5-2015

A Descriptive Study Examining Medical Records of Late-Preterm Infants Readmitted to the Hospital within 30 Days of Birth Hospitalization Discharge

Devon G. Hill-Larson
University of Arkansas, Fayetteville

A Descriptive Study Examining Medical Records of Late-Preterm Infants Readmitted to the Hospital within 30 Days of Birth Hospitalization Discharge

A thesis presented

by

Devon G. Hill-Larson

Presented to the College of Education and Health Professions

in partial fulfillment of the requirements

for the degree with honors

of Bachelor of Science in Nursing

University of Arkansas

March 2015

Abstract

This descriptive study evaluates the most common factors for readmission of late-preterm infants. It is hoped that this important information will allow a hospital in Northwest Arkansas to better identify late-preterm infants at risk for readmission to the hospital within 30 days of their birth hospitalization. Identification of at risk infants will allow for specialized care and education.

Common factors that result in readmission of preterm infants include jaundice, feeding difficulties, temperature instability, infection, hypoglycemia, and respiratory problems. Education of healthcare professionals and parents of the vulnerability of late-preterm infants, who are often overlooked since they are usually of the same size and weight of term infants, is of utmost importance. Diligent evaluation, monitoring, and early return appointments are also important. The local hospital in Northwest Arkansas, where I conducted data collection, receives readmissions of preterm infants who are born in hospitals all throughout Arkansas and its border states, however, for this study I only collected data from late-preterm infant medical records who were hospitalized at birth at this specific hospital in Northwest Arkansas and who met other study criteria.

Preterm birth is a growing problem in the United States, with the percentage of late-preterm births growing since the 1990's. This descriptive study will attempt to identify factors and trends related to readmission of late-preterm infants to a hospital in Northwest Arkansas. Readmission of late-preterm infants causes a financial burden not only to the family of the child but also to the healthcare institution.

Introduction

Late-preterm birth is defined by the Centers for Disease Control and Prevention (CDC) as birth occurring prior to 36 weeks, 6 days gestation and after 34 weeks, 0 days gestation (CDC, 2014). The rate of infants born prematurely is rising in the United States. Late-preterm infants comprise the fastest growing subset of neonates, accounting for 74% of all preterm births and 8%-9% of total births in the United States (Kugelman & Colin, 2013). The proportion of all US births that were late-preterm increased from 7.3% in 1992 to 8.5% in 2002 (Underwood, Danielsen, & Gilbert, 2007), while another study found this same proportion of US births that were late-preterm increased from 7.3% in 1990 to 9.1% in 2005 (Engle, et al., 2007). One of the objectives of *Healthy People 2020* is to "reduce late-preterm or live births at 34-36 weeks gestation." In 2007, 9% of live births were late-preterm or occurred at 34-36 weeks gestation. *Healthy People 2020* has set a goal for late-preterm births to decrease to 8.1% by the year 2020 (Healthy People 2020, 2015). Currently the proportion of late-preterm births is decreasing as desired, according to *Healthy People 2020*; and, as of 2012, the proportion of late-preterm births in the United States is 8.1% (Healthy People 2020, 2015). Laughon and co-workers, speculate that the increase in late-preterm births correlates to an increase in Cesarean sections and inductions at this gestational age and is potentially avoidable. For this reason, elective Cesarean section deliveries should be postponed until 39 weeks' gestation (Laughon, et al., 2010). This is because many organ systems, including the brain, lungs, and liver need the final weeks of pregnancy to fully develop (Burgos, Flaherman, &

Newman, 2011). According to one study from the *Journal of Perinatology* the most common cause of readmission after discharge from the hospital is acute respiratory distress (Underwood, Danielsen, & Gilbert, 2007).

Hospital readmissions within 30 days of inpatient discharge are costly. If the number of late-preterm infants continues to increase, their impact on hospital costs will continue to increase as well (Shapiro-Mendoza, et al., 2006). Kornhauser and Schneiderman noted that average medical care costs for the first year of life at approximately $32,000 for preterm infants versus $3,000 for a full-term infant (Kornhauser & Schneiderman, 2010). It has also been conservatively estimated that long-term medical, educational, and productivity costs associated with the birth of all infants before 37 weeks' gestation is approximately $51,600 per infant or a total cost of $26.2 billion. The total resources and costs associated with late-preterm birth are also likely to be a substantial part of the total cost of all preterm births, due to the population of late-preterm infants being significantly larger than the population of infants who are born prior to 34 weeks (Engle, et al., 2007). Late-preterm infants were found to have increased readmission rates and more use of medical resources (Kugelman & Colin, 2013), such as respiratory syncytial virus (RSV) prophylaxis, which consists of a costly series of five injections ($8,000-$16,000 for the series or $1,300-$2,600 per injection) (Synagis for RSV, 2011) during the first year of life. The federal government has invested heavily in policies, incentives, technical assistance, and new payment methods to prompt healthcare providers to reduce avoidable readmissions. As a result, many institutions have taken steps to reduce readmission rates including patient and

family education, home healthcare visits, and follow-up checks by phone following discharge.

Late-preterm infants suffer from a "threefold higher infant mortality rate compared with term infants (Kugelman & Colin, 2013)." In a US multistate study, it was discovered that "infants born between 32 and 36 weeks' gestation had more than a twofold risk for having congenital malformations", compared to term infants, and late-preterm infants are "about four times more likely than term infants to die of congenital malformations (Kugelman & Colin, 2013)." With the increased survival of infants born prematurely (< 37 weeks gestation), late-preterm infants suffer from a variety of health problems related to the immaturity of their organs, and may require support following discharge. McLaurin and co-workers noted that late-preterm infants born between 34 and 37 weeks gestation are readmitted to the hospital at twice the rate of term infants (McLaurin, et al., 2009). Shapiro-Mendoza and co-workers state in their study on neonatal morbidity and mortality that infants with neonatal morbidity were more likely to be "firstborn, be breastfed at discharge, have labor and delivery complications, be a recipient of a public payer source at delivery, or have an Asian/Pacific Islander mother. Non-Hispanic African Americans had a decreased risk for neonatal morbidity compared to other racial/ethnic groups (Shapiro-Mendoza, et al., 2006)." However, information found on the Morbidity and Mortality Weekly Report published by the CDC states that non-Hispanic African Americans born in the United States have the highest infant mortality rates (CDC MMWR, 2011). Notably, rates of late-preterm birth in Arkansas also increased from 9.3% of births

in 2010 to 9.6% in 2011 (CDC, 2012), above the national average in 2012 of 8.1% of all births.

