiled and compared. The following table (Table 1) contains the individual questions used in the PRE/POST survey instrument to assess the student's level of knowledge regarding methamphetamine as well as the correct response to the

question. Table 1 also lists the percentage of students who answered correctly on the PRE and POST surveys. A paired samples t-test was conducted to determine differences in PRE/POST knowledge scores. The result indicated a significant increase in student knowledge from PRE to POST test ($t(33) = -16.94, p < .001, d = 3.66$). The Cohen's d (3.66) represents a large effect size indicating significant practical impact in the change from PRE to POST knowledge scores. These results reflect the quantitative data component of the study. While 24 of the 25 questions illustrated an increase in knowledge from PRE to POST survey, it should be noted that one question (Question 23) illustrated a decrease in knowledge from PRE to POST.

Table 1.

PRE/POST Knowledge Survey Questions and Correct Answers with Student Response Percentages

PRE/POST Survey Question and Correct Response	PRE (%) (n=36)	POST (%) (n=36)
1. Which of the following most accurately describes the prevalence and severity of methamphetamine use as it relates specifically to the state of Tennessee? Answer: Top 3	41.7	83.3
2. Methamphetamine is also known by various street names, including all of the following except? Answer: Zoom	30.6	97.2
3. What is the most common ingredient in methamphetamine? Answer: Pseudoephedrine	30.6	97.2
4. Additional ingredients that are essential to the process of manufacturing methamphetamine include which of the following? Answer: Lithium	41.6	80.6

5. Under what category of drugs is methamphetamine classified as? Answer: Stimulant	61.1	100.0
6. The physiological and psychoactive effects of methamphetamine occur due to mechanisms that increase levels of all the following neurotransmitters except: Answer: Epinephrine	0.00	52.8
7. This neurotransmitter is involved in reward, motivation, pleasure, and motor function. Increased levels of this neurotransmitter result in the sense of increased alertness and intense euphoria, effects that lead people to use methamphetamine. Answer: Dopamine	52.8	91.7
8. The effects of methamphetamine use occur as a result of the drug's effect on which primary body system? Answer: Nervous System	80.6	94.4
9. Pharmaceutical methamphetamine is still available legally and is prescribed, though infrequently, to treat all of the following except: Answer: Constipation	72.2	94.4
10. Methamphetamine causes which of the following acute short-term effects? Answer: Increased sexual pleasure	22.2	83.3
11. Additional acute short-term effects of methamphetamine use include which of the following? Answer: Irregular heartbeat	83.3	83.3
12. Methamphetamine causes which of the following chronic long-term effects? Answer: Hallucinations	38.9	83.3
13. Effects due to secondary methamphetamine exposure include which of the following? Answer: Respiratory distress	25.0	75.0
14. Methamphetamine often leads to consumption of increased doses in order to produce the same desired effects. This lends to the drug's highly dangerous nature and is referred to as?	86.1	91.7

Answer: Tolerance

15. In regards to the demographic characteristics that are unique to the population of methamphetamine users, current literature studies illustrate that methamphetamine using women are more likely to demonstrate which of the following? 88.9 100.0

Answer: Low socioeconomic status

16. Common maternal complications that can occur as a results of maternal methamphetamine use in pregnancy include all of the following except: 2.8 58.3

Answer: Miscarriage

17. Studies show that methamphetamine-abusing mothers are at risk of having seizures, which occur as a result of what? 30.6 69.4

Answer: High blood pressure

18. Maternal methamphetamine use can lead to alterations in placental function which ultimately compromises fetal development by: 72.2 88.9

Answer: Decreasing available oxygen to the fetus

19. The fetal hypoxemia secondary to maternal methamphetamine use is likely caused by: 47.2 100.0

Answer: Vasoconstriction

20. Common fetal complications that can occur as a result of maternal methamphetamine use include which of the following? 83.3 97.2

