INTRODUCTION

Late preterm infants are born at gestational age between 34 weeks and 36 weeks and 6 days. They have higher morbidity and mortality rates than term infants (gestational age >or equals 37 weeks) due to their relative physiologic and metabolic immaturity, even though they are often the same size and weight of some term infants **(Wang et al., 2004)**

The term near term incorrectly implies that these infants are almost term and only require routine neonatal care **(Raju et al., 2006).**

Ultrasound of the abdomen is a noninvasive and reliable method of diagnosis **(Franco et al., 2008).**

Real time ultrasound (US) is a clinical tool used in a number of medical fields such as cardiology, obstetrics, and emergency medicine where the primary physician interprets images **(Moore and wilson, 2011).**

The portability and ease of use of US along with the small size and thinner body fat of neonates makes this modality a potentially useful beside diagnostic tool for neonatologists **(Evans et al., 2011).**

In neonatology, real-time ultrasound is increasingly being used to evaluate intra-ventricular hemorrhage, assess

cardiac function and aid in placement of central catheters **(Fleming et al., 2011).**

It is known that functional maturation of the gastrointestinal tract is quite different over time with respect to its anatomical development **(Neu, 2007).**

Differerent motor patterns occur in the proximal and distal stomach **(Hasler WL.2009).**

In the proximal stomach receptive relaxation and accommodation occur which are both mediated by neurons in the brain stem via vago- vagal reflexes. The distal stomach exhibits different motor patterns in the fed and fasted state, the distal stomach grinds and mixes. Extrinsic neurons are not essential for this contractile activity, but it can be modulated by vagal pathway **(Epelman et al., 2007).**

The current clinical approaches as abdominal distension, gastric residuals, stooling pattern, bowel sounds and abdominal radiography to determine intestinal health are poor and lack sensitivity and specificity, best illustrated by the fact that abdominal radiographs regularly miss frank perforation in the sick neonate**(Epelmanet al., 2007).**

Real-time bowel US (RTBUS) is a relatively new tool that can aid in the diagnosis of necrotizing enterocolitis (NEC).

US findings such as echogenic bowel, pneumatosis, bowel wall thinning and lack of perfusion to intestinal loops, are strongly indicative of NEC and NEC severity **(Kim et al., 2005).**

Radiographes are much less sensitive for detection of necrotic bowel when compared directly to RTBUS **(Faingold et al., 2005).**

AIM OF THE WORK

The aim of the study is to assess gastric emptying time in late preterm infants receiving premature formula milk in comparison to late preterm infants receiving breast milk.

LATE PRETERM INFANTS

Definition:

Late preterm (LPT) infants those born between 34 0/7 and 36 6/7 weeks gestation account for nearly three fourths of preterm births in the United States and are the fastest growing cohort of premature infants**(Hamilton et al., 2007).**

Epidemiology:

Preterm deliveries occur as a result of spontaneous preterm labor, including cases when premature rupture of membranes proceed the onset of labor, or medical interventions (i.e, labor induction or cesarean delivery) that are initiated to reduce poor outcome associated with specific maternal or fetal conditions**(Hamilton et al., 2013).**

In 2005, there were nearly 375, 000 late preterm births. This figure corresponds to a dramatic increase in the incidence of late prematurity within the past two decades in the United States by 25% from1990 to 2005, and by 9.6% between only 2000 and 2005**(Martin et al., 2007).**

In contrast, the percentage of infants _ 40 weeks of gestation has decreased by 15% since 1990, and infants born before 34 weeks of gestation have increased only moderately by 8.5% from 1990 to 2005 **(Davidoff et al., 2006).**

A number of interrelated factors, including increases in the number of multiple births, the national obesity epidemic and related fetal macrosomia, the trend toward later-life childbearing, consumer demand and preferences for elective inductions and Cesarean births, proliferation of obstetric malpractice litigation, practice guidelines opposing post-term deliveries, and advancements in fetal monitoring have been implicated in regard to the recent pervasiveness of late prematurity **(Engle and Kominiarek, 2008).**

Factors associated with increased late preterm birth:

In one study based upon data from the British Colombia Perinatal Database Registry, maternal risk factors that were more common in late preterm compared to term infants included chorioamnioitis, hypertension, diabetes, thrombophilia, premature rupture of membranes, primigravida, and teenage pregnancy **(Khashu et al., 2009).**

Other factors:

- **Increasing maternal age**

Higher maternal age (women in their thirties) is associated with increased risk of premature birth compared with women who are between 21 and 24 years of age. These women are more likely to conceive multiple fetuses spontaneously or

seek Assisted Reproductive Technique (ART), which also result in multiple births **(Hamilton and Martin, 2010).**

- **Inaccurate gestational age**

Prenatal gestational age may be determined by several methods. Clinical assessment by either history or physical examination of the uterus may be imprecise resulting in inaccurate gestational age **(Engle and Kominiarek, 2008).**

- **Increased maternal obesity**

Women who are overweight or obese are more likely to have a preterm than non obese women due to obesity related medical and antenatal complications **(Khashu et al., 2009).**

Morbidity:

Late-preterm infants are at higher risk than term infants of developing medical complications that result in higher rates of mortality and morbidity **(Engle et al., 2007)** including thermal instability, respiratory problems, hypoglycemia, jaundice, and feeding problems.

More recently, there has been recognition that the late preterm infant is at increased risk for a number of complications associated with immaturity, including increased hospital

readmissions, delayed oral feeding skills and failure to thrive (**Mc Gowan et al., 2011).**

During the birth hospitalization, the late preterm infants compared with term infants are more likely to have the following complications **(Leon et al., 2012):**

- Hypothermia.
- Hypoglycemia.
- Respiratory distress.
- Apnea.
- Hyperbilirubinemia.
- Developmental Immaturity.
- Feeding difficulties.

Hypothermia

Late preterm infants are more susceptible to hypothermia compared with term infants as they have less white adipose tissue for insulation, cannot generate heat as effectively from brown adipose tissue, and lose heat more readily due to larger ratio of surface area to weight **(Vachharajani and Dawson, 2009).**

Hypoglycemia

Neonatal hypoglycemia is more common in late preterm infants because of their higher metabolic rate and limited stores **(Khashu et al., 2009).**

Term appropriate for gestational age infants have greater stores of fat and glycogen, which they are able to convert to calories and with temperature instability, brown fat and other energy reserves of the late preterm can be easily depleted **(Garg and Devaskar, 2000).**

The resulting hypoglycemia may lead to permanent neurological damage. The American Academy of Pediatrics (AAP) has published a clinical practice guideline for postnatal glucose screening and monitoring of late preterm and term infants **(Adamkin, 2013).**

The risk of hypoglycemia is reported to be three times greater in late preterm infants than in term infants. Hypoglycemia may occur in newborn infants of all gestational ages as a result of insufficient metabolic response to the abrupt loss of maternal glucose supply after birth **(Mc Laurin, et al., 2009).**

Respiratory morbidity

The incidence of and the risk of respiratory morbidity, including respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), pneumonia, respiratory failure (RF), and the need for ventilator support, are greater in late preterm infants compared with term infants. Respiratory morbidity increases with decreasing gestational age as illustrated

by a retrospective report from the consortium on safe labor **(Hibbard et al., 2010).**

Apnea

The reported incidence of apnea in the late preterm infants (4 to 7 percent) is greater than in term infants (1 to 2 percent) **(Vachharajani and Dawson, 2009).**

Hyperbilirubinemia

The risk of bilirubin induced brain injury and kernicterus are greater in late preterm infants compared with term infants due to relative immaturity of blood brain barrier, lower circulating bilirubin- binding albumin concentrations, and higher risk of concurrent illness **(Bhutani et al., 2008).**

Developmental Immaturity

Late preterm infants are at particular risk for poor feeding because of their developmental immaturity **(Radtke, 2011).**

Cardiorespiratory instability contributes to lack of stamina necessary for feeding. Immaturity of state regulation also leads to fatigue during feeding. These infants often tire quickly and fall asleep before a feeding is complete. Immaturity of the suck/ swallow/ breathe pattern, as well as decreased oral motor tone, contribute to sucking difficulty **(Radtke, 2011).**

The immature infant is unable to generate enough negative pressure in sucking for efficient and successful breastfeeding **(Meier et al., 2007).**

Most notably, studies suggest that the late preterm infant is at risk for neurodevelopmental and neurocognitive impairment compared to term infants **(Chan and Quigley, 2014).**

This is not surprising given the amount of brain growth that occurs between the 34th week of gestation and term, when brain weight and cortical volume increase approximately 50% **(Kinney, 2006).**

