CO-BEDDING TWINS IN A NEONATAL INTENSIVE CARE UNIT: A DESCRIPTIVE CASE STUDY

by

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ABSTRACT

Co-bedding twins in the NICU is evolving as a practice which attempts to replicate and capitalize upon the infants' unique prenatal environment and experience. The purpose of this descriptive case study was to explore the relatively unknown phenomenon of co-bedding to generate rich, descriptive, contextual knowledge in order to develop context specific family-centered care interventions. The study focused on the behaviours during co-bedding of one set of twins, born at 30 weeks gestation, and the family's and the consistent nurse's perceptions of the co-bedding experience. Four behavioural observations were conducted on each infant using the Neonatal Individualized Developmental Care and Assessment Program (NIDCAP) naturalistic behavioural observations (Als, 1995).

The picture of co-regulation that emerged from the descriptions of the infants' behaviours, and the parents' and nurse's perceptions was one of holding onto, touching, reaching towards, responding to each other's stress behaviours, calming each other, and crying when separated. Co-regulation, in this study, was characterized by infants who were calmer and more settled, fell asleep more easily, slept for longer periods, woke together, and whose biorhythms, sleep-wake cycles, and body temperatures became increasingly more synchronous. The development of a mutuality in circadian rhythm between the infants, as well as their close physical proximity to each other, assisted the parents in caring for their infants both in a NICU and at home, and facilitated nursing care in the NICU.

Co-bedding is a developmentally supportive, family-centered care strategy for twins that may contribute to physiological stability, thereby enhancing shortterm and longterm neurological and developmental outcomes both in and beyond the NICU, while capitalizing on the unique experience of twinship.

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The best ideas are common property
Seneca

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CHAPTER ONE: INTRODUCTION

The human infant begins life in a warm, peaceful, protected environment. It is a dim world of muffled sounds and gentle oscillations. The fluid filled womb provides cutaneous input while fetal movements provide tactile self-stimulation; the fetus spends most of the time sleeping and perhaps, even dreams (Gottfried & Gaiter, 1985). However, for some infants this idyllic life comes to an abrupt end. Premature birth removes an infant from the protective uterine milieu and catapults the infant into an intensive care environment, now known to be particularly harsh and unlike that experienced at any other time of life (Avery & Glass, 1989).

Neonatology is a relatively new field which is less than four decades old, yet no other field has advanced as rapidly. There have been major innovations in technology and therapy related to the care of critically ill newborns and premature infants. The threshold of viability has been extended to unprecedented levels with a new population of very-low-birth-weight (VLBW) infants (<1500 grams) and extremely-low-birth-weight (ELBW) infants (< 1000 grams) surviving (Saigal, 1994). However, these successes have not been achieved without a price. During the developing years of neonatology, the focus was mainly on reducing mortality. With increased survival rates in this population of infants, there has been a shift in emphasis from survival only to improved quality of life, both in and beyond the neonatal intensive care unit (NICU) (Lacy & Ohlsson, 1993). The past decade has been characterized by increasing concern for the longterm developmental and psychological outcomes of high-risk infants who begin their lives in a NICU.

There is an ever increasing number of twins and their families who find themselves starting life in a NICU. Health care professionals who are caring for

increasing numbers of these infants and their families require knowledge of the unique problems and needs of multiple birth families in order to support and attend to their unique experiences. Some authors have suggested that we are in the midst of an epidemic of multiple births (Bowers, 1998). Canada and the United States are experiencing the highest number of multiple births in recorded history. In Canada, approximately 4,300 women give birth to multiples annually (Statistics Canada, 1996), while in the United States this number is estimated to be 50,000 women (Ventura, Martin, Curtin, & Mathews, 1997).

In 1996, there were 45,883 live births in British Columbia (B.C.) with almost 97.6% of the live births being singletons (44,784) (B.C. Vital Statistics Agency). Twins were born about one in every 43 live births and triplets, one out of every 2,000 live births. In 1997 there were 44,371 live births in B.C. with 2.3% of these being multiple births (B.C. Vital Statistics Agency). A twin was born approximately one in every 45 live births and a triplet one in every 900 live births. From April 1996 to April 1997, the total number of live births at Children's & Women's Health Center (C & W) of B.C. was 7,056. Of these live births, 144 infants were twins and eight were triplets, whereas from April 1997 to 1998 out of 7,253 live births 161 infants were twins and 10 were triplets (C. Nishi, Information Analysis Department, C & W, personal communication, February 10, 1999).

The causes for the increase in multiple births are related to the increased availability and use of assisted reproductive technologies, such as in-vitro fertilization and gamete intrafallopian transfer, fertility enhancing drugs, and the delaying of childbirth into the third and fourth decade by many women (Bowers, 1998). Rates of multiple pregnancies resulting from the use of assisted reproductive technology have been documented as high as 15% to 30%

(Fitzsimmons, Bebbington & Fluker, 1998).

Multiple birth infants are over represented in the NICU. Kiely (1998) reported that 50% of twins and 90% of triplets were born prematurely compared to 8.5% of singletons. Fitzsimmons et al. (1998) documented that of all twin and triplet births at C & W) between 1985 and 1996, the average length of a twin pregnancy was 35 weeks gestation, while the average length of a triplet pregnancy was 32.5 weeks gestation. In 1997 there was a total of 673 infants admitted to the Special Care Nursery (SCN) at C & W. Of these admissions, 116 infants or 17.2% were a twin and 23 infants or 3.4% were a triplet, whereas in 1998 out of 620 admissions to the SCN, 92 infants or 14.8% were a twin and 23 infants or 3.7% were a triplet (Newborn Care Program, C & W). In 2% of cases in 1997 and 3% of cases in 1998 only one of the twin pair, almost always twin B, was admitted to the SCN.

Preterm birth is the most common single risk factor for developmental problems in childhood, with learning disabilities being the most pervasive developmental problem (Glass, 1994). Learning disability is a catch-all term, which includes children of low average, or otherwise normal intelligence who have deficits in visual perception or visual-motor integration, language difficulties, poor attention span, hyperactivity, and behavioural and/or social interaction problems (Bennett, 1987; Glass; Hack et al., 1994; Whitfield, Grunau, & Holsti, 1997). Also coined the "new morbidities" of neonatal intensive care, a broad array of evidence implicates the NICU environment as a causative factor of learning disabilities (Blackburn & VandenBerg, 1993). Reports of school-age children who were of VLBW indicate that as many as 50 - 60% have learning disabilities (Whitfield et al.). In the absence of major medical complications, this large number of children with developmental problems is profoundly

disconcerting to families, health care professionals and society as a whole.

NICUs have become high-tech marvels where intensive care is administered around the clock, with hectic activity, bright lights, and noise levels equivalent to light auto traffic, that goes unabated, 24 hours a day (Gottfried & Gaiter, 1985). Too big, too loud, and too much are the beliefs and assumptions of an ever increasing number of health care professionals who care for infants receiving intensive care. It is precisely this point of view that sparked a developmentally-supportive care movement towards a kinder, gentler, and a more nurturing NICU (White & Newbold, 1995). Beyond technology there is the recognized value of the importance of human touch and contact.

As developmentally supportive care continues to evolve, health care professionals continue to explore means of providing appropriate and supportive developmental environments and care opportunities to infants and their families experiencing neonatal intensive care. One such opportunity is that of co-bedding -- bedding twins together in the same incubator or bed. Increasingly, families are advocating for their twins to have this experience.

Co-bedding of twins, in the NICU setting, is evolving as a practice which attempts to replicate and capitalize upon the infants' unique prenatal environment and experience (Lutes, 1996). In utero, behaviours of twins include synchrony in sleep and awake states, fetal movements, and heart rate accelerations (Gallagher, Costigan, & Johnson, 1992; Sherer, Nawrocki, Peco, Metlay, & Wood, 1990). It is hypothesized that twins may have a unique ability to support each other during their transition to extrauterine life because of their shared intrauterine experiences (Nyqvist & Lutes, 1998). It is also suggested that separation at birth deprives the infants of the mutual physical contact and physiologic interdependence experienced in utero (Nyqvist & Lutes). When

twins are swaddled or nested together, sharing the same boundaries, they have the opportunity to co-regulate (balance and support each other), and to continue to progress in their unique interactive development. It has also been hypothesized that twins who are co-bedded within a short period of time following birth seem to handle the stress of the NICU better than those who are separated (Lutes).

There is a paucity of research on co-bedding; a literature review revealed only one clinical study, published by Nyqvist and Lutes in July 1998. However, accumulating anecdotal clinical experiences in the SCN at C & W, as well as from other NICUs provides a rich data source (L. Lutes, personal communication, July, 1998; A. Samuelson, Nurse Educator, St. Mary's Hospital, Duluth, Minnesota, personal communication, November, 1996; L. Wham, Lactation Consultant, NICU, Las Vegas, Nevada, personal communication, September, 1997). In order for health care professionals to continue to support this practice and to enable parents to realize their wishes, descriptive information will provide knowledge about the phenomenon of co-bedding twins.

Context of the Research Problem

The philosophy of family-centered care has been adopted as the standard in many children's hospitals in the last twenty years (Johnson, Jeppson, & Redburn, 1992). According to Edelman (1991), it is practically, morally, and legally the best way to provide care to children and their families. Increasingly, as health care professionals in the NICU embrace and begin to incorporate tenants of both developmentally supportive and family-centered care into their way of caring for and being with families, a climate has evolved where they are more willing to explore practice issues that address the mental health and quality of

life of infants experiencing intensive care, and their families. Coupled with the fact that many families are more informed and sophisticated consumers of health care, family-centered care provides families with a voice in how their infants are cared for in a NICU.

In the past, standard practice has been to separate twins in the NICU and sometimes place them in different neonatal nurseries or hospitals. Little attention has been given to the impact of this separation on the long term physical and mental health of twins and their families. Enacting a developmentally supportive and family-centered caregiving philosophy in the NICU helps caregivers to recognize and acknowledge the unique needs of twins and their families. Caregivers working in the NICU are beginning to question what it was like for twins to share a womb from conception until birth. How did they interact in the womb? How is their development affected when they are separated at birth?

Consistent with several NICUs throughout North America, the SCN at C & W is beginning to offer co-bedding to twin infants when they no longer require an incubator for thermoregulation and they are well into their recovery phase. The practice of co -bedding in the SCN has been a consumer driven one, which came into being November, 1995 when a family requested that their twins co-bed. Each twin had required several weeks of ventilator support, and both had experienced intraventricular haemorrhages resulting in hydrocephalus and neurological impairment. However, as these infants progressed beyond the acute phase of their health challenges, the parents expressed a desire to normalize their infants' environment. This mother had skin-to-skin cuddled and breastfed her twins together. Thus, the parents' request to co-bed their twins seemed like a natural progression as these parents tried to construct family cohesiveness in the

NICU. The parents shared what literature they had with health care professionals and with other parents of twins in the SCN. Parents posted information on co-bedding at the bedspace of their infants.

For some caregivers, it was a very exciting time to see parents drive practice change. For others, it created conflict, fear, and confusion around issues of safety and the lack of documented research evidence. Thus, like many other NICUs, health care professionals sought to support the parents in their request, while at the same time they strived to ensure safe practice in the absence of research on co-bedding. The multidisciplinary team liaised with other units to learn from their clinical experiences with co-bedding.

More recently, another set of parents had joined a twins support group prenatally, and had a vision of their twins sharing the same bedspace. However, things took a very different turn when not only were the twins born prematurely in March, 1998, but one of the twins had a complex syndrome. Despite the complexity of one twin's illness, the parents were unwavering in their quest for their twins to co-bed. The situation was further compounded by the fact that the "well" twin was transferred to an intermediate care neonatal nursery. Although the parents' efforts were extraordinary, the barriers were too great, and co-bedding was neither realized nor facilitated within the current health care structure.

The latter story illuminates the gap between what we are able to offer and the support desired by families of twins. Furthermore, it highlights the extraordinary physical and emotional stress imposed upon a family when their infants are placed in separate hospitals or nurseries for care. As nurses and health care providers, it challenged us to critically examine our clinical practice, and to strive for the holistic care that is inherent in a family-centered approach.

In the SCN, approximately 18 sets of twins have been co-bedded since 1996 (Appendix A: co-bedding protocol, SCN, C & W). More recently, in 1999, two sets of triplets have co-bedded. Co-bedding is initiated only upon parents' request. Parents and nurses have been encouraged to journal on infants who are co-bedding and to record observations, impressions, infants' subtleties, and nuances that are not captured in current documentation. Examples of observations recorded by nurses and parents in the SCN include:

> . . .when one twin moves, the other settles in . . . their hands in each other's face do not seem to bother either one! They have been face-to-face while supine, prone, and side-lying, and appear happy and settled everyway.
>
> . . . the babies are often sleeping nestled up to each other and are not disturbed by each other's cries or activity.
>
> K awake and fussing while J sleeping undisturbed by her activity. K settled prone . . . she wriggled until her head settled against J.
>
> . . . some things I noticed with B and C while they were together. B usually has a heart rate of 160 - 180 beats per minute at rest, and higher if he is warm. While sleeping beside C his temperature increased to 37.3°C, but his heart rate was between 140 - 160 beats per minute. The boys heated each other up and required only one light blanket over them. Both of the boys slept through a period when the other was crying. Once they both woke together . . .

Focus of Inquiry

This study focused on the behaviours of one set of twins during co-bedding and the family's and nurse's perceptions of this experience. The purpose of this case study was to explore the relatively unknown phenomenon of co-bedding using an in-depth case study method to generate rich, descriptive, contextual knowledge on co-bedding through observation and interpretation of the behaviours of one set of twins and through analysis of the family's and consistent nurse's perceptions of the co-bedding experience. This descriptive

knowledge contributed to the identification of key concepts for health care practice in order to develop context specific, family-centered care interventions for twins who are co-bedding and their families.

Research Questions

This study sought to identify, describe, and interpret the behaviours of twins who co-bed using the Synactive Theory of Infant Development, developed by Als (1986). The following questions reflect the focus of this inquiry and guided this researcher during data collection:

1. What are the behaviours of one set of twins who co-bed?
2. What are the co-regulatory behaviours that the infants' demonstrate?
3. In what context do co-regulatory behaviours occur?
4. What are the perceptions that their parents attach to this experience?
5. What are the perceptions that their nurse attaches to this experience?

Operational Definitions

The operational definitions used in this case study are the following:

Preterm infant: An infant who is born at < 37 weeks gestation (Wyly, 1995).

Co-bedding: Lightly swaddling or nesting twins together with one blanket so that they share the same boundaries. The infants are positioned so that their hands are free to reach their own face and the face and body of their sibling (Lutes, 1996).

Organization: Organization involves establishing integrated functioning between the infant's physiological and behavioural systems. When these systems are well integrated, the infant is able to interact with the environment without disruptions in autonomic, motor, and state functioning. As a result, the infant will not experience alterations in vital signs, colour, state, or digestive functions (D'Apolito, 1991).

Self-regulation: The behaviours that infants use to calm and console themselves to try and maintain physiological and behavioural systems stability in response to environmental stimuli (Blackburn & VandenBerg, 1993).

Co-regulation: The ability of twins to balance and support each other, by enhancing one another's physiological stability, motor organization, and state control mediated by physical contact during co-bedding. Co-regulation behaviours include moving closer, touching, holding, hugging, rooting and sucking on each other, smiling, being awake at the same time, and decreased need for ambient temperature support (Lutes, 1996; Nyqvist & Lutes, 1998).

Theoretical Perspective

A conceptualization of developmentally supportive care as it pertains to the focus of inquiry provided the theoretical perspective for this study. Developmentally supportive care is a philosophy, an approach to caregiving, and a way of being with infants and families. It is a complex of relationships, interventions, and caregiving strategies centered around reducing environmental stress, helping an infant stabilize at each stage of maturation, augmenting the infant's competencies, and providing opportunities for parenting (Als, 1986; Lawhon, 1997; VandenBerg, 1997).

Attention is focused on the quality, timing, process, and content of care delivery, as aspects of the infant's experience that can be affected by caregivers, to improve short- and longterm medical and developmental outcomes (VandenBerg, 1997). At the heart of developmentally supportive care is the relationship the caregiver builds with the infant and family. The family is seen as the major social context in which infants live, grow, and develop. Thus, caregiving is provided within the context of family-centered care, ensuring parents and infants have every opportunity to get to know one another (Lawhon, 1997; VandenBerg, 1997).

Al's (1982, 1986) Synactive Model provides the theoretical framework for

understanding the emerging behavioural organization abilities of infants. This model is based on the assumption that infants actively communicate via their behaviour, which becomes an important route for understanding their thresholds of stress and stability (Als, 1986). The theory conceptualizes the infant as continually interacting with the environment via five subsystems: 1) physiologic/autonomic, 2) motor, 3) state, 4) attentional/interactive, and 5) self-regulatory (Als, 1982, 1986; Blackburn & VandenBerg, 1993). These subsystems are interdependent, interrelated, and mature sequentially. When the five subsystems are well integrated, an infant is able to interact with the environment without disruption in physiological and behavioural systems functioning. At each stage of development, new competencies and organizations are learned against the backdrop of previous development.

Observation and assessment of the infant's responses to the caregiver and other aspects of the environment, across these five subsystems of behavioural functioning, enables the caregiver to structure the infant's experiences, and care for the infant in a way that helps the infant stabilize at each stage of maturation, supports the infant's emerging behaviours and organization, and reduces stress (Blackburn & VandenBerg, 1993). Infants are viewed as competent and active partners in the relationship of caregiving, and in determining their own developmental trajectories.

In this theoretical model, the preterm infant is viewed as a displaced fetus who is not yet biologically programmed to handle the extra-uterine environment, and who is particularly sensitive and vulnerable to sensory overload, due to a decreased ability to selectively process input (Als, 1986; Blackburn & VandenBerg, 1993). Term infants who experience respiratory distress, pain, or other health challenges also have reduced ability to maintain

physiological and behavioural systems stability, in response to stimuli.

The interruption of intrauterine life to the contrasting neonatal intensive care environment is viewed as profound and extraordinary. Assumptions about the NICU environment include that the noise and light levels normally found in a NICU: (1) are excessively high, (2) routinely overload and overstimulate the infant, (3) result in disturbances to the infant's sleep-wake cycle and inhibit deep sleep, and (4) do not enable the infant to experience day-night rhythm patterns necessary for development (Als, 1986; Blackburn &VandenBerg, 1993; Thomas, 1989, 1995). In summary, both routine caregiving activities and the nature of the NICU environment are sources of stress for the infant, and can be costly in terms of energy expenditure and physiological and behavioural stability.

How is developmentally supportive care enacted, and how would one recognize it in clinical practice? The following principles of caregiving define developmentally supportive care:

(1) Care is cue-based or infant led.

This means that caregiving is contingent upon the infant's behavioural cues. This involves engaging in dialogue with the infant through reading and responding to the infant's behavioural cues during caregiving. If the approach to providing care is not working, the infant will respond with stress and instability cues, such as, vacillations in heart and respiratory rates, colour changes, tremors, startles, and finger splaying (Als, 1986; Blackburn & VandenBerg, 1993). Care is then adjusted to those cues. The infant is supported after caregiving until he or she has returned to a calm, peaceful sleep.

2) Care is based on the infant's biorhythms and sleep-wake cycles.

Traditionally, professional caregivers' schedules govern when care happens, irrespective of the infant's needs at the time or ability to handle it. The

philosophy of developmentally supportive care requires health care professionals to challenge and question delivery of services that are scheduled and routine based, and to critically examine professional practice that is rooted in tradition. It involves thinking through all the handling events in a 24-hour period and planning them in relation to the infant's sleep-wake cycles. The infant is helped to "stretch" out his biorhythms to fit a 24 hour cycle, by assisting him to consolidate his sleep cycles, supporting every opportunity for deep sleep, and by promoting day-night cycling (Thomas, 1995).

3) Care supports the infant's self-regulatory (self-calming) abilities.

Enacting developmentally supportive care involves learning the behaviours the infant has brought forth from the womb to calm himself, and then attending to and encouraging these skills (Lawhon, 1997; VandenBerg, 1997). Support is provided before, during, and after caregiving activities and interactions with the infant, to assist the infant to maintain physiological and behavioural systems stability.

4) Care supports the infant's state regulation.

Attending to cues, biorhythms, sleep-wake cycles, self-regulation, individualization, and the environment contributes to state regulation (Als, 1986; Blackburn & VandenBerg, 1993). It includes helping the infant to achieve calm quiet sleep and calm awake periods, smooth transition between states, and as the infant matures, alerting and orienting to his or her world.

5) Care is individualized according to the infant's unique needs.

Caregiving routines and procedures are adapted to support the infant's unique needs and lived experiences. Care is variable, contextual, and contingent upon the infant's current sensory capabilities and thresholds to handling. Ways to individualize care become clear to caregivers through observing and watching

the infant's pattern of behaviour.

6) Care is relationship-based.

Developmentally supportive care is neither a task-oriented activity, nor is it protocol driven. Care is done *with* the infant, not *to* the infant. It involves attentively and affectively being there for the infant, to ensure that support during caregiving is nurturing and well timed (VandenBerg, 1997).

7) Care that is developmentally supportive is family-centered care.

Many developmental specialists and families view developmentally supportive care as exactly the same as family-centered care, in that by providing support and education to the family, the infant's development will be optimized (Lawhon, 1997; VandenBerg, 1997). More specifically, providing family-centered support, care, and services for parents and the extended family, during the stressful NICU stay, can promote family stability, and enable families who are destabilized by the birth of a preterm infant to refocus their energy around caring for their infant (Wyly, 1995). Thus, the family as the major social context in which the infant grows, lives, and develops is personified, as well as the belief that neonatal care includes caring for parents and families.

Significance of the Study

Parents of twins are seeking support antenatally for co-bedding and are setting up resources prior to birth (personal communication, S. Semonick, Surrey-Delta Parents of Multiple Births Association, June, 1998). Consequently, more parents are arriving in the NICU with knowledge and information in regards to co-bedding as a way to help their infants recover and attain earlier discharge home (personal observations). The impetus to implement co-bedding, in the SCN at C &W, arose from the desire to be responsive to the needs of these families, as well as a desire to search for validation of more holistic, family-

centered, developmentally supportive nursing practice. This single case study can "plant a seed" and raise awareness and sensitivities to co-bedding as a contextualized family-centered care initiative. The findings can assist health care professionals in their clinical practice.

A secondary intent of this study is to serve as a pilot case, and a prelude to a multiple case study design. A pilot case study may reveal inadequacies in the initial design or it may help to articulate it. The findings of this case study can help to facilitate conceptual clarification for the research design, and generate pertinent hypotheses and propositions for further inquiry. Replicated, nonexperimental, single-subject research conducted by nurses, in the course of their practice, can significantly contribute to the development of nursing knowledge, providing contextualized family-centered nursing care. Furthermore, the evidence from multiple cases is often considered more compelling, and the overall study is therefore regarded as being more robust (Smyth, 1989; Sterling & McNally, 1992).

Summary

This chapter presented an introduction to the study, including the purpose and the background which prompted its inception. The philosophical perspective of the study was introduced, and the theoretical framework was reviewed; definition of terms and assumptions were explicated. The significance of the potential results of this study was articulated.

Chapter Two contains a review of the literature based on the three theoretical perspectives that informed this study: developmentally supportive care, family-centered care, and the experience of twinship. Chapter Three outlines the study method including the study design, selection of participants, data collection and analysis procedures, instrumentation, limitations, and

human subject considerations. Chapter Four presents a detailed description of the study findings which includes the four behavioural observations for each infant, the perceptions of the parents and the consistent nurse of the co-bedding experience, and a chart review. Chapter Five articulates the picture of co-regulation that emerged from the findings, and discusses the research findings in relation to the literature review. Chapter Six presents the summary of the research study, conclusions drawn, and the implications for health care practice, education, and research.

CHAPTER TWO: LITERATURE REVIEW

Introduction

The philosophies of developmentally supportive and family-centered care, and the literature on twinship provided the framework for the literature review and informed the case study protocol. The literature on particular components of developmentally supportive care as well as a group of studies examining the integration of these components into a developmentally supportive care protocol were reviewed. Family-centered care theory provided an important perspective to this study because it provided a context for exploring co-bedding in the NICU setting. The adoption of a family-centered care philosophy by C & W has created a milieu where health care professionals are becoming increasingly more attentive to family participation in care and decision-making, while their infants receive intensive care. This shift in thinking by health care professionals has created a degree of openness and flexibility in the SCN to explore co-bedding for individual families and their preterm infants. The third body of literature that formed part of the theoretical framework for this study was that of twinship: the uniqueness of being a twin, mother-infants attachment, twin activity in utero, and co-bedding. Given the absence of research available on co-bedding, published clinical anecdotal accounts provide a rich source of information from which to explore the phenomenon of co-bedding.

Developmentally Supportive Care

The evidence supporting positive clinical outcomes associated with developmental care for VLBW infants has been steadily accumulating (Als et al., 1986; Als et al., 1994; Becker, Grunwald, Moorman, & Stuhr 1991, 1993; Buehler, Als, Duffy, McAnulty, & Liederman, 1995; Fleisher et al., 1995; Stevens,

Petryshen, Hawkins, Smith, & Taylor, 1996). The concept of developmentally supportive care has been extensively researched with most of the research to date primarily focused on the significance of particular components of an individualized developmentally supportive care protocol, rather than on the protocol as a whole (Lotas & Walden, 1996). The components of developmentally supportive care that have been studied as individual interventions include: positioning and containment strategies, light and sound levels, nonnutritive sucking, and skin-to-skin cuddling. Each of these interventions as individual strategies has been associated with significant improvements in some aspect of the infant's physiological and behavioural stability or functioning (Lotas & Walden).

Positioning

Developmentally supportive positioning of an infant as an essential component of developmental care has been studied in relation to its effect on an infant's physiologic, motor, state, and self-regulatory subsystems. Physiologic flexion is vital for the development of normal body movement and control (Fay, 1988). Most preterm infants, depending on gestation, never become large enough in utero to develop physiologic flexion. In general, preterm infants demonstrate weak muscle tone and are unable to combat the force of gravity placing them at risk for the following positioning disorders: widely abducted hips (frog-leg position); shoulder retractions; ankle and foot aversion; arching and increased extension of the neck, trunk, and extremities (Blackburn & VandenBerg, 1993; Fay, 1988; Short, Brooks-Brunn, Reeves, Yeager, & Thorpe, 1996).

Masterson, Zucker, & Schultze (1987) documented the effect of body position (supine versus prone) on energy expenditure and on the distribution of sleep-awake states in 42 healthy LBW infants. Infants with birth weights between

920 and 1760 grams were eligible for the study if they were receiving no ventilatory support or supplemental oxygen therapy, and were on full enteral feedings. Each infant was randomly assigned to either the supine or prone position for the first three-hour interfeeding period; the position was then reversed for the second period. Outcome data demonstrated that LBW infants in the prone position had significantly lower metabolic rates, enhanced deep sleep, and spent less time awake than in the supine position. There was no change in the amount of time spent in light sleep between the prone and supine positions indicating that the infants exchanged deep sleep for wakefulness when supine (Masterson et al.). Additionally, when only periods of light sleep were examined the difference in energy expenditure remained significantly lower in the prone versus the supine position.

