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MEASUREMENT OF AXILLARY TEMPERATURES IN NEONATES

The University of Arizona

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MEASUREMENT OF AXILLARY TEMPERATURES IN NEONATES

by

Lauren Patrice Hunter

A Thesis Submitted to the Faculty of the

COLLEGE OF NURSING

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

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ABSTRACT

This descriptive study determined how many minutes were needed to measure axillary temperature. Two types of thermometers, glass and electronic, were used simultaneously for temperature measurement in degrees Fahrenheit, in 40 healthy full-term newborns. Stabilization of an axillary temperature was defined as the point at which temperature did not increase more than 0.2°F in a one minute period of time. For both the glass and electronic thermometers, stabilization occurred for 100% of the sample by three minutes.

Descriptive statistics suggest that a 3 minute temperature reading can identify healthy newborns with a normal or subnormal temperature, and display a trend for elevated temperatures. When all 3 minute and 5 minute temperature readings were compared, the difference was 0.3°F or less for all subjects but one (0.4°F). Pearson correlations demonstrated positive and significant ($r=.90$; $p\leq .001$) relationship between stabilized glass and electronic thermometer readings.

CHAPTER 1

INTRODUCTION

This study was designed to measure the length of time needed to determine an axillary temperature in the neonate. Roy's Adaptation Model (Roy, 1980) was utilized as a guide for the constructs presented in the study.

Temperature measurement in the neonate, as a nursing practice, has often been based on tradition not substantiated by research. Although the axilla as the site of choice for temperature measurement is safer for the newborn, the use of the rectum remains prevalent. One reason for this is uncertainty over the length of time needed to determine measurement of the axillary temperature.

Statement of the Problem

How many minutes are needed to measure the axillary temperature of the neonate in Fahrenheit degrees?

Statement of the Purpose

The purpose of this study was to determine the length of time in minutes needed to measure axillary temperatures, in Fahrenheit degrees (°F), in 40 healthy neonates after their transition to birth and prior to discharge from a large urban southwestern hospital. The investigator sought to discover the time at which the axillary

temperature remained stable, that is, did not increase more than 0.2°F in a one minute period of time. The study investigated the length of time required using two types of thermometers, glass mercury and electronic, for temperature measurement. The two types of thermometers from a vast variety were chosen for specific reasons. Glass mercury thermometers are commonly used by parents at home and by nurses in some newborn nurseries for temperature assessment. Use of electronic thermometers is the standard method used for newborn temperature in the newborn nursery where data was collected.

Definition of Terms

For the purpose of this study, the following terms were defined:

1. Neonate: A healthy term newborn over six hours of age and prior to discharge from the hospital. A term neonate will fall between 38 and 42 weeks of gestation and be appropriate for age (AGA) on examination. The neonate's weight at birth will be between 2600 grams and 3800 grams. A healthy neonate is born without medical complications and continues to be complication free throughout its hospital stay. The healthy neonate graduates (without difficulty) from transition (six hours), to an open crib in the regular nursery. Apgar measurements at five minutes are seven or better.
2. Normal Axillary Temperature: 36.5 to 37 degrees centigrade (°C) (97.7 to 98.6°F) (American Academy of Pediatrics, 1971).

3. Axillary Measurement: A method of measuring temperature whereby the thermometer bulb in a glass mercury thermometer or the probe tip of an electronic thermometer is completely covered by folds of skin, pressed between the arm and the thorax, high in the axilla.
4. Stable Axillary Measurement: The temperature does not increase more than 0.2°F in a one minute period of time.

Significance of the Problem

It is paramount to determine the length of time necessary for the measurement of axillary temperatures in neonates. Without a standard measurement time, axillary temperatures cannot be considered an accurate, useful alternative to rectal temperatures for nursing assessment of the newborn.

Research substantiates that rectal temperatures in the neonate are potentially hazardous resulting in chance of perforation (Davis, 1972; Blainey, 1974; Fonkalsrud & Clathworthy, 1965; Greenbaum, Carson, Kincannon & O'Loughlin, 1968; Horowitz & Bennett, 1976), loss of fluids and calories (Schiffman, 1982) and a rise in blood pressure with a lowering of partial arterial pressure of oxygen (Flemming, Hakasson & Svenningsen, 1983). The hazards involved with rectal temperatures can occur for the neonate whether the care given is by a professional nursery nurse or other caregiver such as a parent or babysitter. Even though a neonate may be held appropriately during the procedure (legs and torso securely held to prevent movement), the risks remain.

As nursing students we learned that a rectal temperature was the true reflection of core body temperature and an axillary temperature, a reflection of skin temperature. Research has not substantiated these claims, though many caregiving professionals still base their choice of measurement on these principles. The same principles have carried over to the population of parents. The common belief prevails that before you call your doctor regarding your sick newborn, you must obtain a "true" temperature (i.e., rectal). Nurses erroneously contribute to this phenomenon by instructing parents, prior to hospital discharge, to take their newborns' temperature rectally to ensure accuracy.

Of great significance is the documented accuracy of axillary temperatures relative to rectal temperatures. Studies of neonates have found significant positive correlations between axillary and rectal temperatures (Buntain, Pregler, O'Brien & Lyon, 1977; Eoff, Meir & Miller, 1974; Flemming, et al., 1983; Torrance, 1968; Schiffman, 1982).

Supposedly, the length of time needed for an accurate rectal temperature has been established. General agreement among most hospital nurseries has been three minutes for a rectal temperature. However research cites varying times for rectal thermometer placement ranging from one to five minutes (Nichols, Ruskin, Glor & Kelley, 1966; Schiffman, 1982; Torrance, 1968).

Even less research involving axillary temperature time placement has been accomplished. Recommendations for the length of time a thermometer should be held in place for axillary temperatures also

varies, from three to over ten minutes (Eoff, et al., 1974; Flemming, et al., 1983; Nichols, et al., 1966; Schiffman, 1982; Sheldon & Dominiak, 1980). The American Academy of Pediatrics (1983) advocates the axillary method of temperature measurement for three minutes.

With the varying information provided above, it is understandable that nurses are confused over axillary or rectal temperatures as part of nursing assessment for the neonate. However, two important aspects supported by research are clear; axillary temperatures are safer than rectal temperatures in neonates, and there is a significant correlation between the two measurements. Even with this knowledge, nurses often rectally re-assess an axillary temperature if the axillary temperature does not fall within normal parameters. In addition, parents continue to use the rectal site for temperature assessment of their newborns. They have been informed by professionals that this is appropriate, though they are often uncomfortable or fearful of the procedure or of harming their newborn.

Mitchell (1973) describes how any temperature measurement is only a rough estimate of the body temperature at any given time. What nurses are looking for is a marked deviation from the normal. A normal rectal or axillary temperature in the neonate is 36.5 to 37°C (97.7 to 98.6°F) (American Academy of Pediatrics, 1971).

By attempting to determine the necessary length of time in minutes needed to obtain a neonate's axillary temperature, this study could assist in developing a standard of practice for axillary tempera-

ture measurements in neonates and further discourage the practice of using the rectum as a temperature site.

Conceptual Orientation

Roy's Adaptation Model (1980) was used as a guide for the conceptual orientation of this study (Figure 1). Roy's model is viewed as a systems model that contains interactionist levels of analysis. The person (patient) is viewed as having parts or elements linked together in such a way that tension on the linkages can be increased or decreased. Increased tension can come from forces within the system or from the environment that impinges on the system. In order to adapt, the individual must respond positively to the forces that impinge upon his/her system.

Roy proposes that an individual's adaptation is influenced by the stimuli he/she is exposed to and his/her level of adaptation. Stimuli fall into one of three groups, 1) focal; stimuli immediately confronting the individual, 2) contextual; all other stimuli present, and 3) residual; beliefs, attitudes and traits. Focal stimuli are everyday phenomena to which the individual must adapt, such as the external environmental temperature and humidity. Examples of focal stimuli for the newborn at birth are loss of heat via evaporation, conduction, radiation and convection.

Roy indicates that each individual's adaptation level is comprised of a zone. The zone depicts the necessary range of stimulation for a positive response to occur. The stimulus must be within this

Figure 1. Conceptual Framework

zone for the individual to respond positively through his/her adaptive modes. Nursing care is aimed at supporting and promoting a person's adaptation. The system of the person and the interaction with the environment are thus the units of analysis for part of the nursing process: nursing assessment. Manipulation of the parts of the system or the environment is the method of nursing intervention.

A modification of Gibbs (1972) model of theory construction was employed in presentation of Roy's Adaptation Model (1980). The constructs selected for this study -- environment, adaptation, and nursing care -- are grounded in physiology and nursing theory. Each of the three constructs, and its subsidiary concepts, are described in the following sections. Relationships among concepts are integrated through each section, and summarized in a final section.

Environment

The first construct in the conceptual orientation is 'environment'. The term 'environment' refers to the sum total of all internal and external conditions and elements surrounding the individual. Roy (1980) proposes that people are bio-psycho-social beings in constant interaction with an ever changing environment, which includes physical, social, and psychological elements. The conceptual orientation for the present study focuses on the external physical environment.

The 'external physical environment' could include various elements, such as weather conditions, type of shelter available, and

the amount of clothing worn. According to Roy's model, the individual is called to adapt in a positive fashion to conditions of the 'external physical environment', defined as physical conditions/elements of the environment outside the person.

In the present study, the 'immediate physical environment' is most relevant to assessment of infants' adaptation to extrauterine life. Specifically, room temperature and relative humidity are particularly influential in an infant's adaptation, via thermoregulation. During data collection, the stimuli of room temperature and relative humidity were measured via a thermometer and a humidity indicator, respectively. The constructs 'adaptation' and 'nursing care' are addressed in the next two sections.

