A STUDY OF THE RESPONSE OF NEONATAL THERMOREGULATION TO THE EARLY SKIN-TO-SKIN CONTACT WITH THE MOTHER AND/OR LAYERED HEAD COVERING OF THE NEONATE

by

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ABSTRACT

Title of Thesis: A STUDY OF THE RESPONSE OF NEONATAL THERMOREGULATION TO THE EARLY SKIN-TO-SKIN CONTACT WITH THE MOTHER AND/OR LAYERED HEAD COVERING OF THE NEONATE

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This quasi-experimental study of 97 mother-newborn dyads, compared three modalities for thermoregulation of the newborn. After scoring the five minute apgar, random assignment of a sample of convenience was made to determine if skin-to-skin treatment of the mother and newborn was as efficient as the radiant warmer for maintaining the newborn's temperature in the thermoneutral range. The study required approval from the Human Subjects Committee and an informed consent signed by the mother.

The mother was entered into the study pending birth of a healthy, stable newborn, had no history of drug abuse, had a healthy pregnancy, no temperature elevation above 38.1C during labor, received no medications known to lower temperature during labor, delivered vaginally, and remained stable after delivery. The stable newborn was entered in the study with apgar scores of at least seven at one minute and eight at five minutes after birth and with the initial axillary temperature between 36.3C and 37.6C.

An axillary temperature measurement was taken every ten minutes, for one-half hour while the newborn remained in the treatment condition. The thirty newborns in Treatment I remained under the radiant warmer, diapered and bare headed. The thirty-three newborns in Treatment II were diapered and placed skin-to-skin with the mother, a cotton sockinette covered the head, and three baby blankets covered the newborn. The 34 newborns in Treatment III were diapered, placed skin-to-skin with the mother, a cotton insert into an acrylic knit cap covered the head, and three baby blankets covered the newborn.

ANOVA and Regression analysis were used in data analysis. No statistical difference was found in the means of the temperatures of the three treatment modalities. The hypotheses were supported.

DEDICATION

This study is dedicated to my husband, Victor Moddee. Without his loving support, this work would never have been started. Also, this study is dedicated to the mothers who trusted me to care for their newborns in those early minutes after the birth of their most precious sons and daughters. Without their support this work could not have been completed.

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CHAPTER I

Introduction to the Problem

Efficient thermoregulation is critical for the newborn infant. Although humans are homeothermic, newborn infants have a limited ability to maintain normal body temperature. Caregivers must support the infant with efficient thermoregulation (Noerr, 1997). In the recent past, the newborn was whisked away from the mother and placed on a radiant warmer. Today, the neonate is often wrapped in blankets and passed from relative to relative. Usually each person holding the infant must loosen the blankets, just a little, to peek at the bundle of joy within the wrap.

An unpublished quality improvement chart review in a healthcare facility located on the Eastern Shore of Maryland, found that by the time of the first temperature reading in the admission nursery, just over one hour of age, forty-five percent of the infants had at least one temperature outside of the thermoneutral range of 36.5°C to 37.5°C (Moddee, 1997). This study was a retrospective chart review that included the temperature data recorded for 59 newborns. Newborn temperature measurements were not available from other healthcare facilities. Therefore a comparison of newborn temperatures between hospitals was not done.

Babies with temperatures outside of the thermoneutral range will remain in the nursery under observation until the temperature is stable. Some will have a complete blood count (CBC) with differential, c-reactive protein, and blood culture done; necessary blood analysis to identify an infection. Infants with enough cold stress will develop low blood sugar. If the blood sugar is below forty milligrams per deciliter, the infant will be placed on a protocol. This protocol will require three additional blood sugar checks over the next six hours. If one of these blood sugar results is under forty then the protocol is continued until two consecutive normal blood sugars are obtained. The attending pediatrician is notified. In the extreme case, this infant is at risk of having an intravenous line for administration of a glucose infusion.

Typically, the infant with temperature control problems remains in the nursery for several hours. When this happens, immediate physical stability is not the only concern. Bonding, a spontaneous process that defines the relationship between a mother and her infant, is interrupted. Bonding is necessary so that a baby can be integrated into the family and have the psychological benefits that enhance healthy maturation. However, we do not measure risks that are introduced when bonding is interrupted. We do not know what the outcome will be for the mother-baby bonding of a particular dyad when early separation occurs. Previous studies show that infant and mother skin-to-skin contact, called kangaroo care, will maintain the neonate in a thermoneutral state. In fact, kangaroo care is the standard of care for pre-term babies in third world countries, where incubators or warming tables are simply not available (Ludington-Hoe, 1993). Thus, for healthy term newborns, mother-baby bonding may not need to be interrupted in the first hour after birth (Vaughans, 1990).

Another problem identified with the current standard of care is the delay in breastfeeding. The baby who is not breastfed in the immediate postpartum period often has difficulty with latching and/or suckling. If this is a lengthy period, it may decrease the mother's desire or ability to breastfeed her baby. The family, the mother, and the baby are at risk of losing the benefits of breastfeeding.

Sub-optimal thermoregulation causes anxiety for the parents. Parents sometimes voice the fear that they do not have a normal baby. In some cases, the mother and baby have remained at least one extra day in the hospital. The pediatrician was reluctant to send that baby home on an early discharge when some of the first vital signs were not in the normal range. The mother was able to remain in the hospital with her new infant. This increases the length of stay for the dyad for at least one day. Often this is nothing more than an inconvenience for the new family. We do not know how many of these babies will be treated as sick babies or how long it will take before the mother and father will treat them as well babies. It is known that when parents treat their babies as sick babies, the child's emotional and social adjustment may be affected. These are the obvious, very real costs of poor temperature regulation practices in the early hours after birth.

Finally the most critical concern, is the accompanying physiologic changes in the severely thermal-stressed newborn. When an infant is cold stressed, brown adipose tissue metabolism produces energy to sustain the increased metabolic rate. An increased amount of oxygen, obtained from a faster respiratory rate, is required to sustain the higher metabolic rate. If the oxygen need is greater than the lungs can provide, hypoxia occurs. With the lack of oxygen, the infant's body turns to anaerobic metabolism to produce energy and lactic acid. This decreases the blood pH and develops metabolic acidosis that causes pulmonary vaso-constriction and leads to further hypoxia and respiratory distress (Thomas, 1994).

Since infants have a very limited ability to shiver and produce heat that controls body temperature, brown adipose tissue metabolism is a crucial function. However, in the process fatty acids are released, which in turn, decrease blood pH and the production of surfactant. This further increases respiratory distress. The increased metabolic rate requiring larger amounts of glucose, uses glycogen stores. Hypoglycemia develops, contributing to a greater deficit of surfactant production. (Surfactant production uses glucose and oxygen.) If the cardio-respiratory system can not keep up with the demand, respiratory distress worsens. The infant becomes critically ill (Thomas, 1994).

The newborn is also at risk of overheating. Although an infant can drastically increase metabolic rate to cold stress, the basal metabolic rate and its accompanying heat production can not be decreased. Since the neonate has very little insulation and very little ability to sweat, there are no reliable internal mechanisms to protect the newborn from environmental temperatures greater than body temperature. Fluid loss and increased respiratory rate result. When the temperature is not decreased, seizure and death may be the outcome (Thomas, 1994)

Purpose

The purpose of this study is to investigate three infant warming interventions by comparing their efficacy for maintaining newborn thermoregulation and to identify the most reliable method for maintaining normal temperatures in the newborn, while preventing prolonged separation of the mother-infant dyad. Additional evidence demonstrating the effectiveness of skin-to-skin contact with the mother and her healthy term newborn (kangaroo care) will be added to the body of nursing research. Statistics will be critically interpreted so that meaningful conclusions can be drawn.

Significance

Thermal support of the newborn is a vital role of all who come in contact with the infant. Since the nurse has more contact with the infant at this time than any other healthcare professional, nurse researchers are in a position to apply and test interventions that will attain this goal (Thomas, 1994). A study such as this is needed in order to determine if there is a better method available that will achieve thermoregulation without separation of the mother-baby dyad in the early hours after birth. Changes in the standard of care, based on research findings can result from this and other studies. Additionally, professional nurses may be influenced to question procedures and to participate in studies which will result in evidence based practice.

CHAPTER II

Literature Review

Historical Background

Written history about newborn care is scarce. In Luke, Chapter two, verse 7, we learn that Mary swaddled her newborn son (Holy bible). Grecian and Roman normal care of the newborn included swaddling, so that the infant would be protected from the change in temperature and the hardness of objects he/she came in contact with. During the middle ages, the newborns in Europe were swaddled. By the last half of the eighteenth century, swaddling became so ritualized that the newborn was compromised. The physician, William Cadogan, recognized the danger of over dressing infants and mounted a campaign against the practice. Swaddling disappeared in England and France, by the end of the eighteenth century (Motil & Blackburn, 1973).

The Egyptians recognized the advantage of environmental temperature control for chick embryos. As the embryo grew, the amount of heat (incubation temperature) required for continued development of the chicken eggs was decreased. This concept, known as graded incubation, was brought to France by Napolean's expedition that returned from Egypt in 1799. It was adopted by the Parisian zoos and used to increase the exotic bird population. In the 1830's Tarnier, an obstetrician and zoo enthusiast, became acquainted with the concept and was one of the first to apply the principles of graded incubation to low birth weight human babies. Tarnier invented an incubator chamber, called a couveuse, which has been recognized as the first attempt to provide graded incubation for the premature infant. Two of Tarnier's students, Budin and Auvard, refined the incubator by adding a thermometer and a temperature alarm to the unit. This enabled nursing attendants to change the temperature of the unit when required and to more adequately meet the thermoregulation needs of the infant. Incubation of the pre-term infant became the practice in western Europe. Tarnier and Budin continued their work to improve the incubator over the next half century. Survival of infants weighing less than 2000 grams treated in the incubator increased from about 38% to about 66% (Baumgart, 1996).

By the 1880's, the principles of maintaining the premature infant in a controlled thermal environment were practiced in the United States. Commercial development of the incubator in Boston and Chicago advanced. In 1922, Julius Hess opened the first premature infant center. The importance of thermoregulation of the newborn was now well grounded and undisputed (Motil & Blackburn, 1973).

Silverman, Fertez, and Berger, in 1958 (as cited in Baumgart, 1996) further defined the optimal ambient temperature of the premature neonate by reducing the humidity and increasing the incubator temperature. This manipulation of humidity and temperature was done to decrease the incidence of infection in the pre-term infant and resulted in improved survival rates with incubator temperatures increased to 29°C and up to 31°C (Baumgart, 1996). The current knowledge about thermoregulation of the newborn is relatively new.

Bruck (1961), Hey (1969), and Smales (1978) each demonstrated that human infants are homeotherms and do react to cold stress by vigorously attempting to raise the body temperature. At thermoneutral conditions, the human newborn's body has minimal heat production and energy output. As temperature decreases below the thermoneutral zone, metabolism increases. However, this process uses energy stores and is limited according to the amount of fuel and oxygen available (Bliss-Holtz, 1991). Although brown fat metabolism supplies energy for temperature maintenance, the newborn is at a thermodynamic disadvantage because of its large surface area, lack of insulation, increased skin permeability and a thermoneutral zone that is higher and narrower than the adult's thermoneutral zone (Baumgart, 1996).

Many newborn temperature studies have been done in the last half of this century. Much has been learned. Some of our knowledge about neonatal thermoregulation is summarized in the review of the literature that follows.

Temperature Control in the Newborn

The hypothalamus acts much like a thermostat to regulate temperature. Sensory stimuli, indicating thermal status, are sent from central and peripheral thermoreceptors to the hypothalamus. There, thermal information is processed and the temperature is adjusted by modifying metabolic rate, muscle tone and activity, vasomotor function, and sweating. Thus, the narrow range of thermoneutrality is maintained. Temperature control is vital for normal cellular function which is regulated by temperature sensitive enzymatic systems. It is at this level that life, itself, is supported (Thomas, 1994).

Although the spinal cord is important in controlling vasomotor reactions, it is the hypothalamus that has the most control of the thermoregulatory system. The posterior hypothalamus directs the reactions to cold and the anterior hypothalamus manages the body reaction to heat. This is accomplished by sending messages via two pathways: the somatomotor system, which produces heat by shivering, and the sympathetic nervous system, which acts on the brown adipose tissue, blood vessels, and sweat glands (Risbourg et al., 1991)

These two effector pathways maintain the temperature within plus or minus one degree of a set-point that is usually 37°C (centigrade). Changes occurring in the body may alter the set-point by as much as a few tenths of a degree. Regardless of the actual set-point, the hypothalamus and its efferent and afferent pathways maintain the body temperature within this narrow range. The system may fail when exposed to severe environmental change (Risbourg et al., 1991).

When the neonate undergoes cold exposure, the endocrine system also is activated and adrenalin is released. Adrenalin speeds up glygogenolysis in the liver and metabolism of brown adipose tissue, producing heat. At the same time, adrenalin causes vasoconstriction which diverts blood from the periphery to the body core, conserving heat. The thyroid hormones are thought to act synergistically with adrenalin to produce and conserve heat (Risbourg et al., 1991).

The nervous system and the endocrine system together effectively produce heat by metabolizing the brown adipose tissue in non-shivering thermogenesis. The body mass of the term infant is usually from two to six percent brown fat. This tissue is located in the axilla, neck, scapula, around the kidneys and near the large vessels of the chest and the heart. The brown fat has a generous blood supply and a greater number of mitochondria than does white fat. Some of the blood returning to the heart from the brown fat of the neck and the chest is circulated to the inner vertebral sinus. This sinus lies around the spinal cord and acts like a heat exchange system. When the infant is exposed to cold, the cooling of the thermoreceptors in the skin send signals to the hypothalamus which sets this previously described heat producing system into action. If heat production is unable to keep the spinal cord in the thermoneutral range, then the neonate begins to shiver. Shivering is expected only after brown fat metabolism is stimulated to the maximum level possible and is not able to maintain core temperature (Risbourg et al., 1991).