Answer: Pre-term birth

21. Neonates born to methamphetamine abusing mothers have been shown to display which of the following? 22.9 72.2

Answer: Decreased head circumference

22. Additional neonatal complications of maternal methamphetamine use include which of the following? 94.4 97.2

Answer: Small for gestational age

23. Behaviors that may be observed in mothers who are using methamphetamine include which of the following? 83.8 77.8

Answer: Paranoia

24. What common physical manifestation is often an indicator of methamphetamine use? 50.0 97.2

Answer: Dental caries

25. Methamphetamine users often the sensation that there are insects creeping on top of, or underneath, the skin. This causes the user to pick at or scratch the skin, which can create open sores. This common hallucination is referred to as:

Answer: Crank Bug

TOTAL AVERAGE NUMBER OF QUESTIONS ANSWERED CORRECTLY	12.5 (50%)	21.7 (87%)
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The quantitative data demonstrated statistically significant results, and adequately addressed the research question: Is there a significance difference in the knowledge of third level BSN nursing students of methamphetamine after presentation of methamphetamine content? The results acquired from the PRE surveys illustrated an apparent knowledge deficit among the third level nursing students enrolled in the maternal-childbearing course regarding the effects of perinatal methamphetamine on maternal and child outcomes. Of the total 25 questions listed in the PRE/POST surveys, the average number of questions answered correctly in the PRE survey was 12.5 (50%). In contrast, the average number of questions answered correctly in the POST survey was 21.7 (87%). The educational presentation significantly influenced the student's repertoire of knowledge surrounding perinatal methamphetamine use by resulting in an approximated 75% increase in knowledge gain, as evidenced by the significant differences in the average number of questions answered correctly in the PRE survey versus the POST survey. Utilization of PRE/POST surveys to assess content knowledge prior to and following the educational presentation was an effective means for acquiring quantitative data and, thus, answering the first research question. Comparison of the quantitative results in

the PRE survey and POST survey showed a significant increase in the knowledge of the study participants after the presentation of methamphetamine-specific information.

Qualitative results were also obtained from the study. Qualitative data was reflected in statements made by each study participant in response to a question regarding applicability of the information presented in this study in future nursing practice. The students were asked to provide a response to the following question: How do you anticipate using this information in your future practice as a nurse? Of the 36 students who completed the PRE/POST surveys, the qualitative question was answered by 33 participants. Table 2 provides a summary of the themes that were reflected in the free response statements by the participants. Table 2 also identifies the prevalence of each theme and the percentage of students whose responses supported each theme. Four major themes emerged from the qualitative data in the POST survey. The four major themes are: (1) educating others, (2) identification of drug use, (3) patient care, and (4) overall presentation benefit.

Table 2.

Major Themes That Emerged from Open Response Questions

Theme	POST% (n=33)
Educating others	63.64
Identification of drug use	51.52
Patient care	21.21
Overall presentation benefit	96.97

Based on the qualitative data, 64% of the students who responded expressed, through their statements, that the information provided in this study had a significant impact on their abilities to educate others. The responses suggested that information from this presentation could be communicated to others in order to increase knowledge and awareness. Communication of this information could be integrated in teaching. The written responses provided by these students confirmed that knowledge of this information will allow them to “educate women and others that are using meth” and “educate the patient on the maternal and fetal complications that can occur due to the substance”. Of the students who expressed how this presentation is anticipated to positively influence in their abilities to educate methamphetamine users, many also stated that this presentation will also increase their abilities to educate the general public and other health care professionals. Thus, the responses provided by the students suggested that an educational presentation could improve one’s ability to enhance knowledge and awareness among others by providing teaching.

