INTRODUCTION

The neonate, especially the premature one, is both dependent on and vulnerable to the intensive care environment to support physiologic and neurobehavioral organization. Concerns about this environment have led to suggestions that it may be a major contributing factor in the persistent incidence of behavioral and learning problems among preterm infants. By modifying the neonatal intensive care environment to provide a more developmentally supportive milieu, we can better meet the infant's physiologic and neurobehavioral needs; support the infant's emerging organization, and faster growth and development. (***Blackburn, 1998)***

It was once believed that neonates were not affected by early life pain and early pain would have no lasting effects on behavior or development. However, research has indicated that the premature neonates possess basic neuronal circuitry to process and behaviorally and physiologically respond to pain exposure. This circuitry is in the developmental phases sensitive to modification from external stimuli. The brain experiences extreme plasticity during the prenatal and neonatal periods and this is a critical period of development that maximizes the

influence of the environment on the brain and behavior ***(Vora, 2007)***.

Environmental noise is a major source of stressful stimulation that can agitate and further complicate medical management of the neonate. Because high volume sound levels may be related to the overall morbidity of the premature population, there are a number of sound measurement studies reported in medical and nursing literature ***(Amy, 2001)***.

The fetal biological clock is an endogenous clock capable of generating circadian rhythms and responding to maternal entraining signals. Clearly, the neonatal intensive care unit is not a surrogate for the maternal placental unit. Although an earlier onset of circadian development did not result with cycled lighting in the neonatal nursery, there may still be important biological effects that have not been studied. There are sufficient data to state that there is no reason for continuing a chaotic, noncircadian environmental approach for the care of the prematurely born infant ***(Mirmiran, 2006)***.

Sleep is a life function as vital as breathing or feeding. In the neonatal period, sleep is the main behavioral state, especially in the preterm newborn.

Moreover, the role of sleep in brain development and functioning is increasingly being emphasized. However, in the reality of a busy neonatal intensive care unit (NICU), it is easy to imagine how many times the newborn's sleep is disrupted by environmental factors or care procedures ***(Bertelle et al., 2007)***.

The use of total parenteral nutrition (TPN) and intravenous fat emulsions in sick or preterm infants is often required to maintain adequate nutrition, yet recent research has shown that when exposed to light these nutrients are altered and deliver a high load of exogenous toxic hydroperoxides to already compromised infants. By protecting these infusates from light, bedside nurses can reduce the amount of hydro peroxides infused and protect NICU patients from the associated risks ***(Baird, 2001)***.

It has been shown that disruptions in the mother–infant relationship result in neuroendocrine, neurochemical and behavioral changes in the adult organism ***(Cirulli et al., 2003)***.

These results support earlier findings of the beneficial effects of KMC on mortality and growth. Use of this technique would humanize the practice of neonatology, promote breastfeeding, and shorten the

neonatal hospital stay without compromising survival, growth, or development ***(Charpak et al., 2001).***

Breast and bottle-feeding are areas of concern in the neonatal intensive care unit (NICU). The clinical issues encompass the typically developing preterm infant, who requires special supports to develop the skills needed for successful oral feeding, and the preterm and term infants with dysphagia, who, when able, require specialized assessment and treatment strategies to facilitate the maturation of sucking behaviors and transition to oral feeding. The primary goals of treatment in this population are to facilitate transition from tube to oral feeding and advance sucking skills sufficiently to support needs for nutrition and hydration as the infant grows ***(Sheppard et al., 2007)***.

AIM OF THE WORK

The aim of this work is to identify the different environmental hazards which neonates may be subjected to inside the neonatal intensive care unit, and to discuss measures that may prevent or decrease their effects on neonatal health thus improving the neonatal outcome.