Fox and Molesky (1990) examined the effects of supine and prone positioning on the arterial oxygen pressure in preterm infants with Respiratory Distress Syndrome (RDS), requiring mechanical ventilation, and supplemental oxygen. The study was a prospective, non-randomized design where infants served as their own controls. Infants (n = 25) in this study had a mean gestational age (GA) of 31 weeks and mean birth weight of 1633 grams. Outcome data revealed that positioning intubated infants with RDS prone resulted in significantly higher partial pressure of oxygen in arterial blood (PaO_2) compared to supine positioning. Although the mean PaO_2 was significantly higher in the prone position, no infant was hypoxemic in the supine position. Of clinical significance however, prone positioning enabled the delivery of lower inspired oxygen concentrations. The findings of this study support the results of earlier studies, and add to the accumulated experimental evidence concerning the benefits of prone positioning in reducing the need for metabolic gas exchange

and enhancing oxygenation in preterm infants.

In a randomized control design, Short et al. (1996) compared the effect of swaddling to standard positioning on neuromuscular development in 50 VLBW infants. In this study, swaddling was defined as wrapping an infant in a blanket to maintain arms and legs in a flexed position, with hands positioned near the mouth. Swaddling is thought to simulate the position in utero, where neuromuscular development is facilitated through weightlessness and containment in flexion (Short et al.). Swaddling has been suggested as an intervention to support hand-to-mouth activity, facilitate motor organization and state control, prolong sleep cycles, and reduce pain-elicited distress in term infants (Short et al.).

In this study, infants in the experimental group were swaddled at least 15 hours per day, while infants in the control group were swaddled less than eight hours per day. There was a significant difference between swaddled and standard-position infants in overall behavioural responses at 34 weeks postconceptional age (PCA). Swaddling facilitated improved symmetrical and flexed postures, flexor tone of the extremities, and midline orientation which, in turn, facilitated better eye-hand-mouth control, and self-calming activities (Short et al., 1996).

More recently, researchers in the area of neonatal pain have explored the use of flexion and other containment strategies, as a nonpharmacologic intervention, in modulating the preterm infant's physiological and behavioural responses to minor pain. Corff, Seideman, Venkataraman, Lutes, and Yates (1995) in a prospective, repeated measure study design examined the effectiveness of "facilitated tucking." A convenience sample of 30 preterm infants (25 - 35 weeks GA), acting as their own controls, were observed during

two separate heelstick procedures, one with and one without the intervention to identify the effectiveness of facilitated tucking. These authors documented that generalized motoric containment of an infant's arms and legs close to the infant's body, while in a side-lying or supine position, resulted in significantly lower heart rates, less crying and sleep disruption times, and fewer sleep-state changes after a painful heelstick procedure than without motoric containment.

The study by Corff et al. (1996) identified one simple nursing intervention to be beneficial in supporting preterm infants' self-regulatory abilities during a minor painful procedure. These authors suggested that parents be taught to use this intervention to provide them with a role in soothing their infant. It may also decrease parents' feelings of helplessness in comforting and caring for their preterm infant (Corff et al.).

Taquino & Blackburn (1994) documented the effects of containment during suctioning and heelstick procedures on physiological and behavioural responses of preterm infants. The sample consisted of 14 preterm infants 24 - 33 weeks GA (mean 28.3 weeks), with birth weights 769-1729 grams (mean 1146 grams). All infants had respiratory distress requiring mechanical ventilation. There were no significant differences in responses of the containment group between suctioning versus a heelstick and therefore, the groups were collapsed into control group versus containment group. Compared to control group infants, infants who received containment had less variation in heart rate changes, more stable oxygen saturation levels, less behavioural stress cues during suctioning or heelstick, and a quicker recovery to baseline status following the procedures.

To summarize, preterm infants require support from caregivers to facilitate and maintain postures that enhance physiologic functioning and motor

control, and reduce procedural stress. Prone and side-lying positions, swaddling, nesting, and containment have been shown to assist the preterm infant to maintain the desired posture, and promote quiescence and energy conservation (Al et al., 1986; Blackburn & Vandenberg, 1993; Corff et al., 1996; Fox & Molesky, 1990; Masterson et al., 1987; Short et al., 1996; Taquino & Blackburn, 1994).

Light and Sound Levels

The effect of light and sound levels in neonatal nurseries has been studied extensively as individual variables that impact on critically ill and preterm infants' physiological and behavioural systems stability. Continuous high environmental light and noise levels are considered a source of stimulation and stress for these infants. The occurrence of sensorineural hearing loss is 4% in LBW infants and 13% in VLBW infants compared to 2% among all newborns (Thomas, 1989).

Average noise levels in NICUs have been documented to range from 50 to 85 decibels (dB), with peak levels of 108 to 114 dB (DePaul & Chambers, 1995; Strauch, Brandt, & Edwards-Beckett, 1993; Thomas, 1989). DePaul and Chambers (1995) and Thomas (1989) documented that noise generated by routine caregiving activities exceeded 50 dB, and that these were repetitive throughout the day and night. To place this in perspective of daily life, the average living room sound level ranges from 40 to 50 dB, conversation speech is about 60 dB, and heavy auto traffic is 75 to 85 dB (DePaul & Chambers; Thomas). It was the perception of some parents whose infants were born prematurely and spent time in a NICU, that poor nocturnal sleeping was a result of exposure to constant light and noise (Mann, Haddow, Stokes, Goodley, & Rutter, 1986).

Noise levels in the NICU result in changes in colour, heart rate, and respiratory effort, and disrupt the sleep-wake cycles that an infant requires for

normal growth and development. Long, Lucey, and Phillips (1980) demonstrated that sudden peaks in noise levels resulted in decreased transcutaneous oxygen tension, increased intracranial pressure, increased heart and respiratory rates, agitation, and crying. The sample size was very small in this study, and consisted of two preterm infants, who were 35 weeks and 34 weeks GA, with birth weights of 2430 grams and 2020 grams, respectively. A total of nine sudden noise levels (generally 70 dB or greater) were noted and resulted from activities such as closing incubator ports.

Mann et al. (1986) studied 41 healthy preterm infants with a mean GA of 31 weeks, mean birth weight of 1630 grams, and ranging between one to 63 days old on entry to the study. The control group (n = 21) were in a nursery environment where the light remained constant. Infants in the experimental group (n = 20) received reduced lighting and noise levels from seven pm to seven am for 19 days. These authors reported that infants exposed to day-night light and sound cycles experienced greater weight gain, spent more time sleeping, and less time feeding than infants who were not exposed to day-night cycles. These differences were significant and became apparent only after the infants were discharged home. These authors concluded that day-night cycling may assist the preterm infant with establishment of a circadian rhythm.

Blackburn and Patteson (1991) examined the effect of cycled lighting on the cardio-respiratory function and activity levels of preterm infants. The sample consisted of nine infants in the control or continuous lighting group (mean GA 31.3 weeks, birth weight 1343 grams, and chronological age 12.1 days), and nine infants in the experimental or cycled lighting group (mean GA 31.2 weeks, birth weight 1425 grams, and chronological age of 12.4 days). The infants in the cycled lighting group experienced an average of 10.7 hours of reduced lighting during

the evening and night hours.

Blackburn and Patteson (1991) found that infants in the cycled lighting group had significantly lower motor activity levels and heart rates during the periods of reduced lighting, compared to periods when the lights were on. There were no significant within group differences in activity levels and respiratory or heart rates for infants in the continuous lighting group when day-night rhythms were examined. During the day, when the lights were on for both groups of infants, there were no significant between group differences for activity level and respiratory rate; however, heart rate was significantly lower for the cycled lighting group.

According to Blackburn and Patteson (1991), the results of this study suggested that decreased light levels at night may facilitate rest and subsequent energy conservation in preterm infants. These authors postulated that the lower heart rates and activity levels, occurring during reduced lighting, may be indicative of decreased arousal and greater physiologic stability. Blackburn and Patteson also suggested that reduced lighting at night may also promote the development of circadian rhythm. However, a confounding variable may have been that the changes in heart rate and activity levels could have been related to overall environmental changes and not just the decreased lighting; when the lights were dimmed, noise levels and staff activity levels in the room also decreased.

Shogan and Schumann (1993) examined the effects of environmental lighting on the oxygen saturation levels of preterm infants in the NICU. Twenty-seven infants ranging between 26-37 weeks GA, two to 56 days of age, and with a mean birth weight 1781 grams, served as their own controls in this study. Although no statistically significant decrease was found in oxygen

saturation levels when the light levels were decreased from 100 footcandles (ft-c) to 5 ft-c, 22% of the study group showed a statistically significant decrease in oxygen saturation when the light level was abruptly increased from 5 ft-c to 100 ft-c. These authors proposed that rapidly increasing illumination may be a cause of stress to the less gestationally and postnatally mature preterm infant. A secondary finding of this study was that environmental noise caused many infants to experience decreased oxygen saturation levels. Although noise was not measured and the levels that caused oxygen desaturations were unknown, the gross findings were consistent with the measured findings of Long et al. (1980).

Strauch et al. (1993) implemented a quiet hour at the end of each eight hour shift in a newborn developmental care unit. These authors reported that sound levels decreased significantly during designated quiet times to a mean level of 52.2 dB, compared with a mean level of 58.3 dB during the control period. During quiet time, 84.5% of infants were in a light or deep sleep state, compared to 33.9% during the control period. There were fewer infants crying during quiet hour than the control period (2.4 versus 14.3%). Sample size and gestational ages of the infants were not documented in this study. However, the unit served as a transition unit for stable preterm infants transitioning from hospital to home.

Torres, Holditch-Davis, O'Hale, and D'Auria (1997) determined the effect of modifying a single aspect of the intermediate care environment on the incidence of apnea and rate of weight gain in convalescent preterm infants. Twenty-two preterm infants were assigned to experimental and control groups using a randomized, matched-pair design. Standard nursing care of convalescent preterm infants was compared with nursing care that provided a one and a half

hour quiet period four times a day, for 21 days. During this quiet time, the infants' incubators were covered and they were left undisturbed, except for emergency care. Two quiet periods were provided during the night to facilitate day-night cycling. Infants in the experimental group had more apnea at the start of the study than infants in the control group. Although both groups showed a reduction in the incidence of apnea over the study period, this reduction was significantly quicker in the experimental group. These infants also gained significantly more weight than infants in the control group when adjustments were made for the differences in starting weight. Torres et al. demonstrated that a simple modification of nursing care which promotes rest in preterm infants, can facilitate weight gain, and possibly reduce apnea, enabling the preterm infant to be discharged home earlier.

Gray, Dostal, Ternullo-Retta, and Armstrong (1998) implemented three components of a developmentally supportive care protocol: lower noise levels, decreased light levels, and flexed, midline positioning. The sample consisted of 49 infants with a mean GA of 35 weeks and a mean birth weight of 2107 grams. The developmental care interventions were implemented following extensive staff education, and consisted of two hours of quiet time during each eight-hour shift. Baseline sound levels in the unit ranged from 64 to 70 dB, which is considered annoying. The highest sound levels were recorded at the change of shift and during new admissions. A comparison of light and noise levels measured between nonquiet and quiet times revealed statistically significant decreases in both variables during this project. Optimal positioning was achieved 78% of the time. Infant responses during quiet time were not recorded in this study. This research utilization project revealed that light and sound levels in the NICU were lowered through implementation of quiet times, and

that improved positioning of infants was achieved through staff education.

Nonnutritive Sucking

Providing critically ill and preterm infants opportunities for nonnutritive sucking (NNS) is a significant developmental care intervention which helps these infants to adapt and respond to their environment. NNS is an important self-calming and self-regulatory activity that improves state control, reduces stress, promotes weight gain, enhances feeding ability, and improves oxygenation (Kimble, 1992). Several studies have examined the various behavioural and physiological effects of NNS on critically ill and preterm infants.

Field and Goldson (1984) found that term and preterm infants who received NNS opportunities, spent significantly less time fussing and crying during and following heelstick sampling, than infants who were not given NNS opportunities. Field and Goldson compared the behavioural states, heart and respiratory rates of 96 preterm and 48 healthy fullterm infants pre- and post-heelstick sampling. Preterm infants were further stratified into minimal care preterm infants (n = 48, mean GA 34 weeks, mean birth weight 2021 grams, mean PCA 35 weeks), and intensive care preterm infants (n = 48, mean GA 29.5 weeks, mean birth weight 1300 grams, mean PCA 41.5 weeks). Term and minimal care preterm infants in the experimental group demonstrated less behavioural distress, less vacillations in heart and respiratory rates, and a quicker return to baseline values compared to infants in the control groups. NNS with a pacifier in the group of intensive care preterm infants was effective in reducing behavioural distress but not physiological arousal. Field and Goldson suggested that self-regulating or calming behaviours such as sucking appeared to help alleviate the general stress of NICU care.

Gill, Behnke, Conlon, McNeely, and Anderson (1988) found that preterm infants (n = 12, median weight 1420 grams, median PCA 32.8 weeks), offered NNS during gavage feedings had increased transcutaneous oxygen levels, lower heart rates, and less restlessness, resulting in lower oxygen expenditure than infants in the control group (n = 12, median weight 1540 grams, median PCA 34.1 weeks). NNS was also an effective modulator of behavioural state in this sample of preterm infants. When NNS was offered to the preterm infants prior to feedings, the time spent in restless states decreased and time spent in awake states increased, when compared to the control group (Gill et al.). The results indicated that NNS can either arouse sleeping infants or calm restless infants. Gill et al. recommended that NNS for five minutes prefeeding is a brief and simple intervention in a busy NICU, in the absence of cue-based feeding protocols.

Bernbaum, Pereira, Watkins, and Peckham (1983) found that NNS during gavage feedings accelerated maturation of the sucking reflex, facilitated a more rapid transition from gavage to oral feedings, decreased intestinal transit time and improved weight gain. The sample consisted of thirty healthy preterm infants, in a transitional nursery, who weighed < 1500 grams at birth and were on average ten days old. Gestational ages of the infants were not documented. Infants in the experimental group were offered NNS opportunities with a pacifier during all gavage feedings, while infants in the control group were not. Neither group were offered NNS between feeds. Infants in the NNS group demonstrated higher sucking pressures and a more coordinated sucking pattern when bottle feedings were introduced, and took six days less in the transition between total oral and total gavage feeds, compared to infants in the control group. An unexpected finding was the significant weight gain for infants who

received NNS opportunities despite a similar caloric intake. These authors suggested that the decreased activity level in infants who were offered NNS helped to reduce energy expenditure and contributed to improved weight gain.

On closer examination of the studies by Bernbaum et al. (1983) and Gill et al. (1988), the findings are remarkable given that infants in the control groups were denied any NNS opportunities throughout the study period, while infants in the intervention groups had their NNS opportunities severely restricted to immediately prior to and during feeding. These authors did not describe alternative strategies, over the course of the studies, to help the infants self-calm or self-regulate following other caregiving activities, or procedures not related to feeding.

McCain (1992), studied the effects of 1) NNS, 2) NNS and rocking, and 3) stroking, to facilitate transition to an inactive awake state prefeeding. The inactive awake state is considered optimal for feeding preterm infants because it enhances their interactive and physiological abilities, thus, enhancing infant-mother interactions and the success of feeding (McCain, 1992). Twenty preterm infants (GA 27 - 33 weeks, M = 31.6 weeks; birth weights, 931 - 2140 grams, M = 1949 grams) served as their own controls and were randomly administered each of the three interventions plus a control condition. The Anderson Behavioural State Scale was used to assess infant state; heart rate was also recorded. Each intervention consisted of 10 minutes of NNS, NNS/rocking, or stroking.

In the McCain (1992) study, NNS was successful in modulating both sleep and restless behaviours to inactive awake states. Preterm infants were most often found to be in restless and sleep states immediately prior to feeding. There was no advantage in the addition of rocking to NNS. In fact, the inclusion of rocking resulted in a higher heart rate than NNS alone. The infants in the NNS

group had the lowest heart rate, lower than infants in the control group. Stroking preterm infants to bring them to optimal states for feeding was not only ineffective, but in terms of heart rate, was less calming than no intervention at all. This adverse finding supported Als (1986) Synactive Theory of Infant Development; stimulation that is inappropriate in quality and/or timing may cause physiological and behavioural overload for preterm infants (Als, 1986). McCain concluded that stroking was an inappropriate intervention in the prefeeding context, whereas NNS was very effective.

Skin-to-Skin Cuddling

Skin-to-skin cuddling, introduced to NICUs in Canada and the United States in the late 1980s, has rapidly evolved as a practice in intensive care nurseries to support parenting and promote physiological and behavioural regulation in the infant (Gale & VandenBerg, 1998; Ludington-Hoe & Swinth, 1996). The greater intimacy of skin-to-skin contact helps many parents to feel connected to their infant, and it enhances closeness and familiarity between the infant and the parent in the NICU (Affonso, Bosque, Wahlberg, & Brady, 1993; Gale, Franck, & Lund, 1993; Gale & VandenBerg; Ludington-Hoe & Swinth). Klaus and Kennell (1982) described holding as one of the critical steps of parent-infant attachment.

Skin-to-skin cuddling facilitates organization of the central nervous system by supporting autonomic, motor, and state systems regulation (Ludington-Hoe & Swinth, 1996). When a parent holds their infant vertically against their chest skin-to-skin, the infant's respirations, heart rate, and oxygen saturation levels become more regular (Acolet, Sleath, & Whitelaw, 1989; Legault & Goulet, 1995; Ludington-Hoe, Thompson, Swinth, Hadeed, & Anderson, 1994), there is less apnea and periodic breathing (Legault & Goulet,

1995; Ludington-Hoe et al.), tone and flexion improve, there is less activity, an increase in deep sleep (Ludington-Hoe, 1990) and body temperature is maintained (Acolet et al.).

Acolet et al. (1989) studied heart rate, skin temperature, and oxygenation by transcutaneous oxygen ($tcPO_2$) and pulse oximetry in fourteen VLBW infants while they were positioned prone in the incubator and during skin-to-skin cuddling. The infants in this study had a mean GA of 28 weeks, a mean birth weight of 1060 grams, and median age of 35 days old at the time of the study; five infants had chronic lung disease. There were no adverse effects detected, such as apnea or bradycardia, when the infants were held skin-to-skin. The infants with normal lungs maintained $tcPO_2$ and oxygen saturation levels, while their heart rate rose significantly during skin-to-skin cuddling. The five infants with chronic lung disease showed a statistically significant increase in $tcPO_2$; oxygen saturation levels and heart rate also increased, but these parameters did not reach statistical significance in this small sample. The infants all wore hats and were covered with blankets during skin-to-skin; their skin temperatures were well maintained or slightly increased. Acolet et al. concluded that infants as small as 1000 grams with stable respiratory effort could enjoy skin-to-skin cuddling, with their parents, with no evidence of cold stress. Far from compromising breathing in infants with chronic lung disease, skin-to-skin contact was associated with an improvement overall in $tcPO_2$ (Acolet et al.).

Ludington-Hoe (1990) examined the effect of skin-to-skin cuddling on correlates of energy expenditure, namely heart rate, activity level, and behavioural state, in eight convalescent preterm infants, who were 34 to 36 weeks PCA, weighed on average 2166 grams at the time of the study, and who served as their own controls. During skin-to-skin cuddling a significant

reduction in activity occurred, the infants spent more time in deep sleep and less time in light sleep, and the infants' heart rates did not decrease as expected; these effects did not extend beyond the skin-to-skin cuddling period. Given that activity accounts for 40% of an infant's daily energy expenditure, Ludington-Hoe concluded that energy conservation was likely during skin-to-skin cuddling.

Ludington-Hoe et al. (1991) evaluated the effect of skin-to-skin cuddling for twelve stable preterm infants in cots, who were within four days of discharge. The infants who were on average 36 1/7 weeks PCA and weighed an average of 2148 grams at the time of the study, served as their own controls. An increase in heart rate and skin and rectal temperatures reached statistical significance. However, heart and respiratory rates, oxygen saturation levels, and skin and rectal temperatures all remained within normal limits, suggesting that skin-to-skin cuddling had no adverse effects.

Ludington-Hoe et al. (1994) conducted a randomized controlled clinical trial with twenty-five convalescing preterm infants who did not require oxygen support. At the time of the study the infants were between 35 6/7 and 36 4/7 weeks PCA and all weighed greater than 2000 grams. Heart and respiratory rates, oxygen saturation, abdominal temperature, and behavioural state were recorded before, during, and after one skin-to-skin cuddling session or control conditions (incubator care).

Average skin temperature and heart rate rose significantly during skin-to-skin cuddling; respiratory rate also increased. Average oxygen saturation decreased 1% during skin-to-skin cuddling, a clinically insignificant drop. Periodic breathing was common for both control and experimental group infants when in their cribs, with heart rates often approaching bradycardic and tachycardic rates. However, this autonomic instability was absent during skin-to-

skin cuddling. The percentage of time the intervention group infants spent in deep sleep during skin-to-skin cuddling was doubled. This significant increase in deep sleep for skin-to-skin cuddling infants differed significantly from the control group infants, who showed no changes. The improvement in sleep time was accompanied by statistically significant decreases in all of the activity states (Ludington-Hoe et al., 1994).

Based on the promising results of skin-to-skin cuddling in convalescing preterm infants, Ludington-Hoe et al. (1994) went on to conduct a pilot study with six infants who required incubator care, and were between 34 and 34 4/7 weeks PCA and weighed greater than 1770 grams at the time of the study, using the same methodological design. Heart rate and abdominal skin temperature increased while periodic breathing decreased remarkably during skin-to-skin cuddling. During skin-to-skin cuddling the infants did not react to environmental disturbances with the usual wide fluctuations in behavioural state compared to infants in the control group. This observation suggested that skin-to-skin cuddling can either mediate or buffer behavioural responses to environmental disturbances (Ludington-Hoe et al).

Affonso et al. (1993) explored the effect of skin-to-skin cuddling on a mother's emotional reactions and on the infant's physiological status. Eight mother-infant pairs participated in skin-to-skin cuddling for a minimum of four hours each day, for six days per week, for three consecutive weeks. Infants were eligible for the study if they were not intubated, receiving intra-venous therapy, or phototherapy, weighed greater than 1250 grams, had no known neurological impairment, and their physical stability was sufficient to permit skin-to-skin contact. Themes that were identified by Affonso et al. from the mothers' perceptions and emotional responses to the experience included: 1) a sense of

mastery as they regained a sense of control over their emotions and self-confidence in being a mother, 2) feelings of reconciliation and healing, which occurred over time, as mothers placed their infants skin-to-skin, and 3) a sense of physical intimacy and emotional closeness with their infant. Affonso et al. found that mothers who held their infants skin-to-skin expressed greater self-confidence and self-esteem than mothers in the control group. These authors concluded that skin-to-skin cuddling facilitated psychological healing and the regaining of the mothering role in a NICU. The physiological responses of the infants were reported in detail by Bosque et al. (1995).

Bosque et al. (1995) compared the physiological response of infants during skin-to-skin cuddling using a pretest- posttest design. Oxygen saturation levels, heart and respiratory rates, and incidence of apnea and/or bradycardia were similar during both skin-to-skin cuddling, and while the infant was in the incubator. The infants experienced less total light and transitional sleep states during skin-to skin cuddling, but there were no differences in the percent of deep sleep. The infants' mean temperatures were slightly lower during skin-to-skin cuddling compared to pre and post periods. However, the infants' mean temperature remained within normal limits; this difference was not considered to be clinically significant. Bosque et al. concluded that extended periods of skin-to-skin cuddling were safe and feasible for eight convalescing preterm infants and their mothers.

Gale et al. (1993) described the experience of skin-to-skin cuddling of 25 intubated infants in the NICU and their mothers. Intubated infants of any weight or gestation were eligible for skin-to-skin cuddling if they were physiologically stable. Physiological stability was defined as stable temperature, absence of bradycardia or decreases in oxygen saturation levels with handling,

and rapid recovery to baseline vital signs after caregiving. The transfer of the infant from the incubator to the parent's chest was found to be most physiological stressful. Infants who weighed ≤1200 grams or were ≤30 weeks PCA were found, in general, to demonstrate a different behavioural response pattern than more mature infants to skin-to-skin cuddling. These VLBW infants tended to have 15 to 20 minutes of quiet comfort with stable oxygen saturation levels on their parent's chest before they became restless, appeared less comfortable, and had frequent decreases in their oxygen saturation levels. As the infants matured, they tolerated longer periods of skin-to-skin cuddling.

Both mothers and fathers in this study described skin-to-skin cuddling as a positive experience and one that was personally beneficial. They reported feelings of stronger identification with their infant, knowing their infant better, and greater confidence in their infant's need for them, and in their ability to meet these needs. Gale et al. (1993) also described the responses of nurses. Following participation in skin-to-skin cuddling by a parent, nurses commented that their attitude about the role of the parent in the NICU changed, particularly in regards to whom the infant "belonged" to. The nurses were impacted in a meaningful way by the empowerment they saw in the mothers. Gale et al. concluded that skin-to-skin cuddling of tiny ventilated infants was safe, and it promoted parent-infant attachment, offering parents a way of being with their infants to overcome some of the barriers to attachment imposed by the NICU environment.

Legault and Goulet (1995) compared skin-to-skin cuddling with traditional cuddling (defined as swaddled in a blanket) evaluating both the infant's physiologic parameters and the mother's satisfaction and preference for method. A convenience sample of 71 infant-mother pairs were recruited from an

intermediate neonatal care unit. The infants' mean GA was 30 weeks and mean birth weight was 1225 grams; at the time of the study infants weighed on average 1409 grams and were an average of 28.6 days old. In a repeated measures design, where infants served as their own control, skin temperature, heart rate, respiratory rate, and oxygen saturation levels were monitored during one session of skin-to-skin cuddling, and during one session of traditional cuddling.

Outcome data from this study revealed little variation in physiologic parameters in the preterm infants who were skin-to-skin cuddling. The skin-to-skin cuddling method produced less variation in heart rate and oxygen saturation levels, longer duration of cuddling, and it was preferred by most of the mothers compared to traditional cuddling. The heart rate decreased in all infants during both cuddling methods, but this decrease was not clinically or statistically significant. Bradycardia was noted in one infant during skin-to-skin cuddling compared with four episodes during the traditional method. Respiratory rate varied with cuddling method, but did not reach statistical significance; the infants had less respiratory pauses during skin-to-skin cuddling.

With both methods the infants had lower oxygen saturation levels. Although cuddling time for both methods was planned for 30 minutes, 31% of the infants during traditional cuddling were returned to the incubator prior to 30 minutes, for oxygen saturation levels of lower than 85%. Of the mothers in this study, 73.8% preferred skin-to-skin cuddling to the traditional method of cuddling. The mothers felt that their infants were closer to them, and that they could touch and caress their infants' entire bodies when skin-to-skin cuddling. Legault and Goulet (1995) concluded that VLBW infants tolerated skin-to-skin cuddling better than traditional cuddling and for long periods.

Although there were differences in these research studies in regards to

whether the infant's body temperature remained the same or increased during skin-to-skin cuddling, the assumption that skin-to-skin cuddling may cause hypothermia in tiny infants was disproven. The infants stayed warm by a process of thermal synchrony. Acolet et al. (1989) and Ludington-Hoe (1990) found a significant increase in heart rate during skin-to-skin cuddling, whereas Bosque et al. (1995) did not. More importantly, none of the studies reviewed found that skin-to-skin cuddling precipitated apnea and bradycardia which was a concern for many health care providers. Instead, the physical contact during skin-to-skin cuddling was nurturing.