In order for brown fat to be metabolized, several conditions must be met. The sympatho-adrenalin system is activated, norepinephrine is released from nerve synapses in the brown fat, and the oxygen supply to the brown fat must be increased. In addition, the levels of prostaglandin E2 and plasma adenosine must be decreased. These two substances suppress thermogenesis while the fetus is in utero (Oya, Asakura, Koshino, & Araki, 1997).

Since the relationship of increased oxygenation of the brown adipose tissue and the onset of non-shivering thermogenesis is not well understood, a group of Japanese physicians designed a study to further investigate this relationship. Serial thermographic recordings were made over the first three days of the newborn's life. At one hour after birth, the interscapular area was the warmest part of the body. Over time, the other portions of the backs of the neonates in the study came closer to the temperature of the interscapular area. The temperature difference indicated the metabolism of brown adipose tissue (Oya, Asakura, Kushino, & Araki, 1997).

These authors found that the highest rate of non-shivering thermogenesis in newborns receiving routine care occurs during the first hour after birth. In this study, newborns were not cold stressed and their basal metabolism within minutes of birth adapted. As a result of no cold stress, non-shivering thermogenesis was less important in temperature maintenance following the first hour after birth. Umbilical arterial blood gas was sampled immediately after birth. When the partial oxygen pressure was low, non-shivering thermogenesis was decreased. The authors concluded that this demonstrated the requirement of high oxygen concentrations to maintain the metabolism of brown adipose tissue in non-shivering thermogenesis (Oya, Asakura, Kushino, & Araki, 1997).

If the neonate is allowed to become too hot or too cold, serious clinical manifestations are quickly apparent. Heat stroke and death will result when intensive overheating occurs. Hypernatremic dehydration may cause brain damage, another result of overheating. Cold stress may have more subtle effects on the newborn. When heat production must be increased there will be a coinciding need for increased calories and oxygen. Respiratory distress results when additional calories and oxygen are not supplied (Hey, 1994).

Newborn infants begin to balance heat loss and heat gain at birth. Because of large surface area to mass ratio, limited insulation of a thin layer of subcutaneous fat, rapid physiologic adaptations to extra-uterine life, and an environmental change from a constant 37.9°C temperature in the amniotic fluid, to a dry cool room, the neonate requires assistance with temperature control. If immediate drying and temperature control measures are not initiated at the moment of birth the neonate may drop his temperature by as much as 4.5°C in the first minutes following birth (Thomas, 1994). Brueggemeyer (1993) wrote that at a vaginal delivery, the wet newborn can lose up to 200 calories of heat per kilogram of body weight for every minute that heat loss continues. Some heat loss at birth helps the infant establish respirations. Thyroid function may also be activated with the immediate cooling that occurs at birth (Vaughans, 1990). It is not known precisely how much heat loss is optimal for the transition to extrauterine life (Thomas, 1994). Cooling of the infant's skin stimulates heat producing activity even before the core temperature changes (Brueggemyer, 1993).

Heat loss and heat gain occurs by convection, conduction and radiation. Heat loss alone occurs with evaporation. The infant reacts the same regardless of how heat is lost or heat is gained. However, the mechanisms of temperature change are important for the nurse to understand so that the environment can be manipulated to maintain the infant in a thermoneutral state (Thomas, 1994).

Convection is the transfer of heat between the newborn and the surrounding air or liquid (Noerr, 1997). Convective heat loss from the newborn begins with the transfer of heat from the core to the skin by the circulating blood. It continues through heat transfer from the skin to the surrounding air. The greater the velocity of the air moving around the infant, the greater will be the change of the infant's temperature (Baumgart, 1993). The greater the temperature gradient between the infant and the surrounding air, the greater will be changes in the infant's temperature. The newborn has a large surface area to body mass ratio providing large areas for contact with air that may result in rapid temperature change. Finally, the smaller diameter of the extremities indicates decreased body fat insulation. Therefore, greater convective heat exchange with the environment occurs, unless the caregiver protects the newborn with adequate thermoregulation practices (Thomas, 1994).

During evaporation, heat loss occurs as moisture on the skin is changed to water vapor. Evaporative heat loss can account for a large temperature change at birth. Noerr (1997) emphasizes that rapid drying is the first important step toward neonatal thermoregulation because this drastically decreases evaporative heat loss (Noerr, 1997).

Radiation occurs with the transfer of heat between two solid objects that are not in direct contact. Radiant heat is a fast method of warming the neonate. However, the newborn can lose heat to surrounding cooler mattress, windows, walls, or any cooler nearby object (Brueggemyer, 1993). Feeling cold while sitting in front of a window on a cold day is an example of radiant heat loss. Radiant heat exchange is often ignored when providing care to the newborn. It can represent significant heat loss. Emissivity, the comparison of an object's ability to give off radiant heat to that of a standardized black sphere of about the same temperature, affects radiant heat exchange. The emissivity of the skin of the neonate is nearly constant, but is regulated to some extent by the use of blankets and clothing. The difference in the temperatures of the solid objects, that is the temperature gradient, will determine the direction of heat flow. When the infant is warmer than nearby objects, the infant will lose heat. The large surface area of the infant increases the amount of heat that he will lose to surrounding objects. In addition, the closer the two non-touching solid surfaces are, the greater the temperature exchange between them. The ambient air temperature does not reflect radiant temperature exchange (Thomas, 1994).

Conduction refers to the transfer of heat from objects that are in contact with each other.

Heat is lost when the newborn is placed on an object that is cooler than his body and gains heat when placed on an object that is warmer than his body, such as when placed on mother's chest or abdomen in skin to skin contact (Brueggemeyer, 1993).

Brueggemeyer (1993) defined the neutral thermal environment as the temperature at which a normal range of body temperature is maintained with the lowest oxygen and caloric use. The maintenance of a stable temperature allows the infant to have normal growth and regulates energy needs. It is between 32ºC and 34ºC for the nude, healthy term newborn. Cold stress is likely with exposure below this range and overheating will occur at temperatures above this range. Adequate thermoregulation of the newborn results in improved survival and growth rates, less apnea, decreased fluid requirements and less consequences of cold stress (Noerr, 1997). However, the newborn's temperature is not the same from the skin of the abdomen, to the axilla, to the body core. The normal temperature is dependent on the site of the temperature check. The normal range for abdominal skin temperature is from 36ºC to 36.5ºC. Rectal and axillary temperature is from 36.5°C to 37.5°C. Although rectal and axillary temperatures are about the same, they vary as much as one degree centigrade. Usually not more than 0.4º C of difference is found between the two sites. Because rectal thermometers increase the risk of trauma, usually an axillary temperature is adequate, since the two are so close in value. Any axillary temperature reading that has significant variance form normal can then be rechecked with a rectal temperature, thereby enabling appropriate and timely interventions to be initiated without placing the infant at unnecessary risk (Brueggemyer, 1993).

In most studies, core body temperature is measured with a rectal thermometer. The newborn's rectal temperature varies with the depth of the placement of the thermometer in the rectum. This means that a rectal temperature probe at a specified depth within the rectum does not necessarily measure core temperature. Therefore, a change in the rectal temperature of a newborn infant may represent changes in the peripheral circulation instead of a change in the core temperature (Okken, 1991).

Both full term babies appropriate for gestational age and small for gestational age, as well as pre-term babies were found to have lower temperatures in the first twelve hours of life. These neonates maintained normal body temperatures twelve hours after birth, independent of the method of warming that was used (Borse, Deodhar, & Pandit, 1997). In addition, data collected by Bliss-Holtz (1993) support the idea that when a full-term infant has a higher axillary temperature than rectal temperature the caregiver should look for cold-stress in that infant. According to Hunter (1991) axillary temperature measurements are safer than rectal measurements and as accurate as rectal temperatures. Based on this finding and because the protocol in the institution where the present study was conducted, mandates axillary measurements, then axillary temperatures will be relied on to provide the data for this study.

Karlsson (1996) investigated skin-to-skin care of nine healthy, hypothermic newborns with a mean rectal temperature of 36.3°C. After seventy minutes, the rectal temperature had increased in all the neonates. The mean rectal temperature increase was 0.7°C, or from 36.3°C to 37.0°C. The temperature of the two, small for gestational age newborns did not differ from the others in the study. Even with the head open to air, heat gain occurred. Karlsson reports that all the neonates were asleep at the end of the study and no signs of apnea were noticed during the study. Karlsson concluded that decreased heat loss from the baby to the environment was prevented by the towel covering the mother and baby and that a very small amount of the heat gain was due to the transfer of heat from mother's body to the body of her neonate (Karlsson, 1996).

Ludington-Hoe (1993) found that mothers holding their babies skin-to-skin unconsciously change the temperature of their own chest and breasts to regulate their babies' temperatures. She found that maternal chest temperature would increase up to two degrees centigrade to warm a cool baby and would drop to cool off a baby that was too warm. Ludington-Hoe also found that if a woman was told that her baby was too warm or too cool, the temperature of her chest would fluctuate in the correct direction even more rapidly to bring the baby's temperature to normal. Ludington-Hoe's work with premature infants supported previous studies demonstrating that the baby's temperature rises quickly for the first ten minutes while being held skin-to-skin with the mother with a blanket over the back of the baby. The infant's temperature then stabilizes within the thermoneutral zone (the temperature range that allows minimal oxygen consumption and the lowest metabolic rate). The infant's heart rate remains stable at baseline plus or minus five beats per minute while skin-to-skin with the mother. Ludington-Hoe found that respiratory patterns stabilized with four times less apnea occurring and for shorter intervals than in babies not cared for in skin-to-skin contact with the mother. Blood oxygen saturation was not diminished during skin-to-skin care (Ludington-Hoe, 1993).

Skin-to-skin contact between mother and baby has been used successfully for low birth weight newborns, those weighing less than 2500 grams. A study of 132 low birth weight infants delivered during the cold season of Magputa, included 57 infants born outside of the hospital into environmental temperatures ranging from below 22°C to 32°C. After initial warming of the infant, the usual means of maintaining a stable temperature was by skin-to-skin contact with the mother. By three days of age, more than one-third of the infants were warmed by skin-to-skin contact with the mother and by five days of age more than one-half of the babies were warmed by skin-to-skin contact (Mondlane, de Graca, & Ebrahim, 1989).

Once discharged from the hospital, no infant was readmitted with hypothermia. All infants were regularly followed. By the time of weighing at least 2500 grams only four of the74 infants who received skin-to-skin care were evaluated with poor outcomes, 6 had satisfactory outcomes, and 64 had good outcomes. Nine of the babies were readmitted to the special care nursery for diarrhea, respiratory infection, jaundice and one with poor suck. (Mondlane, de Graca, and Ebrahim, 1989).

Phillips (1974), concerned about the removal of the infant from the delivery room without giving the parents an opportunity to hold the baby, designed a study to test the difference in infants' temperatures held by the mothers while still on the delivery table and those infants immediately placed on the radiant warmer. This study tested the idea that adequately dried and covered infants can be placed in their mothers' arms without significant heat loss. One hundred and fifteen infants were divided into two groups, the mother held study group, and the radiant warmer control group. All of the infants were initially well dried and wrapped in pre-warmed blankets with the head covered. Rectal temperatures were read at five minutes and at fifteen minutes after birth. Although, about one-third of the mothers holding their infants loosened the blankets to peek at their infants, there was no significant difference in the temperature of the neonates in the two groups after fifteen minutes, at a .01 significance level. This study found that it is safe for mothers to hold their adequately dried and wrapped newborns for fifteen minutes after birth in a delivery room setting with an ambient temperature between 72°F and 75°F (Phillips, 1974).

Gardner (1979) continued to develop the concept, that a mother can keep her newborn warm, immediately after birth, with skin-to-skin contact. This study demonstrated that the mother's body would warm a nude neonate with skin-to-skin contact (which came to be called kangaroo care), when the parts not in touch with the mother were covered with a blanket. Although this was a small study of ten treatment and nine control neonates, the author effectively demonstrated that the mother's body can maintain her neonate at a safe temperature. This group of infants was vaginally delivered to mothers who had either caudal, local, or no anesthesia, had one minute apgar scores of at least 8 and five minute apgar scores of at least 9, and weighed from five pounds and seven ounces to nine pounds and fourteen ounces. The ambient temperature was not recorded. In this study, Gardner (1979) used the same assumption as did Phillips (1974) that the average normal decrease in the neonate's temperature immediately after birth will be

.18°F, (0.1°C) per minute, which is approximately equivalent to 200 calories per kilogram per minute (Gardner, 1979).

Another study of one hundred neonates was done to gather data which would determine if it was necessary to place infants on heated devices for maintenance of temperature in the first minutes after birth. Fifty of these subjects were held in the arms of a parent and fifty were immediately placed in a transporter. The neonates were delivered in ambient room temperature ranging from 68° F to 72° F. Inclusion criteria were as follows: the neonate must be born by vaginal delivery after a normal labor, without complications, weighing at least five pounds, and have apgar scores of at least seven at five minutes. Each infant was immediately dried and wrapped in a pre-warmed blanket and weighed. Then a second blanket was wrapped around the baby. Within forty minutes of delivery all newborns in both groups were taken to the admission nursery. Rectal temperatures taken with electronic thermometers were recorded at birth, at five minutes after birth, and on admission to the nursery. No significant difference was found in the temperatures of the two groups of infants (Hill & Shronk, 1979).