Causes of preterm delivery are well established. Intrauterine growth restriction (IUGR) is a common cause for late-preterm birth and is thus more common among late-preterm infants compared to term infants (Kugelman & Colin, 2013). It is also important to note that an infant "being small for gestational age (SGA) substantially increases the already higher mortality rate" of late-preterm infants (Kugelman & Colin, 2013). Maternal complications are associated with increased neonatal morbidities. Maternal morbidities, which include, hypertension, preeclampsia, diabetes mellitus, maternal smoking, and acute conditions such as chorioamnionitis (infection that results from premature rupture of membranes), are common causes of preterm delivery in late-preterm infants. Additionally, compared with infants delivered via planned vaginal delivery, "late-preterm infants who are delivered by elective Cesarean section delivery had significantly higher rates of mortality, risk for special care admission, and respiratory morbidity (Kugelman & Colin, 2013)." "Eighty percent of late-preterm infants will have a neonatal course with no significant complications," however, compared with term infants, late-preterm infants are at increased risk for resuscitation at birth, feeding difficulties, jaundice, hypoglycemia, temperature instability, apnea, and respiratory distress (Kugelman & Colin, 2013). These morbidities can result in screening for sepsis and the ultimate use of antibiotic therapy, intravenous fluid administration, ventilator support, and increased length of stay in 30% of the 20% of late-preterm infants who have significant

complications (Kugelman & Colin, 2013). Naturally, the rate of complications decreases with increasing gestational age throughout the late-preterm period. Thus the 37-weeker has a lower morbidity and mortality risk than the 34-weeker.

The reasons for Emergency Department visits and readmissions do not always relate directly to the preterm status but to common problems such as respiratory and gastrointestinal conditions. It is not known how many readmissions are related to inadequate caregiving and parenting at home or if they could have been averted by earlier intervention measures. Parents of all infants experience a period of transition immediately following discharge from the hospital. This transition period is critical for parents of preterm infants in which they must now take on all of the caretaking responsibilities and activities. If parents lack the knowledge and skills for caring for the infant at home, they may not be equipped to handle the challenges they face. Late-preterm infants are often cared for in the well-baby nursery after birth and are discharged from the hospital by two to three days of age (Underwood, Danielsen, & Gilbert, 2007). Late-preterm infants account for >70% of all preterm births in the United States (Tomashek, et al., 2006) and are often treated as developmentally mature because they are usually of normal birth weight (≥2500g) and the same size as term infants (Underwood, Danielsen, & Gilbert, 2007). The late-preterm infant may appear outwardly mature but may experience inadequate thermoregulation, immature and weak suck and swallow reflexes, and poor immunological and respiratory defenses. The American Academy of Pediatrics recommends that postnatal discharge “be limited to infants who are of singleton birth between 38 and 42

weeks gestation and who have a birth weight appropriate for gestational age." However, in practice, late-preterm infants are discharged early despite their gestational age of 34-37 weeks (Tomashek, et al., 2006). Engle and co-workers state that late-preterm infants who are discharged early and have a less than two night hospital stay after a vaginal delivery "may be at increased risk for neonatal morbidity compared with term infants who are discharged early" (Engle, et al., 2007). Another study by Escobar and co-workers found that the highest readmission rate occurred among preterm infants 33-36 weeks gestation who had an inpatient length of stay of less than four days (Escobar, 2005). However, some studies have been divided on whether early discharge is associated with increased neonatal morbidity and hospital readmission.

Literature Review

Feeding Difficulties, Temperature Instability, & Hypoglycemia

Late-preterm infants are prone to temperature instability, feeding difficulties, and hypoglycemia. The few weeks that distinguish prematurity from term gestation are important. Successful oral feeding behaviors necessary for survival depend on the physical maturity and brain development of the infant (Hallowell & Spatz, 2012). Although late-preterm infants "may appear physically mature and clinically stable at birth, they are actually developmentally unprepared for successful oral feeding behaviors necessary for extrauterine life (Hallowell & Spatz, 2012)." Feeding difficulty is a common outcome associated with hospital readmission within the first week of life. When an infant is born late-preterm, little can be done to accelerate growth and maturity to improve feeding behaviors,

however, an understanding of how brain development affects oral intake may help establish practices to facilitate successful feeding in the late-preterm infant (Hallowell & Spatz, 2012). An understanding of the pathophysiology of milk production is also important in understanding how best to feed late-preterm infants. As prolactin rises mid-pregnancy through to the second postpartum day, mammary epithelial cells begin to produce milk; this process is called lactogenesis. The rapid drop of maternal progesterone following delivery of the placenta initiates lactogenesis II, however, copious milk production does not occur until 3-8 days postpartum (Hallowell & Spatz, 2012). Late-preterm birth presents a potential problem in establishing successful feeding-sucking coordination and limited removal of available milk from the breast. As a consequence of poor milk removal, there is feedback inhibition, which results in delayed lactogenesis II and a down-regulation of milk volume within the first few days of birth (Hallowell & Spatz, 2012). This can lead to feeding difficulties in the late-preterm infant, which can predispose the infant to hyperbilirubinemia and dehydration, potentially resulting in hospital readmissions. Feeding behaviors follow a pattern of development, which correspond with increasing brain maturation. The infant must be able to adequately control breathing, spontaneous breathing without the need for supplemental oxygen, adequate oral feeding, and maintenance of body temperature without the addition of supplemental heat, in order to feed well. Feeding and oxygenation milestones are achieved last, in terms of development, typically between 34 and 36 weeks gestation. The physiologic maturity required to master suck-swallow-breathe coordination