Although current research demonstrates benefits of skin-to-skin cuddling, primarily in relation to physiological stability, evidence for improved developmental function is beginning to emerge (Gale & VandenBerg, 1998; Ludington-Hoe & Swinth, 1996). Skin-to-skin cuddling supports the infant's development by facilitating parent-infant co-regulation, defined as the sensory interaction of touch and smell, feeling each other's heartbeats, and hearing each other's sounds, as the infant is enclosed within the parent's body (Gale & VandenBerg). "The closeness of skin-to-skin cuddling facilitates a sensory dialog between infant and parent" (Gale & VandenBerg, 1998, p.69), which becomes an important mode of communication. Analogies can be drawn between the process of parent-infant co-regulation that occurs during skin-to-skin cuddling and the process of infant-infant co-regulation that occurs when twin infants are co-bedded together. The literature available on skin-to-skin cuddling is congruent with the early clinical evidence available on co-bedding which reveals thermal synchrony, and autonomic, motor, and state regulation resulting from close physical contact between twins.

The evolution of co-bedding in the SCN has followed a similar path to

that of skin-to-skin cuddling. Both initiatives have been consumer driven on the part of the parents and have received attention in the media. Stories on the television, in newspapers and magazines, and appealing photographs of either parents and their tiny infants snuggled together, or premature twins snuggled together have generated much public interest, and challenged health care professionals to explore these experiences with parents. The research available on the efficacy of skin-to-skin cuddling in VLBW and ELBW infants is sparse. In some NICUs, skin-to-skin cuddling is promoted based on results of initial studies of healthier preterm or fullterm infants. As individual NICUs gain experience and competence with skin-to-skin cuddling of more stable and mature preterm infants, the practice is extended to less mature and more fragile infants (Bosque et al. 1995). Thus, the skin-to-skin cuddling experience in the NICU can provide insight and context for the implementation of co-bedding.

Developmentally Supportive Care Protocol

Each of the individual components of developmentally supportive care, positioning, light and sound levels, NNS, and skin-to-skin cuddling, have been reported to affect the infant's autonomic, motor, state, self-regulatory and interactive subsystems in important ways. Although there is a lack of research studies that evaluate these integral components of developmental care as a whole in one protocol, the research supporting each component of developmentally supportive care provides cumulative evidence towards the benefits of a total individualized developmental care protocol (Lotas & Walden, 1996). A small group of studies examining the impact of an integrated developmental care protocol, in which all components of the protocol are used synergistically to provide developmentally supportive care for preterm infants, in the NICU, were reviewed. The following studies focused on preterm infants

who were free of known congenital defects, chromosomal anomalies, and fetal exposure to drugs of addiction.

Als et al. (1986) used a phase lag design, over a two year period, to examine the impact of an individualized developmental care protocol in 16 singleton, VLBW infants who were receiving ventilation and had developing bronchopulmonary dysplasia (BPD). In this study BPD was defined using classification developed by Northway and Rosan (1968). The developmental care protocol was implemented in the second year of the study. Eight control and eight experimental infants were selected for the study based on the following criteria: 1) birth weight ≤1250 grams, 2) GA ≤28 weeks, 3) required ventilator support for ≥24 hours within the first 48 hours of life, and 4) oxygen requirements of 60% for more than two hours, during the first 48 hours of life.

Als et al. (1986) demonstrated that modification of standard or traditional NICU caregiving procedures, according to the individual preterm infant's behavioural responses, resulted in improved medical status during hospital stay, and improved developmental outcomes at nine months of age for eight infants given developmentally supportive care, compared with eight infants given standard care. Infants in the experimental group spent significantly fewer days on the respirator (18 vs 43 days), required fewer days of supplemental oxygen (33 vs 66 days), and achieved earlier complete breast and/or bottle feedings (50 vs 79 days)(Als et al., 1986). Medical outcome variables that did not reach statistical significance included: average weight gain from birth to discharge, younger age at hospital discharge, and shorter hospital stay, although the group differences favoured the experimental group. No significant group differences were noted for weight, length, and head circumference at three, six, and nine months corrected age (Als et al., 1986).

Developmental outcomes for infants in the experimental group were more favourable when compared to infants in the control group in this study. One month after their expected due date, experimental group infants demonstrated significantly better behavioural organization scores, as measured by the Assessment of Preterm Infant Behaviour (APIB) (Als, 1986). These infants were more well modulated, had greater motor control and self-regulatory abilities, significantly less motor extension behaviours, and more normal reflexes (Als et al., 1986). Additionally, infants in the experimental group had significantly better mental and psychomotor performance, as measured with the Bayley Scale of Infant Development, and significantly better behaviour regulation scores in videotaped play observation, at nine months corrected age (Als et al., 1986).

Als et al. (1994) replicated the 1986 study, by using a larger multicentered randomized controlled trial design. These authors demonstrated similar benefits from individualized developmental care in terms of medical and neurodevelopmental outcomes in 38 singleton VLBW infants, born between 24 and 30 weeks gestation, with developing BPD. Control group infants (n = 18) received standard NICU care which included a standard developmental care protocol, involving uniform draping of incubators with covers, dressing the infants, as well as a 24 hour visiting policy for the parents. Infants in the experimental group (n = 20) were cared for by a nurse specifically educated in individualized developmentally supportive caregiving for at least one shift in a 24 hour period, beginning on admission.

Outcome data that reached statistical significance and favoured the experimental group of infants included fewer days on oxygen (56.8 vs 139.4 days), reduced incidence of intraventricular hemorrhage (IVH), reduced severity of

BPD, earlier transition to oral feedings (59 vs 104 days), and earlier discharge home (39.7 weeks PCA vs 2 months corrected age). Medical outcome variables that favoured the experimental group, but failed to reach statistical significance included shorter duration of mechanical ventilation (28.3 vs 63.8 days), decreased incidence of pneumothorax, and increased average daily weight gain. Of note, the incidence of IVH in control group infants was higher than in many other NICUs (Merenstein, 1994). This finding may be attributed to the fact that the study was conducted prior to implementation of surfactant therapy.

Infants in the experimental group scored higher on developmental outcomes, as measured by the APIB, and visual evoked potential measures at two weeks after their expected due date. At nine months corrected age, experimental group infants had significantly higher Bayley Mental and Psychomotor Developmental Index scores, and improved behavioural regulation scores in videotaped play observation. Three of the 14 parent-infant interaction variables, turntaking, synchrony of interaction, and quality of the interaction favoured the experimental group. Als et al. (1994) concluded that VLBW preterm infants in this study benefited from individualized developmental care in the NICU, in terms of medical and neurodevelopmental outcome.

Becker et al. (1991) investigated whether developmentally supportive caregiving implemented through a general program of nursing staff education, and accompanied by ongoing support and consultation could significantly improve shortterm and longterm outcomes, including medical and growth parameters during hospitalization and behavioural organization at discharge. The sample included 45 VLBW infants and the entire nursing staff of an 18-bed NICU. There were 21 infants in the control group, with a mean birth weight of

1190 grams and mean GA of 28.3 weeks, and 24 infants in the experimental group, with a mean birth weight of 1208 grams and a mean GA of 29 weeks. Using a phase lag design, the infants were studied before and after staff education in developmental care protocols designed to minimize NICU environmental stress, reduce procedural stress, and facilitate motor and state organization in VLBW infants.

Infants in the experimental group demonstrated decreased morbidity, as measured by the Minde's Neonatal Morbidity Scale (Becker et al., (1991), than infants in the control group. Experimental group infants spent fewer days on the ventilator, but this difference did not reach statistical significance. The groups did not differ on either days on continuous positive airway pressure (CPAP) or total days on oxygen. Age at first oral feedings and at last gavage feeding, weight gain, and length of hospital stay favoured infants in the experimental group.

Infants in the experimental group demonstrated improved behavioural organization at discharge, as measured by the Brazelton Neonatal Assessment Scale (NBAS) (Brazelton, 1984). In the Becker et al. (1991) study, the NBAS was given during the week prior to discharge; infants in the experimental group were discharged an average of two weeks earlier than control group infants. The pattern of younger age, but comparable behavioural organization for experimental group infants could, in itself, be interpreted as support for the effectiveness of a developmentally supportive care protocol (Becker et al.). The results of the Becker et al. (1991) study demonstrated that the individualized developmentally supportive nursing care approach for VLBW infants can have a positive impact on their progress during hospitalization. Although the Als et al. (1986, 1994) studies included formally trained primary nurses, a level of expertise not available to most nurseries, Becker et al. (1991) demonstrated that

beneficial effects of developmental care can be achieved with the resources available in most nurseries.

Becker et al. (1993) reported in more depth on the physiological and behavioural outcomes of the VLBW infants in their 1991 study, and also described the effectiveness of the staff education program. The caregiving behaviours of the nurses were assessed by direct observation to determine whether the following components of a developmentally supportive care protocol were being implemented: (a) containment with hands or by swaddling with a blanket; (b) use of positional supports (nests and blanket rolls) for flexed positioning; (c) opportunities for NNS; (d) caregiving in sidelying rather than supine, and; (e) reduction in light and sound levels. Nurse and infant behaviours (oxygen saturation levels, motor activity, posture, and sleep-wake states) were recorded during 18 minutes of routine caregiving, twice a week.

Outcome data of nursing care practice in this study showed significantly greater use of containment, postural support, and opportunities for NNS during the intervention period. Infants were placed more often in a side-lying position. Light levels were reduced most dramatically within incubators and cribs, and day-night cycling was achieved in the convalescent care nursery. There was an overall reduction in noise levels, but a diurnal pattern was not achieved. Results thus indicated that the education program was generally effective in introducing a change in nursing practice to a developmentally supportive caregiving approach (Becker et al., 1993).

In the Becker et al. (1993) study, infants in the experimental group had higher oxygen saturation levels than control group infants. The total amount of motor activity did not differ between groups. However, the quality of motor activity favoured the experimental group infants, who had more flexor

movements and posture, spent less time in mixed and extended postures, and had less disorganized movements than control group infants. The amount of diffuse-alert state, the precursor to alert-wake state, was significantly higher in the experimental group infants. This is of particular importance because time spent in alert states is thought to enhance social development and parent-infant interactions, and to be more predictive of later cognitive development (Becker et al., 1993). There was a fourfold increase in the time spent in an alert state from 30 to 34 weeks PCA for experimental group infants, compared to a twofold increase for control group infants. These authors concluded that developmentally supportive nursing care may be associated with greater physiological stability, and more optimal organization of motor and waking behaviours over time.

Fleisher et al. (1995) using a randomized controlled trial design, demonstrated that developmentally supportive care improved medical and neurodevelopmental outcomes of VLBW infants with developing BPD. BPD was not defined in this study. Using the same inclusion criteria as Als et al. (1994), forty VLBW infants with birth weights ≤1250 grams, GA ≤30 weeks, and who required mechanical ventilation were randomly assigned to treatment or control groups. Infants in the control group (n = 18 survivors) received routine nursing care, which included primary nursing, some draping of incubators, and positional support. Infants in the intervention group (n = 17 survivors) were cared for two out of three shifts by nurses who received training in developmentally supportive caregiving.

Outcome data revealed that infants in the intervention group had fewer days on positive pressure ventilation (37.6 vs 59.7 days), achieved full enteral feedings earlier (22.9 vs 36.5 days), and had shorter hospital stays (91.5 days vs 115.2 days), compared to infants in the control group. The incidence of suspected

necrotizing enterocolitis (NEC), defined as feeding intolerance sufficient to withhold enteral feeds for at least 72 hours, was higher in the control group infants. Infants in the experimental group had improved neurodevelopmental outcome two weeks after their expected due date, as measured by the APIB. More specifically, these infants had more organized performance on motor system function, state regulation, interactive capabilities, and in the ability to self-regulate than infants in the control group. The findings by Fleisher et al. (1995) are consistent with the findings of Als et al. (1986, 1994) that demonstrated improved outcomes for preterm infants who received developmentally supportive caregiving.

Buehler et al. (1995) assessed the effectiveness of developmentally supportive care for 24 low-risk preterm infants, GA 30 - 34 weeks, who did not require mechanical ventilation. Twelve healthy full-term infants were used as a comparison group. The preterm infants were randomly assigned to either a control group and received conventional or standard care, or to the experimental group and received developmentally supportive care. The conventional care group received a standard developmental protocol involving uniform draping of incubators, use of clothing, and a 24 hour visiting policy for the parents. No formal effort was made to prevent contamination effects from the experimental to control group care. Therefore, any experimental effects found were considered to exceed contamination. Formal observations of the preterm infants' behaviours, using APIB, were conducted every seven days until hospital discharge. All three groups of infants were assessed in terms of medical, behavioural (APIB or Prechtl's Neurological Examination of the Fullterm Newborn Infant), and electrophysiologic (quantitative electroencephalograph [EEG]) outcomes at two weeks after their expected due date.

None of the medical outcome measures showed significant between-preterm group differences (Buehler et al., 1995). Both groups of preterm infants were discharged from hospital at a mean PCA of 36 weeks; their weight gain was comparable. However, there were significant differences for behavioural outcome measures. The preterm control group was significantly less well organized than the preterm experimental group on measures of physiologic, motor, state regulation, and attentional functioning. The preterm infants who received individualized developmental care were not only better organized and adjusted than the preterm infants who received standard care, but they were also comparable on electrophysiologic performances to the healthy group of full-term infants. Significant neurophysiologic differences were found between the preterm control and experimental groups, even though there were no medical differences between the groups at the time of the EEG (Buehler et al.).

Based on the study results, Buehler et al. (1995) suggested that differences in experience during the last trimester, a period of active brain development, differentially influences the preterm infant's cortical development and neurodevelopmental functioning. The frontal lobe, in particular, appears sensitive to unexpected environmental stimuli. These differences, measurable at two weeks after the infant's expected due date, may foreshadow the behavioural and scholastic disabilities documented in preterm children at preschool and school ages (Buehler et al.).

To determine the effectiveness of developmentally supportive interventions, Stevens et al. (1996) used a comparative phase-lag design to compare the clinical outcomes of 124 preterm infants. Data were collected for the infants in the conventional-care group (n = 61 survivors, mean GA 28.4 weeks, mean birth weight 1078 grams) during an eight-month period, prior to the

implementation of developmental care. Following extensive staff education, including the training and certification of several nurses as developmental specialists, data were collected for the developmental-care group infants (n = 63 survivors, mean GA 28.5 weeks, mean birth weight 1140 grams).

The Physiologic Stability Index (PSI) developed by Georgieff, Mills, and Bhatt (1989) was used to assess the level of physiologic instability, and provided an overall assessment of the severity of the infant's illness. PSI scores were calculated weekly, and data on the incidence and frequency of developmental care interventions were summarized weekly for each infant. Developmental care was found to have a positive effect on physiological stability, but between group differences did not reach statistical significance. This may be, in part, because no formal effort was made to prevent contamination of the control group by nurses knowledgeable in developmentally supportive caregiving (Stevens et al., 1996).

Finally, the Stevens et al. (1996) study provided information about the most frequently used developmentally supportive care interventions for VLBW infants in their trajectory through the NICU. Developmental interventions were used with varying frequency for all infants in the experimental group. Nesting, flexion, containment, NNS with a pacifier, minimal handling, and clustering of care were most frequently implemented in the first weeks of the infant's stay in the NICU, and decreased over time as they were considered less appropriate. Other interventions such as time-out, offering a pacifier, and swaddling were implemented consistently throughout the infant's stay. These findings are important because they provide information and insight into the consistency and frequency with which developmentally supportive interventions may be applied in daily nursing practice, information that is generally lacking in the

literature. This study also documents more specifically the relationship between developmentally supportive nursing care components and infant outcome.

Stevens et al. (1996) concluded that developmentally supportive care had a positive effect on physiologic stability over time, and on one growth outcome (head circumference), for VLBW infants in this study. Developmentally supportive care had no effect on other clinical outcome measures including days on the ventilator, days on oxygen, and weight gain in this study. These authors conceptualized that physiologic stability is reflective of reduction in stress for infants receiving neonatal intensive care and, as such, could be considered an indicator of quality of life in this population.

Summary

To summarize, the research investigating the effects of individual components of developmentally supportive care, and the synergistic effects of these components in a developmentally supportive care protocol has been promising. Positional support, reduced lighting and sound levels, NNS, and skin-to-skin cuddling were found to facilitate and enhance physiologic, motor, and state regulation in the preterm infant. Prone positioning increased oxygenation and reduced energy expenditure (Fox & Molesky, 1990; Masterson et al., 1987). Swaddling and containment were found to enhance neuromuscular development (Short et al., 1996), and modulate pain-elicited distress in preterm infants (Corff, et al., 1995; Taquino & Blackburn, 1994). Reduction in lighting and sound levels were found to enhance physiological stability (Long et al., 1980; Shogan & Schumann, 1993; Torres et al., 1997). Blackburn & Patteson (1991), Mann et al. (1986), and Strauch et al. (1993) suggested that day-night cycling may assist the preterm infant in establishing a circadian rhythm. NNS was found to be an important self-regulatory activity and modulator of behavioural state in

preterm infants (Gill et al., 1988; McCain, 1992). The process of parent-infant co-regulation during skin-to-skin cuddling was found to enhance physiologic, motor, and state control, and reduce energy expenditure in the preterm infant while skin-to-skin (Acolet et al., 1989; Bosque et al., 1995; Ludington-Hoe et al., 1991, 1994). Affonso et al. (1993) and Gale et al. (1993) found that parents who skin-to-skin cuddled with their preterm infants reported feelings of greater confidence in identifying, knowing, and caring for their infant, as well as feelings of reconciliation and healing.

In comparative phase-lag studies (Als et al., 1986; Becker et al., 1991, 1993) and randomized controlled trials (Als et al., 1994; Fleisher et al., 1995), VLBW infants who received a developmentally supportive care protocol demonstrated more optimal respiratory and feeding status, lower morbidity levels, shorter hospital stays, and improved behavioural organization. The Als et al. (1986) and (1994) studies followed infants up to nine months corrected age, and found that those infants who had received developmental care continued to demonstrate improved neurodevelopmental outcomes over control group infants. Buehler et al. (1995), in a randomized controlled design, also reported that preterm infants who received developmental care showed behavioural and electrophysiologic performances comparable to fullterm infants at two weeks after the expected due date, whereas preterm infants in the control group performed significantly less well; no between preterm group difference in medical outcomes were found. Stevens et al. (1996), in a comparative phase-lag design found that a developmentally supportive care protocol enhanced physiologic stability in preterm infants over time, suggesting stress reduction and improved quality of life while in the NICU.

The studies investigating application of a developmental care protocol

have often been criticized for their methodological limitations and confounding variables which include: small sample size, sample selection bias, nonprobability sampling, complexity of observations and instrumentation used, over-generalization of results, and for using a large number of dependent variables, with inappropriate analysis (Garland, 1995; Lacy, 1995; Lacy & Ohlsson, 1993; Lotas & Walden, 1996; Ohlsson, 1995; Stevens et al., 1996). Even though there is some variation in the definition of specific outcomes measured, instrumentation used, data collection methods, and education of caregivers, it is remarkable to note that in all studies noted above, preterm infants who received an individualized developmentally supportive caregiving protocol had improvements in some aspect of their medical, behavioural, or developmental outcomes. The similarities of these findings are even more noteworthy considering some of the acknowledged limitations and potentially confounding variables that existed through the studies.

Health care professionals in NICUs throughout North America are advocating widespread implementation of developmentally supportive care in response to promising documentation of its benefits (Lotas & Walden, 1996; Garland, 1995). Critics of the research on developmentally supportive caregiving suggested the methodology is too flawed to draw conclusions, and further well designed studies are required prior to advocating universal adoption of this approach to caregiving (Lacy & Ohlsson, 1993). On the other hand, others experts suggested that although many issues regarding the effects of developmental interventions remain unresolved, the clear differences in medical, developmental, and behavioural outcomes cannot be ignored (Lotas & Walden; Merenstein, 1994). The potential benefits, coupled with the lack of any identified adverse effects on this vulnerable population of infants, argues favourably for

the adoption of developmentally supportive caregiving as standard practice in NICUs (Lotas & Walden).

Family-Centered Care

Family-centered care is the second body of literature that formed part of the theoretical framework for this case study. The provision of family-centered health care for infants and children has come to the forefront in the last several years (Dunst & Trivette, 1996). There have been major changes in the participation of families in child health care since the middle of the 20th century (Johnson, 1990). The role of families in hospitals has changed dramatically from the passive, almost invisible role of the 1940's and the early 1950's, to one of ever increasing participatory involvement and collaboration in the nineties (Johnson).

Over the past two decades, the philosophy of family-centered care has emerged in response to the changing health care needs of infants and children, and in the recognition of the central and integral role of the family as nurturer and caregiver (Ahmann, 1994a; Edelman, 1991; Rushton, 1990a; Thurman, 1993). Research on families of both critically and chronically ill children reveals parental wishes for family-centered approaches to care (Ahmann, 1994a). A multiplicity of factors have driven this paradigm shift including: the parent-infant attachment literature, developmentally supportive caregiving, more sophisticated consumers, technological advances, and legislative changes (Bohlig & Sutphen, 1994). Although there are several forces driving changes with regard to parents within the NICU, they all culminate in the ideals represented in family-centered care (Bohlig & Sutphen).

Historically, NICU service delivery models have been more infant-centered than family-centered (Brown, Pearl, & Carrasco, 1991). Beginning in the

1970s, the approach to caregiving in the NICU began evolving from an infant-focused to a parent-infant focused model, and then to family-focused model (Wyly, 1995). In contrast to the infant stimulation programs in the 1970s, the NICU in the 1980s was viewed as over-stimulating (Wyly). In the 1980s, interventions in the NICU turned towards individualized infant assessments, the concept of behavioural or developmentally supportive caregiving, and facilitation of parent-infant interactions (Wyly). Currently, there is a transition occurring in the NICU setting from a family-focused model to a family-centered care approach. The philosophical and service delivery underpinnings of a family-centered care approach distinguish it from family-focused approaches that are supportive of families, but do not alter the nature of care delivery (Wyly). Additionally, participatory involvement of the family distinguishes a family-centered approach from "good clinical practice" (Dunst, 1997).

Philosophy of Family-Centered Care

In the broadest sense a family-centered care philosophy is about meeting the needs of families and their newborns in a humanizing way (Avard, Post, & Drown, 1990). The central tenets of family-centered care are: (1) the family is the constant in the child's life and thus, interventions are designed to enable and support families in their natural caregiving roles, and in fulfilling their infant's physical, social, and emotional needs; (2) to recognize the pivotal role of the family in the child's care and development; (3) to recognize that every family is unique and has strengths, and; (4) to empower and enable families by supporting their individual needs and lived experiences (Ahmann, 1994a; Brown, Pearl, &, Carrasco, 1991; Dunst, 1997; Johnson, 1990; Shelton, Jeppson, & Johnson, 1987; Thurman, 1993). Emphasis is placed on supporting family capabilities and strengths instead of their weaknesses and problems (Dunst; Dunst & Trivette,

1996; Hartrick, 1997; Rushton, 1990b). Family-centered care is not an end in and of its self, but a means, a way of being, and a continual pursuit of being responsive to the needs, concerns, and priorities of infants and families.

Partners in Care is a parent advocacy committee at C & W whose members have adopted the key tenants of family-centered care. In a pamphlet developed by Partners in Care (B.C.'s Children's Hospital, 1997), family-centered care at C & W is described as:

> . . . interacting with families in collegial ways, and respecting their choices and priorities are the cornerstones of family-centered care. Family-centered care in practice is . . . health care professionals and families collaborating on decisions, consulting each other, . . . negotiating differences, . . . and respecting each others expertise.

A key component of family-centered care is parent-professional partnerships. A critical step in developing collaborative relationships with families is to value and respect parental opinions, preferences, and suggestions regarding ways to enhance their infants' care. Parents know their infants best and can provide a valuable perspective regarding the responses of their infants to caregiving (Rushton, 1990b). Creating partnerships with families, from the time of admission, sets the stage for parental confidence and competence in meeting their infants needs after the critical care or NICU experience (Rushton, 1990b). Participatory experiences include various kinds of opportunities that strengthen existing family capabilities and promote acquisition of new skills (Dunst & Trivette, 1996). According to Johnson (1990) it is important to remember that families should be encouraged to participate at a level that they choose, not a level set for them by health care professionals or the hospital; this element of choice is vital.

Family-Centered Care in Practice

While conceptual acceptance of the principles of family-centered care has been easily forthcoming, the incorporation of family-centered care in daily clinical practice has lagged significantly behind (Ahmann, 1994b). Even though there is disagreement among health care professionals on how family-centered care should best be implemented, most caregivers in the NICU recognize the importance of moving in that direction (Wyly, 1995). Thurman (1991) suggested that while a shift has occurred toward family-centered care in children's health services, generally this approach has not been integrated extensively into neonatal intensive care services. Brown et al. (1991) found that while most current programs endorse family-centered care as a "best practice" for developmental interventions with infants, few programs actually implemented these practices, and that most programs utilized only limited components of family-centered care.

Although at the organizational level C & W espouses a family-centered care philosophy, in reality, the approach varies greatly between hospital programs and departments and between health care providers themselves. One of the difficulties in advocating for family-centered care is that many health care professionals genuinely believe that their practices are consistent with the philosophy of family-centered care, yet their actions often do not reflect their beliefs (Johnson, 1990). In subtle and not so subtle ways, the attitudes and practices of many health care professionals, as well as the policies of health care agencies concerning families, do not stand up to a comparison with family-centered principles (Johnson).

Several barriers have been identified impeding the shift in practice to a family-centered care approach including: the technological nature of the NICU,

ethical dilemmas, staff shortages, organizational structure, professional attitudes, and economic trends (Rushton, 1990b). The infant's dependence on complex technology for life support can make parents feel as though they are without control or a role in the life of their infant. Another difficulty is that various aspects of family life, and ways of being with their infant are not established prior to admission of their infant to the NICU, but instead are emerging with the birth of their infant (Bohlig, & Sutphen, 1994). Attitudes of health care professionals, including the reluctance to view parents as competent, also impede a family-centered approach (Cardoso, 1991). Many health care professionals lack experience and familiarity sharing power and decision-making with families, resulting in discomfort with the process. Furthermore, the issues and priorities for family-centered care may not be considered priorities for the NICU staff.

Collaborating with families in the NICU presents challenges for health care professionals who are oriented toward the critical care that maximizes an infant's chance of survival (Wyly, 1995). Family-centered care with its open, multidimensional nature, requires health care professionals to be flexible, and to adapt to the changing demands of the situation. This means making the family the unit of care instead of isolating the infant's needs from those of the family (Rushton, 1990b). To practice a family-centered approach also requires health care professionals to shift from a professionally-centered view of health, to a collaborative model that recognizes the families' values and priorities as central in the plan of care (Ahmann, 1994a). A lag in practice may be due to the depth with which contrary belief systems are embedded in the values of health care professionals (Wyly, 1995).

Family-Centered Care in the SCN

Family-centered care provides a context from which to explore co-bedding twins in the SCN at C & W. Similar to other health care organizations, there is a milieu at C & W where family-centered care is becoming an increasingly pervasive dimension of care delivery and decision-making. Representation by families continues to occur on an ever increasing number of hospital committees. Additionally, the focus of C & W's hospital accreditation in 1995 and 1999 was family-centered care practices, and consumer or family satisfaction. Thus, the request by parents to co-bed their twins in the SCN conceptually fits within this larger paradigm shift of being responsive to the desires and priorities of families.