Early mother-baby contact and newborn thermoregulation as studied by Vaughans (1990), gave more evidence that early mother-baby contact maintains thermoregulation and is as effective as the radiant warmer in keeping the newborn's temperature within normal limits. This was a replicated study, using research completed by Phillips (1974), and by Hill (1979). Twenty infants, divided in two groups were studied. The first group was placed on a warming bed and the other group was placed in the arms of the mother. Ten minutes after the warming treatment began, the axillary temperature was measured. The researcher included infants of 36 to 40 weeks gestational age with apgar scores of at least seven at one minute and at five minutes, who were not in distress. Vaughans (1990) found that some temperatures were below normal in the skin-to-skin group and in the radiant warmer group. Vaughans concluded that further investigation was needed to determine the reason for the lower than normal temperatures in both groups. Her study suggests that neonatal thermoregulation is not at risk with early mother/baby kangaroo care.

Maintaining Body Temperature with Head Treatments

Hats have been used to assist with maintaining neonatal body temperature. However, some of the materials used in newborn head covering have been found to be inefficient insulators and do not protect the infant from heat loss. D'Apolito (1994) compiled a literature review covering the efficacy of materials used in hats for newborns. She reported that the tubular, cotton stockinette, including the double knit variety has limited value in thermoregulation, offering as low as two percent increase in insulation effect. This has important implications for the selection of head covering, since the head comprises about twenty-one percent of the surface area of the newborn. The newborn's brain generates a greater proportion of the body heat, used for maintaining temperature, than does the brain of an adult. Thinsulate hats provided newborns with sixty-five percent heat conservation. Gauze and cotton lined wool hats allowed twenty-five percent heat conservation. D'Apolito suggests that any material at least one-quarter inch thick, that holds its shape with use, and has at least ninety percent air volume will provide adequate insulation to maintain thermal support to the head of the neonate.

Several unresolved issues regarding materials used in hats were identified. It is not known how effective knitted hats are in keeping the neonate's head warm. Will other materials, such as the flannel blanket, be effective if they are placed over the head? (D'Apolito, 1994).

Greer (1988) performed an experimental study comparing the heat maintenance capacity of three head treatments of the newborn under the radiant warmer. When comparing the three modalities which included, no covering, stockinette covering and fabric insulated bonnet, the latter was most efficient. However, that was not demonstrated until thirty minutes after the treatment was applied. All treatments were applied within one minute after birth. Rectal temperatures were checked at five, fifteen and thirty minutes after birth. The stockinette was the least effective method of preventing heat loss. The newborns randomly assigned to the bonnet treatment maintained heat most efficiently. The investigator concluded that the single layered cotton stockinette should not be used on an infant's head while the infant is under the radiant warmer because cooling occurred with its use, the opposite effect from the intention of the intervention (Greer, 1988).

In a study by Rowe, Weinberg, and Andrews (1983) an effective insulating hat was described as covering most of the head without covering the face, staying in place for at least four to six hours, and having the ability to help the newborn maintain a stable temperature. A concern that bacteria would grow on the infant's scalp was demonstrated to be unfounded by these researchers. Also, a fabric of moderate insulation properties was used in order that too much heat build-up would not occur. These authors found that a relative insulation value of 2.6 clo (1 clo is equal to 0.18 C-hr-m^2 / Calories) is sufficient to prevent heat loss and will not allow the build-up of too much heat. A thinsulate material, close in insulation value to a gamgee material, was used in the study and was effective in prevention of significant heat loss (Rowe, Weinberg, & Andrew, 1983).

Stothers (1981) studied heat loss as controlled by head insulation and found that oxygen consumption was significantly less in infants with the head covered by the hat. The conclusion from the study is that proper head covering helps to prevent thermal stress (Strothers, 1981).

Mother-Baby Bonding Issues

While this present study deals directly only with the issue of temperature control of the newborn, a purpose of this study is to gain more knowledge to enable application of good neonatal temperature control practices to include earlier, less restricted maternal-infant contact, when appropriate. It is of interest to look at the current knowledge regarding bonding, in order to give more relevance to this study.

The Klaus and Kennell (1970) report supports the idea of the risk of disordered attachment for the mother-newborn who experience early separation. The mother may interpret the lack of contact as her inability to care for the neonate. Leifer, Leiderman, and Barnett's study (as cited in Klaus and Kennell, 1970) compared the mothering behavior of women who had early contact with their premature infants with those who had late contact. An analysis of three mother-infant observations found that mothers who were allowed early contact with their infants had greater caregiving skills only after the first observation period. However, those mothers who had early contact with their infants exhibited greater attachment behavior at all three observation periods. Attachment behavior was defined as looking at, caressing and smiling at the infant, as well as the closeness with which the infant was held. The three observation periods were at the fifth visit in the discharge nursery, in the home one week after discharge, and in the clinic one month after discharge. The authors do caution that widespread change in the procedures of caring for the mother and the newborn should not occur until sufficient evidence of damage done by present practices is documented. These differences become important, as recognized in Rubenstein's work (as cited by Klaus and Kennell, 1970) that demonstrated early attentiveness by the mother develops greater exploratory behavior in the infant. This may have a strong influence on infant development (Klaus and Kennell,1970).

Brazelton (as cited by Mundal, VanDerWeele, Berger, & Fitsimmons, 1991) states that medically unjustified separation of the mother and infant at birth can be harmful. He believes that this period after birth enhances attachment, but that this is not a critical period for healthy attachment. The important issue, according to Brazelton in studies with substance abusing mothers, is that the caregivers relate to the mother that she is important to her infant (Mundal, VanDerWeele, Berger, & Fitsimmons, 1991).

Mundal et al. (1991) used the University of Washington Intrapartum Risk Index of 1984 to address maternal-newborn attachment. This tool measures maternal attachment by the eye to eye contact between mother and infant, the attention that the mother gives to the infant, affectionate touching of the newborn, rapport with the staff, and the reaction to the labor and delivery experience. The authors write that this risk index is a tool that can aide the perinatal staff in evaluating its success in enhancing the development of a strong maternal-infant bonding. Mundal et al. (1991) shows that bonding is improved through encouraging mother-newborn close physical contact and teaching attachment skills in the immediate postpartum period. The researchers conducting the study concluded that less strong bonding in the mothers who were separated from their infants at birth is at least in part a function of that separation at birth. Attachment differences were significant only if separation of mother and infant occurred (Mundal, VanDerWeele, & Fitsimmons, 1991).

Although mother-newborn bonding is natural and happens unconsciously, some occurrences can interrupt this attachment process. Immediate separation of the newborn from its mother may be one of those occurrences (Vaughans, 1990).

Mother-infant attachment behaviors naturally begin at birth. Studies show that social integrity of the mother-baby dyad is altered by separation at birth. Studies by Klaus and Kennell (1970) suggest that physical contact immediately after birth is important for the development of the most effective parenting behavior.

Newport (1984) recognized that not only was heat conservation necessary to protect the infant, but maternal attachment must also be encouraged. She concluded that the two objectives could be met with one action. The nurse should bring the baby to the mother immediately after birth. She compared temperatures, pulse rates, respiratory rates, and the presence of diarrhea, ketonuria, and weight loss with a group of infants placed on the radiant warmer and another group placed nude, skin to skin with the mother. She found that after fifteen minutes infants were slightly warmer on mother's chest as compared to the radiant warmer. All parameters were normal in the experimental group. Newport found that skin-to-skin contact not only fostered maternal attachment but also added to the physical stability of the newborn (Newport, 1984).

A study was carried out by Klaus et al. (1972) to test the hypothesis that close maternal contact soon after birth makes a difference in subsequent maternal attachment behavior. The mothers in the traditional contact group were given a brief glimpse of their babies after birth, a brief period of contact between six and twelve hours after birth and thirty minutes every four hours to bottle feed their babies. The experimental group were given their nude babies with a heated panel up overhead for one hour within the first three hours after giving birth, and five extra hours of contact each of three days following delivery.

Caretaking scored higher by the mothers in the extended contact at one month after delivery. The mothers with the extended contact also scored higher with support behavior during the physical examination of the infant at one month. Finally, the mothers in the extended contact group spent more time touching their infants. All of these behaviors are considered markers for close maternal attachment. These results suggest that there may be a sensitive time immediately after birth, when close contact with the infant will foster the development of maternal attachment behaviors in the adult woman (Klaus et al., 1972).

Initiating Breastfeeding

The mother who has made the decision to breastfeed her infant will often voice the desire to feed her baby in the early moments after birth. If she does not, then Lawrence and Lawrence (1999) suggest the delivery room attendants should encourage breastfeeding. Attachment is facilitated with skin-to-skin contact with mother and baby. When the initiation of breastfeeding is prevented, immediately after birth a negative long term impact on the length of nursing and the success of breastfeeding occurs. Should aspiration occur during early feedings, colostrum is absorbed by the respiratory mucosa without causing irritation. Oxytocin levels are significantly increased with breastfeeding during the first hour after birth. Increase in Oxytocin levels are associated with enhancement of mother-newborn bonding (Lawrence & Lawrence, 1999).

A study of the short term effects of breastfeeding behavior on various amounts of contact between the mother and newborn was done in Sweden by a group of psychologists. The study was done on a group of primiparous women who were not aware of the experimental aspect of the study. The women were divided into three study groups (Carlsson et al., 1978).

Some women were permitted limited contact with their newborn. This meant that the woman could only hold her infant for a maximum of five minutes immediately after birth, while in the delivery room. The baby was then removed from the mother, for the next four hours and placed in a separate crib beside the mother's bed. At the end of this time the mother and baby were moved to the ward where they would stay until discharge home (Carlsson et al., 1978).

The two other groups had extended mother-baby contact immediately after delivery. For about one hour, the mother kept her naked newborn in her bed. The newborn was in a position for nursing, touching the breasts of the mother. The nursing routine for one group of these mothers was to advise and support the mother. The mother was encouraged to nurse her infant. The infants in this group received no supplemental feeding, were weighed one time daily, and had extra contact with their mothers from two to four hours between meals. The nursing routine for the second group focused on nursing the newborn. There was no extra contact between meals and the infants were given supplemental feedings. The babies in this group were weighed before and after each meal (Carlsson et al., 1978).

The mothers in the two groups with the extended contact demonstrated more contact behaviors. Contact behavior was rocking and/or caressing the newborn, holding the newborn either in her arms against her body or in her lap, smiling and/or talking to the newborn and burping her newborn. The limited contact mothers displayed more behaviors not indicating contact with the infant, such as, talking to someone other than the infant, looking away from the infant, and not having physical contact with the infant. The study supports the conclusions of previous studies done in different countries, by different investigators, that the events occurring immediately postpartum influence maternal behavior, at least in the first days following delivery

(Carlsson et al., 1978).

In a study of delivery room routines on the effect of successful breastfeeding, Righard and Alade (1990) found that when contact between the mother and her newborn was uninterrupted for the first hour or until the infant breastfed, breastfeeding progressed more favorably and had longer duration. The delay in beginning to nurse, as well as administration of Demerol to the mother during labor, had the potential to alter the infant's suck. Wimmer-Puchinger and Nagel (as cited in Righard & Alade, 1990) show that the early sucking pattern is a reliable indicator for the duration and success of breastfeeding. Righard and Alade demonstrate that early separation of the mother and newborn is followed by a shorter duration of breastfeeding. A separation of fifteen to twenty minutes disturbed the first feeding at the breast (Righard & Alade, 1990).

Summary

The literature review has focused on several points. First, the physical differences of the newborn which makes effective thermoregulation practices critical for maintaining the infant in a thermo-neutral state. Then the mechanisms of newborn heat loss and heat production were explored. This was followed with a review of temperature regulation studies. Finally studies addressing bonding and breastfeeding as related to thermoregulation were reviewed. The ground work was laid to support the idea that temperature control issues and bonding issues are of great importance in the early moments of the newborn's life. Both adequate temperature control and early maternal-infant bonding are necessary for a successful beginning.

Theoretical Framework

Environmental stress accounts for most of the temperature instability of the newborn. Cold stress or the effects of excessive heat rapidly develop when ambient temperatures are outside of the thermoneutral zone. This causes an unstable internal environment for the newborn that would result in death for many neonates, if interventions were not promptly initiated. Betty Neuman's nursing theory of the wellness-illness continuum based on the systems concept, will be used to provide a framework for this study.

Neuman proposes that the individual is a composite of physiological, psychological, socio-cultural, developmental, and spiritual variables. Interpersonal, intrapersonal and extrapersonal stressors are acting on the individual, in his environment. The environment is divided into internal and external spheres. According to Newman it is the individual's defense system that buffers or protects one against stress in the environment. The defense system, which surrounds the central core (in this case, the neonate) varies in the amount of protection it can offer (Haggart, 1993).

The outermost defense, from Neuman's theory, is a flexible line of defense that encircles the neonate. As this line weakens, when the environmental temperature is too harsh, the normal line of defense is set in motion to prevent temperature change. The infant changes posture. If too warm, the infant extends its limbs. If too cool, the infant flexes its extremities. As further destabilization occurs, then the lines of resistance to prevent damage become active. Metabolism increases. As more energy is needed to maintain temperature than is available, the infant regresses in the direction of illness and death. Hypoglycemia, hypoxia and acidosis develop. If equilibrium can be achieved and temperature stabilized in a normal range, the infant moves toward health and wellness. The goal of Neuman's concept is to gain equilibrium with the environment which she defines as wellness. The health of the client is placed on a continuum from wellness to death (Haggart, 1993).

Neuman emphasizes the socio-cultural aspect of the human in her theory. An awareness of socio-cultural diversity is necessary as nurses work with different families. Mother and babies from different cultures behave differently. The norm shifts from one culture to another. Nurses will empower mothers to use the natural warming of skin-to-skin and enhance early bonding as the socio-cultural background of the neonate's family is understood and appropriate interactions for the individual mother-baby dyads develop (Haggart, 1993).