necessary for successful feeding occurs at the same time that late-preterm infants are born, so not surprisingly, feeding can be a problem for this population (Hallowell & Spatz, 2012). Early discharge of late-preterm infants may influence the increased incidence of feeding difficulties, weight loss, and hyperbilirubinemia, all of which are common problems associated with late-preterm infants. The typical hospitalization after vaginal delivery is 48 hours and after Cesarean delivery is 96 hours. Discharge within 48 hours does not allow for lactogenesis II to occur and maternal milk supply to be established (Hallowell & Spatz, 2012). Although it makes sense to allow late-preterm infants to go home with their mothers at 48 hours to facilitate bonding and breastfeeding, these infants require closer observation during birth hospitalization and require a follow-up within 48 hours of discharge to ensure that baby is receiving adequate oral intake in order to avoid readmission. "Successful establishment of milk production and breastfeeding may play a significant role in influencing hospital discharge and readmission (Hallowell & Spatz, 2012)."

An infant's response to cold exposure after birth is related to gestational age and is affected by physical size, the amount of mature brown and white adipose tissue, and maturity of the hypothalamus—the part of the brain that regulates thermoregulation (Engle, et al., 2007). Late-preterm infants have less white adipose tissue for insulation and cannot generate heat from brown adipose tissue effectively due to their immaturity. In addition, late-preterm infants are likely to lose heat more readily than term infants due to their larger ratio of

surface area to weight and their smaller size. As a result, late-preterm infants are likely to lose heat more readily than term infants.

Hypoglycemia can affect newborn infants of all gestational ages due to insufficient metabolic responses to the loss of the maternal glucose supply after birth. The incidence of hypoglycemia is inversely proportional to gestational age (Engle, et al., 2007). Preterm infants are at an increased risk for developing hypoglycemia after birth due to immaturity of body systems (Engle, et al., 2007). Post-discharge hypoglycemia can be related to poor suck reflex or failure to thrive. It is important to note that hypothermia and hypoglycemia can potentially worsen preexistent respiratory distress (Tomashek, et al., 2006). Also, the immaturity of the gastrointestinal (GI) system and feeding difficulties in late-preterm infants predisposes the infant to constipation, dehydration, and hyperbilirubinemia. Infants who have feeding difficulties, slow GI transit time, delayed gastric emptying, jaundice, sepsis, and respiratory disease have all been linked to having a higher incidence of sudden infant death syndrome (SIDS) (Engle, et al., 2007 & Escobar, et al., 1999).

Hepatobiliary Problems

Jaundice and hyperbilirubinemia occur more commonly and are more prolonged among late-preterm infants than term infants. During the first month after birth, late-preterm infants are more likely than term infants to develop and be readmitted for hyperbilirubinemia (Engle, et al., 2007). Jaundice is caused by the physiological destruction of red blood cells in the infant, and its importance lies in the ability of the bilirubin pigment produced to cross the blood brain barrier,

resulting in neurotoxicity and bilirubin-induced brain injury (Kornhauser & Schneiderman, 2010 & Raju, et al., 2006). Jaundice, which results from hyperbilirubinemia, is common, while jaundice severe enough to cause kernicterus is rare. Kernicterus is what occurs when bilirubin crosses the blood brain barrier, causing brain injury (Burgos, Flaherman, & Newman, 2011). Although kernicterus is rare in the late-preterm infant population as compared with the very preterm and extremely preterm infant populations, late-preterm infants who are cared for as term infants or who are given no targeted attention as related to pre-discharge risk assessment, feeding, discharge follow-up instructions, or breastfeeding may develop acute or chronic post-icteric sequelae, leading to kernicterus. Bhutani and Johnson also found that post-icteric sequelae were more severe and frequent in late-preterm infants (Bhutani, et al., 2006). Late-preterm infants are two times more likely than term infants to have significantly elevated bilirubin concentrations five to seven days after birth. Because bilirubin levels commonly peak at three to five days of age, The American Academy of Pediatrics recommends that a healthcare provider examine newborns within 48 to 72 hours after discharge (Underwood, Danielsen, & Gilbert, 2007). Readmission for jaundice occurs in 1% to 2% of all newborns at an average cost of more than $3,000 per admission.

Neurodevelopmental Challenges

The last half of gestation is described as a critical period for brain development and is characterized by rapid and dramatic changes in one or more molecular, neurochemical, and/or structural parameters. The term “hierarchy of

vulnerability" provides a prospective that states that although late-preterm infants are more mature than very preterm infants, their brain is still immature and can be damaged under some adverse conditions (Kugelman & Colin, 2013). "Brain weight at 34 weeks is only 65% of that of the term brain and gyral and sulcal formation is incomplete (Kugelman & Colin, 2013)." In the late-preterm infant, the period between 34 and 40 weeks gestation is critical because the percentage of both gray matter and myelinated white matter to total brain volume increases exponentially. Late-preterm infants are often perceived to have similarly low risk for developmental problems as infants born at term due to their low rate of intraventricular hemorrhage (0.2%-1.4%) (Kugelman & Colin, 2013). Because the risk is low, late-preterm infants often do not undergo routine brain ultrasonography. Recently, however, there has been growing concern that these infants are more vulnerable to brain injury than previously thought (Kugelman & Colin, 2013). Conditions such as, periventricular leukomalacia (PVL) are no longer restricted to the very preterm infant and occurs in late-preterm as well as term infants. Some studies are also reporting a "threefold increased risk for developing cerebral palsy" in late-preterm infants compared to term infants (Kugelman & Colin, 2013). There is also increasing evidence that late-preterm infants have more subtle neurodevelopmental issues, such as inferior academic performance and behavioral problems, and although these subtle neurodevelopmental issues will not likely cause an increase in readmission rates within 30 days of birth hospitalization discharge, (Kugelman & Colin, 2013) it is

important to note that intraventricular hemorrhage and PVL are serious conditions that can cause readmissions within this time period.