Parent-professional partnerships is a new and evolving endeavor for health care professionals in the SCN. Certainly the difficulties transitioning to a family-centered approach discussed in the literature hold true for the experiences in the SCN. Collaborating and negotiating with parents, in the implementation of co-bedding twins in the SCN, represented a significant challenge for many health care professionals, as they tried to move from philosophical acceptance to enacting family-centered care in their daily practice.

Responding to parental preferences to co-bed their twins was complicated by the fact that no published studies were available in North America. There was however, clinical anecdotal data available. Therefore, within a family-centered care milieu, health care professionals sought to alter care delivery for twins and their families in the SCN. Importantly, the implementation of co-bedding twins in the SCN did not imply a casualness for safe, competent, evidence-based practice, but instead, consistent with family-centered care, it placed the families and their experiences at the center of the caregiving endeavor (Hartrick, 1997).

From the perspective of family-centered care theory, co-bedding may enhance a family's capacity to care for their infants and be a family in the SCN. Facilitating co-bedding of twins may support families in their natural caregiving roles, as they prepare for caring for their twins at home, and in meeting their infants' needs after the NICU experience. The potential for nurturing and comfort that twin-to-twin contact may provide can help families promote their own health and healing. The NICU experience is often so overwhelming for many families, that it remains a vivid, sometimes bittersweet memory long after their infants have gone home (Wyly, 1995). According to Thurman (1993), the experience that families remember most is the amount and kind of support they received from health care providers. Affleck and Tennen (1991) described mothers' recurring memories of the NICU months after their infants' discharge. The emotional quality and the frequency with which memories of the hospitalization intruded in these mothers' day to day lives, were partly determined by how they had construed or coped with their infant's intensive care. Thus, facilitating a parent's request to co-bed their twins may assist parents to cope with and construct positive memories of their NICU experience.

Summary

Family-centered care theory formed part of the theoretical framework for this case study because it provided a context that enabled the implementation of co-bedding in the SCN. Although family-centered care has progressed in the last several years, much remains to be done in order to provide care that is truly family-centered. The challenge ahead lies in the implementation of family-centered care practices. Improving practices with families will most likely occur when health care professionals more fully understand the characteristics and consequences of different approaches to their work (Dunst & Trivette, 1996).

"Different conceptual and theoretical orientations provide different lenses for viewing one's work with families and for improving health care and other human practices" (Dunst & Trivette, 1996, p. 336). Family-centered care is one such orientation where the approach of "doing with" rather than "doing for" can only serve to strengthen families.

The Experience of Twinship

The third body of literature that contributed to a theoretical perspective for the concept of co-bedding is that of twinship. Twins, and in particular monochorionic twins have been studied extensively to investigate the origins of individual differences, as well as to try to clarify the nature-nurture controversy (Piontelli et al., 1997). Twinship is the closest of all human relationships (Case, 1993; Theroux & Tingley, 1978). Twins, particularly monozygotic or identical twins, "enjoy a bond even closer that the symbiotic connection between mother and child. Cell by cell, their earliest growth and development takes place within a shared oceanic world" (Noble, 1993, p. vii). Twin-born children begin their life sharing -- sharing the womb, sharing their mother. This is an experience that is unique to twins. The connectedness that some twins share throughout their lifetime may be due, in part, to their development in the close proximity of the womb with another growing being (Jodoin, 1986). This prenatal experience, as well as their genetic connections, makes twins, twins. No other human being born a singleton has had to share to this extent, and the sharing continues in their daily lives. They share space, they share time, and they share attention. The experience of co-bedding within the NICU context seeks to capture the intensity of the bond that exists between twins, and the extraordinary potential of twinship.

Maternal-Infants Attachment

The literature on being a twin focuses on the paradox of nurturing individuality while acknowledging the uniqueness of the twin relationship (Albi, Johnson, Catlin, Duerloo, & Greatwood, 1993; Frazer, 1977; Gromada, 1981; Jodoin, 1986; Noble, 1991). Many experts suggest that flexibility and sensitivity is required to allow for the growth of two individuals within the confines of the twin experience. Helping twins to mature as distinct entities is one of the most crucial tasks faced by parents (Gromada; Jodoin). From the moment of birth, it is important to consider and treat each infant as individual and unique, no matter how alike they may seem.

According to Gromada (1981) the key to promoting individuality lies with maternal-infants attachment, and a mother's own need to develop an intimate relationship with each twin. Although the importance of mother-infant attachment has been studied extensively, there is a paucity of research on mother-twin attachments and interactions. The attachment process for a mother with twins is an entirely different experience, and can take much longer compared with maternal attachment to a single infant (Gromada). A basic principle of maternal-infant attachment is monotropy, or difficulty in forming a close attachment to more than one infant at a time. A mother of twins seeks to identify the separateness of each infant, and seeks to identify each infant as an individual apart from the twin; a mother of twins must establish two intimate and separate mother-infant relationships (Frazer, 1977).

Initially, some mothers attempt to resolve the issue of individuality and sameness by stressing the similarities between their twins; they treat the two infants as one, or treat them as exactly alike (Frazer, 1977). However, a mother soon discovers that her infants have differing temperaments and a differing

rhythm of needs. Conversely, other mothers immediately focus on the differences in their twins' appearance, behaviour, and character (Frazer).

Gromada (1981) also found that mothers of twins often attached to "the unit" or the twins, first. Once attached to the unit, the mother began to discover the individual characteristics and personality of each infant. Generally, a mother first notices a difference between each infant's physical appearance followed by differences in behavioural and personality characteristics. Even efforts in identification by behavioural differences can result in treating the infants as a unit, in that, the identified behaviour of one twin may be generalized to the other (Frazer, 1977). Time and shared experienced between mother and infant are necessary for the mother to learn behavioural differences.

Much of the attachment process takes place prior to birth (Gromada, 1981). Thus, if a mother knows she is carrying two infants she begins to attach to two infants instead of only one. During pregnancy, mothers work at identification of each twin through fantasy; following birth, mothers work at identification by establishing congruence between the infants she fantasized in utero, and the real infants she holds in her arms (Frazer, 1977; Gromada). In the case study by Frazer, the mother searched for differentiating features and qualities in an effort to identify the infants as individual human beings so that she might establish a unique relationship with them. The recognition of an infant as one with whom she had previous experiences helped to provide the basis for extrauterine identification.

The second major task that Frazer (1977) described in the "work" of becoming the mother of twins, after identification, was the work of management of twins. Management included feeding, transportation, and fairness. The mother, in the case study by Frazer, established feeding as her primary caretaking

function through which she assessed her ability to care for her twins. She felt consumed with their demands and worked toward establishing a synchronous schedule of sleeping, waking, and feeding for her infants. Although the schedule seemed to treat the infants as a unit, the mother responded to each twin in a separate manner demonstrating an awareness of each infant's needs and individuality. According to Frazer, the discovery of the uniqueness of each twin assisted in the development of a distinctive mother-child relationship.

Anderson and Anderson (1987) described the beginning relationship of ten mothers with their twins. The study explored the mothers' perceptions of each twin and their relationship. The mothers in this study developed a relationship with their twin infants by differentiating their physical characteristics, and polarizing their personality characteristics. The mothers emphasized the differences rather than similarities in their infants' feeding and vocal behaviours, and their awareness of the environment.

Authors have documented that parents who valued individuality tended to focus on the differences in their infants, facilitating the development of a unique relationship with each infant (Anderson & Anderson, 1987). On the other hand, parents who valued equality and fairness tended to focus on similarities, which were not always conducive to the development of individual relationships. Some parenting literature on twins advises mothers not to compare the twins (Anderson & Anderson, 1987). However, according to Frazer (1977), comparison is an important process for parents; comparisons may actually serve to reaffirm the differences between the twins themselves, and help to anchor the twins within the family constellation.

It is extremely important for the mother of twins to see both infants together immediately following birth; seeing her twins together is the reality of

the situation (Gromada, 1981). For twins born prematurely, this is not always possible. Therefore, it is helpful when twins require hospitalization to place the incubators side by side. Mothers who have been separated from one infant, either at birth or when one twin was discharged earlier, reported that they attached easier to the infant who came home first (Gromada). Although it is understandable for this to happen, the outcome can be devastating. If the mother is unaware she is favouring one twin over the other, the mother-child relationship with the excluded infant will suffer and, in turn, the twin-to-twin relationship will also suffer. Theoretically, co-bedding in the NICU may be a strategy that potentially facilitates twins to be discharged at the same time, or with in a shorter time period of each other.

A possible issue with co-bedding could be that it impacts on the attachment process because it encourages parents to treat their infants like a unit. A potential outcome of co-bedding is the synchronization in sleep-wake cycles and feeding times of twins (Nyqvist & Lutes, 1998). Consequently, the infants are fed together and cared for together. Gromada (1981) found that of the mothers she interviewed, almost all the identical twins in her study fell into the same daily routine without the mothers actively trying to put them on the same schedule. Additionally, when both infants have similar routines there may be a lack of time and quiet moments with each infant. More significantly, the key is to nurture individuality and the development of separate infant-parent relationships within the context of co-bedding in a NICU.

When the maternal-infants attachment process is successful and a strong relationship exists between the mother and each of her twins, she interacts and responds to each infant as an individual. Encouraging the development of strong, healthy attachments with each twin, even prior to birth, leads naturally

to an individualistic approach toward nurturing twins (Gromada, 1981). Although the discussion of the attachment process with twins has focused on the mother, the intent was not to exclude the father. However, the literature available concentrated on maternal-infants attachment and interaction.

Activity of Twins in Utero

Several studies correlating the intrauterine behaviour of twins have shown an extraordinary amount of simultaneity in twin activity (Devoe & Azor, 1981; Gallagher et al., 1992; Ohel, Samueloff, Navot, & Sadovsky, 1985; Piontelli et al., 1997; Sherer et al., 1990; Sherer, Abramowicz, D'Amico, Caverly, & Woods, 1991). Several researchers have documented the occurrence of simultaneous fetal heart rate (FHR) accelerations in twins during nonstress testing (Devoe & Azor; Sherer et al., 1990, 1991). Some researchers hypothesized that tactile communication exists in utero between twins (Sherer et al., 1990, 1991). In addition to simultaneity in FHR accelerations and fetal movement epochs, Gallagher et al. documented synchronous fetal behavioural patterns between twins, based on the fetal behavioural states described by Nijhuis, Prechtl, Martin, and Bots (1982). More recently, Piontelli et al. described the existence of intra-pair stimulation in twin fetuses to be an active component of the intra-uterine environment.

Devoe & Azor (1981) studied simultaneous nonstress fetal heart rate testing in twin pregnancy. Twenty-four sets of twins in the third trimester of pregnancy underwent 120 simultaneously recorded nonstress tests (NSTs). Synchronous patterns of FHR accelerations occurred in 14 of the cases (58%) and were associated with twins of similar weights, usually supported by monochorionic or fused dichorionic placentas (71%). Discordant weights (defined as a birth weight difference of more than 20%) between twins and

separate placentas were found in asynchronous twin pairs. Simultaneous FHR accelerations occurred 83% of the time when placental sites were common or shared, and 33% of the time when placental sites were separate.

Ohel et al. (1985) documented the correspondence between FHR accelerations and maternal perceptions of fetal movement in twin pregnancies. FHR accelerations, considered to be an indication of fetal well-being, take place in conjunction with fetal movements, occurring at or near the onset of, but not as a response to fetal movements (Sherer et al., 1990). The ratio of FHR accelerations associated with fetal movement has been shown to increase with advancing gestation in singleton pregnancies (Ohel et al.). Ohel at al. documented an increasing ratio of FHR accelerations to total fetal movements, with increasing gestational age in thirty-four normal twin pregnancies, 28-40 weeks gestation.

During continuous fetal monitoring, the mothers indicated whenever they felt fetal movements. While the rate of FHR accelerations associated with fetal movements to total fetal movements in twin pregnancies was found to be significantly lower than that of singleton pregnancies, the number of FHR accelerations was similar. The finding of a lower ratio of FHR accelerations to total fetal movements, together with the similarity in the number of accelerations in both groups, suggested that the lower ratio in twins was due to a greater number of fetal movements perceived by the mothers. The higher rate of maternal perception of fetal movements in twin pregnancies was therefore, attributed to the cumulated effect of two normally active fetuses (Ohel et al., 1985).

Sadovsky, Ohel, & Simon (1987) evaluated the incidence of simultaneous and independent fetal movements in ten normal twin pregnancies, between 33

and 39 weeks of gestation. The frequency of independent fetal movements was 75.7% and that of simultaneous fetal movements was 24.3%. Sadovsky et al. proposed that independent fetal movements may represent spontaneous fetal movements, originating in the fetus itself. The simultaneous fetal movements may indicate the presence of an external stimuli and therefore, are evoked responses. The possibility that movement of one twin fetus stimulated movement in the other twin was rejected by these authors, based on the finding that in no instance did one fetus move immediately after the second started to move (Sadovsky et al.).

Sherer et al. (1990) in a prospective study of 52 twin pairs and a total of 152 pairs of NSTs, found that 57% of the total FHR accelerations coincided. Only 9% of spontaneously coinciding FHR accelerations were precisely synchronous. Significant FHR accelerations were defined as those that attained a 15 beats/minute rise above baseline and had a duration of 15 seconds. Accelerations were considered simultaneous if the beginning of one occurred within 15 seconds of the beginning of another. Women who were not in labour were included in the study regardless of fetal lie, presentation, maternal disease, or obstetric complications, with the premature rupture of membranes being the only exclusion criteria. Mean GA at the time of NST was 35 weeks.

Sherer et al. (1990) did not confirm the greater synchrony rate of twin NST responses with dichorionic placentas and between twins with growth discordancy, reported by Devoe and Azor (1981). However, the similar results in frequency of simultaneous FHR patterns, 58% reported by Sherer et al. (1990) and 57.1% reported by Devoe and Azor, led Sherer et al. (1990) to conclude that tactile communication exists in utero between twins, with one twin being stimulated by movements of the other. The findings revealed a higher incidence of

simultaneous FHR accelerations than would be expected by random occurrence. Sherer et al. (1990) hypothesized that the mechanism through which tactile communication between twin fetuses may occur is one of intrinsic vibratory-tactile stimulation of one fetus by the other.

Sherer et al. (1991), based on the hypothesis that simultaneous FHR accelerations in twin pregnancies may represent in utero tactile communication between the two fetuses, studied fetal vibratory acoustic stimulation in seven normal twin gestations with simultaneous FHR monitoring. Mean gestation at time of nonstress testing was 35 weeks; mean GA at birth was 36 weeks. All stimulations resulted in immediate, synchronous FHR accelerations in both fetuses, regardless of gestational age or fetal positioning. This finding is in contrast to coinciding, yet nonsynchronous, spontaneous FHR accelerations that occur naturally. The documentation of immediate synchronous FHR accelerations of both twins in response to similar stimuli supported the findings of Sadovsky et al. (1987). However, Sherer et al. (1991) suggested that different processes were responsible for spontaneous and for evoked fetal movements in twin pregnancies.

Gallagher et al. (1992) examined the synchrony of behavioural patterns in twin gestations, considering FHR accelerations, fetal movement epochs, and the concept of fetal behavioural states, in 37 fetal monitoring strips from 15 twin pregnancies. The mean GA at the time of monitoring was 34 weeks and the mean GA at birth was 34.9 weeks. The definition of FHR accelerations was consistent with the previous studies reviewed. In this study, fetal movement epochs were defined as bursts of activity at least 10 seconds in length, and rising at least 30 arbitrary units above baseline; fetal movements epochs were considered simultaneous if one fetal movement began within 15 seconds of

another (Gallagher et al.).

When FHR accelerations alone were considered, synchrony was noted 36% of the time. When fetal movement epochs alone were considered, synchrony was observed 43% of the time. When the fetal behaviour patterns of the twins were examined, on the basis of descriptions of behavioural states by Nijhuis et al. (1982), it was noted that the twins were synchronous 94.7% of the time. The frequency of synchronous FHR accelerations, fetal movement epochs, and behavioural patterns was not affected by gestational age. Monochorionic twins exhibited greater synchrony of fetal behaviour patterns (100%) compared to dichorionic twins (92%). Monochorionic twins also demonstrated greater synchrony in FHR accelerations (46%) compared to dichorionic twins (30%). Like-sex twins were more synchronous in fetal behaviour patterns (98%) compared to the unlike-sex pairs (90%). This difference was not significant for FHR accelerations or movement epochs alone. The tendency toward greater synchrony in like-sex pairs may reflect the greater likelihood for monozygotic twins to be synchronous (Gallagher et al., 1992).

The concept of fetal behaviour patterns in the Gallagher et al. (1992) study revealed a greater degree of synchrony in twin intrauterine behaviour than was demonstrated for either FHR accelerations, or fetal movement epochs alone. Findings by Gallagher et al. supported the earlier findings of Devoe and Azor (1981) and Sherer et al. (1990, 1991), and contributed to the cumulative evidence that twins exhibit remarkable synchrony of behaviour in utero. Use of the concept of fetal behaviour patterns demonstrated that this synchrony is even greater than had been previously conceptualized. Gallagher et al. recommended that the role of fetal behaviour states must be considered when twin interactions and behaviour are studied.

Piontelli et al. (1997) investigated the patterns of evoked behaviour in twin pregnancies during the first 22 weeks of gestation. These authors hypothesized that the existence of intra-pair stimulation would indicate the functioning of fetal tactile and proprioceptive sensibility. Video recordings of ultrasonographic observations were collected on eight twin pregnancies at eight, nine, and ten weeks gestation, 20 twin pregnancies at 11, 12, and 13 weeks gestation, and 20 twin pregnancies at 15-16, 18-19, and 21-22 weeks gestation. All age groups were subdivided into monochorionic and dichorionic pregnancies. In this study, intra-pair stimulation or evoked movements were defined as those occurring within four seconds following a stimulus, and lasting until the fetus reached a state of quiescence.

Outcome data revealed that intra-pair stimulation before 11 weeks gestation was an exceptional occurrence; it was only noted in monochorionic pregnancies with the mechanism likely due to the close proximity of the fetuses, and thinness of the membrane dividing the two amniotic sacs (Piontelli et al., 1997). Intra-pair stimulation occurred progressively more frequently, beginning at 11 to 13 weeks in monochorionic twin pregnancies, and from 12 weeks onward in dichorionic pregnancies. Intra-pair stimulation became a constant and increasing characteristic of all twin gestations after the fifteenth week, and was proposed to be an important and consistent determinant in the intrauterine behaviour of all twins from early mid-gestation (Piontelli et al.). These authors also observed that fetuses can be stimulated even when in motion, and movements which began as evoked can then continue independent of the initial stimulus.

Intra-pair stimulation represented 27% of the total fetal activity of all pregnancies at 15-16 weeks, and 29% at both 18-19 and 20-22 weeks gestation.

Movements progressed with advancing gestation from startles and generalized body activity, increasing in complexity and variability, and becoming more localized to include hand to face contacts or leg extensions (Piontelli et al., 1997). Another interesting finding was that after the tenth week of pregnancy there were epochs in which the fetuses seemed to be unresponsive to stimulation. Piontelli et al. postulated that these rest/activity cycles could perhaps represent the development of behavioural states in the human fetus. These authors concluded that the existence of intra-pair stimulation should not be interpreted that fetuses are having complex interactions, but simply that intra-pair stimulation does exist, and it is an active component of the intrauterine environment (Piontelli, et al.).

Co-Bedding

Twins begin postnatal life with experiences that differ from those of singletons. It is hypothesized that because of their shared intrauterine experiences, "twins are born with unique expectations about what constitutes a natural habitat after birth, and their transition may be facilitated by stimuli generated from uninterrupted physical contact" (Nyqvist & Lutes, 1998, p. 451). Co-bedding twins is a developmentally supportive care strategy based on knowledge of synchronization in sleep and awake states between twin fetuses, a high incidence of coincidental fetal movements and FHR accelerations, and a correlation in blood pressure, because of their shared environment, intrauterine tactile communication, and physiologic interdependence (Gallagher et al., 1992; Levine, Hennekens, & Jesse, 1994; Lutes, 1996; Piontelli et al., 1997; Sherer et al., 1990, 1991). Co-bedding is based on the assumption that adaptation to the extrauterine environment is enhanced by continued physical contact between twins, instead of the sudden deprivation of such contact.

The efficacy of co-bedding has not been supported by scientific research. With the exception of one study published by Nyqvist and Lutes (1998), all of the information available on co-bedding is based on anecdotal clinical evidence encompassing observations, experiences, and the narratives of families and health care professionals. Providing twins the experience to co-bed has been a standard of care in Europe for many years (Lutes, 1996). Since early 1994, several hospitals in the United States have begun to explore co-bedding; St. Mary's Hospital in Duluth, Minnesota, was the first NICU to actively pursue this concept (Miller, 1998).

The media has played a significant role in generating public interest and drawing attention to the practice of co-bedding twins. In November 1995, the Worcester, Massachusetts, Telegram and Gazette reported a story about preterm twin girls, Brielle and Kyrie, who were co-bedded. The impact of this story was profound, raising awareness of the concept of co-bedding among health care professionals and the public, and serving as a major impetus for implementation of co-bedding in North America. The following is a summary of Brielle and Kyrie's story:

> After their birth, at 28 weeks gestational age, the twins were cared for in separate incubators for several weeks. Kyrie, the larger of the twins, at two pounds, three ounces, gained weight steadily, maturing on a steady course. However, Brielle, who weighed two pounds, had difficulty from the start with irregular breathing, frequent bradycardia, and oxygen desaturations. This was coupled with very slow weight gain. Her condition gradually deteriorated, until one day Brielle had an acute episode where she became very distressed with an increased heart rate, more severe oxygen desaturations, and marked colour changes. According to her mother, "she was turning colors and was really getting worked up. Her heart rate was way up. . . . You could tell she was completely stressed out". . . .
>
> When Brielle was placed in the incubator next to her sister, she immediately snuggled up to Kyrie and calmed down. Kyrie

> wrapped her arm around her ill sister. Within minutes, Brielle's blood oxygen readings improved and eventually stabilized. Brielle soon began gaining weight and did not experience any further episodes (adapted from VandenBerg, 1996 based on article published in Worcester, Massachusetts,Telegram and Gazette, November, 1995).

A second powerful narrative appeared in Twins (1997, July/August). The mother described her twins interactive development in utero and the effects of separation and illness in one twin, Matthew, following birth:

> Both twins [Matthew and Joshua] were inside one amniotic sac. Nothing separated our twins' ability to touch one another. . . . I was monitored very closely during the remainder of the pregnancy . . . we had plenty of opportunity to see the [babies] during the ultrasounds, and we quickly began to recognize each one. . . . The extraordinary bond forming between them became more apparent as the pregnancy progressed. The babies were crammed together so tightly that one could not move without the other's cooperation. Even their hearts were practically beating in rhythm, seemingly speeding up and slowing down in unison (Weg, 1997, p. 18).

One of the twins, Matthew, was born with a heart defect and was admitted to the NICU immediately following his birth. The infants remained separated following their birth. Joshua was with his parents, while Matthew remained in the NICU awaiting cardiac surgery. The mother described her infants' responses during their separation from each other:

> It was so sad seeing the twins separated. They were identical. However, by looking into their eyes it was easy to tell them apart. Joshua's eyes twinkled as we all cuddled. . . . Matthew's eyes were sad and lonely and seemed to be calling out for something. I couldn't help thinking that Matthew was feeling the absence if his brother . . . (Weg, 1997, p. 18).

On the morning of Matthew's cardiac surgery the parents were able to bring Matthew and Joshua together, momentarily, for the first time since birth. The mother described the interaction that occurred between Matthew and

Joshua:

> We lay Joshua next to Matthew. At first, both babies lay there, but then a calmness came over Matthew and his heart rate slowed down a little. He turned his head toward Joshua and his eyes opened wide as he gazed at his brother. There was a spark in Matthew's eyes that morning for the first time (Weg, 1997, p. 19).

The benefits of co-bedding are theoretical to date, and include an improved rate of growth and development, less days in hospital, and a decrease in the number of rehospitalizations (Lutes, 1996). Clinical observations reveal that twins who co-bed experience less vacillations in heart rate, have more stable respiratory control, have decreased oxygen requirement, and better weight gain (Lutes; Miller, 1998). When infants are co-bedded, they have been observed to balance and support one another by assisting each other to maintain both motor and state control (Lutes; Miller). Families have reported enhanced parent-infants attachment and an easier transition to home. Given that one nurse on each shift cares for twins who are co-bedded, parent-nurse communication improves, consistency increases, and preparation for transition to home is enhanced (Lutes). It is also conceptualized that the experience in caring for the infants together facilitates the nurse's understanding of the parents' journey at home.

Nyqvist and Lutes (1998), through structured interviews with mothers of preterm infants, documented the responses of preterm twins to co-bedding, and explored the needs of parents of twins during their infants' stay in the NICU. Seven sets of twins were co-bedded within one to eight days of life, in a hospital in Sweden. The infants were born at a mean GA of 33.4 weeks (range 29.4 to 35.6 weeks), with a mean birth weight of 2131 grams (range 1245 - 3080 grams), and were hospitalized for a mean of 27 days (range 6 - 63 days).

Mothers' observations of their infants' responses to co-bedding were

categorized according to the Synactive Theory of Development (Als, 1986, 1995). All mothers in this study, observed differences in their infants' motor behaviours during co-bedding. "The infants showed a variety of movements directed at each other, such as moving closer, touching, holding, hugging, rooting, sucking on each other, and smiling" (Nyqvist & Lutes, 1998, p. 452). The mothers described their infants as more restless when they were separated, and perceived their restlessness and fussiness as signs that they missed and looked for their twin sibling.

Most of these mothers thought that their infants preferred to face each other. They described their infants as calmer and more secure when in this position, and it made it easier for their infants to touch and embrace each other. One mother observed, on more than one occasion, that her infants changed their position to enable them to be face-to-face. Mothers interpreted their infants' behaviours of touching each other faces, and sucking on each other fingers or face either positively or negatively. Some mothers felt that this activity made their infants "angry" and more hungry, while other mothers perceived that these behaviours facilitated breastfeeding (Nyqvist & Lutes, 1998). All mothers observed changes in their infants' sleep-wake states during co-bedding. Their infants woke up together and were awake at the same time. Following caregiving and feeding, they seemed to calm down and fall asleep more easily, which the mothers attributed to feeling the presence of the other twin.

Nyqvist and Lutes (1998) documented that co-bedded twins required a lower environmental temperature. The authors suggested that twins who are co-bedded may be able to maintain their temperature without the support of an incubator or a waterbed, at lower weights and earlier gestational ages than when they are separated. In this study, one set of twins began co-bedding at four days of

age while in an incubator and receiving phototherapy. Within a few days, the infants had axillary temperatures as high as 38.5°C. Various measures to reduce their temperatures were unsuccessful, and finally the incubator heat was turned off, and the portholes left open. The authors did not indicate the length of time this intervention was required. However, turning off the incubator heat stops airflow, and in combination with opening portholes could be considered an unconventional intervention. This intervention is not advocated in the neonatal thermoregulation literature (Thomas, 1994). The twin infants were transferred to a heated waterbed, in a crib, where they continued to be warm; the waterbed was then removed. At weights of 1440 and 1470 grams, the infants were able to maintain their body temperatures clothed and co-bedded, without additional thermoregulatory interventions.