Interventions by the caregivers may lead toward wellness or illness of the neonate. The temperature of the neonate must be monitored and the neonate maintained in the thermoneutral zone if maximum health and growth are to be achieved (Thomas, 1994).

Bonding also works toward the stability of the neonate. Ideally, two of the most critical concerns for the healthy newborn, thermoregulation and mother-baby bonding, can be combined and a single intervention can maximize the successful accomplishment of both goals. Holism, an important aspect of Neuman's theory, is exemplified when working with the thermoregulation of the neonate and simultaneously bonding the infant in the new family unit.

Assumptions

1. The Average rectal temperature and the average axillary temperature of a stable newborn is approximately equal (Hey, 1994).
2. The skin axillary temperature will decrease before the rectal temperature will decrease (Brueggemyer, 1993).
3. The newborn's temperature at birth is, on the average, 37.7° C or about 0.5° C to 1.0 °C higher than the temperature of the mother (Okken,1991).
4. An initial decrease in the newborn's temperature of 0.1°C to 0.2° C per minute during the first five minutes after birth is normal and desirable (Baumgart, 1996).
5. Bonding naturally begins at birth, and may be jeopardized by delaying mother-baby contact in the first several hours after birth (Mundal, VanDerWeele, Berger, & Fitsimmons, 1991).

Hypotheses

There are two hypotheses in this study.

1. There is no significant difference in the axillary temperatures of healthy, term neonates at ten minutes, twenty minutes and thirty minutes after being dried and placed skin-to-skin on the mother's chest with warmed baby blankets over the back

and stockinette cap covering the head and in the axillary temperatures of neonates ten minutes, twenty minutes and thirty minutes after being placed on a radiant warmer bed.

2. The healthy, term neonate, with an acrylic knit hat and a cotton liner covering the head, placed skin-to-skin with the mother and the back and extremities covered with pre-warmed baby blankets will maintain its temperature in the thermoneutral zone, between 36.5°C and 37.5°C.

Definition of terms

1. Skin-to-skin with mother: The infant is placed directly on the chest of the mother. Three cotton baby blankets, previously warmed in a warmer to a temperature of 109°F are placed under the radiant warmer set at 36.5°C, and then transferred to the back of the infant at the time the infant is placed skin-to-skin with the mother.

2. Radiant warmer: A standard piece of equipment, pre-set at 36.5°C, to control the infant's thermal environment with a radiant heat source on an open table that allows observation of the infant and maintenance of the thermoneutral temperature range for the infant.

3. Cotton stockinette cap: A single layered ribbed cotton stockinette cap is placed over the head of the infant to protect against heat loss.

4. Acrylic knit cap: The acrylic cap is hand knitted with an inside liner of cotton. The cotton layer and the knit cap fit snugly around the infant's head.

5. Thermometer: The electronic thermometer, accurate to one-tenth degree. One of two thermometers will be used to collect all data. These thermometers are tested prior to the commencement of the study for accuracy and were provided by the central stores of the hospital where this study was conducted.

6. Temperature: An axillary temperature of the newborn, except when otherwise stated. (If

temperature reading is not axillary, the site will be identified). Body temperature is a measurement of the balance between heat loss and heat gain. Heat is gained internally by metabolism and externally from a heat source such as the radiant warmer. If temperature is rising, more heat is being produced or a lesser amount of heat is being lost. When body temperature is stable, an equal amount of heat loss and heat gain is occurring. When body temperature is decreasing, more heat is being lost from the surface of the body than is being accumulated either from internal heat production through metabolism or from an external heat source (Lutz and Perlstein, 1971).

7. Apgar score: A score that denotes newborn stability at birth. The one-minute and five minute scores are recorded on all babies born in the hospital. Five items (the color, muscle tone, heart rate, respiratory rate, and reflex irritability) are assessed on a scale of zero to two. Total scores range from zero to ten; the higher the score, the more stable is the post-natal condition. Eight to ten signifies good adjustment to extrauterine conditions. Less than four identifies the seriously depressed newborn (May and Mahlmeister, 1990).

8. Gravida: The number of times a woman has been pregnant, regardless of the outcome of each of the pregnancies.

Chapter III

Methodology

The study was approved by the Human Subjects Committee of Salisbury State University (see Appendix A) and the Institutional Review Board of the Medical Center (see Appendix B) where the study was investigated. Since the study involved manipulating the environment of newborns, a very careful review of the protocol was made by both committees. Every attempt was made to keep babies who were entered into the study from becoming cold stressed.

Research Design

A quasi-experimental design was used. Randomization of treatment was done on a sample of convenience. Each mother was asked to participate in the neonatal temperature control study by allowing her newborn to be placed skin-to-skin on her chest after the initial assessment, about five minutes following the birth or by allowing her newborn to be monitored in the radiant warmer bed according to the assigned treatment.

There will not be a true control group, because all infants need assistance with temperature control. Data collection will proceed at ten-minute intervals for one-half hour. Mothers were encouraged to use the option to drop out of the study if they became tired or for any reason wished to discontinue the treatment before the half-hour was completed, and their infant would have been discharged from the study without penalty. In an effort to exclude confounding variables, an infant who developed any other problem, except cold stress was excluded from the study. Careful attention was given to the prevention of errors in obtaining and recording individual temperatures. For that reason all data was collected, using the same site, the same thermometers, and by the same investigator.

Description of the Research Setting

The study was carried out in a Regional Medical Center in Maryland. At the time of the study, between two thousand and twenty-five hundred births occur at this facility annually. The labor and delivery suite was about five years old. The delivery rooms have a controlled relative humidity of 50-52 % and individual thermostats regulating the temperature to the comfort of the laboring women. When the investigator arrived near the time of delivery, the thermostat was reset at 72°F. Every room had equal treatment of outside windows that were airtight. Each room was equipped with all necessary materials to deal with the delivery. Each room had a small anteroom separating the baby and the delivery from discernable air currents that may be caused by a door opening from the hall. The radiant warmer was placed on the inside wall, away from the strongest sources for convective and radiant heat loss.

The researcher was a full time employee at the medical center. All research was done by the researcher, during off duty time, as required for approval of the study. The researcher gathering data, often became the caregiver of the infant. This did not represent conflict for determining which newborns met the criteria for entering the study, because the apgar scores were determined by other nurses in the delivery room. Data was collected between May of 1999 and March of 2000.

Sample

The study population and sample includes all newborns delivered at the facility, whose mothers have pre-authorized their admission to the study. However, both mother and baby must meet pre-determined criteria. The mother must be delivered vaginally and not experience any major complications, such as hemorrhage or blood pressure instability. Additional requirements for the mother-baby dyad's inclusion in the study were the maintenance of maternal temperature below 38.1°C during labor, rupture of membranes no greater than eighteen hours and avoidance of medications known to decrease body temperature (i.e. Aspirin, Tylenol, antihypertensive medication, and Diazepam) during labor.

The newborn was included if a signed informed, maternal consent was obtained, was greater than thirty-six weeks gestational age, had apgar scores of at least seven at one minute and at least eight at five minutes of life, had initial temperatures between 36.3°C and 37.6°C, and showed no signs of respiratory distress nor had any recognized problem that would be expected to compromise the newborn's stability. These were newborns who, even if the study were not in progress, would have remained in the delivery room until the mother was taken to her postpartum room.

One-hundred eighty mothers indicated they would join the study. Of those, 97 mother-newborn dyads met the criteria and completed the one-half hour study, during which time four temperatures were recorded. Of those completing the study, 64 mothers were Caucasian, 27 were African-American, and six were of Asian or Hispanic ethnicity. Another 81 laboring women said they would enter the study but either maternal problems or newborn problems prevented their entry into the study. Of those mothers who gave consent for the study but did not meet the criteria: 16 had unexpected cesarean births, one had prolonged rupture of membranes, one developed a late pregnancy induced hypertension, one was too tired, nine did not want their baby under the radiant warmer (drew a treatment they did not want to accept), four women had temperature elevations during labor, and one woman was excluded because of admission to recent drug use. Three newborns were excluded for precipitous, uncontrolled birth. Eight newborns were excluded because the initial temperature was outside of thermoneutral range. Reasons for other exclusions are summarized as: two newborns were delivered with high forceps, three had low apgar scores at one minute, two newborns had thick meconium with prolonged suctioning, and seven infants had respiratory distress. In addition, one dyad was lost to the study when the attending midwife made the decision that care on the warming bed was not in the best interest of this mother and baby, the investigator was not called for six of the deliveries, and seven mother-newborns dyads were lost to unknown reasons. Fifty-two male newborns and forty-five female newborns met the criteria and remained to finish the study.

Data Collection Methods

An interview with each prospective adult subject, as described below, identified all possible study subjects. Once a newborn was entered into the study, direct measurement of a series of four axillary temperatures was made with an electronic thermometer. Finally a chart audit was done, to capture information on items which may affect the temperature, thus, acting as confounding variables.

Two electronic thermometers, with built in batteries, were used for the study. The thermometers were released for use in the study after being certified as accurate to one-tenth degree centigrade. Each month, the temperature of the investigator was checked with the study thermometer and another electronic thermometer in circulation in Labor and Delivery. The two thermometers were always in agreement to the nearest one-tenth degree. The thermometers are checked for accuracy on a routine basis by engineers in the Biomedicine Department.

Procedure

As soon as possible after the admission procedure was completed, the researcher approached the laboring woman, and requested that she and her baby enter a temperature control study for newborns. The experiment was explained to each mother, who then was given a paper to read, further describing the proposed experiment. (See appendix C.) If the mother signed the consent, (See appendix D.) her nurse was alerted to call the researcher for the delivery. The father of the baby, if present, was also encouraged to read about the study and sign the consent, if in agreement with the study. If the mother did not wish to join the study, she was thanked for her time and was excluded from further involvement in the research. The care of both herself and her newborn proceeded in the usual manner, without interruption.

Once the mother agreed to participate in the study with her newborn, she or her significant other, reached into a bag and blindly drew out a number for a random assignment to a study attempt to add a feeling of warmth and caring to the proposed idea of an experiment on the newborn. A number from one to three was glued to a heart shaped piece of plywood. The number represented the treatment to which the newborn would be assigned. A "1" was assigned to the radiant warmer, a "2" was assigned to the mother's chest with a cotton stockinette cap, and a "3" was assigned to the mother's chest with a cotton insert into an acrylic knit cap.

Immediately after the birth of the newborn, the umbilical cord was cut. The newborn was transferred to a pre-warmed sheet and placed under the radiant warmer where he/she was immediately, vigorously, and thoroughly dried. The attending nurse, often assisted by the researcher, recorded birth time, identified the infant, administered antibiotic treatment to the eyes, checked the axillary temperature, heart rate and respiratory rate, diapered the infant, and recorded apgar scores. No infant was accepted for the study until the five minute apgar score of at least eight was obtained. Between five and six minutes after birth, the stable newborn was entered into the previously randomly assigned treatment. The diapered newborn was transferred to the bare chest of the mother with the proper hat treatment and covered with three pre-warmed baby blankets or remained on the radiant warmer on dry blankets that replaced the damp receiving sheet.

An axillary temperature measurement was recorded for every newborn at ten minutes, at twenty minutes, and at thirty minutes, plus or minus one minute after the treatment was begun, regardless of the study group to which the newborn was assigned. If a low normal temperature, 36.5°C was recorded, the mother was advised that her baby's temperature was on the low normal side and was encouraged to rearrange the newborn so that maximum skin-to-skin contact for the best warming results could be achieved. When the newborn was on the radiant warming bed, the heat output was adjusted to maintain the temperature in the normal range. Every effort was made to keep the newborn safe and the temperature within a normal range.

At the end of the half hour of study, the mother was encouraged to attempt to breastfeed her

At the end of the half hour of study, the mother was encouraged to attempt to breastfeed her newborn and assisted to do so, if she wanted help. The newborn was treated according to the mother's desire. Many mothers chose to keep their newborn skin-to-skin, some wanted the father of the baby to take a turn at bonding, other mothers passed the baby to various friends and relatives in the room, and a couple were so tired they opted to place the baby on the warming bed, to protect him/her from falling. Between one and one and one-half hours after the removal of the placenta, the mother and her newborn were moved to the postpartum unit. At this time they were separated. The newborn was placed in the nursery and the mother in a room near the nursery. A temperature, weight, and vital signs were checked and recorded within the first minutes of the arrival of the newborn to the nursery. This temperature is the experimental temperature number five.

Data Analysis

The Data was analyzed using the Analysis of Variance (ANOVA). The temperature versus the treatment was first approached with the one-way ANOVA. Next, the temperature within groups was analyzed with the one-way ANOVA. Then other, potentially confounding variables were studied using ANOVA. The newborn's blood glucose level, a routine test on all newborns was compared to the treatment assigned to the newborn. With regression analysis, temperature four, the last temperature during the study, was used to determine the relationship of race, maternal age, and the gestational age of the neonate to the actual temperatures.

Regression analysis was also used to discover any relationship between the baby nurse, the delivery nurse, the delivery physician or midwife and the hours in labor prior to the birth of the infant. The one-way ANOVA was used to identify the relationship between the infant's temperature and if the laboring woman was induced, augmented or labored without intervention. Possible confounding variables were sorted out using regression analysis and one-way ANOVA. Maternal race was the only variable identified with a significant relationship to newborn

CHAPTER IV

Results

The purpose of this study is to provide evidence that would guide thermoregulation practices while also addressing the need for the infant and the mother to begin a bonding relationship as soon after birth as possible. Three methods of warming the newborn were compared. The infants in Group I were dried and placed under the radiant warmer. They were diapered and left on dry pre-warmed blankets with the thermostat set at 36.5° C. The infants in Group II were dried and assessed under the radiant warmer, and at five minutes after birth, were capped with a cotton stockinette over the head, and placed skin-to-skin with the mother. Three flannel baby blankets were placed over the backs and arms. The infants of Group III were treated identically to the infants of Group II, except these infants were capped with an acrylic knit cap over a cotton liner.