Respiratory Problems

According to many studies, respiratory complications are prime morbidities of late-preterm infants (Kugelman & Colin, 2013). Respiratory problems are among the top reasons for readmissions of preterm infants post-discharge. Apnea occurs more frequently among late-preterm infants than in term infants, with an incidence of apnea reported between 4% and 7% compared with less than 1%-2% at term (Escobar, et al., 1999). It is also suspected that late-preterm infants may be at higher risk of centrally mediated apnea because their central nervous systems are developmentally immature, meaning they have fewer sulci and gyri, as well as less myelin. Late-preterm brains are also approximately 2/3 the size of a term infant's brain (Kugelman & Colin, 2013). One study analyzed readmission rates for respiratory illness in infants less than 32 weeks gestation with mean birth weights of 1104-1188g. The study found preterm infants with no history of mechanical ventilation showed a 10-fold increase in readmissions compared with control infants. Among the 43 infants who required no mechanical ventilation beyond the day of birth, 10 (23%) required readmission. More than 80% of readmitted infants required their first admission within four months of discharge. This study also examined seasonal factors related to readmission. The researchers found that initial hospital discharge between the months of September-December, months immediately preceding peak respiratory viral season, resulted in an almost threefold increased risk of

readmission compared with discharge between the months of May-August. This study found that respiratory illness contributes significantly to post discharge morbidity in preterm infants with and without chronic lung disease (Cunningham, McMillan, & Gross, 1991).

A large retrospective study found that the odds of respiratory distress syndrome (RDS) decreased significantly with each advancing week of gestation up to 38 weeks compared with infants born at 39 and 40 weeks gestation—what are considered full-term infants (Kugelman & Colin, 2013). Although, there is a relatively low risk for respiratory distress syndrome (RDS) (10.5%) or transient tachypnea of the newborn (TTN) (6.4%) at 34 weeks compared with more preterm infants, this rate still poses an increased risk for late-preterm infants when compared to term infants, who have a very low risk for RDS and TTN at 0.3% (Kugelman & Colin, 2013). RDS and TTN are high risk for readmission and longer hospitalizations in late-preterm infants. Friedrich and co-workers, in a longitudinal study, found that "despite normal lung volume, healthy preterm infants had persistently reduced airflow through the age of 16 months (Friedrich, et al., 2007)," which could lead to the conclusion that preterm birth is associated with altered lung development. Having reduced airflow can complicate acute conditions such as respiratory syncytial virus (RSV) and can lead to readmissions of late-preterm infants within 30 days of initial discharge.

Raju and co-workers have underscored the importance of educating healthcare providers and parents about the vulnerability of late-preterm infants and stress that these infants require diligent evaluation, monitoring, referral, and

early return appointments (Raju, et al., 2006). These actions may decrease hospital readmission rates of late-preterm infants post birth hospitalization discharge.

Study Aims

The aims of this study are to describe trends of readmissions of late-preterm infants 30 days or less from birth hospitalization discharge at a hospital in Northwest Arkansas. This descriptive study will assist the hospital in identifying factors most frequently associated with readmission, so targeted discharge education can be designed in the future.

Methods

This study was conducted following approval from the University of Arkansas Institutional Review Board and the Northwest Arkansas hospital's Quality Improvement Department.

Design

The design of this thesis project is a descriptive study examining medical records of infants readmitted to the hospital within 30 days of their birth hospitalization discharge. Infants involved in this study were late-preterm infants, defined as infants born between 34 and 37 weeks gestation. All infants born and discharged home from the Northwest Arkansas hospital meeting the late-preterm infant designation were included in this study. Infants transferred to a Neonatal Intensive Care Unit were excluded from this study. All patient information was de-identified in accordance with the Health Insurance Portability and Accountability Act (HIPAA) guidelines. All medical record reviews were

conducted in the hospital setting in a hospital in Northwest Arkansas. Medical record reviews were pulled from readmission dates ranging between the months of January 2010 and August 2014, and 70 medical record reviews were conducted and used for descriptive analysis. Retroactive medical record audits of all late-preterm infants readmitted within 30 days of their birth hospitalization and meeting the study criteria were reviewed to identify factors that caused their readmission. Each case was assigned a random number and only information pertinent to the results of this study was examined. Information pertinent to this study that was collected from the medical records review include: gestational age, birth weight, discharge weight, breast/bottle fed at birth hospitalization discharge, readmission weight, diagnosis at readmission, and method of feeding (breast or bottle) at readmission.

Data Analysis

Use of descriptive and summary statistics were used for this study to provide a summary of the data collected. A Chi-square test and Mann-Whitney U test were also performed. Statistics were run on SPSS—predictive analytics software.

Results

Of the 70 chart audits conducted, 32 (45.7%) of the patients were female and 38 (54.3%) were male, as shown in Table 1.

Table 1: Gender percentages of late-preterm infants.

	Frequency	Percent
F	32	45.7
M	38	54.3
Total	70	100.0

During birth hospitalization, all patient feeding statuses were recorded in the electronic health record and were recorded as breastfed, bottle-fed, or breast and bottle-fed. Sixty-five point seven percent were breastfed initially after birth and 15.7% were bottle-fed; 18.6% were both breast and bottle-fed. At readmission, 58.5% of patient feeding statuses were not recorded in the electronic health record. Twenty-one point four percent of patients whose feeding statuses were recorded at readmission were breastfed, 11.4% were bottle-fed, and 8.6% were both bottle and breast-fed. Thirty-five point seven percent of the 70 readmitted late-preterm infants were born via Cesarean section and 64.3% were birthed vaginally. The Emergency Department was the most frequent readmission department, followed by Pediatrics. Fifty-one point four percent were readmitted to the ED, 18.6% as Outpatient, 4.3% to Observation, and 25.7% to Pediatrics. The most frequent reason for readmission was for hepatobiliary problems, at

25.7% of those readmitted, followed by respiratory problems at 17.1%, infection at 10%, gastrointestinal problems at 10%, metabolic problems at 5.7%, injury at 2.9%, feeding problems at 2.9%, orthopedic problems at 2.9%, fatigue/malaise at 1.4%, fussiness at 1.4%, hemorrhage at 1.4%, maternal anxiety at 1.4%, and weight loss, neurological, and urinary each at less than 1%, all data shown in Figures 1 and 2. No patients were readmitted for cardiac problems. Maternal anxiety represents the diagnosis of "person with feared complaint in whom no diagnosis was made." Seventeen point one percent of those readmitted within 30 days of initial discharge were readmitted more than once in this 30-day period. Birth weights ranged from 1.1kg (2.2lbs) to 4kg (8.8lbs). Discharge weights and weights at readmission were limited with seven patient discharge weights and 49 patient readmission weights missing.