A second major theme illustrated in the qualitative data concerns the effect of educational presentation on the students’ ability to identify methamphetamine through accurate recognition of specific signs and symptoms. Reflective statements made by the students suggest that the teaching information improved the students’ abilities to “know signs and symptoms of using”, thus enhancing their abilities to “identify potential meth users”, ultimately making methamphetamine users “easier to spot”. Over one half (51.52%) of the respondents provided a response that

supports this idea. Based on the students' responses, educational teaching can have a significant impact on one's ability to identify methamphetamine users by enabling them to distinguish specific signs and symptoms indicative of methamphetamine abuse.

A third major theme was noted in the reflective statements by the students. Approximately 20% of the respondents reported that the teaching provided in this study was beneficial to increasing their confidence and ability to care for methamphetamine users. The qualitative data confirmed the students' beliefs that increased knowledge on this topic will allow them to "care for those using methamphetamine use" through an improvement in their abilities to "assess my patients", "complete more pointed and effective assessments", and to identify "what resources we can give them rather than just let the case worker handle it". In summary, written statements by 21.21% of students suggest that educational teaching can enhance level of confidence and the ability to care for primary and secondary methamphetamine users through assessment and referral.

A fourth major theme was evident in the written responses made by 32 of the 33 study participants. Written statements by all but one student (96.97%) suggest that the educational presentation was beneficial overall and will positively enhance future nursing practice. One student (3.03%) reported uncertainty regarding utilization of the teaching information in professional practice due to reservations surrounding what particular field of nursing the student intends to pursue. Another student expressed acknowledgement of feelings of sadness and anger regarding primary and secondary

methamphetamine use. Based on the qualitative results, it appears that the educational presentation also elicited personal judgment and feelings of frustration and anger. In response to the question regarding utilization of this information in nursing practice, one student stated that “this information” and “methamphetamine in pregnancy angers me, and it makes me want to take action”, and that “she [mother] should be prosecuted”. Despite this, an overwhelming number of the responses (96.97%) provided by the students show that the educational teaching was beneficial and will positively impact each student’s future practice as a nurse, whether through patient teaching, identification of drug use, patient care, or overall general practice.

The qualitative data acquired from the free response statements made by the students in the POST survey demonstrated meaningful student impact, and adequately addressed the second research question of this study: How does the presentation on methamphetamine impact the anticipated future clinical practice of the student? Four major themes were noted throughout the students’ responses – (1) educating others, (2) identification of drug use, (3) patient care, and (4) overall presentation benefit. Based on their own words and the subsequent themes that were drawn from their responses, it is apparent that the educational presentation on methamphetamine will have a positive impact on the students’ future clinical practice as nurses. Aside from the response made by one student, who reported uncertainty surrounding use of this information in practice, feedback from a greater majority of the students (96.97%) showed that the students felt the study was both relevant and applicable to their

general knowledge base as well to their practice as both student nurses and future registered nurses.

Presentation of methamphetamine content resulted in increased knowledge of the effects of methamphetamine and the outcomes of perinatal methamphetamine use on maternal and child well-being, as evidenced by the quantitative data. The students report that increased knowledge stimulated consideration of personal attitudes and beliefs. They anticipate that it will influence their abilities to further educate the general public, their work colleagues, and patients, to identify signs and symptoms of primary and secondary methamphetamine use. They report that identification of use will enable them to assess and initiate referrals for their patients. Their ability to carry out these functions, as stated in their written responses, reflects the overall significant impact this information will have on their future clinical practice. As a result, the qualitative data effectively addressed the research question.

An overall look at the quantitative and qualitative data illustrated that the educational presentation led to a significant increase in knowledge of content and anticipated use of information from the educational presentation in future practice can lead to potential positive implications. While examining the PRE/POST data, it was apparent that some of the data reflected only minor knowledge gains. Comparison of the data also revealed that there were specific questions in which only minor increases in the percentage of students answering a question correctly were observed. There were many questions in which students demonstrated a high level of knowledge on the PRE survey. This is reflected in the PRE/POST percentage scores

for Questions 8, 9, 11, 14, 18, 20, and 22. In light of this finding, the PRE/POST survey data showed an overall statistically significant increase in the average number of questions that were answered correctly from the PRE survey to the POST survey. However, while the data was statistically significant, there is still room for improvement.