Demographics

This sample of convenience, with randomly assigned treatments, was composed of normal healthy mother-newborn baby dyads. The woman was admitted to the delivery room, closest to the nurses station, that was available at the time of entry to the hospital. The delivery rooms have a controlled relative humidity of 50-52 % and individual thermostats regulating the temperature to the comfort of the laboring woman. When the investigator arrived near the time of delivery, the thermostat was reset at 72°F. Every room had equal treatment of outside windows that were airtight. Each room had a small anteroom separating the baby and the delivery from discernable air currents and distractions. The radiant warmer was placed on the inside wall, away from the strongest source for heat loss by convection or radiation. (See table 1 for the frequency distribution of delivery room assignment.) Although different rooms were used for the study, the conditions were as similar as they could be in regards to temperature, relative humidity, and equipment.

Table 1. Room Number of the Laboring Women. (N = 97)

Room Number	Frequency	Valid Percent
1	8	8.2
2	20	20.6
3	13	13.4
4	8	8.2
5	7	7.2
6	10	10.3
7	16	16.5
8	8	8.2
9	5	5.2
10	2	2.1
Total	97	100.0

No one with pregnancy induced or chronic hypertension was accepted in the study. No mother hemorrhaged during the delivery. No mother, who had a documented temperature above 38.1°C, was entered in the study. No mother was accepted in the study if a medication that is known to reduce temperature was given. The ages of the mothers ranged from 17 years of age to 41 years of age. The average maternal age was 27.12 years with a standard deviation of 6.21 years. (See table 2 for a frequency distribution of maternal age.)

Table 2. Frequency distribution of Maternal Age (N = 97)

Maternal Age	Frequency	Valid Percent
17	2	2.1
18	5	5.2
19	7	7.2
20	6	6.2
21	6	6.2
22	4	4.1
23	2	2.1
24	6	6.2
25	5	5.2
26	2	2.1
27	3	3.1
28	5	5.2
29	2	2.1
30	6	6.2
31	7	7.2
32	8	8.2
33	7	7.2
34	2	2.1
35	3	3.1
36	4	4.1
37	2	2.1
38	1	1.0
40	1	1.0
41	1	1.0
Total	97	100.0

The ethnicity/race of the mothers was categorized as Caucasian, African-American or other. Other was of Asian or Hispanic origin. Two-thirds of the sample was Caucasian. See table 3 for the frequency distribution according to ethnicity or race.

Table 3. Maternal Ethnicity/Race frequency distribution (N = 97)

Race	Frequency	Valid Percent
Caucasian	64	66.0
African-American	27	27.8
Asian/Hispanic	6	6.2
Total	97	100.0

This pregnancy for the mothers in the study ranged from their first pregnancy to the eighth pregnancy. Eighty-one percent (81.2%) of the mothers had 3 or fewer pregnancies, while eighteen percent (18.8%) of the mothers had four or more pregnancies. See table 4 for the frequency distribution of number of pregnancies of the women in the study, including this pregnancy. Prior pregnancies for subject 40 were not recorded.

Table 4. Frequency Distribution of the Number of Pregnancies (N = 96).

Number of Pregnancies	Frequency	Valid Percent
1	22	22.9
2	29	30.2
3	27	28.1
4	11	11.5
6	6	6.3
8	1	1.0
Total	96	100.0

This was the first delivery for thirty-one percent (31.6%) of the women in this study. For those women who had previously given birth, the range was from one to eight previous deliveries. Most (57.8%) of the women with previous deliveries had one or two previous deliveries. Only 9.6% of the mothers had three or more previous deliveries. See table 5 for the frequency distribution of prior births per woman. Prior births for subject 40 were not recorded.

Table 5. Frequency Distribution of Prior Births (N = 96).

Prior Number of Births	Frequency	Valid Percent
0	32	32.6
1	37	38.9
2	18	18.9
3	5	5.3
4	2	2.1
5	1	1.1
8	1	1.1
Total	96	100.0

Rupture of membranes occurred at birth to twenty-five hours prior to delivery. The intent was to have no rupture of membranes greater than eighteen hours prior to delivery. The information was not consistently available. Consequently two women were admitted to the study with rupture of membranes (ROM) greater than eighteen hours. The actual time, to the closest hour, between ROM and the time of birth is summarized in table 6. As the data reveal, the majority (72.1%) delivered in eight hours or less from rupture of membranes. Only 24.7% delivered after nine hours or more after rupture of membranes.

Table 6. Length of time between ROM and Delivery (to the closest hour) N = 97.

Time from ROM to Delivery	Frequency	Valid Percent
0 hours	3	3.1
1-4 hours	43	43.2
5-8 hours	27	27.6
9-12 hours	14	14.3
13-18 hours	8	9.1
19-25 hours	2	2.0
Total	97	100.0

Newborns admitted to the study were at least 37 weeks gestational age. More infants (34.7%) had a gestational age of 40 weeks. Whereas 42.3% of the newborns had a gestational age less than 40 weeks, only 22.7% had a gestational age greater than 40 weeks. See table 7 for the frequency distribution of gestational age.

Table 7. Gestational Age of Newborns in the Study (N = 97).

Gestational Age	Frequency	Valid Percent
37	6	6.2
38	12	12.4
39	23	23.7
40	34	35.1
41	20	20.6
42	2	2.1
Total	97	100.0

Birth weights are recorded on newborns upon arrival to the nursery. The intent was to enter newborns into the study who weighed at least five and one-half pounds or 2496 grams. The small newborn, under a somewhat arbitrary figure of five and a half pounds has less fat for insulation against temperature loss and greater surface area to permit rapid temperature loss. This puts the infant at higher risk for cold stress. All newborns in this study were greater than five pounds and seven ounces or 2466 grams. The smallest weighed 2476 grams. And the heaviest weighed 4828 grams (10 pounds and 10 ounces). The average weight for the newborns in this study was 3505.71 (about 7 pounds 11 ½ ounces) with a standard deviation of 495.94 grams. See Appendix E for the frequency distribution of the birth weights of the newborns in this study.

Apgar scores are taken one minute after birth and again at five minutes after birth. These scores are taken to evaluate an infant's stability as he/she adjusts to extra-uterine life. A score of seven is adequate. A score of ten is seldom achieved. Eight or nine is the usual score seen on a newborn who is adjusting well to breathing and oxygenating its own blood. All infants in this study achieved apgar scores of seven to nine at one minute and eight to ten at five minutes of life. At one minute, 95.1 % of the newborns had eight or nine apgar scores. This is very desirable. Only 4.1% of the newborns had a one-minute apgar score of seven and no infant with a one-minute score below seven was admitted to the study. The frequency distribution of the one-minute apgar scores of all newborns admitted into the study are represented in table 8.

Table 8. Frequency Distribution of the One-minute Apgar Scores (N = 97).

One minute Apgar scores	Frequency	Valid Percent
Seven	4	4.1
Eight	39	40.2
Nine	54	55.7
Total	97	100.0

The five-minute apgar score ranged from eight to ten. Almost ninety-six percent (95.9%) of these newborns obtained scores of eight or nine. This demonstrates good adjustment to extra-uterine life. The highest possible apgar score is ten. Ten was recorded on the remaining 4.1% of the newborns in the study. The importance of this statistic is that it demonstrates that only stable newborns were entered into the study. See table 9 for the distribution frequency of the five-minute apgar scores of the newborns studied.

Table 9. Five minute Apgar Score of Newborns in the Study (N = 97).

5 minute Apgar Scores	Frequency	Valid Percent
Eight	2	2.1
Nine	91	93.8
Ten	4	4.1
Total	97	100.0

Fifty-three percent (53.6%) of the newborns were males and forty-six (46.4%) percent were females. Table 10 represents the frequency distribution for gender of the newborns in the study.

Table 10. Gender of Newborns (N = 97)

Gender	Frequency	Valid Percent
Male	52	53.6
Female	45	46.4
Total	97	100.0

All newborns in the study were delivered vaginally. This is the least stressful way for a term, normal baby to be born. Seven deliveries were assisted with vacuum extractor or with low-outlet forceps. A baby born naturally is called a spontaneous delivery. Almost ninety-three percent (92.8%) of the newborns were spontaneous vaginal deliveries. Just over seven percent (7.2%) were assisted by forceps or vacuum extraction. See table 11 for the frequency distribution of the type of vaginal delivery.

Table 11. Type of Vaginal Delivery (N = 97)

Type of Delivery	Frequency	Valid Percent
Spontaneous	90	92.8
Low forceps	1	1.0
Vacuum extractor	6	6.2
Total	97	100.0

To minimize the risk of metabolic acidosis, brain damage, and inability to adjust to extra-uterine life, glucose levels are taken on newborn infants. Normal range is still disputed. At the facility where this study was conducted, above forty percent per deciliter is considered normal.

(Thirty-five percent or greater is generally considered normal for the blood glucose during the first 24 hours of life.) Protocol provides for every newborn to have the blood glucose done and charted on admission to the newborn nursery. A blood glucose was not charted on one newborn in the study. The blood glucose levels of the newborns in this study ranged from 35mgs/dl to 93mgs/dl. (See table 12). The median glucose was 60 milligrams per deciliter, the mean was 60.58 mgs/dl, with a standard deviation of 11.66 mg/dl. One can see that the glucose levels of the infants in this study are within safe levels, only one was at 35 mg/dl, the cut off for normal and all others were 40 mgs/dl or greater. The newborn with 35 mg/dl was placed on the hospital protocol.

Table 12. Frequency Distribution of Glucose levels (N = 96).

Blood Glucose Levels	Frequency	Valid Percent
35-39mgs/dl	1	1.0
40-44mgs/dl	12	12.4
45-49mgs/dl	7	7.3
50-54mgs/dl	8	8.2
55-59%mgsdl	17	17.8
60-64mgs/dl	11	11.5
65-69mgs/dl	19	19.8
70-74mgs/dl	9	9.3
75-79mgs/dl	8	8.3
80-84mgs/dl	3	3.0
85-89mgs/dl	0	0
90-94mgs/dl	1	1.0
Total	96	100.0

The heart rates of all the newborns accepted in the study were within normal range. Above 100 and below 160 at the time of birth is considered within normal range. As customary the heart rate was counted for six seconds and multiplied by ten. The baby nurse then used the heart rate to help determine the apgar score. The precise number was not recorded. An actual one-minute count was first taken in the nursery. The one-minute heart rates are recorded in Table 13. As the table indicates, the heart rates ranged from 110 beats per minute to 165 beats per minute with a median of 140 beats per minute, a mean of 139 beats per minute, and a standard deviation of 11.19.

Table 13. Heart Rates of Newborns in the Study (N = 97)

Heart Rate	Frequency	Valid Percent
110	1	1.0
120	9	9.3
122	1	1.0
124	2	2.1
128	1	1.0
130	6	6.2
132	7	7.2
133	1	1.0
134	2	2.1
135	1	1.0
136	3	3.1
138	5	5.2
140	19	19.6
142	5	5.2
144	7	7.2
146	1	1.0
148	3	3.1
150	9	9.3
152	4	4.1
154	2	2.1
156	2	2.1
158	1	1.0
160	4	4.1
165	1	1.0
Total	97	100.0

The total number of newborns admitted to the study was 97. The newborns were divided into the three study groups with a random assignment to a group. The first group received treatment one. Their temperatures were taken under the radiant warmer. The second group received treatment two. They were placed skin-to-skin with the mother after being diapered and capped with a cotton stockinette. The third group received treatment three and were placed skin-to-skin with the mother after being diapered and capped with a cotton insert into an acrylic knit cap. See table 14 for the frequency distribution of the treatment groups. (Throughout the analysis and the discussion Group I is the same as Treatment I, Group II is the same as Treatment II and Group III is the same as Treatment III.) Thirty-five percent of the newborns were in Group III and received Treatment III.

Table 14. The Number of Newborns in Each Treatment Group (N = 97)

Treatment Group	Frequency	Valid Percent
Group I	30	30.9
Group II	33	34.0
Group III	34	35.1
Total	97	100.0

Temperature one was taken within the first five minutes after birth. Temperature one was always checked while the newborn was on the radiant warmer, just prior to the five-minute apgar assessment. The frequency distribution of temperature one is found in table 15. The temperature range for temperature one was from 36.3°C to 37.9°C with a median temperature of 37.1°C. The mean for temperature one was 37.1°C with a standard deviation of .39°C.

Table 15. The Frequency Distribution of Temperature One. (N = 97).

Temperature One	Frequency	Valid Percent
36.3°C	1	1.0
36.4°C	4	4.1
36.5°C	10	10.3
36.6°C	1	1.0
36.7°C	6	6.2
36.8°C	4	4.1
36.9°C	4	4.1
37.0°C	6	6.2
37.1°C	17	17.5
37.2°C	10	10.3
37.3°C	8	8.2
37.4°C	7	7.2
37.5°C	6	6.2
37.6°C	7	7.2
37.7°C	4	4.1
37.9°C	2	2.1
Total	97	100.0

Temperature two was taken ten minutes after the treatment was started. This temperature is the first temperature that is influenced by the skin-to-skin treatments. The frequency distribution of temperature two is recorded in table 16. This first temperature ranged from 36.2°C to 37.7° with the median temperature being 37.1°C. The mean temperature was 36.9°C with a standard deviation of 0.37.

Table 16. Frequency Distribution of Temperature Two (N = 97).