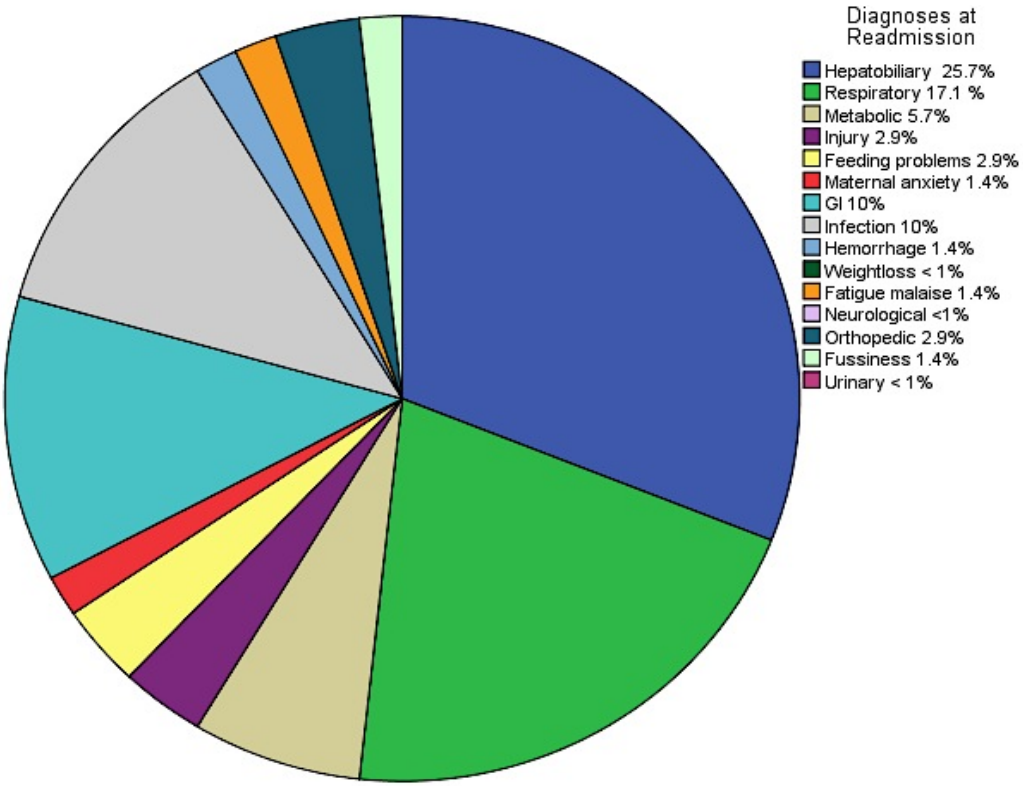


Figure 1: Percentages of each diagnosis at late-preterm infant readmission.