Interpretation of the data leads to future implications that involve considering what improvements can be made and developing solutions to remedy these issues in future studies. In this case, additional studies that address the minor increases in knowledge gain from the PRE to POST survey would be necessary. As shown by the data, another important point to note is that fewer respondents answered Question 23 correctly in the POST survey when compared with the percentage noted in the PRE survey data. In order to address these specific areas, it is possible to consider the content structure outlined in the presentation. Analysis of the PRE/POST survey questions, survey answer choices, and student interpretation of the PRE/POST survey questions and teaching is also necessary to allow the questions to be clarified in order to reduce ambiguity and increase reliability. Improvements within these areas may potentially lead to an even more significant difference in knowledge gain in future studies.

Based on the quantitative results, additional information would be necessary if these students intend to focus their practice in this area or plan to practice within a setting in which this population of patients is more prevalent. Regarding the qualitative data, the written responses from the students, the major themes that

surfaced from these comments, and the percentage of respondents whose responses supported these themes indicate that there was strong impact on how they anticipate using this information in their future practice.

In summary, the quantitative data showed that there was a significant difference in the knowledge of BSN students after presentation of methamphetamine content. Comparison of the PRE/POST data showed that the presentation of methamphetamine content led to an approximate 75% increase in knowledge gain. The qualitative data showed that the presentation of methamphetamine content is anticipated to impact the students' future clinical practice. Increased knowledge and awareness of methamphetamine is expected to influence future practice by enabling the third level nursing students to integrate this knowledge through health teaching, identification of drug use, patient care, and in general nursing practice.

Chapter 5

Conclusion

The first research question addressed in this project was: “Is there a significance difference in the knowledge of third level BSN nursing students of methamphetamine after presentation of methamphetamine content?”. From the quantitative data results, there were statistically significant increases in the knowledge of methamphetamine use and related maternal and child complications. The second research question of this project was: “How does the presentation on methamphetamine impact the anticipated future clinical practice of the student?”. From the qualitative data results, the students report that they anticipate that the information they have learned will have a strong positive impact on their future practices. Based on the quantitative and qualitative data results, the research questions were addressed and the learning outcomes were met.

Utilization of a combined teaching method, which included a standardized patient role play scenario and a Prezi presentation, was an attempt to provide specific information in an innovative and informative manner. The results acquired from the PRE/POST data showed that the teachings strategies used supported a sizeable knowledge gain, as evidenced by the quantitative data results. The students reported a strong anticipated impact of the knowledge on their future practice, as reflected in the qualitative data. Overall, results of this project were that the students acquired knowledge about methamphetamine and anticipated a strong impact on their professional nursing practices. The results of this project create a solid foundation for

additional studies on teaching the effects of perinatal methamphetamine use and related maternal and child complications.

Implications for Future Research

Nurses possess unique responsibilities as they serve as both health care providers and educators. The more knowledgeable nurses are, the more equipped they are with not only the ability to identify signs and symptoms of methamphetamine use, but also with the ability to further educate their peers, work colleagues, and patients. Education prepares nurses to work within their scope of practice to treat disease, prevent disease, and promote health. This concept was used in the development and implementation of this study.

This project was a unique approach to address a potential knowledge deficit regarding perinatal methamphetamine use among student nurses. Future projects and studies that emphasize additional teaching measures and strategies to further enhance knowledge and awareness need to be conducted in order to reduce the frequency of methamphetamine-related complications. Additional studies are necessary to measure the effectiveness of various teachings strategies.

This study should also be replicated in additional venues outside of the medical arena as increased knowledge of methamphetamine and methamphetamine-related complications can be useful in any setting. Future studies could be conducted at other university nursing schools and within other university departments, such as the Health and Human Performance department or Exercise Science department. In addition to the college setting, additional studies should also target high school

students because use of methamphetamine among high school students has contributed to the prevalence of the problem surrounding methamphetamine abuse in the United States.