NEONATAL
INTENSIVE CARE UNIT ENVIRONMENT

Definition of Neonatology:

Neonatology is a subspecialty of pediatrics that consists of the medical care of newborn infants, especially the ill or premature newborn infant. It is a hospital-based specialty, and is usually practiced in neonatal intensive care units (NICUs). The principal patients of neonatologists are newborn infants who are ill or requiring special medical care due to prematurity, low birth weight, intrauterine growth retardation, congenital malformations (birth defects), sepsis, or birth asphyxias ***(Lemmons, ٢٠٠١).***

Neonatology, or the study and care of newborns, is a relatively young medical specialty. Although its development began in the late 19th century, spurred on by the invention of the incubator, neonatology began to have a huge impact in the 1950s and 60s. Prior to this time, about half of all premature babies did not survive. Knowledge and understanding of the physiology of the premature baby, and the functioning of immature organs, accumulated ***(Lussky, 1999)*.**

With the introduction of NICUs, both the technology and the expertise, survival rates for pre-mature babies and full term babies born with medical problems began to climb. This incredible improvement in survival is due to increased understanding of newborn baby physiology, better management, and application of newer technologies ***(Peter, ٢٠٠٦).***

A mere 30 years ago, a description of today's highly advanced state of neonatal care would have been met with disbelief. Yet we now know what is possible. Perhaps the next 30 years will bring about an equally miraculous decline in the incidence of low birth weight and its attendant problems. With education and superb prenatal care for all pregnant women, the goal is attainable ***(Yaffe, ٢٠٠١).***

Neonatal Intensive Care Unit

A NICU is a special area of the hospital that is devoted to the care of critically ill babies. Typically a NICU is completely separated from the nursery for healthy newborns, and may not even be in the same building (the nursery is always located near the rooms for the mothers). The staff for the NICU and the staff for the newborn nursery are completely separate as well ***(PHILIP, 2002).***

In most hospitals, babies are only admitted to the NICU directly from the delivery room, the newborn nursery, or from another hospital's NICU or nursery. Babies usually stay in the NICU until they are ready to go home, even if that takes several months. This is much different from an adult or pediatric intensive care unit, where the patient will leave the unit as soon as they are stable and do not need help with their breathing and constant monitoring ***(Neonatology on the web, 2003).***

Levels of Neonatal Care

The concept of designations for hospital facilities that care for newborn infants according to the level of complexity of care provided was first proposed in 1976 ***(Lussky, 1999)***.

The functional capabilities of facilities that provide inpatient care for newborn infants should be classified uniformly, as follows:

*Level I (basic)***:** a hospital nursery organized with the personnel and equipment to perform neonatal resuscitation, evaluate and provide postnatal care of healthy newborn infants, stabilize and provide care for infants born at 35 to 37 weeks' gestation who remain physiologically stable, and stabilize newborn infants born at less than 35 weeks' gestational age or ill until transfer to

a facility that can provide the appropriate level of neonatal care ***(Howe, 2004).***

Level II (specialty): a hospital special care nursery organized with the personnel and equipment to provide care to infants born at more than 32 weeks' gestation and weighing more than 1500 g who have physiologic immaturity such as apnea of prematurity, inability to maintain body temperature, or inability to take oral feedings; who are moderately ill with problems that are expected to resolve rapidly and are not anticipated to need subspecialty services on an urgent basis; or who are convalescing from intensive care ***(Thompson, ٢٠٠٦).***

Level II care is subdivided into 2 categories that are differentiated by those that do not (level IIA) or do (level IIB) have the capability to provide mechanical ventilation for brief durations (less than 24 hours) or continuous positive airway pressure ***(Silverman, 2003).***

Level III (subspecialty): a hospital NICU organized with personnel and equipment to provide continuous life support and comprehensive care for extremely high-risk newborn infants and those with complex and critical illness. Level III is subdivided into 3 levels differentiated by the capability to provide advanced medical and surgical care. Level IIIA units can provide care for infants with birth

weight of more than 1000g and gestational age of more than 28 weeks. Continuous life support can be provided but is limited to conventional mechanical ventilation ***(MacDonald, 2005).***

Level IIIB units can provide comprehensive care for extremely low birth weight infants (1000g birth weight or less and 28 or less weeks' gestation); advanced respiratory care such as high-frequency ventilation and inhaled nitric oxide; and advanced imaging with interpretation on an urgent basis, including computed tomography, magnetic resonance imaging, and echocardiography and have pediatric surgical specialists and pediatric anesthesiologists on site or at a closely related institution to perform major surgery ***(Toubas, 2000).***