Adaptation

The second construct in the conceptual orientation is 'adaptation'. The term adaptation refers to a positive response to a change. Roy (1980) proposes that an individual must respond positively to the ever changing environment in order to adapt. The individual uses both innate and acquired mechanisms for adaptation to the environment. Innate mechanisms are seen in the newborn. When born, the neonate must effect many physiological changes to accomplish a successful transition from fetal to neonatal life. For example, during the neonate's first breaths, the lungs must expand, effective air exchange must occur and the right to left circulatory shunt must terminate. These changes are

all innate physiological adaptive responses to extrauterine life and the new environment.

According to Roy's model, there are four adaptive modes of adaptation: physiologic needs, self concept, role function, and interdependence relations. The focus of the present study is on the physiological needs mode of the newborn. This mode is concerned with the structure of the body, its physical integrity, and how it functions. 'Newborn physiological adaptation' to the environment refers to the ability to positively respond in a physiologic mode to an environmental condition/element. Thermoregulation in the newborn is one mechanism for effecting adaptation in the physiological mode. Thermoregulation refers to the process of maintaining a thermoneutral zone.

The thermoregulatory system operates to keep the neonate's temperature field in a neutral basis — zero output from the system. Surrounding thermoregulation is a zone whereby the neonate may still respond positively to changes in the environment. At birth, some heat loss is inevitable as the neonate encounters the immediate physical environment. The heat loss occurs through evaporation from wet skin, especially the head; convection, the transfer of body heat to the cooler surrounding air; radiation, the transfer of body heat to cooler solid objects not in contact with the neonate; and conduction, the transfer of body heat to cooler solid objects in direct contact with the neonate (Korones, 1986).

As stated previously, the physiologic needs mode is utilized to maintain physical integrity (a positive response) within the environment. Regulation of the body temperature, thermoregulation, is a component of the physiologic needs mode.

One method of assessing the adaptive response of the neonate's thermoregulatory system to the immediate physical environment is temperature measurement in Fahrenheit degrees, via a thermometer. Assessment of people's temperatures is a common nursing care activity. The construct nursing care and related concepts are discussed next.

Nursing Care

'Nursing Care' refers to the process of supporting and promoting an individual's adaptation via the four adaptation modes (Roy, 1980). At birth, the neonate emerges from a relatively constant and warm environment, the uterus, to an external environment that fluctuates widely in temperature. In utero the placenta dissipates heat from the fetus, whose temperature is higher than that of the mother (Korones, 1986). To promote adaptation to the new environment, nurses dry the newborn quickly and enfold him/her in dry blankets often with contact to the mother's own warm body. In addition, efforts are made to ensure a warm delivery room to minimize heat loss and support adaptation by the neonate to the changed environment.

How do nurses know that the procedures above promote and support the neonate's adaptation? As a component of 'nursing care', the nursing process, a problem solving approach, is utilized. One component

of the nursing process is 'nursing assessment'. Nursing assessment is the collection and analysis of data regarding patient behavior and influencing stimuli (focal, contextual, residual) to identify a person's level of adaptation. During the first six hours of life (transition) and thereafter, nurses assess the neonate's adaptation to extrauterine life. In addition, the immediate physical environment is assessed and controlled to support/promote the neonate's physiological adaptation needs.

'First level nursing assessment' refers to the identification of behaviors in each adaptive mode and the recognition of the person's position on the health-illness continuum. One aspect of 'first level nursing assessment' is measurement of vital signs, such as temperature, heart rate and respiration, to assess the neonate's physiological adaptation to the changing environment.

Specifically, the neonate's temperature can be assessed with a thermometer. The frequency of assessment of the temperature is determined by the neonate's adaptation to the external environment and ability to maintain thermoregulation. Through temperature measurement, thermal stress can be identified and steps to prevent hypothermia or hyperthermia initiated. Ensuing infection and other disease processes can also be identified using temperature measurement and other assessment tools as part of 'first level nursing assessment'.

Conceptual Orientation Summary

Using Roy's (1980) model as a guide for conceptual orientation, one can see that the environment continually impinges upon the individual's system. Adaptation is the individual's response to the ever changing environment. Nursing care is directed toward supporting and promoting the individual's adaptation via the four adaptive modes. To support/promote the newborn's adaptation to a new environment at birth, nurses dry and clothe the newborn, and place him/her in a warm environment.

The external physical environment is particularly prone to continual change. Because of this, the individual must respond positively in a physiological mode in order to adapt to environment conditions.

The newborn is particularly vulnerable to the immediate physical environment, especially the room temperature and relative humidity. Changes in these conditions (measured via thermometer and humidity indicator) impinge upon the newborn's adaptation, specifically his/her thermoregulatory system. As the room temperature and humidity change, the newborn must adapt via the physiological needs mode to maintain a thermoneutral zone. The newborn's capacity to thermoregulate is measured by the ability to maintain a normal temperature (97.7 to 98.6°F) as indicated by a thermometer.

Nursing assessment, a component of nursing care is a problem solving approach for diagnosing potential/real patient problems. Nurses utilize nursing assessment, part of the nursing process, to ascertain the individual's adaptive ability. Data are collected and analyzed

regarding patient behavior and influencing stimuli, to form a diagnosis about the patient's adaptation.

First level nursing assessment is utilized to assess and monitor the newborn's adaptation to the immediate physical environment. Newborn behaviors in each appropriate adaptive mode are identified along with the newborn's position on the health-illness continuum. One method of first level nursing assessment, vital signs measurement, assists in assessing the newborn's physiological adaptation to the immediate physical environment. Specifically, the newborn's temperature in Fahrenheit degrees, via a thermometer, assesses the thermoregulatory status. A normal newborn temperature range indicates that the newborn is adapting to the immediate physical environment via the physiological needs mode. The newborn's temperature (along with other factors) determines the frequency of further assessment of the newborn's temperature and the amount of environmental control the nurse must provide to assist the newborn's adaptation.

General Summary

This study measured the length of time in minutes needed for axillary measurement of temperatures in healthy newborns. Both glass mercury thermometers and an electronic thermometer were used for temperature measurement. From this study the investigator sought to discover the time at which the axillary temperature remained stable; did not increase more than 0.2°F in a one minute period. Though axillary temperature measurements are safer than and as accurate as

rectal temperature measurements, little research has been conducted concerning the necessary placement time for axillary temperatures in newborns. By attempting to determine the necessary length of time in minutes needed to obtain a neonate's axillary temperature, this study could assist in developing a standard of practice for axillary temperature measurements in neonates and further discourage the practice of using the rectum as a temperature site. This knowledge would be useful to the nurse in assessment of the newborn's temperature, using the axillary method. Roy's Adaption Model (Roy, 1980) was used as a guide for the constructs 'environment', 'adaption', and 'nursing care' presented in the study.

CHAPTER 2

REVIEW OF THE LITERATURE

The review of the literature covered the following topics pertinent to the present study of measuring axillary temperatures in the newborn: 1) thermoregulation in the newborn, and 2) a critique of current literature regarding the safety, accuracy, and time efficiency of axillary versus rectal temperatures.

Thermoregulation in the Newborn

The process of thermoregulation in the newborn is complex. In the past it has been believed that the newborn's thermoregulatory system was not mature. In truth, the full term normal infant is capable of maintaining his/her temperature (Bruck, 1961; Korones, 1986). The thermoregulatory system is a multiple input system controlled by several local temperatures: cutaneous thermal receptors, thermal receptors of the hypothalamus, thermal receptors in the spinal cord, in the abdominal cavity, and possibly in the mucosa of the respiratory passages. In the thermoregulatory system, heat dissipation is stimulated by the internal warm receptors. Cutaneous cold receptors are responsible for vasoconstriction efforts and the maintenance and promotion of heat production (Sinclair, 1978). This system operates to keep the temperature field in a neutral basis -- zero output from the system. If neutrality is not maintained, effector systems attempt to

restore the balance. Sinclair (1978) analogizes the newborn's temperature control ability to that of a system that includes a negative feedback loop. Further, Sinclair states "thermoregulatory responses elicited through cutaneous receptors are determined by the skin temperature, the rate and direction of temperature, and the size of the stimulated area" (1978, p. 162).

The cutaneous receptors are connected to the central nervous system by axons that lead to the thalamus, the middle brain and the hypothalamus. Sinclair (1978) describes the posterior hypothalamus as the master site of control. Signals sent from thermal sensor sites are received and processed by the posterior hypothalamus. In turn, messages are sent to the various effector systems via the central nervous system.

Heat loss to the environment for the newborn can occur through convection, dependent on air flow and the surrounding temperature; radiation, the temperature of solid objects surrounding the newborn; conduction, when a cold surface comes into direct contact with the newborn's body; and evaporation, through the lungs and body surface loss.

These four mechanisms vary according to external environmental conditions. Sinclair states "the main external variables will be the difference in temperature between the infant's body and the environment, the velocity of air flow, the relative humidity, and the exposed surface area for heat exchange" (1978, p. 95). External environmental conditions in nurseries are usually monitored by room

thermometers and barometers to assist in the maintenance of the newborn's thermal equilibrium. In addition, newborns are "appropriately" clothed and wrapped, by nurses, to decrease body surface exposure. Stave (1978) defined the thermoneutral zone between newborn and environment as "the range of ambient temperature within which metabolic rate is at a minimum, and within which temperature regulation is achieved by non-evaporative process alone" (p. 464). A "clothed and wrapped" healthy term newborn can maintain thermal equilibrium when the room temperature is 64.4°F to 71.6°F (Phillip, 1975; Sinclair, 1978) and a relative humidity of 40 to 60 percent (Sinclair, 1978). Korones (1976) believes normal full term infants can generally maintain heat balance in an open bassinet when the room temperature is approximately 75°F if they are clothed with diaper and shirt, covered with a cotton blanket and not exposed to air drafts. The lower limit of the newborn's ability to thermoregulate is 68°F to 73°F. For healthy term naked newborns, room temperature is maintained at 87.6°F to 93.2°F (Scharping, 1983; Stave, 1978) and humidity at 50 percent. The American Academy of Pediatrics (1971) recommends 75.2°F and a humidity of 50 percent if possible.