Methamphetamine continues to be a prevalent community problem. Nurses possess the ability to intervene by increasing public awareness. Presentations designed to increase knowledge among nurses on methamphetamine will equip nurses with the information to enhance awareness among the public, and ultimately, lead to a reduction in methamphetamine use.

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Appendix A

Informed Consent

Purpose of the Study: This study involves research that has been previously reviewed regarding the effects of maternal methamphetamine use on maternal, fetal, and neonatal outcomes. An in-depth examination of the current literature has been completed and serves as the basis for this study. The purpose of this research project is to provide educational content on the effects of perinatal methamphetamine use on maternal and child outcomes to third level undergraduate nursing students in the maternity nursing course and to examine changes in students' knowledge, attitudes, and understanding of the issues surrounding methamphetamine use. This study has been approved by the Institutional Review Board at the University of Tennessee at Chattanooga.

Description of Procedures to be Followed: The methods and procedures employed in this study will consist of online PRE and POST surveys and the educational presentation. You will be asked to respond to a series of 30 questions on the survey instrument following this consent form. The PRE survey will consist of 25 content based questions as well as 5 demographic related questions. The content based questions presented in the PRE/POST surveys will address topics relating to the history, origin, and prevalence of methamphetamine, the definition of methamphetamine, the overall effects of methamphetamine, the impact of maternal methamphetamine use in pregnancy on maternal and child outcomes, and signs and

symptoms of methamphetamine use. The questions on the PRE survey will mirror those on the post-assessment. The POST survey will consist of 25 content based questions, 1 demographic related question, and 1 reflection question. Following completion of the PRE survey, you will be provided with educational content related to maternal methamphetamine use and the effects on child outcomes. Once the educational presentation has concluded, a POST survey will be distributed immediately following implementation of the educational program.

Expected Time Required for Participation: The PRE survey will be made available for completion on September 6, 2016. The educational content will be presented on October 4, 2016. The POST survey will be distributed for completion immediately following the educational presentation. The PRE/POST surveys will require approximately 45-60 minutes to complete. Provision of educational content will require approximately 30-45 minutes. Participation is solely voluntary. You may withdraw from the study at any point in time. However, it is anticipated that you will participate throughout the entire course of the study as content provided in this study will be incorporated into the content structure of the maternal childbearing course.

Risks/Benefits: The risks associated with this study are minimal to none. The only notable risk is discomfort related to the methamphetamine content or personal experience related to such. You will be provided with contact information for the University's Counseling and Personal Development Center (423-425-4438) in the

event you feel the need to discuss issues raised by this study. There are many notable benefits anticipated from this study. The specific information provided in this study will benefit you as a nursing student by enhancing your knowledge about methamphetamine so that you are better prepared to inform others of the detrimental effects of methamphetamine in any case. This study will not only benefit you by contributing to your field of knowledge and enhancing your practice as a nurse but will also benefit society as a whole. You will be knowledgeable about methamphetamine and will be able to care for and further educate your patients on the effects of methamphetamine.

Confidentiality: No identifiable participant information will be kept and all data will be analyzed collectively with no identification of individual participants. You, the student, will be asked to provide your UTC ID for the purpose of cross referencing PRE/POST data. However, all research records will be confidential. Any and all forms associated with the survey will be kept in a locked file in Dr. Cherry Guinn's office in the UTC School of Nursing. In addition to the author of this project, Dr. Guinn and Dr. Holcombe, who are faculty members of the School of Nursing and members of this project committee, will solely have access to all data utilized and acquired in this study. All online responses collected will require password protected access and will be guarded using Qualtrics enhanced SSL encryption.