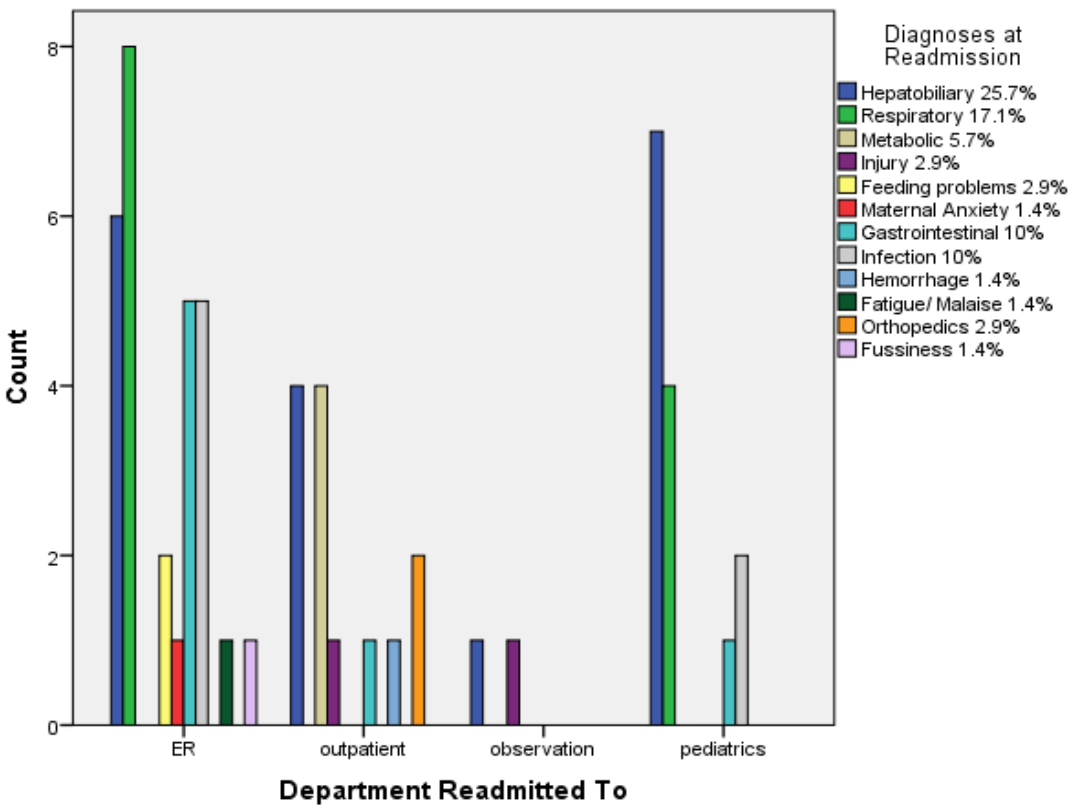


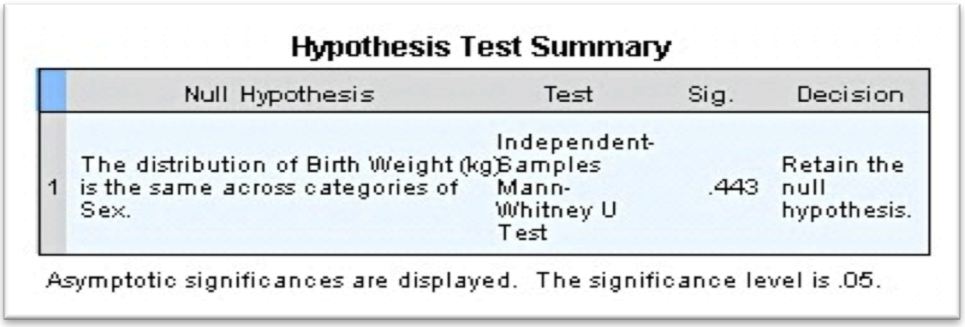
Figure 2: Number of late-preterm readmissions per department organized by diagnosis at readmission.

Ten percent of the 70 patients readmitted were born at 34 weeks gestation, 14.3% at 35 weeks gestation, 28.6% at 36 weeks gestation, and 47.1% at 37 weeks gestation. Mean birth weight was 2.75 kg, as shown in Table 2.

Table 2: Mean birth weight (kg) of late-preterm infants.

Birth weight (kg)		
N	Valid	70
	Missing	0
Mean		2.749247

A Mann-Whitney U Test was run to determine if there were differences in birth weights between male and female late-preterm infants. The null hypothesis was that the distribution of birth weights (kg) is the same across categories of sex, as seen in Figure 3. Median birth weight was neither statistically nor significantly

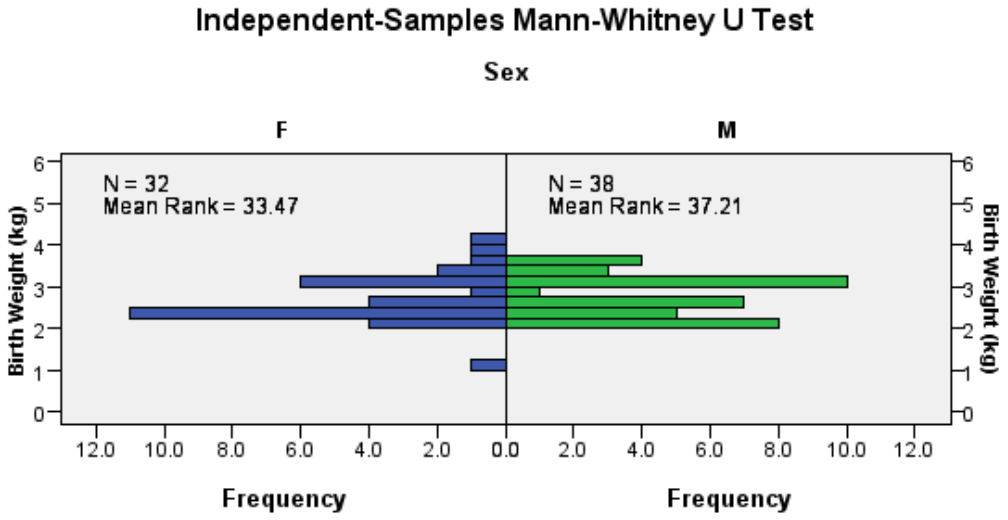

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Birth Weight (kg) is the same across categories of Sex.	Independent-Samples Mann-Whitney U Test	.443	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 3: Hypothesis test summary of a Mann-Whitney U test for birth weight by gender in late-preterm infants.

different between males and females, U = 673, z = .766, p = 0.433, using an exact sampling distribution for U, shown in Figure 4. This Mann-Whitney U test lead to a decision to retain the null hypothesis, also shown in Figure 3.



Total N	70
Mann-Whitney U	673.000
Wilcoxon W	1,414.000
Test Statistic	673.000
Standard Error	84.819
Standardized Test Statistic	.766
Asymptotic Sig. (2-sided test)	.443

Figure 4: A Mann-Whitney U test with independent sampling.

A Chi-square test was performed to determine if the infants readmitted within 30 days of birth hospitalization discharge were more likely to be readmitted through the Emergency Department, as opposed to other departments/units. The two variables used were: readmitted more than once in 30 days and location of readmission. Readmission more than once in 30 days and location of readmission

were found to be significantly related. The percent that came in through the Emergency Department (51.4%), shown in Table 3, is correlated with the percentage admitted more than once in 30 days (17.1%). Chi-square = 54.889 (33), *p* 0.010, shown in Table 4.

Table 3: Percent of patients readmitted to the ER, Outpatient, Observation, and Pediatric unit.

	Frequency	Percent
ER	36	51.4
Outpatient	13	18.6
Observation	3	4.3
Pediatrics	18	25.7
Total	70	100.0

Table 4: Chi-square analysis of Emergency Department readmissions of late-preterm infants readmitted within 30 days of birth hospitalization discharge.