The newborn's physiologic response to heat is vasodilation. This occurs particularly in the hands and feet which are favorable to heat loss by radiation and convection. In addition, an increased rate of heat loss due to evaporation, presenting itself in the form of perspiration in newborns, is associated with rectal temperature exceeding 37.2°C (Smith & Nelson, 1976).

In response to cold, the newborn will first vasoconstrict to conserve body heat and then attempt to increase heat production. In attempts to conserve heat, newborns may assume a flexed or fetal position, or even cry.

In order to produce heat by metabolic activity the newborn will increase his muscular activity. Heat production is dependent upon a regular source of energy, caloric intake and/or the body's own resources to allow for the metabolic increase. If glucose, the normal energy source for metabolism, is limited or overwhelmed in the newborn, brown fat adipose tissue from the body's own reserves becomes critical for energy. Brown adipose tissue (BAT) provides this energy via a process called non-shivering thermogenesis (NST).

A BAT cell is comprised of a central nucleus, glycogen, multiple mitochondria, and fat vacuoles. BAT has an extensive nerve supply which arises from the sympathetic nervous system and a rich blood supply. Davis states,

"the large number of small fat vacuoles provides a large fat to cytoplasm interface, which enhances the rapidity which the stored fat (triglycerides) can be utilized. The large number of mitochondria provide the energy in the form of ATP for rapid metabolic turnover and heat production. The presence of glycogen in the cell provides a ready source of glucose for the increased energy needs and production of ATP" (1980, p. 368).

In the healthy newborn at birth, BAT may comprise from one to six percent of the total body weight (Holdcraft, 1980). Brown fat is deposited subcutaneously between the scapulae, in the axillae, and surrounding the kidney after 28 weeks gestation. For the term newborn,

from the time of birth until two to three weeks after delivery, BAT cells will continue to increase in size and number.

The areas of BAT disposition appear to have two functions. First, BAT surrounding vital organs provides the warmth needed for the continuance of necessary and important biochemical activities provided by major organs. Second, the heat generating BAT warms the blood of the major vessels prior to entry into peripheral circulation (Davis, 1980).

In summary, it is evident that the external environmental temperature surrounding the newborn and its own complex mature thermoregulatory system maintain a delicate balance in providing thermal equilibrium. If the newborn's thermoregulatory system becomes disturbed or unable to compensate for varying environmental temperature, it is necessary for nurses to help support and maintain the newborn's thermal equilibrium. Nurses assess the amount and type of support needed to maintain thermal equilibrium by monitoring a newborn's temperature and responding accordingly.

Two common sites for measurement of a newborn's temperature are the axilla and the rectum. In discerning which of the above methods is more appropriate for the newborn, safety, accuracy and time-efficiency were addressed.

Safety of Axillary versus Rectal Temperatures

For safety reasons, the American Academy of Pediatrics (1971) believes axillary temperatures should preclude the use of rectal temperatures. Their conclusion is based upon research by Torrance

(1968). Research does substantiate that rectal temperatures are potentially hazardous.

Ulcerations and perforation of the rectum can occur from rectal insertion of thermometers (Blainey, 1974). The anterior wall of the rectum is particularly vulnerable to perforation if a rectal thermometer is not inserted correctly. To prevent rectal perforation, the thermometer must be placed posteriorly in the rectum and advanced less than three centimeters (British Medical Journal, 1970). This is a difficult task to accomplish as no scale of measurement is imprinted upon mercury thermometers to determine advancement. Fonkalsrud and Clathworthy's (1965) retrospective study of rectal perforation found eight cases of rectal perforation, six due to enema tubes, and two due to rectal thermometers. Davis (1972) found infants with bowel diseases such as Hirschsprungs' disease or enterocolitis to be at an increased risk from rectal thermometers.

Increased mortality can be expected for infants who experience rectal perforation of the bowel. In a study by Horowitz and Bennett (1976), rectal perforation resulted in 30 percent mortality. Greenbaum, et al. (1968) discovered a 70 percent mortality rate among five of seven infants who had a rectal perforation.

The most serious consequence of rectal temperature is rectal perforation. However, rectal temperature measurement is associated with other adverse factors to the newborn. Schiffman (1982) found an increase in fluid loss and caloric loss from the stimulation to the bowel initiated by rectal temperatures. Flemming, et al. (1983)

correlated an increase in blood pressure and a lowered partial arterial pressure of oxygen (PaO_2) when rectal temperatures were measured in 18 newborns.

Authorities in newborn care believe the safest route for routine temperature measurement in normal newborns to be the axilla. The American Academy of Pediatrics (1971) believes axillary temperature to be dependable and safe for temperature measurement in newborns. Davis (1972) recommends axillary temperatures for safe monitoring. Blainey (1974), who reviewed site selections for temperature measurement found the axilla safe, accessible and the site of choice for controlled environment. Eoff, et al. (1974) studied temperature measurement in 30 newborns. She concluded that the axillary site involved no risk to the infant. Eoff and Joyce (1981) studied temperature measurement in 50 children (ages one to six). Her conclusion, the axilla is the preferred site for temperature measurement. Buntain, et al. (1977) studied temperature measurement in 69 newborns. He too believes the axilla provides easy access, simplicity, safety and a decreased incidence of infection spread among babies.

Axillary temperature measurements have no known risks (perforation, ulceration, caloric and fluid loss, changes in blood pressure and arterial PaO_2). In addition, axillary temperatures are simple, accessible, and decrease the chance of spreading infection among nursery occupants.

Accuracy of Axillary versus Rectal Temperatures

In the past, rectal temperatures have been considered more accurate than axillary temperatures, but this assumption has not been substantiated. Whether axillary or rectal, Mitchell indicates "the recorded temperature is only a rough estimate of the body temperature at any given time" and suggests "what physicians are looking for is a marked deviation from the normal temperature" (1973, p. 389). Assessment of body temperature by the rectal or axillary method is a determination of the average temperature of the interior portions of the body (core temperature) as reflected by the temperature of the blood in the major vessels of the site. The major blood vessel used to reflect the temperature in the rectum is the inferior hemorrhoidal artery, and for the axilla, the axillary artery.

Axillary temperatures may be falsely high due to nearby deposits of brown fat and because artificial warmth can be created from the opposing surfaces of the thorax and inner arm (Korones, 1976). Rectal temperatures may be normal in a cold-stressed newborn because of the metabolic hyperactivity which initially compensates for thermal losses. Cold stress is sensed by thermal receptors in the skin, especially over the face, which in turn triggers an increased metabolic rate. This response activates prior to a drop in core temperature (Korones, 1976).

Continuous skin temperatures, usually via abdominal probes, are used for small or sick babies. The axilla and rectal sites are used for healthy newborns, to assess the "average" temperature of the body. For

practical purposes, an axillary temperature is as accurate as a rectal temperature. In addition, the axillary site is not potentially harmful.

Blainey (1974) noted the difficulty in assessing accuracy of rectal temperature. First, how does one assess whether the thermometer is surrounded by feces or against the bowel wall? Second, precise replication of repeated rectal measurements is difficult and will yield different results.

Buntain et al. (1977) studied rectal and axillary temperatures in 69 normal newborns in a neonatal nursery. He found positive correlations ($p < .001$) at 3 minutes ($r = .671$), 5 minutes ($r = .701$) and 10 minutes ($r = .757$) in axillary and rectal temperature measurements using a mercury thermometer. This correlation improved as the length of time used to measure an axillary temperature increased.

Eoff, et al. (1974) studied 30 normal infants in bassinets with a mean age of three to five days. The positive correlation between axillary and rectal temperatures was .92. Rectal temperatures were 0.5°F higher than axillary temperatures. They concluded that axillary temperatures were probably as accurate as rectal temperatures for infants in stable environments. Practically speaking, the difference between axillary and rectal temperatures should not make a difference in the diagnosis of an infant's status. Eoff and Joyce (1981) utilized 50 toddlers and preschoolers to determine the possibility of a clinically significant difference between axillary and rectal temperatures. Using a Pearson Rho correlation, coefficient .90, a high

positive correlation between axillary and rectal temperatures was obtained.

Torrance (1968) found the difference between simultaneous axillary and rectal temperature measurements in 120 premature babies to be $.05^{\circ}\text{C}$. She did not believe this to be clinically significant. Schiffman (1982) found a positive correlation between consecutive axillary and rectal temperature measurements. The mean difference was less than 1.0°F . Her population for study consisted of 46 full-term newborns, with a mean age of 3 hours, 45 minutes. Measurements were taken while newborns were in a incubator with an average warmer temperature of 84°F . She recommends axillary temperature for newborn measurement. Flemming, et al. (1983) found axillary temperature measurements to be as accurate as those by rectum. This study utilized 18 newborns with birthweights of 850 to 3000 grams, naked in incubators with an environmental humidity of 60 to 80 percent. Measurement tools consisted of glass thermometers and disposable electronic probes. Korones (1986) believes axillary temperatures provide a close estimation of rectal temperatures for both term and preterm infants (less than 0.10°C). His data was based upon five minute measurements using mercury thermometers.

Of great significance is the documented accuracy of the axillary temperatures relative to rectal temperature. Available literature seems to indicate clinically that axillary and rectal temperatures have a high degree of correlation in regard to accuracy. Studies of neonates have found significant positive correlations

between axillary and rectal temperatures (Buntain, et al., 1977; Eoff, et al., 1974; Flemming, et al., 1983; Torrance, 1968; Schiffman, 1982). Based upon the literature review the assumption can be made that for practical purposes an axillary temperature measurement is as accurate as a rectal temperature measurement.