Another set of twins born at 33 weeks gestation began co-bedding in an incubator on the second day of life, necessitating a decrease by two degrees in the ambient incubator temperature (Nyqvist & Lutes, 1998). However, when the twins were separated on the eighth day of life because one twin required phototherapy, the infant not receiving phototherapy required an increased incubator temperature by 1.5 - 2°C, to maintain normal body temperature. According to the authors, both infants became restless and fussy, and did not sleep well until co-bedding was resumed. However, other variables could have accounted for the increased restlessness such as, the hyperbilirubinemia in one twin. The two cases reported by Nyqvist and Lutes (1998) provide clinical evidence that physical contact between twins might reduce the duration of time twins' require thermoregulatory support with an incubator or waterbed.

Nyqvist and Lutes (1998) also explored with the mothers ways in which NICU staff could support parents of twins during their hospital stay. Mothers, in

this study, recommended that parents be: 1) assisted to set realistic expectations in caring for their infants; 2) provided with the opportunity to hold their infants in privacy, to offer a reprieve from the NICU environment, and; 3) provided with advice for coping at home, such as, assistance with a feeding plan and how to manage during the night.

Success at co-bedding twins requires flexibility and preplanning within the neonatal nursery (Lutes, 1996). Currently, most neonatal nurseries initiate co-bedding when infants are stable and free of infection (Lutes; Miller, 1998; Lutes & Nyqvist, 1998). Several neonatal nurseries co-bed twins while the infants require an incubator, are under a radiant warmer, or are receiving phototherapy, while other neonatal nurseries wait until the infants are on minimal or no supplemental oxygen and in a cot (Lutes; Annette Samuelson, Nurse Educator, St. Mary's Medical Center, Duluth MN, personal communication, November 1996).

It is suggested that co-bedding be initiated as soon as possible after birth (Nyqvist & Lutes, 1998). Infants are generally not considered eligible for co-bedding based on the following exclusion criteria: 1) ventilation, CPAP, umbilical catheter, arterial line, or pleural drainage; 2) risk of transmission of infection between infants; 3) insufficient space for two infants with tubing and lines; and 4) following surgery (Nyqvist & Lutes, 1998). Nyqvist & Lutes, as well as others (co-bedding policy, St. Mary's Medical Center, Duluth MN, November 1996), suggested that CPAP tubes and intravenous lines do not necessarily preclude cobedding, provided that they are positioned out of reach of the other sibling. Furthermore, each set of twins should be assessed on an individualized basis for their eligibility to co-bed.

Although there is a paucity of literature available on co-bedding, the

information that is available identifies several key components of care related to the practice of co-bedding twins. The components include proper identification of each infant, infection control, positioning, thermoregulation, sleep-wake cycles, potential separation, and discharge planning. Careful identification of co-bedded twins is an important component of care. Administration of medications and care are managed by colour coding everything in the bed with one colour for each infant. Parents are encouraged to select a colour coding for their infants and to keep them dressed accordingly.

Infection control is another critical component of care. Twins are often colonized with different nosocomial organisms, and as individuals have different risks and resistance to infection. The incidence of nosocomial infection is statistically higher in twins, as is the risk of Group B streptococcus (Mahlmeister, 1996). Proponents both for and against co-bedding question the risk factor for increased transmission of infection with co-bedding. Issues such as exposing the "well" twin to the septic evaluation and/or treating the well twin represent valid concerns and dilemmas. According to Miller (1998), infants are not necessarily separated when one twin becomes sick with an infection. Instead, the "sick" infant is treated, and the well infant is closely monitored for signs of sepsis. At the point where one twin becomes critical, the pair is separated, and co-bedding is resumed when the sick infant is stabilized.

When co-bedding twins, the recommended positioning is to lightly swaddle the infants together with one blanket, rather than individually, and to collectively support the infants with a nest (Nyqvist & Lutes, 1998). Their hands should be free to reach their own face, as well as the face, and body of their sibling, to facilitate touching each other, and consequently affect each other's motor organization. Some infants give clear behavioural cues of preference for a

certain position by being more settled, calm, and able to fall asleep more easily in certain positions (Nyqvist & Lutes). Furthermore, the mother may know her infants' positions in utero and provide guidance for choice of positioning. Although Lutes (1996), Miller (1998), and Nyqvist and Lutes recommended that infants be swaddled in the same blanket to encourage touching between the twins, DellaPorta, Aforismo, & Butler-O'Hara (1998) indicated that the standard practice in their NICU did not usually include swaddling in a blanket until very close to discharge. Clinical anecdotal information recently posted on the internet revealed that several other NICUs swaddle each infant separately during co-bedding (V.A. Jensen, personal communication, February 6, 1998).

Data from the study by Nyqvist & Lutes (1998) provide initial guidelines on thermoregulatory management when initiating co-bedding, and when separation of the twins is required; thus, the risks of hyperthermia and hypothermia, respectively can be avoided. Particular attention is required to prevent the risk of overheating when phototherapy is initiated during co-bedding. The thermoregulatory dynamics that occurs between twins during co-bedding can be compared to the thermal synchrony that occurs between parents and their infants during skin-to-skin cuddling. In the same way that parents transfer heat to their infants through conduction, during skin-to-skin cuddling, it appears that twins are able to help each other maintain a normal body temperature during co-bedding (Nyqvist & Lutes).

Health care professionals with more experience with co-bedding twins recommend that the skin probe be placed on the smaller and more fragile infant; the incubator can be adjusted to either servo-control or a constant air temperature (Lutes, 1996; M. Redd, personal communication, April 19, 1998; co-bedding policy, St. Mary's Medical Center, Duluth MN, November 1996). Co-

bedding can also be accomplished by placing the infants crosswise in the same incubator or radiant warmer if there is not adequate space lengthwise (Nyqvist & Lutes, 1998). Incubators specifically designed for co-bedding twins have recently become available; in addition to a larger space for caregiving, dual skin probes are available for simultaneous skin temperature monitoring.

Several health care professionals voice concern in regards to placing two infants in a powerful, therapeutic device that was designed, tested, regulated, and prescribed to thermoregulate one infant (personal observations; M. Buus-Frank, personal communication, January 12, 1998; E.B. Mallow, personal communication, December 15, 1997). Proponents concerned with this approach, question whether the neutral thermal environment of one infant can accurately predict the thermoregulatory needs of the second infant.

A cardinal guideline when caring for an infant on a radiant warmer is to always use a skin temperature probe. Anecdotal clinical data reveal that infants who are co-bedded under a radiant warmer often show no difference in temperature. This may be, however, because most infants have some capacity to regulate their own temperature. When two infants are co-bedded under a radiant warmer and servo-controlled to one infant, the temperature of the second infant may be equal to the first one, but his energy expenditure may be excessive because he is not thermoneutral. DellaPorta et al. (1998) described an incident in which one twin suffered hypothermia as a consequence of the bed temperature being set more to meet the needs of the larger twin.

The organization and timing of daily caregiving activities, feeding pattern, and the cycling of light, sound, and activity levels are important entrainers of circadian rhythm (Thomas, 1995). These components of care become the context for the emergence of a day-night rhythm; for this reason, the 24 hour day is

structured in relation to the infant's sleep-wake cycle (Thomas, 1995). Successful transition to home is facilitated by helping the infant develop rhythms consistent with the home environment (Thomas, 1995). Co-bedding provides the opportunity for twins to wake up for feeding and to sleep at the same time, facilitating synchronization of these activities. It is hypothesized that co-bedding twins may facilitate a mutuality in their circadian rhythm and sleep-wake patterns (Nyqvist & Lutes, 1998).

The decision to co-bed twin infants should rest with the parents. Some parents may consider it advantageous that their twin infants sleep and wake up together. Other parents may find it difficult to try to meet the needs of two infants at the same time. Co-bedding should be initiated when parents are present to assist in transferring the infants into the same bedspace (DellaPorta et al., 1998; Miller, 1998). Benefits reported by parents include that they can spend their entire hospital visits with both infants and can be assured, that in their absence, the twins are keeping each other warm and comfortable (personal observations).

Significantly, co-bedding is not for every infant and family. Some health care professionals have observed that some twins do not like being co-bedded (Lutes, 1996). S. Zampino (personal communication, April 20, 1998) found in the NICU, Tallahassee Memorial Regional Medical Center, that some infants do not like staying in an incubator with their twin. In the SCN at C & W two sets of twins have required separation. Both sets of twins did not begin co-bedding, in a crib, until approximately two months after birth. With one set of twins, both infants were particularly irritable and both had chronic lung disease. They co-bedded from about 34 weeks PCA until their expected due date, at which time they were separated for frequently waking each other. Additionally, these infants

had great difficulty settling to sleep and the motor activity of one twin seemed to stimulate the other twin; a pattern of re-stimulation emerged between the two infants. Lutes recommended that ongoing developmental assessments of twins' behavioural responses to one another during co-bedding is important. It could be hypothesized that twins who are separated for a long period of time prior to the initiation of co-bedding may not tolerate being placed next to their twin. It is possible that there are unknown innate factors which may contraindicate co-bedding.

The practice of co-bedding has raised new issues in regards to the transition to home. It can be conceptualized that co-bedding simulates the environment some parents will provide for their infants once home, thus, facilitating the transition to home. On the other hand, what happens when one twin is ready to go home sooner than the other? DellaPorta et al. (1998) described a situation where a mother was not willing to take one twin home while the other twin still required hospitalization. This led to an increased length of stay of four days for one infant. In the SCN, C & W, there have been similar experiences. In one instance, one twin continued to require oxygen and was on medications for chronic lung disease, while the other twin was ready for home. Parents offered to provide total care to the infant who could be at home so she could remain with her sister. They were even willing to take the second twin home on higher oxygen concentrations before they were willing to separate their twin infants. Since the initiation of the practice of co-bedding twins in the SCN, there is the general perception that the discharge of one twin has often been delayed by several days in order to avoid separation. Co-bedding fosters the idea that one twin might derive benefits from the other twin, and parents want their infants to stay together. The discharge home of co-bedded infants together raises

additional implications from budgetary and staffing aspects of care delivery.

Summary

To summarize, the literature on twinship, maternal-infants attachment and the activity of twin fetuses in utero provide perspectives that support the practice of co-bedding twins in a NICU. The literature on twins described twinship as the closest of all human relationships (Case, 1993; Noble, 1991; Theroux & Tingley, 1978). Co-bedding twins in the NICU seeks to capture the intense bond and extraordinary potential of twinship. The literature on maternal-infants attachment revealed that the attachment process for a mother of twins is entirely different compared to a mother of a single infant (Anderson & Anderson, 1981; Frazer, 1977; Gromada, 1981). Co-bedding twins in a NICU may impact on the attachment process in regards to the parental work of identification and management of twins.

Several studies correlating the intrauterine behaviours of twins revealed a remarkable occurrence of synchronous FHR accelerations and fetal movement epochs between twin fetuses (Devoe & Azor, 1981; Sherer et al., 1990, 1991). Gallagher et al. (1992) and Piontelli et al. (1997) documented synchrony in fetal behavioural states. Sherer et al. (1990, 1991) suggested that tactile communication exists in utero between twins, while Piontelli et al. proposed that intra-pair stimulation was an active component of the intra-uterine environment. The notion of shared intrauterine experiences provides a rationale for the continuation of this close physical contact and interactive development following birth, mediated through co-bedding.

A review of the literature on co-bedding revealed one research study by Nyqvist and Lutes (1998), documenting mothers' observations of their twins' responses to co-bedding. The infants' co-regulatory behaviours described by

Nyqvist and Lutes included moving closer, touching, holding, hugging, rooting, sucking on each other, and smiling. The findings by Nyqvist and Lutes were congruent with anecdotal accounts, and narratives published in health care journals and the parenting literature, documenting the observed benefits of close physical contact between twins who co-bed in the NICU (DellaPorta et al., 1998; Lutes, 1996; Miller, 1998; Weg, 1997).

A small amount of literature was available describing key components of care related to the practice of co-bedding twins in a NICU (DellaPorta et al., 1998; Lutes, 1996; Miller, 1998). Components to consider when implementing co-bedding of twins included: 1) clear identification of each twin at all times, 2) potential risk for increased transmission of infection, 3) positioning the infants to facilitate co-regulation, 4) thermoregulatory management, 5) potential synchrony in sleep-wake cycles and the organization of caregiving, 6) potential for separation after the initiation of co-bedding and 7) transition to home.

There is legitimate concern about the rapid adoption of the practice of co-bedding twins with limited understanding of the potential risks. The internet abounds with discussion on the practices and experiences of NICUs with co-bedding twins, yet there is a lack of sound research evidence on this practice. Clearly, there is a great need for research in order that the approach to co-bedding twins in a NICU is both clinically and scientifically sound.

Conclusion

In conclusion, developmentally supportive care theory, family-centered care theory, and the literature on twinship converged to shape this researcher's theoretical perspective, and informed the case study protocol. The literature on individual components of developmentally supportive caregiving including positioning, light and sound levels, nonnutritive sucking, and skin-to-skin

cuddling, as well as the synergistic effects of these components in a developmentally supportive care protocol was examined. All of the studies reviewed provided promising documentation of the benefits of developmentally supportive caregiving, with infants achieving improvement in some aspect of their medical, behavioural, or developmental outcomes.

The theory of family-centered care was explored and considered as providing an important theoretical perspective and context for this study. The adoption of a family-centered care philosophy at C & W has created a climate where health care professionals are more open to exploring and supporting developmentally supportive, family-centered care initiatives, making it possible to consider co-bedding twins on an individual basis.

From the literature review on twinship it can be articulated that co-bedding seems to make biological sense. The literature on being a twin, mother-infants attachment, and twin activity in utero provided knowledge and perspectives on the unique relationships and interactive development between twins, which can continue in a NICU through the experience of co-bedding. A review of the literature revealed strong clinical anecdotal accounts that collectively support co-bedding. However, there is little research available to provide a solid evidence-base for co-bedding twins in the NICU. The ability for twin infants to potentially assist one another through their NICU experiences, is yet, another dimension of the extraordinary potential of twinship worthy of exploration.

CHAPTER THREE: METHODS

Introduction

It is evident from the literature review that co-bedding twins in a NICU is virtually an unexplored phenomenon. The generation of a knowledge base on the phenomenon of co-bedding is required through research. Case study method was used to describe the behaviours of one set of twins during co-bedding, and the perceptions of the parents and a consistent nurse. In this chapter an overview of the research design, selection of the participants, data collection and analysis procedures, limitations of the study, and human subject considerations are discussed.

Design: Case Study Method

Phenomena of concern to nursing are often holistic, complex events that evolve over time, and cannot be studied meaningfully apart from their context (Sterling & McNally, 1992). Case study or nonexperimental single-subject research is a method of inquiry that investigates a contemporary phenomenon within its real-life context, facilitating retention of the holistic and meaningful nature of real-life events (Yin, 1994). Given that little information has been published on the co-bedding of twins in the NICU context, a case study design was ideal for developing detailed, in-depth descriptions and documentation of this newer and unexplored concept. A descriptive clinical case study, with a temporal perspective, provides the health care professional with an understanding of the interactions and behaviours of twins over the course of co-bedding (Yin, 1994).

The case study method was chosen given the "fit" with the focus of inquiry, and this researcher's philosophical worldview. As daily clinical practice provides a wealth of descriptive data about pertinent clinical nursing

phenomena, this practice-oriented approach "makes better investigative use of the day-to-day observations and interventions that are part of nursing practice" (Barnard, 1983, p. 31). A case study method of inquiry is viewed as helping to bridge the research-practice gap (Meier & Pugh, 1986).

Traditional research methods generate knowledge based on findings specific to groups of people. The challenge to the practitioner then becomes individualizing general knowledge to a particular client. Case study method offers the perspective of understanding "persons in particular" (Runyan, 1982; Yin, 1994). Because traditional research methods alone do not adequately explore those questions that, philosophically, are at the center of nursing practice, case study research provides an important knowledge base that may be unattainable through using large between-group experimental designs (Smyth, 1989; Sterling & McNally, 1992).

The following three principles, advocated by Yin (1994), were incorporated into this case study design to enhance reliability. First, the collection of multiple sources of evidence to converge on the same set of facts or findings. Case study results are considered more convincing and accurate if they are based on different sources of evidence (Yin, 1994). Utilizing multiple sources of evidence, in and of itself, ensures multiple measures of the same phenomenon, thereby enhancing validity of the case study (Yin, 1994). In this study, the case study method helped to generate rich data from multiple sources, converging to provide a comprehensive, holistic, and meaningful picture of the concept of co-bedding. The multiple data sources included repeated behavioural observations of the infants, a chart review, and an interview with the parents and a nurse, to uncover thoughts, feelings, insights, learnings, and observations about the phenomenon.

The second principle advocated by Yin (1994) to enhance reliability of the case study was the establishment of both a case study protocol and data base to provide a paper trail. The NIDCAP behavioural observation sheets and narratives, the interview transcriptions, and patient charts provided the data base; refer to Appendix B for the case study protocol. Third, the draft case study report was reviewed by key informants, including the physiotherapist who conducted the NIDCAP behavioural observations, and the nurse who was interviewed for this study.

In case study inquiry, analytical generalizations rather than statistical generalizations are proposed (Smyth, 1989; Sterling & McNally, 1992; Yin, 1994). Case study results may be generalized to theoretical propositions, or to a broader theory with the goal of theory expansion or development (Yin, 1994). Although the focus was on one set of twins and their family, the case study was examined and analyzed within the framework of a larger body of literature and research findings, specifically developmentally supportive care, family-centered care, and the experience of twinship. In this study, the behavioural observations of one set of twins, and an interview with the family, and the nurse contributed to the development of a knowledge base about the relatively unexplored phenomena of co-bedding. These findings can assist nurses and other health care professionals in their daily practice.

Selection of Participants

The infants and their family for this case study were recruited from the SCN at C & W. The Clinical Nurse Leadership group provided assistance in identifying a family of twins who were receptive to co-bedding, and met the study criteria. Selection criteria for the set of twins were: 1) they did not have a prolonged separation, and were co-bedded within a month of their birth, 2) they

were free of known congenital and chromosomal anomalies, and fetal exposure to drugs of addiction, and 3) they had normal head ultrasounds. The twins were born at 30 weeks gestation. The family was selected based on their willingness to participate in the study, ability to speak English, and their willingness to spend time with their infants each day. The mother was a 34 year old primigravida, who conceived twins spontaneously. The mother was a publicist and the father a journalist.

Although the initial selection criteria for nurse participants for this case study was the inclusion of primary nurses, none of the nurses met this criteria. The purpose for including only primary nurses in the case study was based on the concept of knowing the patient. Knowing the patient is based on knowing the particular infants' (and family's) pattern of responses, and knowing the infants (and family) as persons (Tanner, Benner, Chelsa, & Gordon, 1993). In order to know the infants and their family, the nurse must become situated within the context of the particular infants and family. Being situated enables the nurse to develop an awareness of the salient distinctions, nuances, and uniqueness of the infants and their family. Consistency and continuity of care inherent in primary nursing offer this opportunity. This researcher believes that nurses who care for infants and their family over the course of co-bedding will be able to contribute a longitudinal, in-depth, contextual perspective that may not be achieved by nurses rotating through patient care assignments.

Although the family selected for the study did not have primary nurses caring for their infants, there was an experienced neonatal nurse who cared for the infants for eight, 12 hour shifts, four shifts preceding co-bedding and four shifts following the initiation of co-bedding. Additionally, this nurse observed the twins progress over the course of co-bedding. Even though this nurse did not

meet the original criteria, it was felt that she could provide a temporal perspective of the experience; this consistent nurse agreed to be interviewed.

Data Collection Procedures

The case study method is a form for organizing and presenting information about individuals and their circumstances, which may draw upon a variety of specific data collection techniques (Yin, 1994). In this case study, data sources consisted of the behaviours of a set of twins who were co-bedding, the perceptions, thoughts, and insights of the family and the consistent nurse, and a retrospective chart review. Data collection occurred over two months. Discharge home was not necessarily a criteria for determining when to cease data collection, since intuitively this researcher recognized that transitions and adaptations may continue for much longer than eight weeks. However, it was assumed that a "snapshot" of co-bedding twins within the NICU context would evolve within this time frame. Appendix B, the case study protocol, provides a temporal organization of the data collection process.

NIDCAP Behavioural Observations

Repeated behavioural observations of each infant were conducted using the Neonatal Individualized Developmental Care and Assessment Program (NIDCAP) observation sheets (Als, 1995) (see Appendix C). Baseline behavioural observations of each infant occurred during their first week of life, and within the week prior to the initiation of co-bedding. The infants co-bedded for one month, at which time they were discharged home from the SCN. Two behavioural observations occurred for each infant at approximately two week intervals during co-bedding. For each behavioural observation, the infants were observed within 24 - 48 hours of each other to account for their maturity, and provide a basis for comparison.

The NIDCAP is a systematic behavioural observation method which is particularly geared to the understanding of the preterm and otherwise at-risk newborn's behaviour (Als, 1986, 1995; Lawhon, 1997). The NIDCAP behavioural observation method was developed in 1984, on the basis of the conceptualization underlying the Assessment of Preterm Infant Behaviour (APIB) scale (Als, 1986, 1995; Lawhon, 1997). The Brazelton Newborn Behavioural Assessment Scale (BNBAS) (Brazelton, 1984) provides a formal method for evaluating the behaviour of the newborn. The APIB, in turn, has been modified from the BNBAS to assess the immature or preterm infant's behaviour (Lawhon, 1997). Both the BNBAS and the APIB involve stimulating and manipulating the infant in order to elicit various behavioural responses. On the other hand, the NIDCAP is a naturalistic observation method where the examiner/observer refrains from all interactions with the infant and the staff.

The NIDCAP observation is based on the Synactive Theory of Development, and is designed to specifically identify the interplay of autonomic, motor, state-organizational, attentional-interactive, and self-regulatory subsystems functioning in both premature and high-risk infants (Als, 1986, 1995). The infant is observed for approximately 20 minutes prior to caregiving or an interaction, throughout caregiving or an interaction, and for 20 minutes following caregiving or an interaction (Als, 1986, 1995). Ninety one behaviours are assessed every two minutes.

Autonomic or physiological function is assessed in terms of respiratory and heart rate patterns, colour changes, oxygen saturation levels, autonomic instability-related motor patterns such as, tremors, startles, and twitches, and visceral signs (Als, 1986; Blackburn & VandenBerg, 1993; Lawhon, 1997). Motor control and organization is assessed through posture, tone and quality of

movements. In general, extension and diffuse behaviours are reflective of stress, while flexion and well defined behaviours reflect self-regulatory competence (Als, 1995).

Assessment of state control involves observation of the available range of sleep-awake states, transition between states, and clarity of states (Blackburn & VandenBerg, 1993). The attentional-interactive system involves assessment of the infant's ability to alert and attend to sensory stimulation such as, faces, sounds, or objects, while the self-regulatory system involves behaviours the infant uses to maintain the balance of the other subsystems and to move smoothly between states. Self-regulatory behaviours include, for example, sucking, hand-to-mouth or face activity, grasping or holding on, bracing against a boundary with arms or legs, trunk tucking, and looking away (Blackburn & VandenBerg). Self-regulatory behaviours may shift into stress behaviours, and some stress behaviours successfully reduce stress and therewith become self-regulatory behaviours (Als, 1995).

The outcome of the NIDCAP behavioural observation is a description of the infant's current thresholds to stress and stability, and capabilities of self-regulation. Based on the infant's behavioural responses, suggestions are provided in regards to caregiving, interacting with the infant, and environmental modifications, that support the infant's self-regulatory capabilities, while reducing signs of stress and disorganization in the infant (Als, 1986; Blackburn & VandenBerg, 1993; Lawhon, 1997). In this study, behavioural observations were performed by a trained observer, who has established 90% reliability in the NIDCAP method with a designated NIDCAP trainer. Permission to use the NIDCAP naturalistic behavioural observation was obtained from Dr. H. Als (January, 1999).

Operational Definitions: Infant Behaviours

The following operational definitions of infant behaviours were taken from the Manual for the Naturalistic Observation of Newborn Behaviour (Als, 1995), and appear in the descriptions of the infants' behaviours.

Airplane: Considered a stress response, the infant's arm (s) are either fully extended out to the side at about shoulder level, or the arms are at an angle and extended out at the shoulder (Als, 1995).

Foot Clasp: The infant positions one foot against the other, either soles of feet together, or one sole against the other ankle or leg. The infant may also fold the legs in a crossed position with feet grasping the legs or resting against them (Als, 1995).

Leg Brace: A self-regulatory effort where the infant extends leg (s) and/or feet towards the edge of the nest, incubator, or caregiver's hand or body. The infant is attempting to stabilize, brace, gain boundary, and inhibit extensor movement or posture (Als, 1995).

Mouthing: The infant makes one or several repetitive lip and/or jaw opening and closing movements. The lips usually stay soft and relaxed, and are not directed forward. These are distinguished from suck-searching where the infant actively extends the lips (Als, 1995).

Respiratory pause: Refers to any cessation of respirations for longer than two seconds. A respiratory pause of greater than 8 seconds is described as an apnea (Als, 1995).

Salute: Considered a stress response, either one or both arms are fully extended into mid air in front of the infant (Als, 1995).

Sitting on air: Considered a stress response, either one or both legs are extended into mid air (Als, 1995).

Sounds: The infant emits undifferentiated, whimper like sounds that resemble diffusely disinhibited vocal discharges (Als, 1995).

Interviews

Interviews occurring at two week intervals with the parents and with the consistent nurse were originally planned, with the purpose of uncovering their perceptions, thoughts, and insights related to the co-bedding experience. However, owing to clinical realities, the parents and the consistent nurse were interviewed once, during the fourth week of co-bedding. Furthermore, the nurse interviewed did not feel that successive interviews were necessary; from her perspective, the infants needed to co-bed for a period in order for her to gain insight into the co-bedding behaviours. Each interview was open-ended, and constructed as dialogue or interactions, rather than as a structured process. Refer to Appendix D for interview guide. The interviews occurred in a family interview room, in the SCN, at a mutually agreed upon time. Interviews were audio-taped and transcribed verbatim. A follow-up phone call with the mother occurred one month after the infants were discharged home. The perceptions of the parents and nurse contributed depth and detail to the portrait that emerged on co-bedding. These perceptions provided data that could not have been captured in the behavioural observations alone.

Journals

Given the paucity of literature on co-bedding, and in order to address safety and comfort issues, staff and parents have been encouraged to share their thoughts, observations, and learnings through contributions to a bedside journal, since the SCN embarked on a journey towards supporting co-bedding. Journal entries, in addition to the formal behavioural observations (NIDCAP), currently represent an effort to compile valuable clinical data, to assist health care professionals and families, in continuing to support co-bedding initiatives in the SCN. Therefore, a source of data for this case study was to include a

continuation of this informal "bedside journal". It was anticipated that analysis of journal entries would enrich the descriptive narratives of the infants' behaviours, with subtle nuances and details of the infants behaviours, as well as perceptions, thoughts, and insights of family members and nurses, at particular points in time, that may not be remembered in an interview. However, there was only one journal entry by a nurse; journalling did not prove to be a useful source of data in this case study.