Chi-Square Analysis of ED Readmissions			
	Chi ^{2} Value	Df	*p*-value
Pearson Chi-Square	54.889[a]	33	.010
N of Valid Cases	58		

Discussion

Overall, my data confirmed the findings in the literature. The top reasons for readmission according to the data include: hepatobiliary problems, respiratory problems, infection, and gastrointestinal problems. It is important to note that the Emergency Department is being utilized primarily for respiratory and hepatobiliary problems. Those with hepatobiliary and respiratory problems could potentially be seen by a Primary Care Provider or Pediatrician for these problems and then directly admitted to the pediatric floor on an as needed basis. This would cut Emergency Department costs and likely decrease parental and familial stress associated with Emergency Department visits.

Limitations

The weights of late-preterm infants at discharge and at readmission were inconsistently recorded in Cerner—the electronic medical record utilized at the Northwest Arkansas hospital. Feeding status (breast or bottle-fed) was also inconsistently recorded in Cerner. This made accurate data analysis difficult. It was hard to identify if weight loss consistently occurred between initial discharge and readmission date. Also, failing to gather and record discharge vitals, including weight, could have potential legal ramifications for healthcare providers (J. Hendren, personal communication, March 3, 2015).

Future Suggestions

Based on this data a study needs to be completed to determine if birth season, such as during peak respiratory viral season, places the late-preterm infant at a higher risk for contracting respiratory infections, such as RSV and pneumonia

during the first 30 days post birth hospitalization discharge. A quality improvement project addressing weights and feeding statuses also needs to be implemented so that all infants, not just late-preterm infants, can be monitored for weight loss, and so readmissions related to feeding problems, GI problems, failure to thrive, and weight loss can be identified early and prevented. Furthermore, future studies should record and analyze the race/ethnic group of the late-preterm infant, the presence of labor and delivery complications, the form of payment for healthcare services (if they were a recipient of a public payer source, such as Medicaid), and if they were a firstborn. Identifying these factors could help determine risk for morbidity in late-preterm infants, and if these factors lead to readmissions, specialized care can be provided for these infants. All frontline providers need to be educated and reminded that late-preterm infants are not full-term infants. Their care should not be defined by the same policies and practices that govern term infants. Specialized care could consist of collaborative counseling by neonatal and obstetric clinicians about fetal, neonatal, and maternal outcomes when maternal or fetal conditions indicate the need for late-preterm birth. The obstetric physician should provide the family with gestational age-specific outcome information and help prepare the family for the late-preterm infant's anticipated course in the nursery. This allows the family to be fully informed and allows for participation in decision-making.

A specialized education program should also be implemented for parents of preterm infants, with special attention to the three subsets of prematurity: extremely preterm, very preterm, and late-preterm. Late-preterm parents should

not receive the same education as extremely and very preterm parents and vice versa. Education should also be provided throughout hospitalization, not just at discharge. Parents and caretakers are under an enormous amount of stress at discharge and are unlikely to remember everything that they are taught. Creating an education program could help spread education out over a span of at least 48 hours to allow for sufficient absorption of knowledge. Furthermore, this education program should include injury prevention and when to take your infant to the Emergency Department or primary care physician. All patients should be provided an appointment within 48-72 hours of discharge with a primary care physician prior to discharge as well. This can help parents who have not identified a healthcare provider for their child to be introduced to and become comfortable with a healthcare provider that is available for their child whom they can ask questions from and schedule appointments with if they are concerned about their child's health. This appointment 48-72 hours after discharge will also help identify signs and symptoms of jaundice and feeding difficulties, inversely decreasing readmissions related to these factors.

Implementing home healthcare visits and/or follow-up checks by phone, such as is recommended in the introduction, might also benefit the late-preterm infant population in Northwest Arkansas. According to the National Bureau of Economic Research, infant mortality rates in the United States "for white, college-educated, married women are about the same as in Europe," but for impoverished mothers in the United States the mortality rate exponentially rises "in the months after leaving the hospital," compared to Europe where the

mortality rate stays the same regardless of socioeconomic status (Tavernise, 2015). Implementation of a home health, public health, or visiting nurse program such as the Nurse-Family Partnership program, which is currently being implemented in Memphis, Tennessee, as well as 800 other cities throughout the United States, could potentially help decrease morbidity, subsequent readmissions, and mortality of late-preterm infants, specifically late-preterm infants who live in poverty. An evidence-based article by David Olds of the University of Colorado summarizes a 27-year program of research that has attempted to improve early maternal and child health through prenatal and infant home visiting by nurses; this program was designed for low-income mothers (Olds, 2006). Home visiting attempts to counter the damaging effects of poverty by changing habits and behaviors that have developed over generations. Olds' reported fewer infant injuries and an improvement of maternal life course as a result of the Nurse-Family Partnership program (Olds, 2006). The Nurse-Family Partnership program held in Memphis, Tennessee is operated by Le Bonheur Children's Hospital and started two years ago in 2013. President Obama's administration funded the program on a national scale in 2010, and so far the "home visits have reached more than 115,000 mothers and children (Tavernise, 2015)." At its best, "the program gives poor women the confidence to take charge of their lives (Tavernise, 2015)." The Nurse-Family Partnership program in Memphis, Tennessee does not enroll infants born prematurely, so this design would not be an appropriate intervention for late-preterm infants in Northwest Arkansas. However, I believe that home health visits and follow-up calls, would

benefit the late-preterm population in Northwest Arkansas and potentially decrease readmissions related to injuries and inadequate caregiving and parenting at home.

Conclusion

In conclusion, late-preterm infants are not term infants. They have needs different from all the subsets of prematurity and require diligent follow-up cares and specialized education for both parents and healthcare providers. Healthcare providers need to be reminded of the vulnerability of this population and trained to recognize subtle signs and symptoms of complications. Parent education should span a period of no less than 48 hours to allow for a more natural, comfortable, and expanded education experience. Finally, all late-preterm patients should be set up with a primary care physician prior to being discharged from birth hospitalization and the initial PCP appointment should occur within 48-72 hours of discharge. With the implementation of the above suggestions, late-preterm readmission should be minimal and controlled.

References

Bhutani, V., & Johnson, L. (2006). Kernicterus in Late-Preterm Infants Cared for as Term Healthy Infants. *Seminars in Perinatology, 30*(2), 89-97.