Time Efficiency of Axillary versus Rectal Temperatures

Few studies have been conducted regarding time efficiency of axillary or rectal temperatures. Supposedly the length of time needed for an accurate rectal temperature has been established. General agreement among most hospital nurseries has been three minutes for a rectal temperature. Research cites varying times for rectal temperature stabilization ranging from one to five minutes (Nichols, et al., 1966; Schiffman, 1982; Torrance, 1968).

The American Academy of Pediatrics (1983) recommends a three minute placement for axillary temperature readings. Torrance (1968) found 95 percent of all infant axillary temperatures (120 subjects) were stable in four minutes. Her criteria for stabilization was the point at which the mercury failed to rise any higher.

Schiffman (1982) sampled 46 normal full term newborns. Axillary temperatures were read and recorded at one, two, three, four, five, seven and ten minutes. Axillary temperatures did not stabilize over a ten minute period. Stabilization for Schiffman's study was defined as the point at which the mercury in glass thermometer failed to rise any further in 80 percent of the cases over a ten minute period.

Flemming, et al. (1983) found axillary temperatures in 18 newborns, using 54 measurements to remain stable ($\pm 0.1^{\circ}\text{C}$) over a 20 minute period. An electronic probe thermometer was utilized to collect the data. Other recommendations for axillary temperature placement of three to five minutes (Capobianco, 1980; Nichols, et al., 1980; Sheldon & Dominiak, 1980) are not substantiated by clinical research.

The review of literature was congruent in suggesting that three to five minutes was the time required to accurately measure a rectal temperature. Two studies found axillary temperatures to stabilize in newborns. Torrance (1968) discovered axillary stabilization within four minutes and Fleming, et al. (1983) using an electronic probe and a controlled environment, found axillary temperatures remained stable over a 20 minute period. In an uncontrolled environment it is possible that axillary temperatures (as other temperatures) would fluctuate more than the $\pm 0.1^{\circ}\text{C}$ in Fleming's study. Changes in the environmental temperature, a cold draft of air, or even a clothing change can precipitate a temperature drop in the newborn.

Summary

From reviewing the literature, it was evident that studies need to be conducted to determine the length of time needed to obtain an axillary temperature in the newborn. It is apparent from the literature reviewed that the axillary method is safer than the rectal method. The literature review demonstrated a positive significant correlation between axillary and rectal methods. The assumption can be made that

for practical purposes, axillary temperature measurements are as accurate as rectal temperature measurements. Based upon the literature review, it must be concluded that the reason for the prevalence of rectal temperature measurements over axillary temperature measurements is due to the unknown length of time needed to obtain an axillary temperature in the newborn. This is especially true since most authors have recommended the use of axillary temperatures for safety reasons even though the length of time needed to obtain an axillary temperature has not been well established.

CHAPTER 3

METHODOLOGY

This descriptive study was designed to determine the length of time needed in minutes to obtain a stable reading of axillary temperatures in the healthy term neonate. Two different types of thermometers, a glass mercury thermometer and an electronic thermometer, were used to measure the axillary temperature readings.

Sample and Setting

The convenience sample consisted of 40 neonates obtained from the regular newborn nursery at a large urban southwestern hospital. Criteria for subject selection were:

1. Consent from parents,
2. 38 to 42 weeks of gestation and appropriate for gestation (AGA) on examination. This is an indication of a term infant based upon the Colorado Growth Chart (Lubchenco, Hansman & Boyd, 1966),
3. Birthweight between 2600 grams and 3800 grams. This indicates that an infant is between the tenth and ninetieth percentile on the Colorado Growth Chart (Lubchenco, et al., 1966),
4. Born without medical complications,
5. Remains "complication free" prior to participating in the study

6. Apgar measurement at five minutes is seven or better. An infant with a score of seven or better at five minutes has a low rate of mortality and morbidity and rarely needs resuscitation (Moore, 1983).
7. Greater than six hours of age. The initial transition for an infant usually lasts six hours. During this time a healthy term neonate will go through a period of reactivity, inactivity and reactivity, while physiological functions stabilize (Moore, 1983).

Protection of Human Subjects

The research proposal and parent consent form were submitted to and approved by the University of Arizona Human Subjects Committee (Appendix A). All parents were informed of their right to withdraw from the project without ill will (Appendix B). Every attempt to safeguard the rights of the subjects was made. No names of infants or parents were collected.

Data Collection

Each evening prior to data collection the investigator reviewed all the newborn charts in the newborn nursery (NBN) to identify newborns that met selection criteria. The following demographic information was obtained and recorded on the Data Collection Form (Appendix C) for those eligible newborns: the newborn's medical record number, birthweight, sex, apgar scores, gestational age, date of birth, diagnosis.

At that time parental consent was solicited for those eligible newborns. Parents were approached individually in their rooms on the postpartum ward. Each parent received a verbal explanation of the study and the consent form. After the verbal explanation, each parent was given a parent consent form to read. After each parent read the consent form and agreed to allow his/her newborn to participate in the study, the consent form was signed by a parent and witnessed by a nursery aide.

Late in the evening after parental consents were signed, the investigator and her assistant returned to the newborn nursery to set up and test data collection equipment prior to actual data collection (see Data Collection Equipment for procedural set-up and reliability testing).

Data collection occurred in the late evening and early morning for several reasons. First, the investigator sought to decrease interruptions between parents and their newborns. Secondly, the investigator sought to decrease interruptions in the nursing care schedule provided to the newborns.

Nursery protocol required that all newborns be returned to the nursery at each nursing shift change (7 a.m., 3 p.m., 11 p.m.). Each night at 11 p.m. the nursing staff weighed each baby and took his/her vital sign measurements. Since the nursing staff were provided with a list of the study participants, it was convenient for the staff to dress the newborns, after weighing, in the appropriate clothing required by the study (1 t-shirt, 1 diaper, 1 blanket). After waiting a

minimum of one-half hour for each subject in his/her bassinet to acclimate to the nursery temperature, nursery humidity and equal amount of clothing, data collection began.

Data Collection Procedure

Data Collector #1 (Investigator)

The investigator was responsible for identifying newborns that met selection criteria, obtaining parental consent, and recording the demographic information on the data collection form. During data collection the investigator had the following responsibilities for each subject:

1. Insure each subject had been in the NBN for a minimum of one-half hour with 1 diaper, 1 t-shirt, and 1 blanket prior to data collection.
2. Scrub hands per nursery protocol prior to data collection on each subject.
3. Bring each subject in his/her bassinet to the data collection site within the NBN.
4. Place the subject on the right side.
5. Unwrap the blanket and take the subject's left arm out of the t-shirt.
6. Simultaneously place the glass thermometer bulb and the IVAC probe tip high in the left axilla of the subject (pressed between the arm and the thorax) and call "start".

7. Read and call out the glass thermometer reading at one minute intervals for five minutes on each subject (the investigator had five seconds on either side of each minute to read the temperature of the glass thermometer).
8. Observe each subject's major state of activity during the five minutes of data collection. At the end of data collection on each subject, tell Data Collector #2 the subject's major activity for recording. See Table 1 for a description of the various infant activities.
9. During the five minutes of data collection on each subject, monitor the IVAC digital display to ensure that arrows are moving rapidly, thereby indicating good tissue contact.

Data Collector #2 (Assistant)

During data collection, the assistant had the following responsibilities for each subject.

1. Immediately prior to data collection on each subject, record the following on the data collection form: the NBN temperature, the NBN relative humidity, the date and time, the glass thermometer number, and the premeasurement glass thermometer temperature (93.8 to 94.2°F).
2. When the investigator calls "start", simultaneously start the stopwatch and read the premeasurement IVAC temperature reading; record the reading.

Table 1. Newborn Activity*

Activity	Behavior
1. Sleeping	Closed eyes. No body movement or occasional muscle twitching, or occasional sucking movement.
2. Awake	Opened eyes. Irregular or active body movements.
3. Fussy/Crying	Continual whimpering or soft cry with body movements. Angry crying with uncoordinated thrashing of extremities.

* Adapted from Moore, 1983, pp. 618-620.

3. At five seconds prior to each minute call out "now", read and record the IVAC temperature reading and record the glass thermometer temperature reading.
4. At five seconds after each minute if investigator did not call out glass thermometer temperature, terminate data collection procedure.
5. Record main activity of each subject.

Data Collection Equipment

Prior to selecting the data collection equipment utilized for this study, the investigator consulted with the Tucson Medical Center's Medical Electronic Department (Dr. Lorin McCray, Director, and James A. Cadwallader III, Assistant Director). With their assistance it was possible to ensure the highest standard of accuracy for all equipment utilized by the investigator for this project.

IVAC Electronic Digital Thermometer, Model #2080

The IVAC #2080 is a rechargeable electronic thermometer capable of measuring temperature from 80°F to 108°F. When tested in a calibrated water bath, accuracy is $\pm 0.2^\circ\text{F}$.

For this study the monitor mode instead of the projective mode of the 2080 was utilized. The monitor mode provides continuous measures of the patient's temperature as it rises or falls via a digital display readout. The monitor mode, with its continuous temperature readings, enabled the investigator to discover the stable axillary measurement. The projective model, routinely used by the NBN where data was

collected, provides only a one time predictive temperature which was not suitable for the study criteria.

A digital display provides a tissue contact pinwheel, consisting of three arrows sequentially forming a circle, with arrows rotating clockwise. This display was utilized to ensure adequate tissue contact between the axilla and the thermometer probe. Rapid motion of the arrows indicates good tissue contact.

Reliability for the IVAC 2080 was established immediately prior to and after each data collection session. A water bath and a precision digital thermometer (TC 100) ensured accuracy of $\pm 0.2^{\circ}\text{F}$ for the 2080.