Temperature two	Frequency	Valid Percent
36.2°C	2	2.1
36.3°C	3	3.1
36.4°C	3	3.1
36.5°C	9	9.3
36.6°C	1	1.0
36.7°C	13	13.4
36.8°C	8	8.2
36.9°C	10	10.3
37.0°C	13	13.4
37.1°C	7	7.2
37.2°C	7	7.2
37.3°C	6	6.2
37.4°C	3	3.1
37.5°C	8	8.2
37.6°C	1	1.0
37.7°C	3	3.1
	97	100.0

Temperature three, taken twenty minutes after the treatment started, ranged from 35.9°C to 37.7°C. The median was 36.9°C. The mean was 37.1°C with a standard deviation of 0.37°C. (See table 17 for the frequency distribution of temperature three).

Table 17. Frequency Distribution of Temperature Three (N = 97).

Temperature Three	Frequency	Valid Percent
35.9°C	2	2.1
36.4°C	1	1.0
36.5°C	9	9.3
36.6°C	5	5.2
36.7°C	9	9.3
36.8°C	10	10.3
36.9°C	12	12.4
37.0°C	3	3.1
37.1°C	13	13.4
37.2°C	10	10.3
37.3°C	4	4.1
37.4°C	7	7.2
37.5°C	5	5.2
37.6°C	4	4.1
37.7°C	3	3.1
Total	97	100.0

At the completion of the treatment, one-half hour after the start of the treatment, temperature four was taken. Temperature 4 ranged from 35.9°C to 37.8°C with a median of 36.9°C. A mean of 37.1°C with a standard deviation of 0.35°C was calculated. (The frequency distribution for temperature 4 is in table 18.)

Table 18. Frequency Distribution of Temperature Four (N = 97).

Temperature Four	Frequency	Valid Percent
35.9°C	1	1.0
36.3°C	1	1.0
36.4°C	1	1.0
36.5°C	5	5.2
36.6°C	1	1.0
36.7°C	8	8.2
36.8°C	11	11.3
36.9°C	11	11.3
37.0°C	10	10.3
37.1°C	12	12.4
37.2°C	5	5.2
37.3°C	5	5.2
37.4°C	8	8.2
37.5°C	13	13.4
37.6°C	4	4.1
37.8°C	1	1.0
Total	97	100.0

A nurse took temperature five on arrival of the newborn to the nursery. This temperature was taken at least one-half hour after the treatment was finished and the newborn had been in an undefined environment from the time of temperature four until temperature five was taken. In some cases the mother continued to hold the infant, other times the infant was given to the father or other family member after being tightly swaddled, and sometimes the infant was returned to the radiant warmer. Temperature five ranged from 35.6°C to 37.6°C with a median of 36.9°C. The mean for temperature five was 36.8°C with a standard deviation of 0.41°C.

Table 19. Frequency Distribution for Temperature Five (N = 97).

Temperature Five	Frequency	Valid Percent
35.6°C	1	1.0
35.8°C	1	1.0
35.9°C	2	2.1
36.0°C	1	1.0
36.2°C	2	2.1
36.3°C	5	5.2
36.4°C	1	1.0
36.5°C	10	10.4
36.6°C	3	3.1
36.7°C	11	11.5
36.8°C	10	10.4
36.9°C	8	8.3
37.0°C	10	10.4
37.1°C	9	9.4
37.2°C	7	7.3
37.3°C	5	5.2
37.4°C	4	4.2
37.5°C	4	4.2
37.6°C	2	2.1
Total	96	100.0

Analysis of the Hypotheses

There are two hypotheses to be analyzed. Hypothesis I proposed that there is no significant difference in the axillary temperatures of healthy, term neonates at ten minutes, twenty minutes and thirty minutes after being dried and placed skin-to-skin on the mother's chest with warmed blankets over the back and a stockinette cap covering the head and in the axillary temperatures of neonates ten minutes, twenty minutes and thirty minutes after being placed on a radiant warmer bed.

The second hypothesis under study stated that the healthy term neonate with an acrylic knit hat and a cotton liner covering the head, placed skin-to-skin with the mother and the back and extremities covered with pre-warmed baby blankets will maintain its temperature in the thermoneutral zone, between 36.5°C and 37.5°C.

In order to evaluate Hypothesis I and Hypothesis II, first the mean temperatures of the three treatment groups were compared. There were no statistically significant differences found at the .05 level, among the treatment groups using the one-way ANOVA to test the hypothesis. Both Hypothesis I and Hypothesis II were supported.

The following tables and discussion will provide an explanation of the studies done and the conclusions reached. When temperature two was the dependent variable, it was found that there were no statistically significant differences among the temperatures of the three groups ($p = .448$). The mean temperatures were about the same, ranging from 36.9°C to 37.0°C (See table 20).

Table 20. One-way ANOVA: Temperature 2 versus Treatment.

	N	Mean	SD
Treatment 1	30	37.0	0.404
Treatment 2	33	36.9	0.332
Treatment 3	34	36.9	0.360

$F = 0.81$. $\underline{p} = 0.448$. Pooled SD = 0.365. Individual 95% CIs for mean based on Pooled SD. (See graph below.)

```
                 --+---------+---------+---------+----
Treatment I                  (------------*------------)
Treatment II          (-----------*----------)
Treatment III       (-----------*----------)
                 --+---------+---------+---------+----
                  36.80     36.90     37.00     37.10
```

Temperature three was taken 20 minutes after the treatment began. When temperature three was the dependent variable, it was found that there were no statistically significant differences among the temperatures of the three treatment groups (p = .205). The mean temperatures were about the same on the average ranging from 36.9°C to 37.1°C. (See table 21).

Table 21. One-way ANOVA: Temperature Three Versus Treatment.

Level	N	Mean	SD
Treatment I	30	37.1	0.412
Treatment II	33	37.0	0.336
Treatment III	34	36.9	0.362

F = 1.61. p = 0.205. Pooled SD = 0.37. Individual 95% Confidence Intervals for mean based on pooled SD of 0.37 °C.

```
                    ---+---------+---------+---------+---
Treatment I                      (----------*----------)
Treatment II           (---------*----------)
Treatment III        (----------*---------)
                    ---+---------+---------+---------+---
                     36.84     36.96     37.08     37.20
```

stopped. When treatment four was the dependent variable, it was found that there were no statistically significant differences among the temperature means of the three treatment groups (p = .395). The mean temperatures ranged from 37.0°C to 37.1°C. (See table 22).

Table 22. One-way ANOVA: Temperature Four Versus Treatment.

Level	N	Mean	SD
Treatment I	30	37.1	0.370
Treatment II	33	37.0	0.318
Treatment III	34	37.0	0.364

F = 0.94. p = 0.395. Pooled SD = 0.351. Individual 95% CIs for mean based on pooled standard deviation

```
               -+---------+---------+---------+-----
Treatment I              (------------*------------)
Treatment II     (-----------*-----------)
Treatment III    (-----------*------------)
               -+---------+---------+---------+-----
               36.90     37.00     37.10     37.20
```

Temperature five was taken between one-half hour and one hour after the treatment had been discontinued. The infants had been in a poorly controlled thermal environment or with unidentified thermal protection since the end of the treatment in the delivery room. Temperature five was taken by the nurse receiving the newborn upon entry into the nursery. The investigator in this study had no control over the newborn's environment after the treatment was finished at the end of 30 minutes, nor the time of the temperature check in the nursery. When temperature five was the dependent variable there were no statistically significant differences among the temperatures of the three treatment groups (p = .635). The mean temperatures were about the same, ranging from 36.9°C to 36.8°C (See table 23.)

Table 23. One-way ANOVA: Temperature Five Versus Treatment.

Level	N	Mean	SD.
Treatment I	29	36.8	0.383
Treatment II	33	36.8	0.362
Treatment III	34	36.9	0.482

F = 0.46. p = 0.635. Pooled SD = 0.414. Individual 95% CIs for mean based on the pooled SD.

```
                    ------+--------+---------+---------+

Treatment I           (-----------*------------)

Treatment II         (-----------*-----------)

Treatment III            (-----------*----------)

                     ------+---------+---------+---------+
```

In order to ascertain whether or not there were significant differences among the mean temperatures over the four temperature readings, analysis of variance techniques were used within each treatment group. The temperatures within the groups were analyzed. A statistically significant difference was found in the means of temperature five for the newborns in Treatment I (under the warmer, p = .020) and the newborns in Treatment II (skin-to-skin with the cotton stockinette, p = .045). No statistically significant difference was found in the temperature means of the newborns in Treatment III (p = .568). This is viewed in tables 24 through 26.

Temperature two, three, four, and five within Treatment I were analyzed. The temperature means ranged from 36.8°C to 37.1°C. The mean of temperature five was significantly lower than the mean of temperature four (p = .020).

Table 24, One-way ANOVA: Temperature 2, 3, 4, and 5 within Treatment I.

Level	N	Mean	SD
Temperature 2, Treatment I	30	37.0	0.404
Temperature 3, Treatment I	30	37.1	0.412
Temperature 4, Treatment I	30	37.1	0.370
Temperature 5, Treatment I	29	36.8	0.383

F = 3.42. p = .020. Pooled SD = .393. Individual 95% CIs for mean based on pooled SD.

```
                               --------+---------+---------+---------
Temperature 2, Treatment 1               (--------*--------)
Temperature 3, Treatment                    (--------*--------)
Temperature 4, Treatment 1                     (--------*--------)
Temperature 5, Treatment 1     (--------*--------)
                               --------+---------+---------+--------
                                     36.80     36.96     37.12
```

Temperatures two, three, four, and five within Treatment II were next analyzed. Again there was found a statistically significant difference in the means of temperature four and temperature five (p = .045). The mean temperatures were very close, ranging from 36.8°C to 37.0°C. (See table 25.)

Table 25. One-way ANOVA: Temperature 2, 3, 4, and 5 within Treatment II.

Level	N	Mean	SD
Temperature 2, Treatment II	33	36.9	0.332
Temperature 3, Treatment II	33	37.0	0.336
Temperature 4, Treatment II	33	37.0	0.318
Temperature 5, Treatment II	33	36.8	0.362

$F = 2.75$. $p = 0.045$. Pooled SD = 0.337. Individual 95% CIs for mean are based on pooled standard deviation. (See graph below for illustration of the means of the temperatures.)

```
                                  -----+---------+---------+---------+-
Temperature 2, Treatment II               (-------*-------)
Temperature 3, Treatment II                 (-------*-------)
Temperature 4, Treatment II                     (-------*-------)
Temperature 5, Treatment II          (------*-------)
                                  -----+---------+---------+---------+-
                                     36.75     36.90     37.05     37.20
```

Then Temperature 2 (taken at ten minutes after the treatment began), Temperature 3 (taken twenty minutes after the treatment began), Temperature 4 (taken thirty minutes after the treatment began), and Temperature 5 (taken in the nursery) of Treatment III (the group the newborns with the acrylic knit cap and the cotton liner) were analyzed. There were no statistically significant differences in the means of the temperatures of Treatment III (p = .568). The temperature means were very close on the average, ranging from 36.9°C to 37.0°C. This group of newborns, on the average, had no statistically significant temperature drop between the time that temperature 4 and temperature 5 were taken as did the newborns in Treatment I and Treatment II. (See table 26.)

Table 26. One-way ANOVA: Temperature 2, 3, 4, and 5 within Treatment II

Level	N	Mean	SD
Temperature 2, Treatment III	34	36.9	0.360
Temperature 3, Treatment III	34	36.9	0.362
Temperature 4, Treatment III	34	37.0	0.364
Temperature 5, Treatment III	34	36.9	0.482

F = 0.68. p = 0.568. Pooled SD = 0.395. Individual 95% CIs for mean based on pooled SD

```
                               -------+---------+---------+---------
Temperature 2, Treatment III     (----------*-----------)
Temperature 3, Treatment III        (----------*----------)
Temperature 4, Treatment III            (----------*----------)
Temperature 5, Treatment III    (-----------*----------)
                               -------+---------+---------+---------
                                    36.84     36.96     37.08
```

In a search of factors that influence the temperatures obtained in each of the treatments, the blood glucose was studied by using the analysis of variance. When blood glucose level was the dependent variable and the treatment was the independent variable, at the .05 level there was no statistically significant association between the blood glucose level and the Treatment, ($p = .474$). The means of the blood glucose levels among the three treatment groups were close on the average, ranging from 58.64 mg per dl to 62.09 mg per dl.

Table 27. One-way ANOVA: Blood Glucose Versus Treatment Group

Level	N	Mean	SD
Treatment I	30	60.90	12.48
Treatment II	33	58.64	10.67
Treatment III	33	62.09	11.69

$F = 0.75$. $p = 0.474$. Pooled SD = 11.61. Individual 95% CIs for mean based on pooled SD.

```
                       ----+---------+---------+---------+--
Treatment I                  (-----------*-----------)
Treatment II           (-----------*----------)
Treatment III                   (----------*-----------)
                       ----+---------+---------+---------+--
                         56.0      59.5      63.0      66.5
```

Maternal age, race/ethnicity, gestational age, birth weight, gender, and hours in labor were examined using regression analysis to determine which variables, if any, contributed to the predicted temperature for the newborns in the study. At the .05 level, maternal race/ethnicity was the only factor in the equation that reached statistical significance ($\underline{p} = .022$). See table 28.

Table 28. Regression analysis: Temperature four Versus Maternal Age, Race/Ethnicity, Gestational Age, Birth Weight, Gender and Hours in Labor.

The regression equation is:

Temperature 4 = 37.1 + 0.00620 maternal age – 0.1421 race/ethnicity – 0.0111 gestational age +0.000135 birth weight – 0.0255 Gender + 0.00135 Hours in labor.

93 cases used (4 cases contain missing values).