Though specific risk factors for neuro-developmental sequelae have not been thoroughly identified, it is probable that suboptimal nutrition during first few weeks of life impacts brain growth anddevelopment, ultimately contributing to neurocognitive risk (**Kapellou et al., 2006).**

Feeding difficulties

Difficulty in establishing successful feeding appears to be the greatest contributing factor in this population‘s increased risk of readmission due to increased risk of dehydration that may require intervention with intravenous fluids (IVF) **(Radtke, 2011).**

Late preterm infants' mothers are at risk for delayed lactogenesis **(Meier et al., 2007).**

These mothers have difficulty creating a full milk supply because late preterm infants are unable to stimulate the breast with adequate negative pressure and spend less time nursing, **(Wight, 2003).**

The infants receive insufficient breast milk intake and, over time, the mothers produce less breast milk. Because this cascade of events often occurs after the late preterm infant is discharged home, readmission may be necessary **(Wight, 2003).**

The pattern of poor feeding leading to breastfeeding failure in the late preterm infant is well described in papers by **(Meier et al., 2007),** and **(Wight, 2003)** which also include strategies for management.

The Supporting Preterm Infants Nutrition program also has thoughtful policies and procedures to screen and support breastfeeding in the late preterm infant **(Escobar et al., 2002).**

Interestingly, the late preterm infant may be less likely to be breastfed than his term or even preterm counterparts **(Ramachandrappa and Jain, 2009).**

Other potential long term effects:

- **Failure to thrive**

Weight gain of the late preterm infant during hospitalization often falls below that which occurs in utero. A survey of 15 NICUs revealed that while mean birth weight of moderate preterm infants was at the 44th percentile, the mean weight for adjusted age declined to the 19th percentile at discharge (**Blackwell et al., 2005).**

Late preterm infants are more likely to be underweight at 6 months and 12 months of age than infants with gestational age between 39 and 42 weeks **(Goyal et al., 2012).**

- **Respiratory outcome**

An increased risk of childhood asthma remains uncertain as results vary regarding a relationship between late preterm birth and asthma **(Harju, et al., 2014).**

Hospitalization of late preterm infants:

In concordance with the growing late preterm population, a study utilizing Nationwide Inpatient Sample (NIS) data from the federal Healthcare Cost and Utilization Project revealed that non-extreme preterm (NEXPT) infants (28 0/7 & 36 6/7 weeks

of gestation) consume two thirds of all hospital expenditures related to prematurity **(Russell et al., 2007).**

Late-preterm infants are often the size and weight of some term infants (born at 370⁄7–416⁄7 weeks' gestation) and because of this fact, late-preterm infants may be treated by parents, caregivers, and health care professionals as though they are developmentally mature and at low risk of morbidity. They are often managed in newborn level 1 (basic) nurseries or remain with their mother after birth **(Stark, 2005).**

Despite appearances and weights often comparable to their term counterparts, late preterm infants tend to lag behind in terms of their cardio-respiratory, metabolic, immunologic, neurologic, and motor development **(Engle et al, 2007).**

In recognition of this contradiction, a multidisciplinary expert panel assembled by the National Institute of Child Health and Human Development in 2005 made the recommendation to classify infants born between 34 0/7 and 36 6/7 weeks gestation as "late preterm, " rather than "near term, " to convey the medical vulnerability extant within this cohort **(Raju, et al, 2006).**

Late preterm infants are physiologically and metabolically immature **(wang et al., 2004).**

As a consequence, late-preterm infants are at higher risk than are term infants of developing medical complications that result in higher rates of mortality and morbidity during the birth hospitalization **(Tomashek et al., 2006).**

In addition, late-preterm infants have higher rates of hospital readmission during the neonatal period than do term Infants (**Paul et al., 2006).**

Another medical record analysis, which included more than 33, 000 infants born at seven different Kaiser Permanente Medical Care Program facilities, found that late preterm infants not admitted to the Neonatal Intensive Care Unit (NICU) were more likely than infants of all other gestational ages to be readmitted to the hospital within 2 weeks **(Escobar et al., 2005).**

The most frequent reasons for re-hospitalization were jaundice (34%) and feeding difficulties (26%). Another study by the same authors found that a gestational age of 36 weeks was one of only three predictors of re- hospitalization at 15 to 182 days following discharge **(Escobar et al., 2006).**

Of particular concern, late preterm infants who are breastfed tend to be readmitted to the hospital with diagnoses of failure to thrive (FTT), jaundice, and dehydration more