Mercury Thermometer

Six standard maximum self-registering mercury in glass thermometers with bulb ends were used for measurement. These thermometers measured Fahrenheit degrees as $.2^{\circ}\text{F}$ intervals from 92°F to 108°F . The glass thermometers were certified to have met the U.S. National Bureau of Standard (1985) code. The code standard limits error to no more than $\pm 0.2^{\circ}\text{F}$ at 98°F to 102°F and no more than $\pm 0.3^{\circ}\text{F}$ at 106°F .

Prior to data collection, the thermometers were labeled one through six with tape and remained so throughout the study. Reliability for the six thermometers was established immediately prior to and after each data collection session. A water bath and a precision digital thermometer (TC 100) were used to ensure an accuracy of $\pm 0.2^{\circ}\text{F}$.

Water Bath

The water bath was designed and constructed by the Medical Electronics Department at Tucson Medical Center. Its recirculating pump and electronic control circuitry are capable of holding water temperature to $\pm 0.2^{\circ}\text{F}$ from 80°F to 120°F . A digital display is used for setting and reading water bath temperature.

Prior to and immediately after each data collection session the IVAC 2080 and the six glass thermometers were subjected to the water bath to ensure the accuracy previously stated.

Portable Precision Digital Thermometer (TC 100)

In addition to the water bath display, the TC 100 was used to measure the accuracy of the IVAC 2080 and the six glass thermometers. The TC 100 thermistor was placed concurrently in the water bath with the IVAC 2080 and the glass thermometers. The TC 100 has a temperature range of 32.04°F to 230.0°F , an accuracy of $\pm 0.2^{\circ}\text{F}$, and a continual digital read-out.

Temperature Gauge

A Taylor thermometer was used to provide an accurate reading of the ambient temperature in close proximity to the instrument. It is capable of temperature measurement from 30°F to 110°F in 2.0° intervals.

Prior to each data collection session the temperature gauge was placed in the NBN at the site of data collection for a minimum of one-

half hour before data collection began. It remained there for individual readings throughout each session.

Humidity Gauge

A Taylor humidity indicator was used to provide an accurate reading of the percent of moisture (relative humidity) in the air, in relation to its moisture holding ability at that temperature surrounding the instrument. It is capable of measuring relative humidity from 0 to 100 percent at 2.0% intervals.

Prior to each data collection session, the humidity gauge was placed in the NBN at the site of data collection for a minimum of one-half hour before data collection began. It remained there for individual readings throughout each session.

Stopwatch

A standard operating stopwatch was used to measure minutes of time during data collection. Accuracy of temperature readings was defined as the ability to read the glass thermometer temperature and IVAC 2080 digital display within five second on either side of each minute.

Interrater Reliability

Interrater reliability was established for the glass thermometers, temperature gauge, and the humidity gauge to ensure that markings on each instrument could be read and that a reading was read correctly. The six glass thermometers were read by both the investigator and her

assistant when taken from the water bath immediately prior to data collection. Agreement was 100 percent.

Immediately prior to each data collection session, the temperature gauge and the humidity gauge were read by both the investigator and her assistant. Agreement was 100 percent.

Pilot Study

A pilot study of 13 subjects was conducted prior to actual data collection. The purpose of the pilot study was two-fold. First, the investigator wanted to practice the testing of the data collection equipment for reliability and the interrater reliability of the data collectors. Second, due to the complexity of the data collection procedure, requiring numerous readings and recording of data by two people, the investigator sought to ensure that the procedure worked cleanly in trial runs. In addition, the pilot study established that the glass mercury thermometer could be read without removing the thermometer and yet maintaining good skin contact as indicated by the tissue contact digital display of the IVAC 2080.

Data Analysis

Descriptive statistics were used to analyze characteristics of the sample, environmental conditions and to compare temperature, individually, and between groups over time. A one way analysis of covariance with repeated measures (covariate equalled the baseline temperature) and paired two-tailed t-tests were used to discover

statistical differences between temperature means. Pearson correlations were conducted to discover relationships among the study variables.

Assumption

1. The infant's actual body temperature will remain stable over the five minute data collection time period.
2. The infant is capable of maintaining thermoregulation after six hours of age.

Limitations

1. One-half hour may not have been enough time for all infants to stabilize to the relative humidity and temperature of the newborn nursery and to the same amount of clothing prior to data collection.
2. Sample varied in age (hours).
3. The environment was not completely controlled.

Summary

This chapter described the development of a descriptive design to measure the length of time in minutes needed to measure an axillary temperature in a term healthy newborn, using two different types of thermometers simultaneously. The sample population, setting, data collection procedures, data collection equipment, interrater reliability, assumption and limitations of the study were presented, as was the plan for analysis. In addition the implications for the pilot study were presented.

CHAPTER 4

RESULTS AND PRESENTATION OF DATA

This study was designed to discover the length of time in minutes needed to obtain an axillary temperature in healthy newborns. Two types of thermometers, electronic and glass, were used simultaneously to measure the Fahrenheit temperatures in the left axilla of 40 subjects.

This chapter presents the characteristics of the sample and statistical analysis of the temperature readings. A secondary analysis of the data discussed the correlational relationship among the study variables. A one way ANCOVA and paired two-tailed t-tests were used to discover statistical differences between temperature means. A discussion of the findings relative to the research question is presented.

Characteristics of the Sample

The sample consisted of 40 healthy term newborns, greater than six hours of age. Eighteen subjects (45%) were male and 22 subjects (55%) were female. Selection criteria required that the gestational age for each subject was between 38 to 42 weeks and appropriate for gestational age on examination. Six newborns (15%) were 38 weeks, seven (18%) were 39 weeks, 24 (60%) were 40 weeks, and three (7%) were 41 weeks (Table 2). This reflects a "full-term" sample of newborns.

Table 2. Frequencies and Percents for Sex
and Gestational Age
(n = 40)

	Frequency	%
Sex:		
Male	18	45
Female	22	55
Gestational Age		
38	6	15
39	7	18
40	24	60
41	3	7

The subjects' ages ranged from seven hours to 63 hours with the average age being 25.2 hours [Standard Deviation (S.D.) = 14.4]. Selection criteria required each subjects' birthweight to be between 2600 grams and 3800 grams. The average birthweight was 3297 grams (S.D. = 285.4).

Selection criteria required the 5 minute apgar score for each subject to be seven or greater. The mean apgar score was 9.0. During the data collection procedure, the investigator assigned a subjective score to each subject concerning his/her activity level (asleep, awake, fussy, crying). Nine (22.5%) subjects were asleep, 23 (57.5%) awake, and eight (20%) fussy/crying during data collection. There was not a statistically significant correlation between activity and temperature. The data collection procedure was completed on each subject without missing data.

Characteristics of Testing Conditions

During data collection the NBN temperature ranged from 76°F to 78°F. The average temperature was 77.1°F. The NBN temperature for this study was within the range cited in the literature as that temperature required for a full term clothed and wrapped newborn in an open bassinet to maintain thermoequilibrium. The newborn nursery relative humidity ranged from 23 to 30 percent, the average being 26.9 percent. This data represents a much lower NBN relative humidity than that recommended by literature review (40% to 60%; Phillip, 1975; Sinclair, 1978). However, this may be a phenomenon endemic to Arizona, which normally has low levels of relative humidity.

Six glass mercury thermometers were used to obtain axillary temperature. Thermometer #1 was used five times, thermometer #2 eight times, thermometer #3 six times, thermometer #4 seven times, thermometer #5 eight times, and thermometer #6 six times.

Stabilization Time

The purpose of this study was to discover the length of time in minutes needed to measure the axillary temperature in a healthy newborn. Stabilization of an axillary temperature was defined as that point at which the temperature did not increase more than $.2^{\circ}\text{F}$ in a 1-minute period of time. Two instruments, an electronic thermometer and a glass mercury thermometer were used for axillary temperature measurement. Using both instruments, temperature measurements were taken simultaneously in the left axilla, at 1-minute intervals for 5 minutes. For the glass mercury thermometer, 27 temperatures (67.5%) stabilized at 2 minutes and 13 (32.5%) stabilized at 3 minutes. For the electronic thermometer, 18 temperatures (45%) stabilized at 1 minute, 20 (59%) at 2 minutes, and two (5%) at 3 minutes. These values are presented in Table 3.

Comparison of Temperature Means

The mean stabilized temperature for the glass thermometer and the electronic thermometer was equal (98.1°F). The standard deviations for the mean stabilized temperatures differed slightly between the glass (S.D. = .518) and the electronic thermometer (S.D. = .485).

Table 3. Frequencies and Percents for Stabilization Time
of the Glass and the Electronic Thermometer

Time	Frequency	Percent
Glass Mercury Thermometer (n = 40)		
1 minute	0	0
2 minutes	27	67.5
3 minutes	13	32.5
Electronic Thermometer (n = 40)		
1 minute	18	45
2 minutes	20	50
3 minutes	2	5

When a minute by minute comparison of the mean temperature for the glass and electronic thermometer was made, differences and similarities were identified. These values are presented in Table 4 and graphically presented in Figure 2.

Because the baseline temperature (Time 0) for the glass thermometer could be controlled by the investigator, it had a very small range, 93.8 to 94.2°F and a low mean baseline temperature of 94.0°F. In contrast, the baseline temperature for the electronic thermometer, which could not be controlled, experienced a broad range of starting temperatures (95.8°F to 98.6°F) and a much higher baseline temperature (97.7°F).

At 1 minute, the mean temperature for the glass thermometer was 97.5°F and for the electronic thermometer 97.9°F. The difference between the two mean temperatures was 0.4°F at 1 minute. This fact is not surprising. When one considers the much lower starting (baseline) temperature (94°F) for the glass thermometer than the electronic thermometer (97.7°F), it is obvious that the glass thermometer had to travel further in °F than the electronic thermometer in the 1 minute period of time.