Predictor	Coefficient	SE coefficient	T	P
Constant	37.073	1.224	30.28	0.000
Maternal Age	0.006196	0.006139	1.01	0.316
Race/Ethnicity	-0.14212	0.06103	-2.33	0.022
Gestational age	-0.01105	0.03305	-0.33	0.739
Birth weight	0.00013456	0.00008226	1.64	0.106
Gender	-0.02546	0.07234	-0.35	0.726
Hours in Labor	0.001346	0.004750	0.28	0.778

S = 0.3370. R-Sq = 15.1%. R-Sq (adjusted) = 9.2%

Since multiple regression has identified that maternal race/ethnicity is important for the prediction of the newborn temperature, the analysis of variance technique was then used to compare the means of the temperature of each racial/ethnic group. Significance was confirmed (p = .001).

In order to evaluate the relationship of temperature four and the maternal race, the analysis of variance technique was used. When all racial/ethnic groups was the independent variable and temperature four was the dependent variable, a statistical significance was found (p = 0.001) beyond the .05 level. The mean temperatures were about the same, ranging from 36.9°C to 37.2°C. (See table 29.)

Table 29. One-way ANOVA: Temperature 4 Versus Maternal Race/Ethnicity.

Level	N	Mean	SD
Temperature 4, Caucasian	64	37.2	0.304
Temperature 4, African-American	27	36.9	0.392
Temperature 4, Asian/Hispanic	6	36.9	0.234

F =7.81. p = 0.001. Pooled SD = 0.328. Individual 95% CIs for mean based on Pooled SD.

```
                        ---------+---------+---------+-------
Caucasian                                       (----*----)
African-American             (-------*-------)
Asian/Hispanic            (--------------*----------------)
                        ---------+---------+---------+-------
                               36.80     36.96     37.12
```

With Temperature four as the dependent variable, and the maternal race as the independent variable, the analysis of variance was used to determine the relationship between temperature four within Treatment I among the race/ethnicity as declared by the mother. Again a statistically significant difference among the races/ethnic groups was found ($p = .017$). The temperature means remained close, ranging from 36.9°C to 37.3°C. Caucasian newborns were warmer, on the average, than the African-American newborns. The temperatures of the Asian/Hispanic newborns were spread over a wider range than were the temperatures of the other ethnic groups.

Table 30. One-way ANOVA: Temperature 4 in Treatment I versus the Race/Ethnicity

Level	N	Mean	SD
Temperature 4,Treatment I, Caucasian	15	37.3	0.272
Temperature 4, Treatment I, African-American	12	36.9	0.411
Temperature 4, Treatment I, Asian/ Hispanic	3	37.0	0.115

$F = 4.78$. $p = 0.017$. Pooled SD = 0.329. Individual 95% CIs for mean based on Pooled SD.

```
                     -----+---------+---------+---------+-
Caucasian                                  (------*------)
African-American          (-------*-------)
Asian/Hispanic          (--------------*---------------)
                     -----+---------+---------+---------+-
                        36.75     37.00     37.25     37.50
```

Continuing to search for relationships, in the race/ethnic data, the analysis of variance was again used to determine the influence of the race/ethnic variable when the dependent variable was temperature four within treatment II. There was no statistically significant relationship (p = 0.088) as seen in table 31. The means of the temperatures were less close in value, ranging from 36.8°C to 37.1°C. The Caucasian newborns continued to be warmer, on the average. The African-American newborns had temperature means midway between the Caucasian and the Asian/Hispanic group. Again the Asian/Hispanic newborns had a broader range of temperatures than did the other ethnic groups.

Table 31. One-way ANOVA: Temperature 4, within Treatment II, among the Race/Ethnicity

Level	N	Mean	SD
Temp 4, within II, among Caucasian	20	37.1	0.311
Temp 4, within Treatment II, among African-American	10	36.9	0.283
Temp 4, within Treatment III, among Asian/Hispanic	3	36.8	0.306

F = 2.64. p = 0.088. Pooled SD = 0.303°C. Individual 95% CIs for mean based on pooled SD.

```
                   -+---------+---------+---------+-----
Caucasian                               (----*-----)
African-American                 (-------*-------)
Asian/Hispanic     (-------------*--------------)
                   -+---------+---------+---------+-----
                   36.5     36.75     37.00     37.25
```

Continuing to define the relationship of race/ethnicity and the treatment and temperature of the newborn, Temperature four within Treatment III was compared with race/ethnicity. There was a statistically significant relationship seen ($p = 0.010$). Only Caucasian and African-American subjects were in this Group. The mean of the temperatures of the African-American newborns was 36.6°C as was compared to the mean of the temperatures of Caucasian newborns which was 37.1°C. (See table 32.)

Table 32. One-way ANOVA: Temperature 4 within treatment III Among Race/Ethnicity

Level	N	Mean	SD
Temperature 4, Treatment III, Caucasian	29	37.1	0.294
Temperature 4, Treatment III, African-American	5	36.6	0.527

$F = 3.06$. $p = 0.013$. Pooled SD = 0.033. Individual CIs for the mean is based on pooled SD.

```
                      -+---------+---------+---------+-----
Caucasian                                (----*-----)
African-American                   (-------*-------)
Asian/Hispanic            (-------------*--------------)
                      -+---------+---------+---------+-----
                      36.5     36.75    37.00     37.25
```

Was this difference a difference of race/ethnicity alone or were there other factors influencing the temperature of these neonates? The birth weight was examined with the analysis of variance. There was a statistically significant difference in the means of the weights of the African-American and the Caucasian newborns ($p = 0.001$). The means ranged from 3551.8 grams to 3622.1 grams. The Caucasian newborns, on the average were heavier. (See table 33.)

Table 33. One-way ANOVA: Birth Weight versus Race

Level	N	Mean	SD
Caucasian	64	3622.1	477.6
African-American	27	3219.7	462.7
Asian/Hispanic	6	3551.8	342.0

$F = 7.07$. $p = 0.001$. Pooled SD = 467.3. Individual 95% CIs for mean based on pooled SD.

```
                    ---------+---------+---------+-------
Caucasian                             (----+----)
African-American    (------*------)
Asian/Hispanic          (-------------*--------------)
                    ---------+---------+---------+-------
                           3250      3500      3650
```

No other significant relationships were found using regression analysis and the analysis of variance. While the Caucasian newborns were on the average heavier than the newborns in other race/ethnic groups and the temperature on the average was higher, the means of all temperature analyses were in the thermoneutral range.

Summary of Findings

The mothers in this study were healthy and the newborns were stable. The maternal age ranged from 17 years to 41 years. Two-thirds of the mothers in the sample were Caucasian. The others were African-American, Asian or Hispanic. The mothers ranged from this being the first pregnancy to the eighth pregnancy. The actual previous births, before this pregnancy, ranged from none to eight. The length of time from the rupture of membranes until delivery ranged from 25 hours to at birth. All newborns in the study were at least 37 weeks gestational age and considered term. The one-minute apgar score ranged from seven to nine. The five-minute apgar score ranged from eight to ten. There were 52 male and 45 female newborn infants in the study. All births were by vaginal delivery.

This newborn temperature regulation study, investigating the effects of three treatments in the delivery room, found there was no statistically significant difference in the means of the temperatures in the three treatment groups at the termination of the study using the analysis of variance techniques. However, there was a statistically significant drop in the means of newborn temperatures in Treatment I and Treatment II between one-half hour to one hour after the treatment was finished. The 34 newborns in Group III (all exposed to treatment III, were placed skin-to-skin with the mother and capped with a cotton insert inside an acrylic knit cap) had no statistically significant drop in their temperatures, on the average, in the interval between the termination of the treatment and the arrival in the nursery. The hypotheses were supported with this study.

Also upon arrival to the nursery, the blood glucose levels on all the newborns were checked. There was no statistically significant difference found in the means of the blood glucose levels among the three treatment groups of newborns.

Finally regression analysis was used to examine relationships between temperature four and maternal age, race or ethnicity, and hours in labor as well as gestational age, birth weight and gender of the newborn. Of all the variables, only the maternal race or ethnicity revealed a statistically significant relationship ($p = 0.022$). The analysis of variance confirmed this relationship by comparing the means of the temperatures of each race/ethnic group($p = 0.001$).

The Caucasian newborns, on the average, were heavier than the newborns in the other race/ethnic groups represented in this study. No statistically significant drop in the means of temperature five was found in the Caucasian newborns. However, the means of all the temperatures were within the thermoneutral range.

CHAPTER V

Discussion

Meaning of the Findings in Relation to the Hypotheses

The purpose of this study is to provide evidence that would guide the best thermoregulation practices while also addressing the need for the infant and the mother to begin a bonding relationship as soon after birth as possible. Two hypotheses were advanced to give direction to the study:

1. There is no significant difference in the axillary temperatures of healthy, term neonates at ten minutes, twenty minutes and thirty minutes after being dried and placed skin-to-skin on the mother's chest with warmed baby blankets over the back and a cotton stockinette cap covering the head and in the axillary temperatures of neonates ten minutes, twenty minutes and thirty minutes after being placed on a radiant warmer bed.
2. The healthy, term neonate, with an acrylic knit hat and a cotton liner covering the head, placed skin-to-skin with the mother and the back and extremities covered with pre-warmed baby blankets will maintain its temperature in the thermoneutral zone, between 36.5°C and 37.5°C.

No statistically significant difference was found when the means of the newborn temperatures in the skin-to-skin care and the radiant warmer care were compared at the finish of the study, with temperature four. Within one to one and one-half hours after birth, there was no statistically significant decrease in the means of the newborn axillary temperatures for the treatment group of skin-to-skin with the mother and a cotton insert in the acrylic knit hat covering the head. Findings from this research are consistent with findings from previous studies of Vaughans (1990), Phillips (1974), Gardner (1979), and Hill and Shronk (1979). The first hypothesis, that there is no significant difference in the axillary temperatures of healthy, term neonates at ten minutes, twenty minutes and thirty minutes after being dried and placed skin-to-skin on the mother's chest with warmed blankets over the back and a stockinette cap covering the head and in the axillary temperatures of neonates ten minutes, twenty minutes and thirty minutes after being placed on a radiant warmer bed can be accepted on the basis of these findings. The first hypothesis is supported by this study.

The second hypothesis, that the healthy, term neonate, with an acrylic knit cap and a cotton liner covering the head, placed skin-to-skin with the mother and the back and extremities covered with pre-warmed baby blankets will maintain its temperature in the thermoneutral zone, between 36.5°C and 37.5°C, is also supported.

All newborns and mothers with any recognized condition that might lead to unstable temperature in the newborn were excluded from the study. Every newborn entered in the study was term, with good weight, and appeared healthy by physical assessment and by history. It is well known that newborns must have adequate protection to maintain temperatures in the thermoneutral zone. This study, of 97 newborns, suggests that protection of the thermal status can be consistently regulated by nurses in the delivery room guiding maternal behavior in skin-to-skin contact with their newborn.

There were several factors that were difficult to control. The delivery room nurse had developed a rapport with the mother and the family. It was difficult for some of these nurses to step back and permit another person to handle the newborn and to develop a relationship that might rival theirs. When this seemed to be a problem, the attending nurse was encouraged to place the infant on the mother's chest. This produced variation in how the newborn was handled. However, there was no low temperature resulting from this variation.

Before the study began, the pediatricians, the obstetricians, and the Labor and Delivery Room Staff were advised and their assistance was solicited. A letter was sent to the Chief of Pediatrics, the Chief of Obstetrics and to the manager of the Labor and Delivery Suite. (See appendix F.) The level of co-operation was tremendous, considering the time and intensity of the involvement of the investigator. However, from the beginning of the study eligible newborns were lost to the study because the investigator was not called. Occasionally, it was the mother, who reminded the delivery staff that she wanted her baby in the study and asked that the researcher be notified. A system was developed where a thermometer was placed on the door outside of the room where a candidate for the study was laboring. That was not very efficient. Finally, a note was left attached to the computer in the room where the candidate for the study was laboring and the unit secretary was given a list of potential candidates for the study. With these two methods in place, the labor and delivery staff were very consistent in calling the investigator, at full cervical dilation or when the time of delivery was thought to be near. Once a mother had agreed to participate in the study and the investigator was there, the mother was advised that her newborn would not be included in the study, if a condition developed that was known to put the baby at risk. In each case, the investigator helped with the infant care and checked the temperature of the newborn. When a newborn was dropped from the study, each mother-newborn dyad was given full attention just as they would have received, if they had been included in the study. This was done so that the mother would perceive that she was important, beyond just offering a baby to the study. These newborns remained on the radiant warmer or were picked up early and taken to the nursery.

One infant in the treatment group with the acrylic hat and skin-to-skin with the mother became cold. The temperature dropped to 35.9°C. The nursery was called, but did not arrive until the temperatures were completed on the radiant warmer. The reason for this temperature drop is not really known. It is known that the infant had prolonged exposure in the room environment before being dried off and before the treatment began, thus, this infant could have been cold stressed prior to the commencement of the treatment. Two other newborns in this treatment group had temperatures at 36.3°C at the second temperature check, ten minutes after the treatment began. They were positioned carefully skin to skin with mother and the temperatures were within normal range at twenty and thirty minutes after treatment started.

The nursery personnel were called when a temperature was outside of normal range. Twenty minutes was a good response time. If the neonate needed immediate attention, the nursery personnel would arrive in less than two minutes. Careful communication was important, so that nursery response time was not compromised when there was critical need for assistance. If the temperature became normal, the nursery was advised and the newborn remained with the mother.

Data analyses suggest that in the absence of risk factors, skin-to-skin contact is safe for those mothers who wish to experience skin-to-skin contact with their neonates. Risk factors were avoided in this study. This study supports the position that there is enough evidence available today to justify encouragement for mothers, who are interested, to begin skin-to-skin contact as soon as possible after giving birth. Providing that the newborn has no risk factors, this practice is without danger to the newborn infant.