Chart Review

A retrospective chart review was conducted to complement the NIDCAP behavioural observations, and perceptions of the parents and the consistent nurse. A chart review provided information on: 1) the infants' progression during their stay in the SCN, 2) daily sleeping and waking patterns, and behavioural state, and 3) notation of body temperature.

Data Analysis Procedures

The goal of data analysis was to generate rich, in-depth, contextualized descriptions of the phenomena of co-bedding from the convergence of the multiple sources of data. The infants' behaviours were analyzed according to the Synactive Theory of Development, as operationalized in the NIDCAP behavioural observations (Als, 1986, 1995). There were several dimensions to the analysis of each infant's behaviours. Firstly, each infant's behaviours were described and interpreted according to the physiological, motor, state-organizational, attentional-interactive and self-regulatory subsystems. Secondly, and more specifically, data analysis included descriptions and interpretations of each infant's current level of organization, and integrated functioning of the five subsystems. Organization was described in terms of the frequency and occurrence of stress and stability cues, including self-regulatory and co-regulatory

behaviours. Thirdly, behaviours were described and interpreted in relation to context, such as, in response to environmental stimuli, a caregiving intervention, or a social interaction.

Fourthly, consistent with a NIDCAP behavioural observation and documentation, data analysis included a description of each infant's strengths and weaknesses, current competencies, developmental goals, and recommendations for caregiving. Fifthly, behavioural observations of each infant prior to and during co-bedding were compared for any changes, and for new behaviours. Lastly, the behaviours of each infant were compared with his sibling.

Interviews were transcribed and reviewed for perceptions, thoughts, and insights of family members and the consistent nurse. Any consistent or shared descriptions or themes between family members' and the nurse's perceptions were identified and described. A final step in data analysis procedures involved sharing the analyzed data with the trained observer, who conducted the behavioural assessments, and the consistent nurse, to validate descriptions and any interpretations.

Assumptions of the Study

Data collection and analysis procedures were based on the following assumptions:

1. Family members possess knowledge and understanding of their infants' behaviours.

2. Family members are willing and able to articulate their perceptions, insights, thoughts, and feelings.

3. Nurses' observations and perceptions are based on knowing the infants, and the infants' particular pattern of responses.

4. Nurses will be willing to share their observations and perceptions of

infants who are co-bedding, and family interactions.

5. Co-regulation behaviours can be extrapolated from the behavioural observations of two infants.

Limitations

One limitation of the study was the lack of a primary nurse(s). Interviewing a primary nurse(s) may have provided insights into the infants' behaviours, based on the concept of knowing the infant, and by providing a temporal perspective of the co-bedding experience. A second limitation of the study was the usefulness and appropriateness of the NIDCAP observation tool. Although the NIDCAP has been extensively discussed in the developmental care literature (Lawhon, 1997; Ludington-Hoe & Swinth, 1996), has been utilized in various research studies (Als, et al., 1986; Als, et al., 1994; Becker, et al., 1991, 1993; Fleisher et al., 1995), and is widely used in clinical practice, no specific documentation as to reliability and validity of the NIDCAP behavioural observation is available. Similar to the criticisms reported in the literature that an observational assessment takes four to six hours to complete (Garland, 1995), the behavioural observations in this study were very labour intensive, with each assessment taking three to four hours to complete.

In regards to the number of baseline observations required prior to co-bedding, it was initially felt that the time lapse of 23 days between the first baseline observation and the first co-bedding assessment was too lengthy. Therefore, a behavioural observation in the week preceding co-bedding was planned. Additionally, because the first behavioural observation on each infant was conducted during the first week of life, it was felt that a significant proportion of the instability observed was, in part, because the infants were transitioning to extrauterine life. However, although a picture was provided of

each infant's current competencies and weaknesses with both baseline observations, and although a slight maturing of physiological and behavioural organization was apparent, one behavioural observation within the week prior to co-bedding would have provided a satisfactory baseline for comparison. Furthermore, baseline data during the early weeks prior to co-bedding could be achieved with a chart review, instead of a lengthy behavioural observation of each twin.

A second point of discussion was the timing of the behavioural observations or more specifically, when to observe and document the behaviours of the infants. The behavioural observation was conducted on the infant who received care, in order to be consistent with NIDCAP format. There was some discussion between the trained observer and this author as to whether an assessment should be completed on the other twin to record his responses, while his sibling received care. Collection of this data was achieved, in part, because on two occasions, the pre-caregiving observation occurred on one twin while the other twin received care. However, prior to embarking on a multiple case study that would include NIDCAP behavioural observations as the data collection tool, it may be worthwhile to conduct complete behavioural observations on the twin who is not receiving care, to find out whether insights can be gained from this approach.

A weakness in utilizing the NIDCAP naturalistic behavioural observation tool is that it was not designed to specifically measure co-regulatory behaviours between twins. Nyqvist and Lutes (1998) recommended that the following behaviours be added to the naturalistic behavioural observation: touching, holding on, moving closer, rooting and sucking on each other. The findings from this case study would support this suggestion. For ease of data collection, it

would be advantageous to record co-regulation responses for both twins, given the interactive and reciprocal nature of co-regulatory behaviours. Data collection would also be facilitated if the NIDCAP observation tool was refined and simplified.

Lastly, video-taping the infants' behaviours would have enhanced reliability and validity of this case study. Video-taping could have occurred simultaneously with the NIDCAP behavioural observations, providing an additional source of multiple measures of the same phenomenon. In a future study, video-taping the infants' behaviours could be an alternative to the lengthy NIDCAP behavioural observations and write-ups.

Human Subject Considerations

Ethical approval was obtained from the Behavioural Research Ethics Board of the University of British Columbia. Approval to conduct the study in the SCN was obtained from the In-Hospital Research Review Committee, C & W. Informed written consent was obtained from the consistent nurse (see Appendix E), and from the parents, who also consented for their infants (see Appendix F). The consent forms outlined the purpose and methods of the study, and assured privacy and confidentiality. To minimize the potential for coerced participation in the study, an SCN Instructor approached the family and nurse, and distributed the explanatory letters (see Appendices G & H).

From this researcher's experience, families generally welcome the opportunity to share their experiences, with an interested person, and may develop new insights and meanings related to their experiences. On the other hand, the in-depth, case study approach may threaten the family's privacy and cause discomfort. Therefore, family members were assured of their right to refuse to participate at any time, or withdraw from the study, without

jeopardizing the health care of their infants. The consistent nurse was also assured of her choice to withdraw, at any point, from the study.

To ensure privacy and confidentiality, no identifiable marks appeared on the audiotapes or transcripts, related to family members or to the nurse. The NIDCAP behavioural observations are part of each infant's legal chart. Therefore, photocopies of the NIDCAP assessments were made for the researcher's use; the names of the infants were blocked so that there were no identifiable marks. All data were handled and stored in a confidential manner.

The family and nurse who agreed to participate in this study will not be identified by name in the thesis report, in any publication arising from this research, or in any teaching materials. The benefits to the family and the consistent nurse were considered to be sharing their perceptions and developing new insights. The family requested a copy of the behavioural observations. A copy of the case study will be offered to the family and to the consistent nurse following submission of this thesis.

Summary

This chapter outlined the case study method, the research design utilized in this study. The selection criteria, and process of data collection and analysis were identified. Case study method enabled the researcher to collect rich, detailed, behavioural descriptions of twin infants' behaviours during co-bedding, utilizing multiple sources of data: the NIDCAP behavioural observations developed by Als et al. (1995), the perceptions of the parents and the consistent nurse, and a chart review. Limitations of the study were articulated. Ethical considerations to protect study participants were described.

CHAPTER FOUR: PRESENTATION OF THE FINDINGS

Introduction

In this chapter the study findings are presented. This chapter begins with a perinatal case history of the infants and their family. Pseudonyms have been used to protect the identity of the infants and their family; twin A will be referred to as Nathan and twin B as Jessan. The descriptions generated from the behavioural observations of the infants, the perceptions of the parents and the nurse, and a retrospective chart review are presented as the research findings.

Perinatal Case History

Nathan and Jessan were born at 30 weeks gestation. Their mother went into spontaneous preterm labour 52 hours after her membranes ruptured. The mother was admitted to the hospital at 27 6/7 weeks gestation and received dexamethasone at that time (length of stay was not documented). She was admitted again three days prior to their birth at 30 weeks gestation. The parents learned they were having twins at an 18 week ultrasound; the pregnancy was noted to be diamniotic and dichorionic.

Nathan, twin A, was a cephalic presentation, born by spontaneous vaginal delivery. Nathan weighed 1340 grams at birth (50th percentile). His head circumference and length were at the 70th percentile. Nathan was vigorous at birth, requiring free flow oxygen. Nathan had mild respiratory distress, and he was placed on binasal CPAP shortly after birth. He did not require surfactant replacement therapy. On day three of life he was intubated for numerous episodes of apnea and bradycardia; he was extubated at five days of age. Although Nathan continued to have some episodes of apnea and bradycardia, his oxygen saturation levels were stable in room air. However, when Nathan was 10 days

old his condition deteriorated with a labile temperature, increasing episodes of apnea and bradycardia, and feeding intolerance. Nathan was treated for five days with the antibiotics vancomycin and cefotaxime. Axilla, throat, and nasal swabs taken at this time were positive for methicillin resistant staphylococcal aureus (MRSA); his blood cultures were negative. He was restarted on binasal CPAP, which he required for a further 12 days until he was 23 days old. Subsequently, Nathan required oxygen therapy for nine days.

Jessan, who was a breech presentation, was born 16 minutes after his twin by an assisted vaginal delivery. There was a difficult extraction of his legs resulting in bruising. At birth, his heart rate was 70 - 80 beats per minute, and he was given bag and mask ventilation to recover. Jessan weighed 1525 grams at birth (80th percentile); his head circumference was at the 90th percentile and his length the 45th percentile. He had mild respiratory distress syndrome, and he was treated with surfactant. He was intubated on admission to the SCN, ventilated for two days, then quickly weaned to room air. Jessan was active and responsive with handling and he liked to have a cover over him inside in the incubator; he settled well. He was started on two hourly gavage feedings of expressed mother's milk.

Coinciding with Nathan's clinical deterioration, Jessan, also at 10 days of age became less stable. He had clusters of apnea, bradycardia and oxygen desaturations. He was at full nasogastric feeds of mostly expressed mother's milk, and he received the occasion formula feeding over the next few days. At this time, Jessan had some transient feeding intolerance, and his temperature was labile, although he remained active with caregiving. Axilla, throat, and nasal swabs taken at this time were MRSA positive. Jessan did not develop a sepsis and he was not treated with antibiotics.

Repeat skin, throat, and nasal swabs taken periodically throughout Nathan's and Jessan's hospitalization continued to be positive for MRSA. Nathan and Jessan were considered colonized with MRSA, but neither infant developed a sepsis. Consequently, no further treatment occurred. Head ultrasounds, routinely conducted in the postnatal period, were normal for both infants.

Infant Behavioural Observations

Four behavioural observations are described and interpreted for each infant. Two baseline observations prior to co-bedding for each infant are presented, followed by two behavioural observations for each infant during co-bedding. Consistent with NIDCAP format, each behavioural observation is presented in the form of a narrative, facilitating a holistic, contextual description of the infants' behaviours.

Pre-Co-Bedding Behavioural Observations Using NIDCAP

The first baseline behavioural observation occurred when Nathan was seven days old and weighed 1235 grams. At the time of his first behavioural observation, Jessan was six days old and weighed 1300 grams. The second baseline behavioural observations occurred when both Nathan and Jessan were 20 days old or 32 6/7 weeks PCA, weighed 1555 grams and 1625 grams respectively, and nine days prior to implementation of co-bedding.

Behavioural Observation #1: Nathan

At the time of the first behavioural observation, Nathan was seven days old or 31 weeks PCA. Nathan was in an incubator, adjacent to his twin brother, lying on his right side, positioned in a shallow nest, wearing an undershirt and diaper, and covered with a very loose fitting sheet. Nathan had an intravenous in his left hand, and he did not require oxygen therapy at this time. The top of

his incubator was covered with a quilt, that did not drape over the sides or ends of the incubator. From an environmental aspect, the room was noisy and busy. During caregiving, the incubator drapes were partially removed and the overbed light turned on, making the lighting level in the incubator very bright.

Nathan was observed for 18 minutes prior to caregiving. Nathan's heart rate was between 155 and 176 beats per minute, with one dip to 131 as the incubator doors were closed loudly. His colour was pink, and his oxygen saturation levels were stable. His respiratory pattern was irregular and fast, ranging from 48 - 78 breaths per minute. He was in a light sleep with very small twitches and two grimaces. For brief periods, up to 30 seconds at a time, he was very still and seemed to move into a deep sleep, but this was not sustained. He looked relaxed and comfortable.

Nathan demonstrated minimal motor activity. His right arm was flexed up to his face with his hand near his mouth, and his fingers loosely flexed. His left arm was loosely flexed at his elbow and up over his head. He did not move his arms until the incubator door was clicked open, when he gently stretched his left arm and flexed it again. Both his legs were tucked in flexion within the nest. He had small spontaneous movements of his right foot. At around seven minutes Nathan extended his right leg over the edge of the nest.

Care was given over a 20 minute period. During this time, Nathan's heart rate increased to 175 - 183 beats per minute during handling. His colour remained pink, and his oxygen saturation levels stable. His respiratory pattern remained irregular and variable, ranging between 32 and 89 breaths per minute. Nathan fluctuated between periods of tachypnea, lasting for four to six minutes, followed by periods of bradypnea, also lasting for four to six minutes. During handling, the incubator doors were open and the noise level increased; Nathan

had an increased number of twitches of his face, body, and extremities.

As the incubator covers were lifted up and the light levels increased, Nathan extended his arms. and he moved his hand from his face to his mouth. As his heel was being wrapped and prepared for blood work, Nathan squirmed, stretched, fisted his right hand, and had one very short self-recovering bradycardia to 82 beats per minute. As his heelprick was done, Nathan grimaced, curled his toes, stretched, and had a respiratory pause. He splayed his fingers after fisting them, and made a brief attempt at clasping his feet, while there was a pause in the procedure. Nathan remained in a light sleep throughout the procedure. Given the severity of the intervention, there was relatively little physical response.

The nurse continued handling Nathan after the bloodwork, providing caregiving with Nathan in a sidelying position. Although the nurse helped Nathan to maintain a flexed and side-lying position, he repeatedly extended and braced his right leg, and moved his hand back to his face. As his chest was auscultated, Nathan thrust both legs up in a sitting on air maneuver, and splayed his fingers. As the nasogastric tube was aspirated, he squirmed. As the gavage feeding was started, Nathan mouthed for four minutes; he was not offered a soother. The feeding ran in very quickly. Throughout caregiving, Nathan remained in a light sleep state, and he did not move into a drowsy state for any period of time.

Nathan was observed for 20 minutes following caregiving. Nathan's heart rate was consistent with his pre-caregiving heart rates; his respirations and oxygen saturation levels were stable. His colour was pink, with two brief changes to red that were associated with increased twitches of his face, body, and extremities. After the feed was completed the incubator was covered, but the

noise levels in the room remained high. Apart from the body and limb twitches, Nathan lay very quietly with his right hand on his face, but not at his mouth. His left arm was flexed over his head and both his legs tucked into the nest. For six minutes his legs were clasped at the feet. Subsequent to this, Nathan had a look of discomfort where he had a fleeting dip in his respiratory rate to 19 breaths per minute, he squirmed, turned red, grimaced, and lifted his left arm up in a salute. He then loosely flexed his left arm, returned to a pink colour, and moved his legs out of the clasped position. Nathan continued in a light sleep with occasional twitches, one small squirm, but no further active movement. After approximately six minutes he settled further, achieving fleeting moments of deep sleep.

Summary. Nathan's temperature was elevated at 38°C during this observation. It was noticeable that despite his age and level of handling he was lethargic, and there was less active movement than would have been expected; for example, the heelprick and squeezing of his heel generated minimal motor activity, and no crying. Nathan did not wake up throughout caregiving. Nathan was sensitive to stimuli from his surrounding environment and handling, as evidenced by his autonomic and motor instability, as he continued to transition to the extrauterine environment. In general, his extension and diffuse behaviours such as, finger splaying, saluting and sitting on air maneuvers, and diffuse squirms reflected stress. His autonomic regulation was immature as evident in his colour changes, irregular respiratory and heart rate patterns, and twitches. Nathan did not demonstrate many active self-regulatory skills, however, he did exhibit beginning self-regulatory competence including attempts at hand to mouth activity, leg bracing, and foot clasping behaviours. His behaviours and responses to handling, in part, likely reflected the fact that

he was developing an infection.

Behavioural Observation #2: Nathan

At the time of the second baseline behavioural observation, Nathan was 20 days old or 32 6/7 weeks PCA, and weighed 1555 grams. Nathan was on binasal CPAP, and lying prone in a shallow nest, loosely covered with a sheet, and his left leg draped over the edge of the nest. The overall lighting in the room was high; however, Nathan's incubator was well draped. There was minimal activity in the room and the noise level was moderate. Nathan was mostly in a light sleep state, throughout this behavioural observation, with fleeting moments of deep sleep. Within light sleep, he had periods where he was more active with squirms, and some active flexion and extensions of his arms and legs over the edge of his nest. However, during pre- and post-caregiving, Nathan was able to flex his legs back within the nest after these periods of activity.

Caregiving occurred over a 20 minute period. During this time, Nathan's heart rate was not significantly altered during handling, ranging from 148 - 164 beats per minute. His respiratory rate was also within the parameters of the pre-caregiving observation, ranging from 17 - 40 breaths per minute, and irregular with some pauses. His oxygen saturation levels were 98 - 99%. Nathan had his temperature taken while he was prone, contained, and supported in a flexed position by the nurse. As Nathan was turned to a supine position to have his diaper removed, with his legs lifted up in the air by the nurse, he tried to put his hand over his face. Nathan moved into a drowsy state, which he was only able sustain for a few minutes. He splayed his fingers several times, and he spread both arms out in an airplane maneuver. When his legs were not being held, he was very active, flexing and extending his arms and legs several times,

stretching, and squirming. His colour became red and somewhat mottled. As the orogastric tube was aspirated, he lay naked and limp, his vital signs unchanged.

Following the limp episode, Nathan attempted to bring his hands together, but he was not successful. Once Nathan had his diaper fastened, and he was turned prone, he attempted to flex into his nest; he splayed his fingers, took his hand up to his chin, and attempted to clasp his hands. As his gavage feeding infused, he had minimal movements of his limbs which were held in a flexed posture, but he had lots of grimacing and mouthing throughout the gavage feeding; he was not offered a soother. Nathan never achieved a wakeful state during caregiving. The noise level increased, but it did not have an effect on Nathan. After the gavage feeding was completed, Nathan was quite unsettled for a period with active flexion and extension of his left arm up over his head, and the occasional squirm and grimace.

Summary. Nathan, now 32 6/7 weeks PCA, remained sensitive to handling. He had low energy levels. He had not yet become accomplished in self-regulatory skills. Although he made some good attempts at hand to mouth activity, bringing his hands together at midline, and hand clasping, he was unable to sustain these behaviours. He had difficulty achieving deep sleep and awake periods with caregiving; this may be secondary to his recent infection. He required support during caregiving to assist him in his motor organization and state control. However, Nathan was able to return to a flexed and tucked position on several occasions, reflecting a maturing in his self-regulatory competence. His autonomic regulation, though still immature, was becoming more stable despite quite exhausting handling. There were no changes in his vital signs, less colour changes, and no increase in his oxygen requirements per binasal CPAP, with caregiving.

Behavioural Observation #1: Jessan

During the first baseline behavioural observation, Jessan was six days old and weighed 1300 grams; he was receiving phototherapy and therefore, he was wearing only a diaper, and he had eye patches on. Jessan was positioned in a shallow nest in an incubator, adjacent to his brother's incubator. The room was busy, noisy, and hectic with several nursery personnel; the lighting level was low.

Jessan was observed for 20 minutes prior to caregiving. Jessan's heart rate remained fairly stable at 149 - 163 beats per minute, for the first 20 minutes. There was one peak briefly at a rate of 177 when noise levels increased, but otherwise he maintained his heart rate at 163 - 171 during increased noise levels. Jessan's respiratory pattern was not well regulated, even when he was at rest. His breathing was irregular with a wide variation in the rate from 26 - 81 breaths per minute. The dips to 26 - 28 breaths per minute were fleeting; his respiratory rate usually ranged between 55 - 63. Jessan's oxygen saturation levels were constant at 97 - 98%. His colour was pink except for two brief episodes where he squirmed and turned red.

Jessan was very settled in his nest with minimal motor activity, and in a light sleep state, with transitions into deep sleep. During peak noise levels he was unable to achieve deep sleep. Jessan's arms were tucked up near his face. His right leg was flexed within the nest, and his left leg was tucked up under his abdomen. He had numerous twitches of his legs. At one point, coinciding with increased noise levels, he showed small right foot movements. At the peak of the sustained noise levels, Jessan squirmed, and had several swallowing actions, although his mouth remained closed.

Care was given over a 16 minute period. During this time, Jessan's heart

rate increased considerably varying as much as 145 to 193 beats per minute, but usually ranging between 170 - 176 beats per minute. Jessan's respiratory rate was the most inconsistent of his autonomic responses remaining irregular and generally slower, ranging from 23 - 57 breaths per minute. Jessan had marked substernal and intercostal indrawing, and one respiratory pause when in the supine position. Jessan's oxygen saturation levels remained stable throughout handling. His highest oxygen saturation levels occurred when he was in the prone position, towards the end of caregiving. His colour became increasingly redder as he was handled, and particularly when he cried, but his colour never became dusky.

The nurse approached Jessan quietly and slowly, turning off the phototherapy lights, and dimming the overhead lights in preparation for removal of his eye patches. Throughout caregiving, the nurse was very sensitive to Jessan's cues and tried to contain him appropriately. As his chest was auscultated, while he was prone, he extended and flexed his legs. He appeared to be leg bracing, but the nest was too shallow.

When Jessan was turned to the supine position, he moved from a light sleep to a drowsy state. His arm and leg activity increased with extensions into leg bracing, and saluting and airplane activity of his arms. He did attempt to return to flexion. The nurse tried to maintain containment during the saturation probe removal and the diaper change, but Jessan squirmed out of position, and he would salute or leg brace again. Jessan did briefly flex his legs, and attempted other self-regulatory maneuvers including a foot clasp, and bringing his hand to his mouth. He was awake and cried while his girth was measured. He was turned slightly to sidelying, and given a soother with a drop of water that he began to suck on. As his eye patches were removed, he cried

again. He tried to tuck his legs up, but ended up with one leg over the edge of the nest. He then attempted to grab his gavage tube.

As Jessan's gavage feeding was started, he was offered a soother and sucked on it vigorously. While the gavage feeding infused, Jessan was in a prone position with his arms and legs tucked into flexion; there was minimal motor activity, and he settled into a drowsy state and then a light sleep state. He continued to suck on the soother; the nurse placed his hand up to the soother and he held on to it.

Jessan was observed for 20 minutes following caregiving. Jessan's heart rate remained elevated, and his respiratory pattern irregular with no pauses and one sigh. Jessan's oxygen saturation levels were stable, and his colour returned to pink. For the entire 20 minutes after the feeding had infused and all handling had ceased, Jessan was unable to achieve a deep sleep state, but he did maintain a light sleep state with minimal activity. Jessan remained flexed in his shallow nest; he continued to hold onto the soother, and he sucked intermittently. The noise and activity levels increased significantly; however, Jessan did not respond until he regained his energy, about 10 minutes later, with small foot movements that correlated with the increased noise levels. He stopped sucking, but continued to hold onto the soother.

Summary. Almost one week old, Jessan continues the transition to extrauterine life as reflected in his immature autonomic regulation, and sensitivity to his surrounding environment. Although Jessan was supported and contained during caregiving, he had difficulty with his motor organization, which was more pronounced when he was in a supine position. Jessan's state control was also immature in that he was only able to sustain fleeting wakefulness. Few active self-regulatory skills were observed however, he did

exhibit some beginning competencies of attempting hand to mouth activity, foot clasping, grabbing at his gavage tube, and NNS.

Behavioural Observation #2: Jessan

At the time of the second baseline behavioural observation Jessan was 20 days old or 32 6/7 weeks PCA, and he weighed 1625 grams. During the behavioural observation, the activity level in the room was very high with extra staff assigned to the room, and shift change report in progress. The noise level was moderate, and the room was brightly lit. Jessan was under dark drapes keeping the lighting in the incubator low. Jessan was observed for six minutes prior to caregiving. He had one apnea and bradycardia, to 63 beats per minute with self-recovery, as the nurse opened the incubator doors. Otherwise, his heart rate, colour, and oxygen saturation levels were stable. His respirations were fast and irregular at 58 - 73 breaths per minute. Jessan was in a light sleep state with fleeting transitions into deep sleep. Jessan lay in a prone position with his legs and arms loosely flexed in a shallow nest, and loosely covered with a sheet; there was little motor activity.

Care was given over a 24 minute period. Jessan's heart rate became more variable, and his respiratory rate more irregular and variable. Jessan's oxygen saturation levels became more labile, initially at 98% as he was turned to a supine position, then dipping to 84% with the girth measurement, and to 87% as his diaper was changed. He recovered to saturate around 96 - 98% in a sidelying position for the feeding, but he never returned to 100%, and he always looked less stable. Jessan's colour was pink, but as the handling continued, particularly throughout his diaper change and girth measurement, Jessan turned red.

As Jessan was handled, he moved quickly from a light sleep state to a drowsy state. Jessan was turned to a supine position almost immediately after

being touched. He became active despite keeping his eyes closed. He stretched out his legs several times as though he was searching for a boundary. He flexed his legs up after each extension as if trying to tuck himself back up. As the diaper was removed and left off for a while, Jessan had a period of limpness; he then brought his hands up to his head, and extended his legs again. His fingers were splayed, and he alternated between waving his arms over his head as if saluting, and resting them on his head. While Jessan remained in a supine position he continued these extended movements of his arms and legs. Jessan was settled in a right sidelying position. During the gavage feeding, Jessan opened his eyes, became quiet and alert, and fixated his gaze on the nurse. Jessan remained in a quiet alert state, with pursed lips, for six minutes. The nurse gently patted him as the gavage feeding infused. Jessan closed his eyes and moved back in to a drowsy state, and then a light sleep state as the gavage feeding ended.

Jessan was observed for 22 minutes following caregiving. His heart rate was stable, but his respiratory rate remained irregular and variable between 27 - 62 breaths per minute. He had two respiratory pauses associated with stretching and grimacing. His colour changed from pink to red, and he remained reddened for the next 18 minutes. Jessan's oxygen saturation levels varied from 93 -98%, changing every two minutes, never a constant. The changes in Jessan's oxygen saturation levels did not correlate with an increase or decrease in activity, noise, or light levels, or with changes in state.

Although Jessan was initially in a light sleep state he was unable to settle; he fluctuated between a drowsy state and a light sleep state. Upon completion of the gavage feeding, and for several minutes thereafter, Jessan looked uncomfortable; he had a small cluster of body twitches, and he then became more active and unsettled. His colour turned red and he grimaced. He extended

his left arm over his face, but this behaviour did not appear to be a sign of stress. He attempted to clasp his hands. He squirmed, and actively extended and flexed his arms with splayed fingers, taking his hand on and off his face, with a weak effort to grasp his gavage tube, and maintain his hands near his mouth.