At 2 minutes, the mean temperature for the glass thermometer (98.1°F) and the electronic thermometer (98.2°F) were closely approximated with only a 0.1°F difference. At 3 minutes (98.3°F), 4 minutes (98.4°F), and 5 minutes (98.4°F), the mean temperature for the glass and electronic thermometers were equal.

Table 4. Means and Standard Deviations for the
Mean Temperatures of the Glass and
Electronic Thermometers Over Time

Time	Mean ($\bar{X}$)		Standard Deviation (S.D.)	
	Glass	Electronic	Glass	Electronic
Baseline	94.0	97.7	.065	.621
1 minute	97.5	97.9	.536	.520
2 minutes	98.1	98.2	.561	.489
3 minutes	98.3	98.3	.534	.482
4 minutes	98.4	98.4	.522	.485
5 minutes	98.4	98.4	.533	.485

Figure 2. Comparison of Mean Temperatures Over Time for the Glass and Electronic Thermometers

Mean Score Change Over Time

Depicted in Figure 3 are the difference over time in the mean temperature scores of the glass thermometer and the electronic thermometer during the 5 minute interval of data collection. The mean temperatures for the glass thermometer were reviewed first. As discussed previously, the mean baseline temperature for the glass thermometer was low: 94.0°F. From this view point it is not surprising to see a sharp rise (3.5°F) in the mean temperature from the baseline (Time 0) to 1 minute. From 2 through 5 minutes, there was a steady and small decrease in the differences between the mean temperatures. From 1 to 2 minutes the mean temperature changed 0.5°F. At 3 minutes the mean temperature changed only 0.3°F and at 4 minutes, 0.2°F. There was no change in the mean temperature (0°F) from 4 to 5 minutes.

The mean temperature score changes of the electronic thermometer over the same 5 minute period of data collection differ somewhat from the glass thermometer mean temperature scores. From Time 0 to 1 minute, the mean temperature changed 0.2°F. From 1 to 2 minutes, the mean electronic temperature score had its highest increase; 0.3°F. From 2 to 5 minutes, there is a steady decrease in the differences between the mean electronic temperatures scores. However, this decrease represents a milder slope than the glass thermometer temperature means, actually stabilizing with a 0.1°F difference in mean temperatures scores from 2 to 3 minutes and from 3 to 4 minutes. Like the glass thermometer, there was no change in the mean temperature scores (0°F) for the electronic thermometer from 4 to 5 minutes.

Legend: Glass = --- Electronic = —

T0 = Time 0 D1 = (T1 - T0)

T1 = 1 minute D2 = (T2 - T1)

T2 = 2 minutes D3 = (T3 - T2)

T3 = 3 minutes D4 = (T4 - T3)

T4 = 4 minutes D5 = (T5 - T4)

T5 = 5 minutes

Figure 3. Mean Score Change Over Time for the
Glass and Electronic Thermometers
(n=40)

Differences Between Stabilized and 5 Minute Temperature Readings

Additional analyses were conducted to discover the difference in Fahrenheit degrees from the stabilized glass and electronic temperature readings and their 5 minute temperature readings. These values are presented in Table 5. From the stabilized glass temperature times (2 and 3 minutes), and the stabilized electronic temperature times (1, 2 and 3 minutes), 0.3°F was the most common change of degrees at 5 minutes. Sixty-five percent of the stabilized electronic temperature readings and 78 percent of the stabilized glass temperature readings had 0.3°F change or less at 5 minutes. However, 14 electronic thermometer readings (35%) and nine glass thermometer readings (23%) demonstrated a 0.4°F and 0.5°F difference between the stabilized temperatures and the 5 minute temperature.

Differences Between 3 and 5 Minute Temperature Readings

From clinical experience, the investigator believed a greater than 0.3°F difference between the stabilized temperature and the 5 minute temperature reading to be a significance difference. A greater than 0.3°F difference between stabilized and 5 minute temperature readings could place a newborn who had a high or low normal temperature within a new temperature range (abnormal) requiring immediate further assessment. For this reason further analysis was conducted. Since all temperatures had stabilized by 3 minutes, using the investigator's definition of stabilization, the data was individually re-analyzed to

Table 5. Frequency of Differences Between Stabilized and
5 Minute Temperature Readings in
Glass and Electronic Thermometers

Fahrenheit Degrees	Frequency	Percent
Electronic Thermometer (n=40)		
0°F	3	7
.1°F	3	7
.2°F	9	22
.3°F	11	27
.4°F	6	15
.5°F	8	20
Glass Thermometer (n=40)		
0°F	0	0
.1°F	5	13
.2°F	12	30
.3°F	14	35
.4°F	7	18
.5°F	2	5

see which stabilized temperatures had the 0.4°F and 0.5°F differences at 5 minutes. Of the 13 (32.5%) glass readings and two (5%) electronic readings that stabilized at 3 minutes, none had a >0.3°F difference at 5 minutes. Of the 27 (67.5%) 2 minute stabilized glass readings, nine had >0.3°F change at 5 minutes. Of the 20 (50%) 2 minute stabilized electronic readings, four had a >0.3°F change in 5 minutes. Of the 18 (45%), 1 minute stabilized electronic readings, 10 had a >0.3°F change in 5 minutes.

The investigator took all of the 1 minute and 2 minute electronic readings and all of the 2 minute glass readings which had a greater than 0.3°F at 5 minutes and analyzed their 3 minute reading for °F differences at 5 minutes. The analysis then used 3 minutes as the required length of time to obtain all axillary temperatures in the sample. All 3 minute temperature readings (99%), except one demonstrated a 0.3°F difference or less at the 5 minute reading (Table 6). This analysis added credence to the previous analysis, which suggested that 3 minutes was an adequate length of time to obtain an accurate average body temperature in the healthy newborn. In addition, the 3 minute electronic and glass temperature readings never varied from each other by more than 0.3°F.

One-Way Analysis of Covariance with Repeated Measures and Paired Two-Tailed t-Tests

The one-way analysis of covariance (ANCOVA) design with repeated measures was used to control statistically for the initial differences in the mean baseline temperature (covariate) and the 1

Table 6. Frequencies and Percents for the Difference in Fahrenheit Degrees from the 3 Minute Temperature to the 5 Minute Temperature Readings

Fahrenheit Degrees	Frequency	Percent
Electronic Thermometer (n = 40)		
.0°F	5	12.5
.1°F	21	52.5
.2°F	13	32.5
.3°F	1	2.5
Glass Thermometer (n = 40)		
.0°F	2	5
.1°F	16	40
.2°F	14	35
.3°F	7	17.5
.4°F	1	2.5

through 5 minute temperature means. The ANCOVA finds the adjusted mean for each temperature at each time and compares them to see if they are equal. This test was conducted separately on both groups (glass and the electronic temperature readings). For both groups there was a statistically significant difference between the adjusted temperature means over time involving at least one pair. It was suspected from viewing the raw data that the significant difference would be between the baseline temperature mean and the 1 minute temperature mean, or possibly, between the 1 and 2 minute temperature means. Because the ANCOVA could not identify where the statistically significant differences occurred, a post hoc analysis using the Scheffe' method was conducted. The Scheffe' method indicated significant differences for all combinations of group temperature means for first the glass thermometer temperature means and then the electronic thermometer temperature means. There are several possible reasons for the statistically significant differences found, which were not expected.

First, the author did not use independent samples (i.e., one group was used) so correlated errors (variance in the temperature reading) could have occurred. This means if an error is in one set of temperature readings, it is there throughout all temperature readings. To illustrate, if one baby normally maintained a higher temperature, all of his or her temperature readings from 1 minute to 5 minutes, would be higher.

Secondly, the homogeneity of covariance assumption needed for the ANCOVA, was violated, as shown by the Sphericity test (significant

at .05). This could be expected because an independent sample was not used. Opinions vary regarding the effect of this violation upon data results. However, Hucks, Cormier and Bounds (1974) believe that if groups have the same number of subjects, the analysis of covariance is robust to the assumption of homogeneity of variance and should not be subjected to empirical testing. For this reason, data was analyzed via the repeated measures ANCOVA.

Another possible reason for the statistically significant differences was the study's use of a restricted sample: healthy newborns. This could automatically produce a small variability in the sample because healthy newborns have normal temperatures, causing a restricted temperature range.

Normally, a small variance is desired because it "flushes out" non-significant hypotheses (does not reject a true hypothesis easily). However, the sample also produced a very small difference in the temperature means between any two groups, and certainly the adjusted temperature means were even smaller. With the very small difference between the differences in the mean temperatures and a very small variance, large t' -values occurred (Scheffe' method), producing statistically significant differences between any two groups.

Relationships Among the Study Variables

A secondary analysis of the data was performed to further describe the variables under study. Analysis of the relationships among the demographic variables, environmental variables, and the stabilized

readings of the electronic thermometer and the glass thermometer were conducted using Pearson Correlations (Table 7).

As expected, a positive significant correlation ($r=.50$, $p=.001$) occurred between the demographic variables, gestational age, and birthweight. Selection criteria utilized birthweights that were congruent with an appropriate for age newborn (Lubchenco, et al., 1966).

Another expected inverse significant correlation ($r=-.93$, $p\leq.001$) occurred between the NBN temperature and the NBN relative humidity. Naturally, as air is heated the relative humidity decreases. No significant correlations occurred between the demographic variables, environmental variables, and the stabilized temperature readings. The relationship between the stabilized glass thermometer reading and the stabilized electronic thermometer was positive and significant ($r=.90$; $p\leq.001$). In addition, the relationship between the 3 minute glass and electronic thermometer readings was positive and significant ($r=.93$; $p\leq.001$).