While it is true that the newborns under the radiant warmer were under tighter thermal control than the newborns in skin-to-skin treatments with their mothers, there were no statistically significant differences in the means of the temperatures of the different groups at termination of the treatment. The newborns in Treatment Group I and Treatment Group II, on the average, had significantly greater temperature drops when temperature five was taken, than did the newborns placed skin-to-skin with the mothers in Treatment Group III. Even with the statistically significant lower temperature means at the time of the first temperature check on arrival to the nursery, temperatures on the average remained in the thermoneutral range. There was a large improvement in the number of infants with a temperature outside of the thermoneutral range when compared to the quality improvement study referred to in chapter one of this study. Greater than 45% of the newborns in that study had at least one temperature outside of thermoneutral range. In this research, 17% of the newborns had at least one temperature outside of the thermoneutral range.

African-American newborns weighed less, on the average, than other newborns in the study. With temperature four, taken at the end of the treatment, on the average they also had the lowest temperatures. The temperature means of all races/ethnic groups were in the thermoneutral range.

Significance

Other research demonstrates the enhancement of maternal bonding when the mother has physical contact with the infant immediately after birth (Mundal, VanDerWeele, Berger, & Fitsimmons, 1991). There are research studies that show breastfeeding progresses with less problems when initiated very soon after birth (Righard & Alade, 1990). This current research offers additional evidence that these practices do not put the newborn at risk when appropriate selection and supervision of the mother-newborn interaction is performed.

The clinical significance of this research is apparent. Mild hypothermia continues to be a significant problem during the transition period after birth. Associated problems with hypothermia have been stated in the literature review. This study offers evidence that skin-to-skin treatment does not decrease the neonatal temperature and that skin-to-skin treatment with a good insulating head covering of a cotton insert and an acrylic knit cap (treatment III) offers protection against hypothermia. This treatment provided slightly superior protection of the temperature as compared to that offered by the radiant warmer at one hour to one-and half hours after birth.

Limitations

The study excluded any newborn or mother with recognized factors that could lead to hypothermia of the newborn. Careful consideration of risk factors should be made before entering an infant in the skin-to-skin treatment without adequate supervision.

The newborns in this study were followed for only one-half hour in their treatment. Possibly a longer study period would have yielded more data supportive of the ability of the mother's body to stabilize the newborn as shown by Luddington-Hoe (1993).

Some newborns in all groups were mildly hypothermic. This may have been caused by various factors not studied, such as the amount of time required to cut the cord, suction the baby on the perineum, the efficiency and promptness of the drying process, other unknowns or a combination of the above factors.

Nursing Implications

This research was undertaken to obtain information that would enable the attending nurses to practice the best newborn thermoregulation measures while encouraging and guiding maternal-newborn bonding. After stabilizing and identifying the newborn the most important nursing action is to facilitate bonding. Research has shown that delaying mother-newborn contact may negatively impact mother-baby bonding. Under certain conditions, some of which have been defined in this study, mother-baby bonding can be occurring concurrently with infant identification and stabilization. Thermoregulation is also best achieved with maximum closeness of mother-newborn with some additional covering over the parts of the neonate not protected by the mother's body. Other measures, such as insulated head covering and pre-warmed blankets are also required. The period immediately after the birth has been one of less observation of the newborn and more attention to charting that was not done during the third stage of labor when the mother was pushing and the delivery was eminent. Nursing practice should change somewhat. This should be a period of more concentrated observation of the newborn and support of mother-newborn bonding.

Sufficient data exists to warrant teaching these concepts in schools of nursing. Mother-baby bonding can and should take place concurrently with temperature regulation in the term, healthy newborn. The radiant warmer can be reserved to stabilize the sick or compromised neonate.

There is sufficient evidence to discontinue the use of the cotton stockinette cap as an only head covering used to protect the neonate against heat loss in the early neonatal period. Consideration should be given to providing a knit cap with a cotton liner for the newborn. This method of preventing heat loss was the most efficacious as found by the analysis of data generated by this study. Nursing can become active in research to define the best head covering to protect the neonate against heat loss.

Future Research

Several questions are posed for future research:

1. What is the optimal delivery room temperature that will help protect the temperature of the newborn and allow the mother to be comfortable?
2. Are there additional factors, or a combination of variables, that put the newborn at risk for hypothermia immediately after birth?
3. Which of these variables that cause concern with thermoregulation and /or stabilization, if any, are not such a problem when the neonate is warmed on mother's chest?
4. What is the best material to use as the head covering for supporting thermoregulation in the newborn?

Appendix A

Statement of Approval

Committee on Human Research

STATE UNIVERSITY

Statement of Approval
Committee on Human Research

Date: December 10, 1998

To: Mary Ann Moddee, Barbara Kellam

Title: A Study of the Response of Neonatal Thermoregulation to Early Skin-to-Skin Contact with the Mother and/or Layered Head Covering of the Neonate

The Committee on Human Research has considered the above application and, on the basis of available evidence, records its opinions as follows:

1) The rights and welfare of individual volunteers are adequately protected.

(2) The methods to secure informed consent are fully appropriate and adequately safeguard the rights of the subjects (in the case of minors, consent is obtained from parents or guardians.)

(3) The investigators are responsible individuals, competent to handle any risks which may be involved, and the potential medical benefits of the investigation fully justify these studies.

(4) The investigators assume the responsibility of notifying the Committee on Human Volunteers if any changes should develop in the methodology or the protocol on the research project involving **a risk to the individual volunteers.**

The application is considered to be:______Exempt,______Expedited,__X__Full Committee.

Sincerely,

Francis I. Kane
Committee Chair

Appendix B

Memorandum

From Institutional Review Board

Medical Staff Services
(410) 543-7007
FAX (410) 543 - 7010

PENINSULA REGIONAL
MEDICAL CENTER

100 East Carroll Street
Salisbury, Maryland 21801-5493

MEMORANDUM

TO: Mary Ann Moddee, R.N.

FROM: Institutional Review Board
Assurance # T4174

DATE: February 5, 1999

SUBJECT: Protocol P99-003 – A Study of the Response of Neonatal Thermoregulation To Early Skin-to-Skin Contact with the Mother of and/or Layered Head Covering of the Newborn.

At its most recent meeting on February 4, 1999, The Institutional Review Board reviewed and approved the changes made to the study and the consent form noted above.

It should be noted that this approval is effective for one year.

As a reminder, no additional changes may be made to the above protocol without first submitting the changes to the IRB for approval. Any inquiries or unanticipated problems must also be promptly reported.

Should you have any questions or need additional information, please feel free to contact us.

Steven Hearne, M.D.
Chairman

tfh

Appendix C

Newborn Thermoregulation Study

Disclosure statement

Temperature Regulation of the Newborn Study Disclosure Statement

I am Mary Ann Moddee, R.N., a graduate student in the Nursing Program at Salisbury State University. I am replicating a study on temperature regulation of the newborn that demonstrated that mothers can be as efficient as special warming beds are in stabilizing the temperature of their healthy newborns.

If your labor and delivery are uncomplicated and your newborn is stable at birth, will you and your newborn be a part of this study?

The study will require that each mother-baby couple is randomly placed in a treatment group. There are three groups.

I. A newborn assigned to group one will be placed on the warming bed, to stabilize his/her temperature in the standard method that is often used.

II. A newborn assigned to group two will be diapered and placed skin-to-skin with his/her mother, with pre-warmed blankets covering the back and arms and a cotton stockinette cap will be placed on his/her head.

III. A newborn assigned to group three will be diapered and placed skin-to-skin with his/her mother, with three prewarmed baby blankets covering the back and arms, and a knitted cap with a cotton insert will be placed on his/her head.

After a mother gives consent for her infant's temperature to be studied, an initial newborn examination is done at birth. If the newborn and the mother are in a stable condition, then they are entered into the study. This means that the infant's temperature will be taken four times, at ten minute intervals during a thirty minute period, while the newborn is protected by one of the three methods listed above. Only the babies who are minimally stressed by the birthing process will be studied.

There are no recognized risks in this study to either the mother or the baby. If you choose to participate is the study, you will help provide evidence for identifying which method is most favorable for warming the newborn immediately after birth. All three methods of warming the newborn are widely used.

Your cooperation and participation are strictly voluntary and your choice to participate or not to participate will in no way affect your care while you are a patient in the hospital. Your participation is very valuable and will help me complete the study of Temperature control of the Newborn. If you choose to participate in this study but become tired before thirty minutes have passed, or for any reason wish to discontinue the study, your request will be carried out. The care for both you and your baby will be unaffected.

I will leave this paper with you to read over and will return to answer your questions in about one hour. If you agree to participate, I will ask you to sign a consent form.

PRMC IRB APPROVED 1/6/00

Appendix D

Informed Consent for Entering the Infant Temperature Control Study

Informed Consent for Entering the Infant Temperature Control Study

I have read the disclosure statement regarding the infant temperature control study being conducted by Mary Ann Moddee, R.N., a graduate student at Salisbury State University. All questions have been answered to my satisfaction. If both myself and my baby are stable after birth, I consent to having my baby assigned to one of three treatment groups and having the temperature checked every ten minutes during a one-half hour period. I understand that my baby will not be allowed to become cold and that if my baby's temperature becomes less than optimal, the study will be discontinued to protect my baby from developing a low temperature (from becoming cold stressed).

I know that I can freely discontinue participation in the study if I choose to, at any time I choose to, by contacting Mary Ann Moddee, R.N., who will be on the Labor and Delivery Unit.

____
Signature of mother

____
Witness

____
Signature of father of baby (optional)

____
Date

APPROVED
JAN 6 2000
PENINSULA REGIONAL MEDICAL CENTER
INSTITUTIONAL REVIEW BOARD

Appendix E

Newborn Weight in Grams, Frequency Distribution

Appendix E. Newborn Weight in Grams Frequency Distribution (N = 97)

Weight	Frequency	Valid Percent
2476	1	1.0
2484	1	1.0
2506	1	1.0
2612	1	1.0
2655	1	1.0
2686	1	1.0
2761	1	1.0
2811	1	1.0
2 841	1	1.0
2858	1	1.0
2879	1	1.0
2911	1	1.0
2933	1	1.0
2985	1	1.0
3021	1	1.0
3037	1	1.0
3042	1	1.0
3050	2	2.1
3111	1	1.0
3132	1	1.0
3151	1	1.0
3566	1	1.0
3586	1	1.0
3198	1	1.0

Appendix E continued. Newborn weights in grams Frequency Distribution (N = 97)

Weight	Frequency	Valid Percent
3205	1	1.0
3214	1	1.0
3225	1	1.0
3238	1	1.0
3244	1	1.0
3281	1	1.0
3291	1	1.0
3292	1	1.0
3305	1	1.0
3307	1	1.0
3326	1	1.0
3330	1	1.0
3338	1	1.0
3348	1	1.0
3352	1	1.0
3357	1	1.0
3368	1	1.0
3381	1	1.0
3446	1	1.0
3452	1	1.0
3455	1	1.0
3475	1	1.0
3486	1	1.0

Appendix E continued. Newborn Weights in Grams Frequency Distribution (N = 97)

Weight	Frequency	Valid Percent
3512	1	1.0
3517	1	1.0
3524	1	1.0
3561	1	1.0
3579	1	1.0
3589	1	1.0
3596	1	1.0
3613	1	1.0
3647	1	1.0
3653	1	1.0
3668	1	1.0
3678	1	1.0
3699	1	1.0
3700	1	1.0
3708	1	1.0
3718	1	1.0
3762	1	1.0
3764	1	1.0
3777	1	1.0
3825	1	1.0
3828	1	1.0
3833	1	1.0
3836	1	1.0

Appendix E continued. Newborn Weights in Grams Frequency Distribution (N = 97)

Weight	Frequency	Valid Percent
3853	1	1.0
3859	1	1.0
3867	1	1.0
3869	1	1.0
3890	1	1.0
3896	1	1.0
3922	1	1.0
3937	1	1.0
3942	1	1.0
3981	1	1.0
4002	1	1.0
4016	1	1.0
4079	1	1.0
4123	1	1.0
4160	1	1.0
4225	1	1.0.
4226	1	1.0
4228	1	1.0
4259	1	100.0
4484	1	1.0

Appendix F

Sample Letter to Seek Support for the Study

721 Ferndale Rd.
Salisbury, Maryland 21801

Phone (410) 742-0578

Dr. Constantine Lambrou
Chief of the Department of OB-GYN
Peninsula Regional Medical Center
Salisbury, Maryland 21801

Dear Dr. Lambrou:

The purpose of this letter is to inform the Obstetricians that the Peninsula Regional Medical Center Institutional Review Board has approved a study of the response of Neonatal Thermoregulation to layered head covering of the newborn and/or early skin-to-skin contact with the mother.

This study is comparing the ability of mother's body with the radiant warming bed to maintain thermoregulation of the newborn in the immediate post-partum period. The study consists of checking and recording the axillary temperature every ten minutes (four times) in a one-half hour period as soon as feasible after the 5 minute apgar score has been recorded. The study has three groups to which subjects will be randomly assigned. The first group of infants will be placed skin-to-skin on mother's chest, clad in a diaper, with pre-warmed blankets to cover the parts of the baby not in direct contact with the mother's body. The second group will be clad in a diaper and a head covering and placed skin-to-skin with mother, with pre-warmed blankets over the parts of the baby not in contact with the mother. The third group, the control group, will be placed under the warmer. This study will be done on volunteer subjects who meet the criteria. The investigator will be Mary Ann Moddee.

Using data obtained from this study, I will write a thesis to complete the requirements for a Master's Degree in Nursing from Salisbury State University. I appreciate the opportunity that the hospital has given me. If you have any interest in the results of the study, I will share with you.

I thank you, also, for this opportunity. I will cooperate in any way possible and I hope to be learning much during the study period. I look forward to beginning the work in April, 1999.

Sincerely,

Mary Ann Moddee, RN

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