Level IIIC units have the capabilities of a level IIIB NICU and are located within institutions that can provide ECMO and surgical repair of serious congenital cardiac malformations that require cardiopulmonary bypass ***(Couto, 2004)*.**

NICU Technologies and Procedures

Environmental Control

- Incubators
- Radiant warmers
- Servo-controlled thermoregulation
- Plastic wrap
- Humidification

Vascular Access

- Umbilical artery/vein catheters
- Peripheral artery/vein catheters
- Central venous catheters
- Infusion and syringe pumps
- Percutaneous Placement of Central Venous Catheters.

(Peter, 2006)

Physiologic Monitoring

- Temperature
- Cardiorespiratory
    - Electrocardiogram
    - Apnea/bradycardia alarms
- Systemic blood presure
    - Oscillometric method
    - Indwelling artery catheter
- Central venous pressure
    - Oxygenation/ventilation

- Arterial blood sampling
- Capillary blood sampling
- Pulse oximetry
- Transcutaneous PO_2, PCO_2
- End-tidal CO_2

- Pulmonary function testing

(PHILIP, 2002)

Laboratory Testing

- Micro sampling methods
- Bedside glucose testing
- Routine chemistry, hematology, serology
- Lumbar Puncture
- Suprapubic Bladder Tap
- Apt Test for Fetal Hemoglobin
- Microbiology
- Pulmonary maturity
- Genetic analysis
- Metabolic screening

Diagnostic Imaging

- Radiography
- Ultrasonography
- Doppler echocardiography
- CT scanning
- MRI scanning

- Nuclear medicine scanning

(Howe, 2004)

Nutritional Support

- Parenteral nutrition
- Enteral feeding techniques
- Special formulas
- Breast milk supplements
- Vitamins
- Minerals
- Trace elements

Respiratory Support

- Supplemental oxygen
- Continuous positive airway pressure
- Chest physiotherapy
- Conventional ventilation
- High-frequency ventilation
- Technique for Insertion of a Chest Tube
- Suctioning of Endotracheal Tubes
- Technique for Insertion of a Pericardial Tube
- Surfactant
- Extracorporeal membrane oxygenation.

(Mazursky et al., 2008)

Life in the NICU

At first, NICU is often a shock to parents. The room is filled with what appear to be impossibly small babies, most of who are hooked up to high-tech looking machines with tubes and wires. Some of the babies are so small they may not even look real; in addition to being very small, their skin seems discolored, perhaps nearly transparent ***(Leuthner, 2001).***

The NICU is a unique place. It operates around the clock and is often very intense. The NICU has rules in order for it to function with maximum efficiency. Life in the NICU is often one of intense and conflicting emotions. The combination of stress, fear of the unknown, worry, and many other considerations can be overwhelming at times ***(Marshall, 2006)*.**

Equipment in the NICU

NICU can be a confusing place with lots of complicated-looking electronics, dials, wires, tubes, strange noises, beeps, alarms, buzzers and flashing lights ***(Rogowski, ٢٠٠٣).***

Here is a sampler of the equipment that is commonly seen in an NICU.

١. *Radiant warmers*

Are used when a baby is very unstable or extremely premature. The overhead arm contains electric heating elements that are directed down toward the infant. The shelves attached to the warmer allow monitors and other equipment to be placed conveniently near to the baby.

Fig. (1): Radiant warmer ***(Neonatology on the web, 2002)***.

The glass sidewalls prevent the baby from being chilled by drafts, and the open nature of the radiant war-mer allows physicians and nurses to have easy access to the baby from all sides ***(Christie and Tansey, 2001)***.

٢. *Incubator*

When a baby is relatively stable but still premature or requiring intravenous fluids or other special attention, he or she is cared for in an "incubator." The incubator keeps the baby warm with moistened air in a clean environment, and helps to protect the baby from noise,