Summary. At 32 6/7 weeks PCA, Jessan's autonomic responses continue to be immature. Consistent with the first observation, Jessan did not tolerate the supine position. Once again his motor distress increased, depleting his energy, as evidenced by his loss of body tone. Large amounts of handling appeared to tire him. However, following this period of motor disorganization and limpness, Jessan was able to achieve a sustained quiet alert period indicating a maturing of his state control. Jessan was beginning to show some self-regulatory competency in using his hands for comfort. Jessan was fairly unsettled following his feeding, and he would have benefited from the opportunity for NNS. Current goals for Jessan remain conservation of energy, and maturation of self-regulatory skills.

Health Status of Infants Prior to Co-Bedding

In the week leading up to co-bedding, Nathan was in an incubator in ambient oxygen of 30%, which was gradually decreased to 23%. He had no more than six episodes of apnea and bradycardia each day. Documentation in the nurses notes on both the infants' behaviours was sparse, and in most cases was limited to the hourly recording of infant state on the flow sheet. However, comments that were present consistently stated, for example: "Nathan is active with handling; sometimes [he] settles with a soother; irritable at times; unsettled at times, and; sometimes upset with alarms ringing and increased noise level around [his] bedside, and bright lights shining in his face." He was dressed, and bundled in the incubator which also seemed to soothe him. Nathan was changed to low flow oxygen per nasal prongs when he was transferred to a crib

for co-bedding.

At 25 days of age and 1780 grams, Jessan advanced to three hourly feedings, and moved into a cot. Jessan continued to have a few episodes of apnea and bradycardia each day. However, at 27 days old he began to have several brief oxygen desaturations, and he was commenced on low flow oxygen per nasal prongs. Jessan was active, and he frequently attempted to pull his nasal prongs out, but he would settle with bundling and a soother.

Co-Bedding Behavioural Observations Using NIDCAP

Nathan and Jessan began co-bedding in a crib when they were 29 days old or 34 1/7 weeks PCA, and at weights of 1745 grams and 1820 grams, respectively. The first co-bedding behavioural observations occurred after the infants had co-bedded for five days. At this time, they were 33 days old or 34 5/7 weeks PCA; Nathan weighed 1935 grams, and Jessan weighed 2085 grams. The final behavioural observation of Nathan during co-bedding occurred when he was 48 days old or 36 6/7 weeks PCA, weighed 2435 grams, and had been co-bedding with his brother for 20 days. The final co-bedding behavioural observation occurred with Jessan when he was 50 days old or 37 1/7 weeks PCA, weighed 2730 grams, and had co-bedded with Nathan for 22 days.

Nathan and Jessan were in a single isolation room at the time of the first co-bedding behavioural observations. Thus, the only activity that occurred in the room was in direct response to their caregiving, and when the family was present. During Nathan's observation, the overhead lights as well as a bedside lamp were on, and there was no crib cover making the environment very bright. However, for Jessan's observation the room was dimly lit. Nathan and Jessan were in a shared, shallow nest made of rolled up towels. They were dressed in sleepers and hats, positioned back to back, and lightly covered with a blanket and

quilt.

Behavioural Observation #3: Nathan

Nathan was observed for 20 minutes prior to caregiving. Nathan's heart rate was stable; his respiratory rate was irregular varying between 11 - 70 breaths per minute at times, but on average ranging between 30 - 35 breaths per minute. He had numerous respiratory pauses, and fleeting episodes of apnea accompanied by oxygen desaturations. Nathan self-recovered within two to five seconds from each of these episodes, which persisted throughout the observation. Nathan's colour remained pink with these dips in his oxygen saturation levels, but he turned red whenever he squirmed. There was only one short episode of tiny facial twitches that coincided with a dip in his oxygen saturations, and some mouthing activity.

Initially, Nathan was in a light sleep state with his arms and legs in a semiflexed position. However, as noise from the running taps increased, Nathan move into a drowsy state, making increased sounds that turned into a soft cry. Nathan stretched and squirmed with active arm and leg extensions, saluted his right arm, and splayed his fingers. He flexed and extended his right arm several times in an attempt to bring his hand to his mouth, but he was not successful. Nathan's motor activity did not disturb Jessan, who was in a light sleep state. Nathan settled down into a light sleep state, and he remained still for the next several minutes. Nathan had a few more squirms with colour changes, mouthing, and active arm extensions. The fleeting dips in oxygen saturation levels and respiratory pauses continued, with no correlation to the bursts of activity.

Care was provided to Nathan over a 28 minute period. Nathan's heart rate became significantly higher and less regular, ranging between 160 - 186 beats per

minute, as his axilla temperature was taken and his diaper changed. He had one decrease in his heart rate, to 124 beats per minute, as the gavage feed was infused, and as Jessan began to have his care procedures. Nathan's heart rate then settled to 142 - 160 beats per minute for the remainder of the feed. Nathan's respiratory rate was irregular and slow at 19 - 48 breaths per minute, while he was actively handled. During the last 18 minutes, as the feeding infused, and as Jessan was handled, Nathan's respiratory rate became more constant at 21 - 31 breaths per minute, and then as Jessan was settled, Nathan's respiratory rate was 30 - 46 breaths per minute.

Nathan's oxygen saturation levels were 89 - 99% as the two minute readings were recorded, but the fleeting dips in oxygen saturation levels (81 - 89%) with respiratory pauses continued. Nathan's colour turned red for the first 10 minutes of handling, while his temperature was taken, and his diaper changed, while he was in a supine position. His colour returned to pink once he was returned to a prone position, but he was paler for the next four minutes.

Upon being handled, Nathan quickly moved from a light sleep state to a drowsy state and made soft sounds. He then moved to a more alert but fussy state, briefly opened his eyes, with increasing motor activity and signs of stress, and a more robust cry. However, he could not sustain this wakefulness for more than a few minutes, and he quickly moved back into a drowsy state. He immediately splayed his fingers, and continued to do so for ten minutes. He attempted to bring his hands to his face, but the nurse held his hands away from his face as she took his temperature. As the covers were lifted off him it became apparent that Nathan's legs were over the top of the nest, and he was actively flexing and extending them, but not in a manner to suggest attempts at leg bracing. As Nathan's diaper was changed, he actively extended and flexed his

arms and legs, saluted his right arm, and then displayed an airplane behaviour.

As Nathan was settled onto his right side and the gavage feeding commenced, he briefly brought his hands to his mouth; he was not offered a soother. Under the covers Nathan had small leg movements. Nathan remained in a shallow nest with his back to Jessan, and with no physical contact. As the handling ceased, and his gavage feeding infused, there was little motor activity; his arms and legs were loosely flexed. Throughout most of the gavage feeding, Nathan only achieved a light sleep state with a few brief periods (less than one minute) of deep sleep.

Nathan was observed for 12 minutes following caregiving, during which time Jessan continued to receive care. Nathan's heart rate returned to the pre-caregiving baseline. His respiratory rate was very irregular, with continuous pauses that were accompanied by brief oxygen desaturations, and from which Nathan recovered without any intervention. His oxygen saturation levels were labile, ranging from 78 - 98%, and which did not correlate with changes in his state. His colour was pink. Nathan was in a light sleep state with two brief episodes of deep sleep. Nathan lay quietly with his arms and legs semiflexed, and his left hand near his face. He remained relatively settled until 12 minutes post-feeding when he had a few squirms, accompanied by reddening of his face, active extension and flexion of his arms, and hand to face activity.

Summary. Nathan did not appear to be disturbed when Jessan was handled for care. However, Nathan and Jessan were positioned in such a manner that there was no physical contact with each other. Additionally, Jessan's caregiving was commenced immediately after Nathan's gavage feeding was started, giving them little opportunity for any interaction or potential co-regulation activities.

Nathan, now 34 5/7 weeks PCA, was experiencing difficulty maintaining autonomic regulation, particularly a stable respiratory effort. His oxygen therapy, discontinued the second day of co-bedding, was restarted the day following this observation for numerous episodes of apnea, bradycardia, and/or oxygen desaturations, with self-recovery. His aminophylline level was low, and therefore, the dosage was increased. His integration of the environment continued to be somewhat immature in that he became less settled whenever the noise levels increased in the room.

Nathan was still working towards self-regulatory competence in that most of his attempts at hand to mouth activity and leg bracing were unsuccessful. A deeper nest would have facilitated Nathan's self-regulatory efforts. Consistently, throughout each of his behavioural observations, Nathan did not tolerate caregiving in the supine position. As soon as Nathan was placed in a supine position he exhibited motor disorganization and stress. He was not as lethargic as he was during the previous assessment however, his energy levels remained low.

Additionally, it seemed that on the days Nathan was bathed and weighed he lacked the energy for breastfeeding. In addition to his immature state regulation, the bright lighting seemed to contribute to Nathan's inability to sustain wakefulness for more than a few minutes; NNS on a soother may have assisted him to transition to an alert state. Furthermore, the increased lighting levels may also have contributed to his inability to achieve deep sleep, as well as an alert state for feeding. Following feeding, Nathan was considerably more settled than in previous weeks demonstrating less diffuse motor activity.

Behavioural Observation #3: Jessan

At the time of the first behavioural observation during co-bedding, Jessan was 29 days old or 34 1/7 weeks PCA, weighed 1820 grams, and had been co-bedding with his brother for five days. Jessan and Nathan were lying back to back with their heads touching. Jessan was almost in a supine position with his head turned to the left, towards Nathan, his arms loosely flexed, and his hands loosely fisted away from his face. Following caregiving, Nathan and Jessan were settled face to face. Jessan's breathing was supported with a small amount of oxygen per nasal prongs, which did not appear to bother him.

Jessan was observed for 20 minutes prior to his caregiving, and while Nathan received care. Jessan's heart rate was stable and his respiratory rate was irregular, ranging between 43 - 52 breaths per minute. He had three episodes of bradypnea: one, after six minutes, to a rate of 29 which did not appear to correlate with any stimulus; the second occurred when Nathan touched Jessan's head, and his respirations slowed to 17 breaths per minute; and the third at 20 minutes, to 16 breaths per minute, which corresponded with a squirm. Jessan's oxygen saturation levels were between 90 - 97% except for one dip to 87%, at eight minutes, when he squirmed, grunted, and turned red. Another similar episode of activity did not result in an oxygen desaturation, but at 12 minutes there was a further dip from which Jessan quickly self-recovered. During this time, Nathan had fleeting dips in his oxygen saturation levels that seemed to correspond with noise from the monitors.

Jessan was in a light sleep state. He had four periods of stillness with more regular respirations, and it appeared Jessan achieved fleeting deep sleep. Jessan did not change states when care procedures began on Nathan. Initially Jessan was very still. As the nurse began to do Nathan's care, Jessan began to make

small mouthing movements; he squirmed, made grunting noises, turned red, grimaced, and then he stretched with another grimace and finger splaying. As he stretched, he brought his hand to his face, then away from his face, back to his mouth, and then away again. Afterwards, his arms and legs remained loosely flexed.

During the last ten minutes of the pre-caregiving observation Jessan was relatively calm. He emitted soft sounds; he had no active arm or leg movements. Jessan had one stretch with finger splaying and grunting; his colour remained stable. Jessan did not appear to respond to Nathan's care until Nathan touched Jessan's head, at which time Jessan's respirations slowed, but he had no active movements.

Care was given over a 38 minute period. Jessan's heart rate during the first 10 minutes of handling was between 136 and 187 beats per minute. Jessan's heart rate dipped to 113 beats per minute as he was turned to his right side, and he had his hat replaced. As Jessan's gavage feeding was started and infused over the next 28 minutes, his heart rate was very stable at 152 - 163 beats per minute for 10 minutes, then 142 - 147 for the next 18 minutes. The slightly higher rate was when Jessan moved into an alert awake state, while Nathan faced Jessan, and made physical contact with his hands on Jessan's face.

Jessan's respiratory rate ranged from 25 - 68 breaths per minute, and was irregular with occasional pauses, as the gavage feeding infused. There was no significant difference in his respiratory pattern between the "hands on" care, and while the feeding infused. Jessan's oxygen saturation levels were generally 96 - 99% with a few dips to 92%, and particularly toward the end of the feeding when there were dips to 83%, 86%, and 87%, respectively. Jessan's colour was pink until he moved to a more drowsy state, and began to squirm and turn red. Jessan

remained red for the first 10 minutes of the feeding, and as he settled to a light sleep state his colour returned to pink.

Jessan quickly moved from a light sleep state to a drowsy state as his covers were lifted. Jessan became quite active as his sleeper was unbuttoned and his temperature taken. His eyes remained closed, but he squirmed, flexed and extended his arms and legs, and his colour turned red. As his chest was auscultated, and then his legs removed from his sleeper, he became very active and briefly attempted to grasp onto his nasal prongs. His legs extended in an attempt to brace against the nest, but instead his legs went over the top of the nest. As his diaper was changed, Jessan saluted and then demonstrated an airplane behaviour; his fingers were constantly splayed during this time. As Jessan's sleeper was replaced he extended his left arm and saluted. Jessan then placed his hand on his head, and rubbed his hand up and down on his face. Jessan moved between a drowsy state and a light sleep state for eight minutes, and then remained drowsy as he was turned to a right sidelying position.

As Jessan was turned to a right sidelying position, facing Nathan, he became alert and quiet with his eyes open. Jessan had his right arm tucked under his right cheek. His legs were loosely tucked into the nest by his nurse. During the first ten minutes of the feeding, Jessan had little active movement apart from occasional finger and hand movements. Nathan became quite interactive with Jessan, reaching out and touching Jessan's face. As Nathan actively moved his hand over Jessan's face, Jessan seemed undisturbed by Nathan's touch. After two minutes, Jessan became drowsy, closed his eyes, and moved into a light sleep state until the feeding was finished. At eight minutes into the gavage feeding, Jessan shrugged his shoulders, made a soft sound, and demonstrated some mouthing movements; Nathan had his finger in Jessan's eye at this time.

At 10 minutes, Jessan had a respiratory pause, a dip in his oxygen saturation levels, and splayed his fingers; his colour was already red.

Jessan was observed for 10 minutes following caregiving. Jessan's heart rate was stable, and his respiratory rate remained very irregular, ranging between 12 - 30 breaths per minute, which was slower than during the pre-caregiving period. There were no respiratory pauses or apnea. Jessan's oxygen saturation levels were 97 - 98%, and his colour was pink. Jessan achieved two periods of deep sleep for approximately one minute each time, otherwise, he remained in a light sleep state. Jessan's right hand remained under his cheek while his left arm was flexed, but not near his face; he had no active movements. Nathan's hands continued to be very close to and occasionally touched Jessan's face. At one point, Nathan stretched his arm on to Jessan's head. Jessan appeared very relaxed and comfortable with this interaction.

Summary. Jessan, now 34 5/7 weeks PCA, continued to experience some difficulty with his autonomic regulation as demonstrated by his irregular respiratory pattern, colour changes, and dips in oxygen saturation levels. However, overall Jessan seemed more robust than Nathan. His motor and state organization was slightly more mature in that he had less diffuse motor movements, and he was able to achieve and maintain a quiet alert period during caregiving. Jessan demonstrated some early skills at self-regulation as evidenced by grasping at his nasal prongs, hand on face activity, and using his hands for comfort.

Evidence of co-regulation behaviours included a slowing of Jessan's respirations when Nathan placed his hand on the back of Jessan's head. Co-regulation also occurred when Jessan transitioned briefly to a quiet alert state in response to Nathan touching Jessan's face. As the touching continued, Jessan

transitioned to a drowsy state and then to a light sleep state. The touching appeared to have a calming rather than disturbing effect on Jessan, assisting Jessan in his state control. Signs of infant-infant co-regulation were also evident in that Jessan appeared to be more settled and calm in close face to face proximity to Nathan, and Jessan was also more settled following his gavage feeding than in the previous two assessments.

Behavioural Observation #4: Nathan

At the time of the final co-bedding behavioural observation of Nathan, he was 48 days old or 36 6/7 weeks PCA, and weighed 2345 grams; Nathan had co-bedded with Jessan 20 days. Nathan and Jessan had been moved, and they were in a 12 bed room. All overhead lights were on; however, their crib was covered making the lighting level very low. The activity and noise levels in the room were high due to the acuity level of other infants in the room. Nathan and Jessan were both lying on their right sides in a "spooned" position, with Jessan facing Nathan's back. The infants were in physical contact with each other. They were dressed in sleepers and wearing hats, with a blanket and quilt loosely on top of them.

Nathan was observed for 16 minutes prior to caregiving. Nathan's heart rate was stable, ranging from 154 - 187 beats per minute, except for two instances where Nathan's heart rate increased to 172 and 187 beats per minute. The increases in Nathan's heart rate occurred when Jessan stirred and actually made soft crying noises. Nathan's respiratory rate was irregular with occasional respiratory pauses. Nathan's colour was pink, and his oxygen saturation levels stable; no twitches were observed. Nathan was in a light sleep state for the majority of the 16 minutes. He had small movements throughout this time with occasional 30 second episodes of stillness, and more regular respirations,

indicating brief periods of deep sleep. Nathan was lying on his right side with his left hand on his face. Both Nathan and Jessan stirred. Nathan stretched, extended his left arm off his face, splayed his fingers, and turned red. As Jessan continued to stir, Nathan brought both his hands together to his mouth, as if to self-console himself. Nathan then settled down for two minutes, in a semi-flexed position, with little activity except for small finger movements. Subsequently Nathan became very quiet as if in a deep sleep.

During the last six minutes of the pre-caregiving observation, Nathan had more stretches and squirms, with active flexion and extension, mainly of his arms, with some finger extensions; he brought his hand to his face and mouth once. Nathan seemed to be waking for his feeding. During this time, Jessan stirred, and his motor activity increased. Both infants were making soft sounds. Following removal of the crib cover, and just before Nathan was uncovered, Jessan cried a little; Nathan immediately turned red, and he demonstrated salute and airplane behaviours.

Care was provided to Nathan over a 28 minute period. During handling, Nathan's heart rate was generally increased to 182 - 196 beats per minute, and his respiratory rate increased to 33 - 63 breaths per minute. As the gavage feeding infused, there was an increase in the number of respiratory pauses, and periods of shallow breathing. None of these alterations in Nathan's breathing pattern caused the cardio-respiratory monitor to alarm, and none were accompanied by oxygen desaturations.

As the covers were removed, Nathan quickly moved into a drowsy state for four minutes. He stirred and put his left hand over his face. Nathan actively flexed and extended both arms and legs. As Nathan was turned to the supine position, he opened his eyes and yawned; his active extensions became more of a

salute then an airplane behaviour. Nathan moved into a quiet alert state; his eyes were open and he fixated on his caregiver. Nathan briefly managed to get his hands together and move them towards his mouth, but this was not sustained, and he quickly moved back to arm extension, salutes, airplanes, and finger splay behaviours. He yawned several times and remained alert. He fussed and made small sounds as his nasogastric tube was aspirated, and his gastric returns replaced. As Nathan's blood pressure was taken, his sleeper removed, and the oxygen saturation probe resited, Nathan stretched out both arms; Jessan held Nathan's arms, and then touched Nathan's face. With this interaction, Nathan briefly became drowsy, but this state was not sustained. As Nathan's diaper was changed, he became fussy with more robust crying.

As Nathan's girth was measured he braced his legs. Throughout caregiving, Nathan mouthed alot, and had several tongue extensions. Nathan was resettled on his right side, beside Jessan. The nurse talked to Nathan, and placed a soother in his mouth; it fell out of his mouth, and she again replaced it. Nathan then held onto his soother, and sucked on it. The gavage feeding was started. Jessan was much more active by now, but this did not appear to disturb Nathan. Nathan's movements ceased and he lay quietly. Nathan continued to hold on to his soother until the gavage feeding ended, with intermittent sucking activity. As the gavage feeding infused, he moved from a drowsy state to a light sleep state. Nathan remained in a light sleep state while the nurse cared for Jessan.

Nathan was observed for 16 minutes following caregiving. His oxygen saturation levels were 93 - 99%, with greater variability than in the pre-caregiving period. Nathan lay quietly on his right side in a light sleep state. He moved his hands away from his soother, and held them in a loose fist away

from his face. After six minutes, Nathan stretched and his colour turned red; there were noticeably more respiratory pauses, but he did not have oxygen desaturations or become bradycardic. On two occasions, there appeared to be fleeting episodes of deep sleep for 20 - 30 seconds. There were a couple of loud noises with no response from Nathan. As Jessan's caregiving and gavage feeding continued, Nathan did not respond to these activities.

Summary. At 36 6/7 weeks PCA, Nathan showed much more competency when handled in that he had less diffuse motor activity, and he was calmer than in his previous assessment. His autonomic responses remained immature. After a brief period of motor stress associated with handling and a change to a supine position, he was able to calm himself and achieve a sustained alert period, which demonstrated a maturing of his state control. He was able to achieve brief periods of deep sleep more easily, and he responded well to being touched by Jessan. He was much more competent in his self-regulatory abilities in that he successfully brought his hands together to his mouth, maintained his hand on his face, held on to his soother, and braced his legs. He tired easily, but his overall endurance had improved.

Nathan's co-regulatory behaviours included reaching for Jessan when Nathan was handled by the nurse, and calming with Jessan's touch. In response to Nathan reaching out for Jessan, Jessan held Nathan's arms, and then touched Jessan's face. On two other occasions an increase in Nathan's heart rate coincided with Jessan's cries. Both infants woke at the same time for their feedings, indicating a developing synchrony in sleep-wake cycles. Nathan appeared to be more settled after feeding than in previous weeks, which may be attributed to either close physical contact with his brother or to maturation, or to both.

Behavioural Observation #4: Jessan

At the time of the last co-bedding behavioural observation for Jessan, he was 50 days old or 37 1/7 weeks PCA, and weighed 2730 grams. Jessan had been co-bedding with his brother for 22 days. During this observation, all overhead lights were on in the 12 bed room however, a crib cover kept the lighting level low at Nathan's and Jessan's bedspace. The activity and noise levels in the room were moderate. Both infants were in left sidelying positions with Nathan facing Jessan's back. Jessan was awake at the beginning of the assessment at 0823 hours. This wakefulness was observed until 1007 hours.

Jessan was observed for 40 minutes prior to caregiving. During this period, Jessan's heart rate was between 150 - 185 beats per minute with a trend to the higher rate. His respiratory rate was irregular and variable between 32 - 72 breaths per minute. His breathing was faster during the first 10 minutes of the observation, and coincided with his fussing. Jessan's oxygen saturation levels were between 95 - 100% with one dip to 91% when he had a diffuse squirm. He had several more squirms accompanied by colour changes from pink to red, and then returning to pink within the minute. There were no twitches or startles. These patterns of autonomic regulation continued without major change during the 40 minutes leading up to caregiving.

During the pre-caregiving observation, Jessan was initially awake and alert, but after a few minutes he moved into a fussy state with some crying and yawning. He had repeated active flexion and extension of his arms and legs; the waving of his arms occasionally ended in hand to face or mouth activity, but this was not sustained. As the sink was in use, creating increased noise, Jessan squirmed, went red, and splayed his fingers. Nathan reached out and touched Jessan at this point; Jessan clasped his hands together in midline, and became

quiet. The next eight minutes were spent mostly alert and quiet, moving briefly to a drowsy state, and then returning to a quiet alert state. Jessan looked around several times, looked at his extended fingers, displayed small head movements, and made occasional soft sounds. During the subsequent 30 minutes, these patterns of motor activity, and state regulation and transitions continued. Jessan demonstrated readiness cues for feeding by mouthing and suck searching.

During the 10 minutes of caregiving prior to breastfeeding, Jessan's heart rate was fast and steady at 176 - 183 beats per minute. His respiratory rate was irregular, ranging between 25 - 43, without significant pauses or apnea. His colour was pink throughout this part of caregiving, and Jessan did not exhibit any stretches associated with previous colour changes. His oxygen saturation levels were stable, and he appeared to tolerate the handling well.

As Jessan was lifted out of the crib, and moved to a bassinet for caregiving, Nathan cried for a short time. As Jessan was placed supine in the bassinet, he waved his arms around, but he did not appear stressed. He looked around and remained quiet and alert. He became a little more active as his sleeper was removed, flexing and extending his arms and legs, extending his fingers, and turning his head from side to side. He tried to bring his hand to his face in these first four minutes, but he was unable to self-console himself. He sneezed once, and yawned three times; there was considerable mouthing for six minutes. By this time, Jessan had been awake for nearly an hour. Jessan's mother positioned him on her right breast where he remained alert for five to six minutes and actively sucked; he then became drowsy. Jessan breastfed for the next 20 minutes.

Summary. Jessan, now 37 1/7 weeks PCA, still required assistance at times with self-regulation, however, he also demonstrated more mature and active self-regulatory capabilities such as, clasping his hands together in midline.

Although he had some squirms, and active extensions of his arms and legs in the supine position, overall he demonstrated motor control. He was able to sustain long periods of alertness, moving successfully from active alert to quiet alert. He had a hard time sustaining breastfeeding after a protracted period of wakefulness, tiring quickly. His energy levels were low.

Jessan and Nathan appeared to engage in co-regulatory activity when, at one point, Jessan was in an active alert state, and displayed a loss of motor control. Nathan reached out and touched Jessan. In response to Nathan's touch, Jessan clasped his hand together, and transitioned to a quiet alert state. Thus, Jessan's motor and state organization was mediated through co-regulation with Nathan. A second example of co-regulation may have occured when Jessan was lifted out of the crib for caregiving, and Nathan immediately began to cry. It appeared that Nathan's crying was precipitated by Jessan's absence.

Chart Review

Temperature Regulation

Upon initiation of co-bedding, the nurse who was interviewed articulated that Nathan and Jessan did not experience any temperature regulation problems in that neither infant became hypothermic. Prior to co-bedding, Jessan had been in a cot for just over 24 hours, and he had maintained his body temperature. Nathan, who was transferred from an incubator to co-bed, also maintained his temperature. A review of the chart revealed that on the second day of co-bedding Nathan's axilla temperature was 36.5°C. His "hands and feet were cool to touch, and a second blanket was applied." However, a temperature 36.5°C is considered within normal limits. A review of Nathan's and Jessan's body temperatures prior to co-bedding did not reveal any similarities or pattern between the infants (See Figure 1). However, within hours of the initiation of co-bedding the infants

demonstrated a beginning synchrony in their body temperatures (See Figure 2). Days were chosen at random during the course of co-bedding to examine patterns in body temperatures between the infants. Over the course of co-bedding, Nathan's and Jessan's body temperatures increasingly coincided, with similarities particularly evident on days 17 and 24 (See Figure 3). Deviations in synchronous body temperature could be related to such variables as timing of bathing and weighing of each infant.