Burgos, A., Flaherman, V., & Newman, T. (2011). Screening and follow-up for neonatal hyperbilirubinemia: a review. *Clinical Pediatrics*, *51* (1), 7-16. Retrieved from http://cpj.sagepub.com/content/51/1/7.full.pdf html

Centers for Disease Control and Prevention. Preterm and Late-Preterm Births: United States, each state and territory, final 2010 and preliminary 2011. (2012, October 3). Retrieved March 9, 2015, from http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_05_tables.pdf

Centers for Disease Control and Prevention. (2013, December 9). *Preterm birth*. Retrieved from http://www.cdc.gov/reproductivehealth/maternalinfanthealth/pretermbirth.htm

Cunningham, C., McMillan, J., & Gross , S. (1991). Rehospitalization for respiratory illness in infants of less than 32 weeks gestation. *Pediatrics*, *88* (3), 527-532. Retrieved from http://pediatrics.aappublications.org/content/88/3/527.short

Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report. QuickStats. Infant Mortality Rates, by Mother's Place of Birth and Race/Ethnicity—United States. (2011, July 8). Retrieved March 9, 2015, from

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6026a6.htm?s_cid=mm6026a6_e%0d%0a

Engle, W., Tomashek, K., Wallman, C., & The Committee on Fetus and Newborn, (2007). Late-preterm infants: a population at risk. *Pediatrics*, *120* (6), 1390-1401. Retrieved from http://pediatrics.aappublications.org/content/120/6/1390.short

Escobar, G. (2005). Rehospitalisation after birth hospitalisation: Patterns among infants of all gestations. *Archives of Disease in Childhood, 90*(2), 125-131.

Escobar, G., Joffe, S., Gardner, M., Armstrong, M. A., Folck, B., & Carpenter, D. (1999). Rehospitalization in the first two weeks after discharge from the neonatal intensive care unit, *Pediatrics*, *104* (1), e2. Retrieved from http://pediatrics.aappublications.org/content/104/1/e2.short

Friedrich, L., Pitrez, P., Stein, R., Goldani, M., Tepper, R., & Jones, M. (2007). Growth Rate of Lung Function in Healthy Preterm Infants. *American Journal of Respiratory and Critical Care Medicine, 176*(12), 1269-1273.

Hallowell, S., & Spatz, D. (2012). The Relationship of Brain Development and Breastfeeding in the Late-Preterm Infant. *Journal of Pediatric Nursing, 27*(2), 154-162.

Healthy People 2020. Reduce Late Preterm or Live Births at 34-36 Weeks of Gestation. (2015, March 12). Retrieved March 13, 2015, from http://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives

Kornhauser, M. & Schneiderman, R. (2010, January). How plans can improve outcomes and cut costs for preterm infant care. *Managed Care*, Retrieved from http://www.managedcaremag.com/archives/1001/1001.preterm.html

Kugelman, A., & Colin, A. (2013). Late Preterm Infants: Near Term But Still in a Critical Developmental Time Period. *Pediatrics, 132* (4), 741-751.

Laughon, S., Reddy, U., Sun, L., & Zhang, J. (2010). Precursors for Late Preterm Birth in Singleton Gestations. *Obstetrics & Gynecology, 116* (5), 1047-1055.

McLaurin KK, Hall CB, Jackson EA, Owens OV, Mahadevia PJ. (2009). Persistence of morbidity and cost differences between late-preterm and term infants during the first year of life. *Pediatrics*, 123(2): 653-659.

Olds, D. (2006). The Nurse-Family Partnership: An Evidence-Based Preventive Intervention. *Infant Mental Health Journal, 27* (1), 5-21.

Raju, T., Higgins, R., Stark, A., & Leveno, K. (2006). Optimizing care and outcome of late preterm (near term) infants: a summary of the workshop sponsored by the national institute of child health and human development. *Pediatrics*, *118*(3), 1207-1214. Retrieved from http://pediatrics.aappublications.org/content/118/3/1207.short

Shapiro-Mendoza, C., Tomashek, K., Kotelchuck, M., Barfield, W., Weiss, J., & Evans, S. (2006). Risk factors for neonatal morbidity and mortality among "healthy" preterm newborns. *Seminars in Perinatology*, *30* (2), 54-60. Retrieved from

http://www.sciencedirect.com/science/article/pii/S0146000506000280

Shortland, D., Hussey, M., & Chowdhury, A. (2008). Understanding neonatal jaundice: UK practice and international profile. *Perspectives in Public Health*, *128* (4), 202-206. Retrieved from http://rsh.sagepub.com/content/128/4/202.abstract

Subcommittee on hyperbilirubinemia. (2004). Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics*, *114*(1), 297-316. Retrieved from http://pediatrics.aappublications.org/content/114/1/297.full

Synagis for RSV. (2011, June 1). Retrieved February 3, 2015, from http://www.regencerx.com/docs/consumerRx/synagis.pdf

Tavernise, S. (2015, March 8). Visiting Nurses, Helping Mothers on the Margins. *The New York Times*. Retrieved March 15, 2015, from http://www.nytimes.com/2015/03/09/health/program-that-helps-new-mothers-learn-to-be-parents-faces-broader-test.html?_r=1&module=ArrowsNav&contentCollection=Health&action=keypress&region=FixedLeft&pgtype=article

Tomashek, K., Shapiro-Mendoza, C., Weiss, J., Kotelchuck, M., Barfield, W.,Evans, S., Naninni, A., & Declercq, E. (2006). Early discharge among late-preterm and term newborns and risk of neonatal morbidity. *Seminars in Perinatology*, *30* (2), Retrieved from http://www.sciencedirect.com/science/article/pii/S0146000506000292

Underwood, M. A., Danielsen, B., & Gilbert, W. M. (2007). Cost, causes, and rates of rehospitalization of preterm infants. *Journal of Perinatology*, *27*, 614-619. Retrieved from http://www.nature.com/jp/journal/v27/n10/full/7211801a.html