Abnormal Temperatures in the Subject Population

Every attempt was made to select only healthy full term "complication free" newborns for this study. In addition, one selection criterion required the subjects to be greater than six hours of age. This criterion was used because it is believed that physiological functions become stabilized within six hours of birth (Moore, 1983). This would lead one to believe that a healthy term newborn would have little difficulty with thermoregulation, a physiological function, after six hours of age. However, of the subjects which participated in

Table 7. Pearson Product-Moment Correlation Coefficients for
 Infant Characteristics, Nursing Environment and
 Stabilized Thermometer Readings
 (n = 40)

	GA	Apgar	Age	BW	Temp	RH	SETR	SGTH	Act
Gestational Age (GA)	1.00								
Apgar Score at 5 minutes	.13	1.00							
Age (Hours)	.03	.07	1.00						
Birthweight (BW)	.50*	.15	-.12	1.00					
NBN Temperature (Temp)	.03	-.23	-.05	-.07	1.00				
NBN Relative Humidity (RH)	-.05	.29	-.00	.06	-.93*	1.00			
Stabilized Electronic Thermometer Reading (SETR)	-.06	.02	.08	.25	-.09	.06	1.00		
Stabilized Glass Thermometer Reading (SGTR)	-.04	.00	.15	.22	-.10	.10	.90*	1.00	
Activity (Act)	-.01	-.17	.17	-.03	.12	-.15	-.10	.06	1.00

* $p < .05$

the study, 24 did not have "normal" temperatures (97.7°F to 98.6°F) at three minutes.

A newborn's average body temperature should not be below 97.04F (Vulliamy, 1982). Low newborn temperatures are possible indicators of cold stress, sepsis, general deterioration, or a suboptimal thermal environment. Several of both the 3 minute glass and electronic temperature readings indicated subjects with low temperatures (<97.0°F). These subjects were immediately identified to the NBN personnel for further evaluation. There was no apparent relationship between either low (<97.0°F), sub-normal (97.7°F), and elevated (>98.6°F) temperatures and subject birthweight or age. However, the NBN relative humidity (mean = 26.9%) was much lower than that cited by literature, 40% to 60% (Sinclair, 1978; Stare, 1978).

A NBN relative humidity of 40% to 60% is thought to assist newborns in maintaining thermoequilibrium. A high NBN temperature in combination with a low NBN relative humidity is capable of expediting evaporative heat loss to the environment in the newborn.

Brown and Valman (1979) define fever as any newborn temperature exceeding 99.5°F. Common causes of fever are an increased environmental temperature, infection, and dehydration. None of the elevated temperatures (>98.6°F) qualified as a fever for either glass or electronic temperature readings (3 and 5 minute readings).

Glass Thermometer Readings

Among the glass thermometer readings, using 3 minutes as the time at which the axillary temperature was measured, eight temperature

readings were found to be elevated, and three temperature readings subnormal or low. When these specific abnormal glass 3 minute temperatures readings were compared to the 5 minute temperature readings, none showed a greater than .3°F difference. These values are presented in Table 8.

The three subnormal/low temperatures ranged from 96.7°F to 97.3°F at 3 minutes and 96.9°F to 97.4°F at 5 minutes. The eight elevated temperatures ranged from 98.7°F to 99.2°F at 3 minutes and 98.9°F to 99.3°F at 5 minutes.

There were eight (5 minute) elevated temperatures (above 98.6°F), ranging from 98.7°F to 99.04°F, that the 3 minute glass temperature readings did not discover. For the eight undiscovered elevated temperature readings that were above 98.6°F, the 3 minute temperature reading ranged from 98.4°F to 98.6°F, and the 5 minute temperature reading ranged from 98.7°F to 99.0°F. However, newborns with temperatures between 98.7°F and 99.0°F, though elevated, can hardly be called febrile. This may have been a normal function of neonatal adaptation, producing a variance in an individual's normal temperature range. There were no subnormal/low temperatures that were not discovered by the glass thermometer at the 3 minute reading.

Electronic Thermometer Readings

Using 3 minutes as the time at which the axillary temperature was measured, 10 electronic temperature readings were found to be elevated and three, subnormal/low. When these specific abnormal 3 minute temperature readings were compared to the 5 minute temperature

Table 8. Difference in Fahrenheit Degrees Between
3 Minute and 5 Minute Glass Temperture
Reading for Abnormal Temperatures
(n = 11)

Fahrenheit Degrees	Frequency	Percent
.0	1	9
.1	5	46
.2	4	36
.3	1	9

readings, none showed a greater than .2°F difference. These values are presented in Table 9.

The three subnormal/low temperature ranged from 96.7°F to 97.5°F at 3 minutes, and 96.8°F to 97.5°F at 5 minutes. The 10 elevated temperature readings ranged from 98.7°F to 99.0°F at 3 minutes and 98.8°F to 99.1°F at 5 minutes.

There were five elevated temperatures at 5 minutes (above 98.6°F) that the 3 minute electronic temperature reading did not discover. Of the five undiscovered elevated temperature readings, the 3 minute readings ranged from 98.5°F to 98.6°F. The 5 minute temperature readings ranged from 98.7°F to 98.8°F, again hardly febrile. There were no undiscovered subnormal/low temperatures at the 3 minute temperature reading.

Findings Related to the Research Questions

The purpose of this study was to discover the length of time in minutes needed to measure an axillary temperature in a healthy newborn. Stabilization of an axillary temperature was defined as the point at which the temperature did not increase more than 0.2°F in a 1 minute period of time. For both the glass and electronic thermometer, stabilization occurred for 100% of the sample by 3 minutes.

Additionally, when descriptive statistics were used to compare temperature means between the electronic and glass thermometers, they were equal from 3 through 5 minutes. When individual patterns of Fahrenheit change for the mean temperature of the glass and electronic thermometer were graphed, a steady decrease in change from 3 through 5

Table 9. Differences in Fahrenheit Degrees Between
3 Minute and 5 minute Electronic Temperature
Readings for Abnormal Temperatures
(n = 12)

Fahrenheit Degrees	Frequency	Percent
.0	2	15
.1	6	46
.2	5	39

minutes was demonstrated. The above data seems to suggest that 3 minutes is the appropriate length of time for measurement of axillary temperatures in the healthy newborn.

Further, when all 3 minute temperature readings were compared to all 5 minute readings, the difference was 0.3°F or less for all subjects except for one, which had a 0.4°F difference. In addition, Pearson Correlations demonstrated a positive and significant ($r=.90$; $p\leq.001$) relationship between the stabilized glass thermometer reading and the stabilized electronic thermometer reading. The relationship between the 3 minute glass and electronic thermometer reading was also positive and significant ($r=.93$; $p\leq.001$).

A repeated measures ANCOVA and Scheffe' test demonstrated a statistically significant difference between adjusted temperature means and combinations of all group means for both the glass and electronic thermometer readings. Possible reasons for this occurrence were correlated errors (i.e., independent samples were not used), a violation of the homogeneity of covariance assumption or the use of a restricted sample. Small differences between the differences in the mean temperature readings and a very small variance could have produced large t-values.

Three minutes temperature readings, for both glass and electronic thermometers, were able to discover all subjects with subnormal/low temperatures. Three minute temperature readings for both thermometers displayed a trend for the ability to discover elevated temperatures in the study sample. Those elevated 5 minute temperature

readings that were not discovered at the 3 minute temperature reading by either the electronic or glass thermometer were hardly considered febrile temperatures. Practically speaking, study results suggest that 3 minutes is the appropriate length of time needed to obtain an axillary temperature in a healthy newborn.

CHAPTER 5

FINDINGS RELATED TO THE CONCEPTUAL FRAMEWORK

The environment continually influences a newborn's ability to physiologically adapt via thermoregulation. A limitation of this study, possibly affecting results, was the inability to completely control the external environment, prior to and during data collection.

It was not known what type of environment each subject was exposed to prior to the one-half hour stabilization time in the newborn nursery. Mild newborn dehydration and/or poor feeding, both frequent occurrences in the first days of life, could have affected the temperature readings. In addition, exposure to a host of environmental conditions prior to the stabilization time in the NBN could not be controlled. During visiting hours on the postpartum floor, newborns are possibly exposed to different room temperatures and air currents. Certainly they are "passed around" to loving family members and friends who must unwrap the blanket for toe-counting and general viewing of such a lovely creation.

One-half hour may not have been enough time for all infants to stabilize to the relative humidity and temperature of the newborn nursery, and the same amount of clothing, prior to data collection. This limit was set arbitrarily for economy of time and to decrease interruptions among parents and newborns and the nursing staff

schedule. This limitation could have effected the subject's temperature readings.

The NBN room temperature was within the boundaries cited by literature as supporting newborn thermoequilibrium. However, the relative humidity readings were lower than the guidelines established in the literature review. The effect of a low relative humidity on temperature readings is not known.

It is also possible that the study's "required" amount of clothing was not enough for some subjects. Empirically, every newborn nursery nurse remembers at least one healthy full term baby that needed to have an extra blanket, booties, or a head cap to maintain its temperature within the normal range.

A striking number of the healthy full term sample (24) had 3 minute temperature readings outside the normal range. This leads the investigator to believe that further study is needed in the areas of neonatal adaptation and thermoregulation. Korones (1986) and (Bruck, 1961) believe the infant is capable of maintaining his/her temperature. However, there are a host of factors that can upset this delicate equilibrium. Perhaps nurses need to question the belief that physiological functions usually stabilize in the newborn by six hours of age (Moore, 1983). At the very least, they must recognize that temperature within each individual is a constantly changing variable, and that thermoregulation mechanisms are very sensitive to changes in the environment.

Additionally, we must remember that the definition of a normal temperature range represents only the mean range from a large sample of newborns. Many healthy newborns may have normal individual temperatures that fall slightly outside of the normal distribution.

As part of nursing care, it is the nurse's responsibility to assess and monitor the newborn's ability to physiologically adapt to its environment. Normally a healthy newborn's temperature along with other parameters and behaviors are assessed every four hours. Each assessment determines the frequency of further assessment of the newborn's temperature and the amount of environmental control the nurse must provide to assist a newborn's adaptation.