Incentives: No incentives will be offered for participation nor will you be penalized

for choosing not to participate in the PRE/POST surveys. If you choose not to participate in the PRE/POST surveys, you will still be expected to participate in the class during which the methamphetamine-related content is presented to the students. You will also be expected to participate in the subsequent assignments/examinations at the discretion of the course instructor as part of the course structure, but your reflections/observations will be omitted from data analysis and/or inclusion in any presentation of the results. Your PRE/POST survey responses will not be reflected as a grade for NURS 3350.

If you choose to participate, please complete the survey according to the directions provided. Participation is completely voluntary and all responses are confidential. If you become uncomfortable or wish to stop answering questions for any reason, you are free to stop taking the survey at any time during the process.

You may get a copy of the finalized results and any reports once the data is analyzed.

If you wish to have this information, please contact:

Tina F. Nguyen

Email Address: RJX263@mocs.utc.edu Phone Number: (423) 834-4794

Thank you for your time and participation.

Sincerely, Tina F. Nguyen, BSN student

If you have any questions about your rights as a participant in this research or if you feel you have been placed at risk, you may contact Dr. Amy Doolittle, Chair of the Institutional Review Board, at 423-425-4289. Additional contact information is available at www.utc.edu/irb.

If you feel the need to talk to anyone about any issues raised by this survey, please contact University Counseling Services at 423-425-4438.

By responding [YES] to the following question, I affirm that:

I have read the study information described above. I voluntarily agree to participate in the study. I affirm that I am 18 years of age or older.

Appendix B

PRE/POST Surveys

PRE/POST Survey

1 Which of the following most accurately describes the prevalence and severity of methamphetamine use as it relates specifically to the state of Tennessee?

- A. Top 15
- B. Top 2
- C. Top 3**
- D. Top 10

2. Methamphetamine is also known by various street names, including all of the following *EXCEPT*:

- A. Zoom**
- B. Crank
- C. Speed
- D. Fire

3. What is the most common ingredient in methamphetamine?

- A. Diphenhydramine
- B. Furosemide
- C. Methylin
- D. Pseudoephedrine**

4. Additional ingredients that are essential to the process of manufacturing methamphetamine include which of the following:

- A. Lithium**
- B. Mercury
- C. Magnesium
- D. Arsenic

5. Under what category of drugs is methamphetamine classified as?

- A. Depressants
- B. Hallucinogens
- C. Opiates
- D. Stimulants**

6. The physiological and psychoactive effects of methamphetamine occur due to mechanisms

that increase the levels of all the following neurotransmitters *EXCEPT*:

- A. Dopamine
- B. Serotonin

C. Epinephrine

D. Norepinephrine

7. This neurotransmitter is involved in reward, motivation, pleasure, and motor function. Increased levels in this neurotransmitter result in the sense of increased alertness and intense euphoria, effects that lead people to use methamphetamine.

A. Dopamine

B. Serotonin

C. Epinephrine

D. Norepinephrine

8. The effects of methamphetamine use occur as a result of the drug's effect on which primary body system?

A. Cardiovascular/Circulatory System

B. Nervous System

C. Muscular/Skeletal System

D. Respiratory System

9. Pharmaceutical methamphetamine is still available legally and is prescribed, though infrequently, to treat all of the following *except*:

A. Obesity

B. Narcolepsy

C. Constipation

D. ADHD

10. Methamphetamine causes which of the following acute short-term effects:

A. Visual disturbances

B. Increased hunger

C. Decreased energy

D. Increased sexual pleasure

11. Additional acute short-term effects of methamphetamine use include which of the following?

A. Decreased respirations

B. Irregular heartbeat

C. Low blood pressure

D. Slightly low body temperature

12. Methamphetamine causes which of the following chronic long-term effects?

A. Hypersomnia

B. Weight gain

C. Hallucinations

D. Memory loss

13. Effects due to secondary methamphetamine exposure include which of the following?
- A. Respiratory distress**
 - B. Seizure
 - C. Stroke
 - D. Pulmonary hypertension
14. Methamphetamine often leads to consumption of increased doses in order to produce the same desired effects. This lends to the drug's highly dangerous nature and is referred to as:
- A. Intoxication
 - B. Addiction
 - C. Withdrawal
 - D. Tolerance**
15. In regards to the demographic characteristics that are unique to the population of methamphetamine users, current literature studies illustrate that methamphetamine-using women are more likely to demonstrate which of the following:
- A. Nulliparous
 - B. Married
 - C. Older age
 - D. Low socioeconomic status**
16. Common maternal complications that can occur as a result of maternal methamphetamine use in pregnancy include all of the following *EXCEPT*:
- A. Miscarriage**
 - B. Hypertension
 - C. Pre-eclampsia
 - D. Pre-term labor/birth
17. Studies show that methamphetamine-abusing mothers are at risk of having seizures, which occur as a result of what?
- A. High blood pressure**
 - B. Rapid heart rate
 - C. Low protein
 - D. Uncontrolled body temperature
18. Maternal methamphetamine use can lead to alterations in placental function, which ultimately compromises fetal development by:
- A. Increasing levels of methamphetamine in the fetus
 - B. Decreasing available oxygen to the fetus**
 - C. Increasing carbon dioxide levels in fetus
 - D. Increasing accumulation of meconium

19. The fetal hypoxemia secondary to maternal methamphetamine use is likely caused by:

- A. Angioinfarction
- B. Vasodilation
- C. Venous stenosis
- D. Vasoconstriction**

20. Common fetal complications that can occur as a result of maternal methamphetamine use include which of the following:

- A. Pre-term birth**
- B. Large for gestational age
- C. Cleft lip and palate
- D. Hydrocephaly

21. Neonates born to methamphetamine abusing mothers have been shown to display which of the following?

- A. Decreased head circumference**
- B. Slightly increased birth weight
- C. Decreased lung capacity
- D. Increased length

22. Additional neonatal complications of maternal methamphetamine use include which of the following?

- A. Increased birth weight
- B. Increased length
- C. Small for gestational age**
- D. Shorter length

23. Behaviors that may be observed in mothers who are using methamphetamine include which of the following:

- A. Excessive happiness
- B. Hypo-vigilance
- C. Obsessive Compulsive Disorder
- D. Paranoia**

24. What common physical manifestation is often an indicator of methamphetamine use?

- A. Contusions
- B. Dental caries**
- C. Onychorrhexis
- D. Alopecia

25. Methamphetamine users often get the sensation that there are insects creeping on top of, or underneath, the skin. This causes the user to pick at or scratch the skin, which can create open sores. This common hallucination is commonly referred to as:

- A. Sensory stage
- B. Crawl phase
- C. Itch phenomenon
- D. Crank bug**

PRE Survey ONLY

1. Have you ever been exposed to a presentation on methamphetamine use?

- A. Yes
- B. No
- C. Not sure
- D. Prefer not to answer

2. Have you ever cared for a patient with methamphetamine overdose?

- A. Yes
- B. No
- C. Not sure
- D. Prefer not to answer

3. Have you ever been educated or provided with specific information on the effects of methamphetamine in pregnancy?

- A. Yes
- B. No
- C. Not sure
- D. Prefer not to answer

4. Have you ever known a family member or friend who has used methamphetamine?

- A. Yes
- B. No
- C. Not sure
- D. Prefer not to answer

4a. If so, what was your relationship to this person?

5. I feel comfortable discussing methamphetamine-related topics with my peers.

- A. Strongly Agree
- B. Agree
- C. Neutral
- D. Disagree
- E. Strongly Disagree

POST Survey ONLY

1. I feel comfortable discussing methamphetamine-related topics with my peers.

A. Strongly Agree

B. Agree

C. Neutral

D. Disagree

E. Strongly Disagree

Reflection

1. How do you anticipate using this information in your future practice as a nurse?