This study suggests that a 3 minute axillary temperature reading can assist the nurse in identifying normal and subnormal/low temperatures without potential harm to the newborn. In addition, a 3 minute temperature reading displays a trend for identifying elevated temperatures. During the study, newborns with low temperature readings (97.0°F) and subnormal temperature readings ($<97.7^{\circ}\text{F}$) at 3 minutes were identified, as well as those with elevated temperatures ($>98.6^{\circ}\text{F}$ but lower than 99.3°F). Nursery personnel were immediately notified regarding these subjects temperature readings so further assessment could occur.

Findings in Relation to Nursing Practice

Human beings are in constant interaction with their environment (Roy, 1980). Nurses assess and monitor the individual's ability to

physiologically adapt to changes in the environment. Study of this phenomenon is an area of interest to nurses.

Study results suggest that 3 minutes is an appropriate length of time to measure the axillary temperature in the healthy newborn. Two types of thermometers, glass and electronic, were used as measurement instruments. For both the glass and electronic thermometer, stabilization occurred for 100% of the sample by 3 minutes.

Additionally, when descriptive statistics were used to compare temperature means of the electronic and glass thermometers, they were equal from 3 through 5 minutes. When individual patterns of Fahrenheit change for the mean temperature of the glass and electronic thermometer were graphed, a steady decrease in change from 3 through 5 minutes was demonstrated. The above data seems to suggest that 3 minutes is the appropriate length of time for measurement of axillary temperatures in the healthy newborn.

Further, when all 3 minute temperature readings were compared to all 5 minute temperature readings, the difference was 0.3°F or less for all subjects except for one, which had a 0.4°F difference. In addition, Pearson Correlations demonstrated a positive and significant ($r=.90$, $p<.001$) relationship between the stabilized glass and electronic thermometer readings and the 3 minute glass and electronic readings ($r=.93$, $p<.001$).

Statistically significant differences for all adjusted group means were found using the ANCOVA with repeated measures. Previous reasons for this were presented in Chapter 4. The instruments used were

capable of measuring temperature only to 0.1°F. In contrast, computer analysis is capable of discerning differences to the one-hundred-thousandth of a degree Fahrenheit. Nurses routinely measure temperature to one-tenth degree Fahrenheit. Current technology involving routine temperature measurement instruments is not capable of a finer distinction. This study suggest that a 3 minute axillary newborn temperature measurement is clinically significant.

Findings from this study demonstrate that nurses who use a 3 minute axillary temperature reading can feel fairly confident in its ability to identify newborns with normal temperatures, and subnormal/low temperatures. In addition, the 3 minute temperature reading displays a trend for identifying elevated newborn temperatures. However, it is important to remember that temperature and environment are not constant, but continually changing variables.

In the healthy newborn, temperatures are monitored to assess neonatal adaptation to thermoregulate. Temperature readings also have the ability to signal other potential/real problems such as sepsis and dehydration. What nurses are looking for is a marked deviation from normal in the healthy full term infant's average body temperature and temperature trends over time. With this in mind, a 3 minute axillary temperature reading should be cautiously balanced against a host of other factors/stimuli and newborn behaviors before a nursing diagnosis is made.

Additionally, parents should be taught to take their newborn's temperature using the axillary method for 3 minutes. As discussed

previously, rectal temperature measurement is potentially harmful and many parents are frightened of the procedure. Parents are provided a safe method of newborn temperature assessment when a 3 minute axillary temperature measurement is taught to them by nursery personnel.

Recommendations for Further Study

This study was based on common theories of environment, neonatal adaptation, and nursing care. Findings are limited by the study's descriptive nature, the small sample size, accuracy of the measurement instruments, and the inability to completely control the subject's environment. Further research should increase application of the findings from this study to other newborns less than six hours of age, premature newborns, small for gestational age and/or large for gestational age newborns, and febrile newborns.

In addition, further research is indicated for the following questions brought about by this study: How does low relative humidity environment affect the newborn's thermoregulation capabilities and temperature? Is the newborn capable of maintaining his/her thermoequilibrium by six hours of age? What is the newborn's true "normal" temperature range?

Summary

This chapter discussed the findings of the study relative to the conceptual framework and nursing practice. Suggestions for further research were offered.

APPENDIX A

HUMAN SUBJECTS AND ACCESS APPROVAL

The University of Arizona

Human Subjects Committee
1609 N. Warren (Building 220), Room 112
Tucson, Arizona 85724
(602) 626-6721 or 626-7575

11 December 1986

Lauren P. Hunter, R.N., B.S.N.
College of Nursing
Arizona Health Sciences Center

Dear Ms. Hunter:

We have received your project, "Measurement of Axillary Temperatures in Neonates", which was submitted to this Committee for review. The procedures to be followed in this study pose no more than minimal risk to the participating subjects. Regulations issued by the U.S. Department of Health and Human Services [45 CFR Part 46.110(b)] authorize approval of this type project through the expedited review procedures, with the condition(s) that subjects' anonymity be maintained. Although full Committee review is not required, a brief summary of the project procedures is submitted to the Committee for their endorsement and/or comment, if any, after administrative approval is granted. This project is approved effective 11 December 1986.

Approval is granted with the understanding that no changes or additions will be made either to the procedures followed or to the consent form(s) used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and your College or Departmental Review Committee. Any research-related physical or psychological harm to any subject must also be reported to each committee.

A university policy requires that all signed subject consent forms be kept in a permanent file in an area designated for that purpose by the Department Head or comparable authority. This will assure their accessibility in the event that university officials require the information and the principal investigator is unavailable for some reason.

Sincerely yours,

Milan Novak

Milan Novak, M.D., Ph.D.
Chairman
Human Subjects Committee

MN/jm

cc: College Review Committee

December 17, 1986

Lauren Hunter, RN, BSN
College of Nursing
University of Arizona

Dear Lauren:

You have been granted access to Tucson Medical Center to conduct your research project entitled, "Measurement of Auxillary Temperatures in Neonates." Your proposal materials have been reviewed and approved by administrative staff of the division of Patient Care Resources and Human Research Committee (HRC). (Please see attached correspondence from HRC.)

To facilitate your data collection activities and to minimize the impact of these activities on the unit, several individuals have been designated as your clinical liaison contracts: Paula Hnyda, Assistant Patient Care Manager, Regular Nursery, Susan Simms, RN, Clinical Nurse Educator, Nursery.

Attached are the data collection policies and procedures which you are expected to follow. Upon completion of your study, you are expected to provide us with a formal copy of your study and to present your findings to interested staff. Accordingly, guidelines for presentation are also attached. Additionally, you may be asked to provide us with a brief written synopsis of your study for potential publication in the department's newsletter.

We wish you a successful research experience, and we look forward to your sharing your results with us.

Sincerely,

Guadalupe S. Olivas
Guadalupe S. Olivas, RN, Ph.D
Coordinator
Publications and Research

GSO:d11

Attachments

cc: Paula Hnyda, Assistant Patient Care Manager, Regular Nursery
Susan Simms, RN, Clinical Nurse Educator, Nursing

hunter.ltr

APPENDIX B

PARENTAL CONSENT FORM

PARENTAL CONSENT FORM

Measurement of Axillary Temperatures in Neonates
 Lauren P. Hunter, RN -- (Home phone: 326-7725)

This is a study about how long it takes to accurately measure a baby's temperature under the arm. I'm asking your permission for your baby to participate in this study because he/she is healthy, and greater than six hours of age.

Your baby's participation in this study involves taking his/her temperature under the arm after resting in his/her crib for 1/2 hour in the newborn nursery. During the "temperature taking" your baby will be dressed in a diaper, a t-shirt, and one blanket. The "temperature taking" will take no more than 10 minutes. As soon as I am finished, I will return your baby to you or leave him/her in the nursery, as you desire. You are welcome to watch the procedure. There is no additional cost to you as parents or your newborn if you choose to participate in this study, neither can I pay you to participate.

There are no known risks. You and your baby's name will be kept confidential. There are no direct benefits to you or your baby, but the results of this study will be helpful to nurses and parents in caring for babies. The information from this study will be written in a thesis, used in further research and made available to other health professionals.

I have read the above "Parent's Consent". The nature, demands, risks, and benefits of the project have been explained to me. I understand that I may ask questions and that I am free to withdraw my baby from the project at any time without incurring ill will (or affecting my baby's medical care). I also understand that this consent form will be filed in an area designated by the Human Subjects Committee with access restricted to the principle investigator or authorized representatives of the particular department. A copy of this consent form is available to me upon request.

In addition, I understand that additional information pertaining to my child may be obtained from medical records. I also understand that as a parent or guardian I am giving consent for my child to participate in this study, knowing that he/she is too young to assent to participation.

Parent _____

Date _____

Witness _____

Date _____

APPENDIX C

DATA COLLECTION FORM

DATA COLLECTION FORM -- PART I

Medical Record # _____ Gestational Age _____
 Diagnosis _____ Apgar: 1 min _____ 5 min _____
 Date of Birth _____ Time of Birth _____
 Birthweight _____ Sex _____
 Parental Consent Signed: Yes / No

Pretest Data

1. Greater than 6 hours of age Yes / No
2. Complication free Yes / No
3. Infant has been in NBN at least 1/2 hour with 1 blanket, 1 t-shirt,
and 1 diaper for wrapping Yes / No

DATA COLLECTION FORM -- PART II

Date _____ Time _____
 Nursery Temperature _____ Barometer reading _____
 Infant on right side Yes / No
 IVAC (projection mode) Temperature _____ Time _____

Temperatures:	IVAC (MM)	MERCURY
Baseline	_____	_____
One minute	_____	_____
Two minutes	_____	_____
Three minutes	_____	_____
Four minutes	_____	_____
Five minutes	_____	_____

Activity (circle one) Asleep Awake Fussy/Crying

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