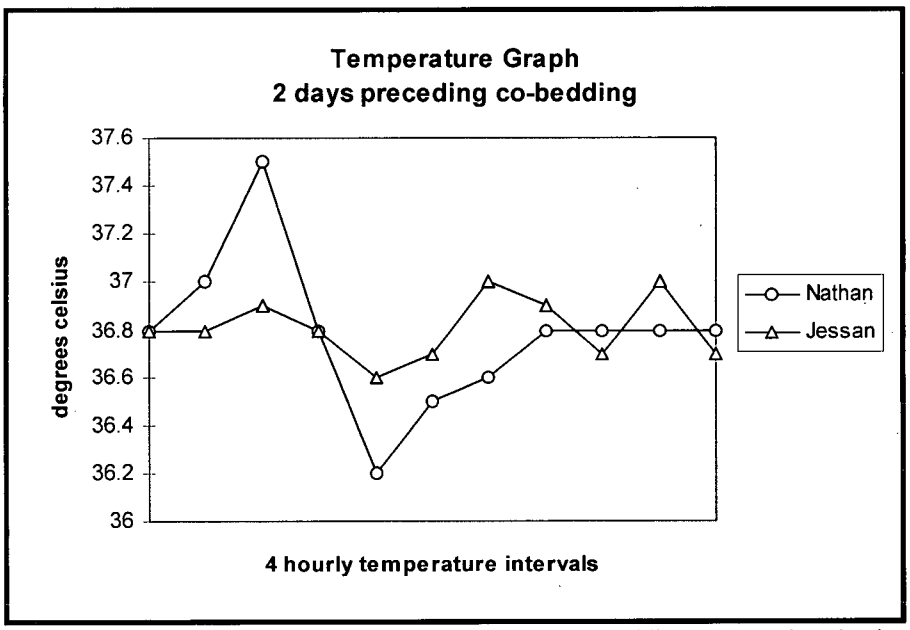

Figure 1. Axilla temperatures of each infant prior to co-bedding. No synchronization found in body temperatures between the infants.

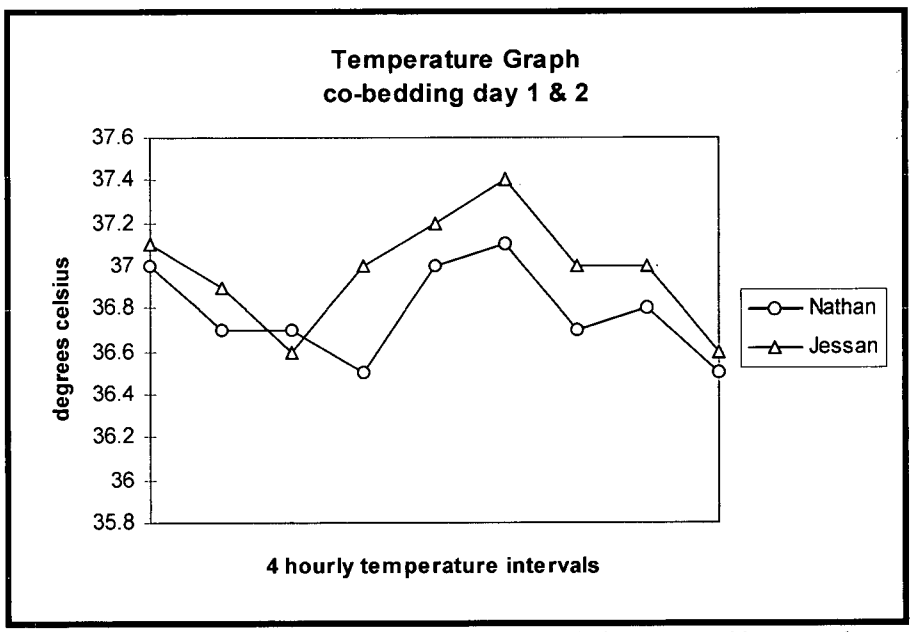

Figure 2. A beginning synchrony in temperature regulation occurred between the the infants within hours of the initiation of co-bedding. Axilla temperatures were taken at four hour intervals with the omission of one night time temperature on each day.

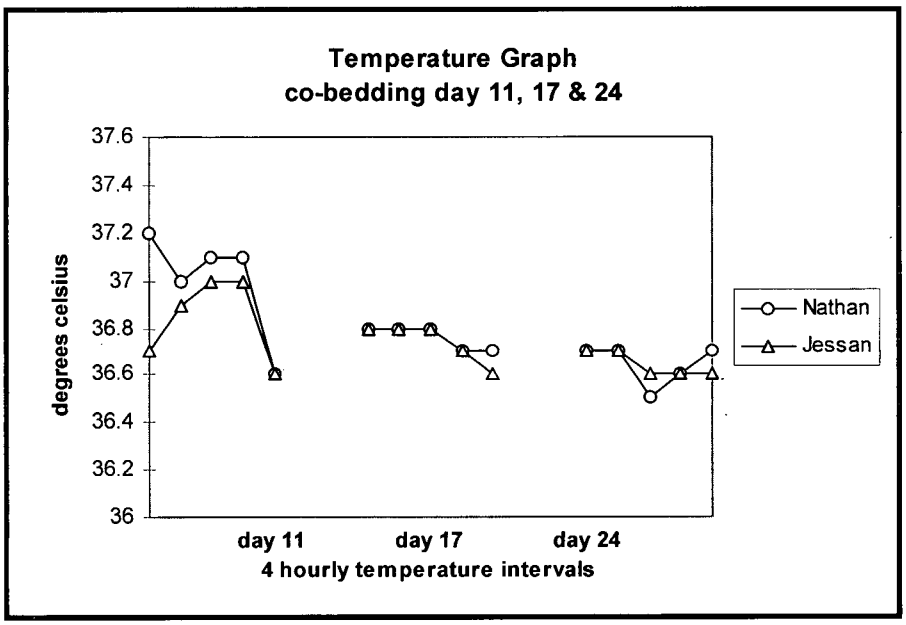

Figure 3. Days chosen at random revealed increased synchrony in body temperatures over the course of co-bedding. Axilla temperatures were taken at four hour intervals with the omission of one night time temperature on each day.

Nursing Documentation of Infant Behaviours During Co-Bedding

A review of the nursing documentation on Nathan's and Jessan's behaviours suggested that they were much more settled after they were co-bedded. Consistently, Nathan was described as "awakes and settles easily" and "alerting and settling well." Jessan was described as "active and bright with handling" and "alerting for brief periods around feedings, otherwise sleeps." There was an initial notation in the infants' charts that co-bedding had commenced. However, it is interesting to note that there was no further documentation in the chart indicating that the infants were co-bedding until the tenth day, at which time their environment was charted as "co-bedding in a crib."

A review of the charts also revealed no documentation on whether Nathan and Jessan were bundled together or separately, or on their positioning such as, facing each other, back to back or "spooned" (both lying on their left sides or right sides). Information on positioning was obtained through the interviews with the parents and the nurse. Nursing documentation on Nathan's and Jessan's interactions with each other occurred when the infants had co-bedded for almost a month. The nurse wrote: "relaxed and comfortable co-bedding with Jessan;" "co-bedding with twin and co-existing very comfortably," and; "quiet and comfortable co-bedding with Nathan."

Behavioural Synchrony

Nathan's and Jessan's progression was simultaneous as they matured and as they co-bedded. When co-bedding was initiated, both Nathan and Jessan were on nasal prongs, and had self-recovering apnea, bradycardia, and/or oxygen desaturations. At 39 days old, after they had been co-bedding 11 days, neither Nathan nor Jessan required further oxygen therapy, and they had their nasal

prongs discontinued. Both infants had their aminophylline discontinued at 44 days of age.

A review of their charts revealed that over time, as Nathan and Jessan co-bedded, their sleep-wake cycles became progressively more synchronized. Hourly documentation of their states indicated that their state increasingly coincided with each other. This was confirmed by the nurse who was interviewed. The nurse stated: "they slept the same amount of time and they woke at the same time." In fact, within a few days of co-bedding Nathan and Jessan had developed a rhythm of waking up together. The nurse commented that by the time her set of shifts were completed, "they were in to a routine . . . they were waking together." The nurse did not feel that one infant woke the other one up. Instead, Nathan and Jessan just ended up waking together. The nurse thought this could be attributed to the fact that Nathan and Jessan were feeling so much better, and were feeling hungry.

Nathan's and Jessan's progression from nasogastric to full nipple feedings almost mirrored each other. Around 37 weeks PCA, bottle feeding was introduced to both Nathan and Jessan. The parents established a feeding routine whereby their father bottle fed one infant, while their mother breastfed the other. At 52 days of age, they both received their last two gavage feedings during the night; at 53 days of age, they both had their indwelling nasogastric tubes removed, as they had each attained full breast and bottle feedings. Nathan and Jessan went home when they were 58 days old, 38 2/7 weeks PCA, and had been co-bedding 30 days. Nathan weighed 2830 grams and Jessan weighed 3035 grams.

Weight Gain

It was not within the scope of this case study to examine weight gain during the pre- and post-co-bedding periods. The preterm infant weight charts

used in the SCN depict growth curves that trend weight gain. It is evident from a review of the growth charts of both infants that weight gain trended higher following the initiation co-bedding. However, this difference needs to be quantified to ascertain whether the trend toward greater weight gain during co-bedding, compared to rate of weight gain prior to co-bedding, is statistically significant.

Perceptions of the Co-Bedding Experience

Parents' Perceptions

The parents were very involved with their infants care throughout their NICU stay, spending several hours a day with their infants.

Sleep -Wake Patterns

The parents found their infants to be more settled and slept for longer periods once they began co-bedding. According to the father, Nathan, in particular, was much more content:

> He [Nathan] was awake a lot and restless. He couldn't get to sleep when he was in the incubator, but since he and Jessan have been together he is much more settled and sleeping a lot longer.

Position and Touch

For the first week of co-bedding Nathan and Jessan were usually positioned back to back. The father described how, at first, Nathan and Jessan could not face each other:

> Nathan was always reaching out, touching, and grabbing at Jessan's face. Jessan had some small scratches on his face. . . . For about the first week or so they couldn't face each other.

From the mother's perspective:

> Some of the nurses turned them [Nathan and Jessan] away from each other. They told us they couldn't put them facing each other because they were touching each other's faces too much. Nathan was doing most of the touching and reaching for his brother. . . . We were worried Jessan wasn't

> [touching], and then the nurses told us that he was starting to reach out too.

The mother did not think that there was any relationship between her infants' position in her uterus, and a preference for a certain position during co-bedding. In fact, neither the mother nor father thought the infants had a preference for a certain position. The parents described the infants as more interactive with one another when they were face to face.

Infant Interactions

The parents were asked to describe an interaction between Nathan and Jessan. The mother described the following interaction:

> There was one time when a nurse and I bathed Nathan and Jessan together one day, in the same tub. We put them on the bed, in a towel, they were a little cold. Nathan grabbed onto the towel and was pulling on it . . . it was like he was trying to pull himself closer to Jessan. I'm sure he wanted to get closer to Jessan.

The father described the following interaction:

> . . . I remember one time I came to visit. . . . Nathan and Jessan were sleeping. They were holding hands. Both Nathan's and Jessan's arms were down by their side. . . . they both had their right arm down and were holding each other's hand. Their left hands were up by their faces and they were also touching . . . together, holding on to each other.

The parents were asked if they thought that Nathan and Jessan spent much time interacting together when the infants were waking up or alert. The parents thought that for the most part the parents were either holding or feeding Nathan or Jessan as soon as they woke up.

Individual Behaviours

The parents identified differences in behaviours, ascribing unique characteristics and personality traits to each infant. According to the father:

> Jessan is more laid back than Nathan. Jessan has always been more settled. Nathan has always been more fussy.

According to the mother:

> Jessan enjoys breastfeeding. He does better breastfeeding than he does with the bottle. Sometimes he gets stressed with the bottle, chokes, and forgets to breathe. Nathan prefers the bottle and does better with the bottle than Jessan does.

Perceptions of Care

Both parents commented that they would definitely recommend co-bedding to other parents of twins. They felt it has been good for their infants to be together and to keep each other company, and for themselves to be able to spend time with them together.

The parents were asked if they had any suggestions or advice on improving support for parents of twins in a NICU. Overall, the parents expressed that they were "pretty happy with the way things have gone." The father commented that a primary nurse (s) would have been helpful and "the one thing that would have made things better. . . more consistency, less nurses, less conflicting ideas." The mother expressed that they had received a considerable amount of conflicting advice in regards to feeding their infants, and as a result it was difficult for them to know what to do. The mother commented that every nurse seemed to have her own opinion which was a source of frustration for them. The mother contacted POMBA (Parents of Multiple Births Association) to seek advice on feeding. The father felt that more information on understanding their infants' behaviours would also have been helpful:

> One thing we need to learn more about is our babies' cues and behaviour, what they're telling us. Their cues when they're feeding. We need to get more comfortable with this.

Six-Week Follow-Up

A follow-up telephone call with the mother occurred at six weeks following discharge; the infants were one month corrected age at this time. Nathan and Jessan continued to co-bed. When asked whether co-bedding facilitated caring for Nathan and Jessan at home, or whether it was difficult to care for both of them when they woke together, the mother commented:

> For the three o'clock morning feed one [Nathan or Jessan] tends to wake, then the other wakes 20 minutes or so later so it works out. Sometimes when they do wake up together and are both very hungry I put them in the car seat and feed them. Once in the car seat they seem to know they'll be fed. . . . but this high-pitched crying, both together, is rare.
>
> . . . One thing that I've noticed when Nathan and Jessan wake together is that one acts hungrier and is more vocal than the other. It seems that each infant has developed a sense of waiting and is watchful while his brother feeds, . . . they seem to know when the other is being fed, so it usually works out.

The mother did not feel that there was a pattern as to whether Nathan or Jessan fed first. The mother felt that co-bedding continued to be beneficial for Nathan and Jessan and facilitated caring for her infants.

Nurse's Perceptions

Sleep-Wake Patterns

The nurse expressed amazement at the almost instantaneous and significant change in Nathan's behaviour once he was co-bedded with Jessan.

> Nathan, when he was in the incubator, he was always the feisty one. His lines [leads] were always coming off . . . he was the mover of the two of them, a little bit hyper, but co-bedding them, he settled right down . . . that amazed me because he [Nathan] settle right down and went to sleep. . . . Even putting them back to back, I mean he [Nathan] did not really know he was with his brother, but I had them touching. They were always touching. They would just go right off to sleep.

Position and Touch

The nurse described that as soon as she put Nathan and Jessan together in the same crib they started touching one another:

> . . . Nathan kept reaching out to his brother . . . he would automatically start grabbing out at Jessan . . . and scratching, and literally grabbing his nose, grabbing his prongs and pulling at them, so I couldn't put them face to face . . .
> So sometimes they were back to back or I spooned them where they were both facing the same way. I put Nathan's arm around Jessan, and that was fine. They both did really well. . . . So, I think it was a while before they were positioned face to face so Nathan would not bother Jessan.

Infant Interactions

Consistent with the parents' perceptions, the nurse described Nathan and Jessan as more interactive with one another when they were face to face. Similar to the parents' and this author's observations, the nurse also felt that Nathan and Jessan were not given time to interact with each other when they were awake and alert. The nurse commented:

> When I had them it was more when they were awake you tended to pick them up, especially when the parents came in. At that time a grandfather was visiting from Ottawa, so he was doing a lot of holding and cuddling. So when they woke you would pretty well picked them up, and got them ready for their feeds.

Facilitation of Caregiving

When the nurse was asked if there were any other observation or perceptions she would like to share, she described the following:

> The other thing I noticed when you fed them, we were tube feeding them at the time, and even though it was funny, Jessan's feeding tube [NG] was a little higher than Nathan's so you would expect Jessan's [NG feed] to go in faster than Nathan's, but when you tube fed them both their feeds went in at the same time. At first I thought this was a fluke so did a little experiment and left it like that all set [three shifts], and the same thing happened.

The nurse stated that she would definitely recommend co-bedding to other parents of twins. According to the nurse, the parents only became aware of the opportunity to co-bed their twin infants once they were in the SCN. The nurse commented:

> When I talked to them [the parents] that day and said I was going to co-bed them, they knew what it [co-bedding] was, but their picture of co-bedding was different than when they came in to see. They sort of thought that Nathan would be at one end of the crib and Jessan at the other. I said, oh no, the whole idea is to put them together, so they were really pleased.

The nurse also commented on several occasions how much Nathan settled down, and how difficult it had been to settle him in the incubator. The nurse felt that co-bedding facilitated caregiving:

> It is easier looking after them, especially around feeding time. When they are co-bedded you are doing things together. They are awake together, you are talking to them together, you are playing with them together, which is kind of nice.

Consistent Themes

Consistent themes between the parents' and the nurse's perceptions were identified and included:

Touching

Increased touching: During the first week of co-bedding the parents and the nurse repeatedly described the increased touching by Nathan and Jessan of one another's face.

Reaching

Constant reaching towards each other: Nathan, in particular, constantly reached out and touched, even grabbed Jessan's face when in a face to face position.

Behavioural Change

Transformation in behaviour: The parents and the nurse consistently commented throughout the interview the significant transformation in behaviour they observed in Nathan. Almost immediately, Nathan's behaviour changed from restless and feisty in the incubator to calm and settled co-bedding with his brother. Although Jessan too, was more settled with co-bedding, the parents and the nurse did not perceive the change to be as dramatic as with Nathan.

Summary

This chapter has provided a descriptive narrative of the co-bedding behaviours of one set of twins. The findings suggest that Nathan and Jessan demonstrated a number of behaviours that could be considered co-regulation. The parents' and nurse's observations and perceptions, in addition to clarifying and validating the infants' behaviours and interactions with each other documented during the NIDCAP behavioural observations, added depth and richness to the emerging portrait of co-regulation. A secondary finding, worthy of discussion, was the usefulness of the behavioural observations in highlighting the importance of integrating a developmentally supportive care protocol into daily clinical practice.

CHAPTER FIVE: DISCUSSION OF FINDINGS

Introduction

In this chapter, the study findings are examined and analyzed in relation to the three bodies of literature that provided the theoretical framework for this study: developmentally supportive care, family-centered care, and the experience of twinship. Consistent with case study method, the results are generalized to theoretical propositions in the literature. A description of co-regulation is articulated in this case study as portrayed by the set of twins, and the perceptions of their parents and consistent nurse. Excerpts from the behavioural observations are highlighted to illustrate the context in which co-regulation behaviours occurred. Perceptions of the parents and the consistent nurse, and the implications for caregiving in the SCN, and in family life are also discussed. Finally, secondary findings of the case study related to continuity of care, implementation of a developmentally supportive care protocol, and usefulness of the NIDCAP naturalistic behavioural observations are examined.

Infant Behaviours During Co-bedding

Co-Regulation

The picture of co-regulation that emerged from the descriptions of the infants' behaviours, and the parents' and nurse's perceptions, was one of the infants holding onto, touching, reaching towards, responding to each other's stress behaviours, calming each other, and crying when separated. Co-regulation, in this study, was characterized by infants who were calmer and more settled, fell asleep more easily, slept for longer periods, woke together, and whose biorhythms, sleep-wake cycles and body temperatures became increasingly more synchronous.

This depiction of co-regulation that emerged from the case study supports the findings of Lutes (1996) and Nyqvist & Lutes (1998), whose descriptions of co-regulation included touching, holding, moving closer, hugging, rooting and sucking on each other, smiling, being awake at the same time, and decreased need for ambient temperature support. Sucking on each others' hands or fingers, hugging, and smiling, documented by Nyqvist and Lutes, were not observed in this set of twins. Nathan and Jessan enhanced each others' autonomic stability, motor organization, and state control by, at times, appearing to respond to one another's stress responses and calming each other, thereby balancing and supporting each other.

Initiation of Co-Bedding

It is suggested that co-bedding be initiated as soon as possible after birth (Nyqvist & Lutes, 1998). Nathan and Jessan began co-bedding at 29 days of age. Consistent with co-bedding guidelines in many other NICUs, Nathan was not considered eligible to begin co-bedding with his twin while he received binasal CPAP. However, Nyqvist & Lutes (1998), as well as others (co-bedding policy, St. Mary's Medical Center, Duluth MN, November 1996), suggest that CPAP tubes and intravenous lines do not necessarily preclude co-bedding, provided that they are positioned out of reach of the other sibling. During this time period, both Nathan and Jessan experienced numerous episodes of apnea, bradycardia, and oxygen desaturations each day. It is conceptualized that co-bedding may have assisted them through this period, and possibly reduced the number of episodes they were having. Outcome data on skin-to-skin cuddling reveals that infants actually have less apnea and bradycardia while they are skin-to-skin because they are stimulated by their parents' respirations and heart beat (Ludington-Hoe & Swinth, 1996). Therefore, it is quite plausible that each infant could provide a

source of stimulation for the other. Furthermore, it may very well be that the episodes of apnea, bradycardia, and/or oxygen desaturations, documented in the infants' charts as self-recovery, may, in fact, not be self-recovery at all, but instead due to stimulation by the other twin.

The Context of Co-Regulation Behaviours

Autonomic Regulation

The context in which co-regulations occurred is illustrated in the following examples. The excerpts from the behavioural observations describe one twin affecting his sibling's autonomic regulation. During one observation, Nathan and Jessan were positioned back to back, with their heads touching. Jessan was almost supine with his head turned to the left toward Nathan. During the pre-caregiving observation of Jessan, Nathan received care. Jessan had three periods where his respirations slowed. One episode occurred when Nathan touched Jessan's head; Jessan stayed very settled, and his respirations slowed to 17 breaths per minute.

A second example illustrating the effect on one twin's autonomic regulation by his sibling's touch occurred when Jessan was settled on his right side, facing Nathan, following caregiving. Nathan reached out, and touched Jessan's head and his face. For an 18 minute period during caregiving, Jessan's heart rate was 142 - 147 beats per minute, however, during the time that Nathan was touching Jessan's face, Jessan's heart rate ranged between 152 - 163 beats per minute. On another occasion, there were two instances when Nathan's heart rate was elevated above baseline which directly coincided with Jessan stirring, and making soft crying noises. Although one could interpret the changes in autonomic regulation of one twin as purely coincidental, given that this response was observed on at least three occasions, it is more plausible that it was

mediated through close physical contact and touching.

State Regulation

Co-regulatory behaviours occurred most often when Nathan and Jessan were positioned face-to-face, and in close proximity to each other. The following examples illustrate co-regulation of state, or the effect that one twin can have on his sibling's state control and state modulation. On one occasion, following caregiving, Jessan was settled facing Nathan. Jessan transitioned from a drowsy to an alert-awake state as Nathan became quite interactive with Jessan, reaching out and touching his head and his face. Nathan actively moved his hand over Jessan's face; Jessan seemed undisturbed by this touching. After two minutes, Jessan became drowsy, closed his eyes, and then moved into a light sleep state. Nathan's hand continued to be very close to, and occasionally touched Jessan's face. At one point, even though Nathan had his finger in Jessan's eye, Jessan only shrugged his shoulders, made a soft sound and mouthing movements, remaining relatively settled with minimal motor activity during this interaction.

Motor Regulation

There were several instances when one twin seemed to respond to his sibling's stress cues. One example, was when Nathan became somewhat upset and unsettled with having his sleeper removed. Nathan squirmed, and he extended and stretched out both his arms. Jessan held onto Nathan's arms and then touched Nathan's face. With this interaction, Nathan briefly transitioned to a drowsy state. This activity was repeated in another observation when, as the nurse commenced Nathan's care procedures, Jessan squirmed, grunted, turned red, grimaced, and stretched. As Jessan was trying to settle himself, Nathan, once again, touched Jessan's head.

During another caregiving session, the activity and noise levels significantly increased for a time. Jessan squirmed, went red, and splayed his fingers. Nathan reached out and touched Jessan, who then clasped his hands together in midline and went quiet. For the next several minutes, both infants were awake, however, Jessan was more alert. Following this period of wakefulness, Jessan was lifted out of the crib, and moved to a bassinet for caregiving; Nathan cried for a short time.

On several occasions, when either Nathan or Jessan were active while receiving care, the twin not receiving care was undisturbed by this activity, and often in a light sleep state. For example, prior to caregiving, as Nathan woke for a feeding, his soft cry, arm and leg extensions, and squirms did not disturb Jessan, who remained in a light sleep state with little movements. While Nathan's gavage feeding infused, Jessan was handled for care; at this time Nathan's respiratory rate became more constant and regular, and he, in turn, was not disturbed by Jessan's caregiving.

To summarize, both Nathan and Jessan were calm and settled in close face to face proximity with each other. It appeared that when Nathan and Jessan were positioned face to face, and provided the opportunity to interact with each other, they engaged in considerable touching, reaching out, and holding on. These examples demonstrate that closeness and touching did not disturb the infants but, in fact, contributed to autonomic, motor, and state regulation of one or both twins. The findings may offer an explanation towards the documentation in the chart by one nurse, "co-bedding with twin and co-existing very comfortably."

Sleep-Wake Cycles

Changes were observed in Nathan's and Jessan's sleep-wake cycles once they were cobedded. Co-bedding provided Nathan and Jessan with the

opportunity to wake up, to feed, and to sleep at the same time, facilitating synchronization of these activities. Following caregiving and feeding, they appeared to calm down, and fall asleep more easily. Nyqvist & Lutes (1998) hypothesized that co-bedding twins may facilitate a mutuality in their circadian rhythm and sleep-wake patterns. The behaviours of Nathan and Jessan certainly seem to support this hypothesis.

Both Nathan and Jessan slept for longer periods once they were co-bedded. A lengthening sleep cycle could very well be attributed to maturity, co-bedding, or to both co-bedding and maturity. However, both parents and the nurse remarked how quickly Nathan became more settled and less fussy almost immediately after he was co-bedded with Jessan, representing a significant change in Nathan's sleeping and waking pattern.

According to Ludington-Hoe (1990), activity can account for as much as 40% of an infant's daily energy expenditure. Ludington-Hoe found that there was a significant reduction in activity when infants were skin-to-skin cuddled, concluding that energy conservation was likely enhanced during skin-to-skin cuddling. Thus, it appears that co-bedding twins may also contribute to energy conservation because each infant in this study was more calmed and settled during co-bedding.

The finding in this case study that, on more than one occasion, Nathan and Jessan transitioned to quiet-alert states when positioned face-to-face, and in close proximity to each other is an important finding. Increased time spent in alert states is thought to enhance social development and parent-infant interactions, and to be a predictor of later cognitive development (Becker et al., 1993). Becker et al. also reported increased alerting periods in preterm infants who received a developmentally supportive care protocol, compared to preterm

infants who received traditional care.

Although Nathan and Jessan slept for longer periods, it would be of interest to examine the proportion of time the infants spent in light sleep states and in deep sleep states during co-bedding. It is difficult to accurately extrapolate this information from the behavioural observations, the parents' and nurse's perceptions, and the documentation in the hospital charts. There are varying reports in the literature on the effects of close physical contact or proximity on the sleep states of infants.

A recent California study examined the impact of bedsharing on infant sleep and sleep position, and whether or not bedsharing between mothers and infants had any effect on sudden infant death syndrome (SIDS) susceptibility (Mosko, 1997). During bedsharing, term infants experienced less deep sleep and more light sleep. Observation of sleep position showed that during bedsharing mothers and infants maintain a high level of awareness of each other, spending most of the night on their sides facing each other. Therefore, it is plausible that twins who co-bed spend more time in light sleep also maintaining a high awareness of each other. One could further hypothesize whether twins or higher order multiples who co-bed may have less incidence of SIDS.

Conversely, it has been documented (Ludington-Hoe, 1990; Ludington-Hoe et al., 1994) that preterm infants spent more time in deep sleep and less time in light sleep while skin-to-skin cuddled by a parent. Clinical anecdotal data from the SCN revealed that disturbed sleep-wake patterns have occurred in two sets of twins, since co-bedding was initiated in 1996. Therefore, documentation on the proportion of time spent in deep sleep and light sleep during co-bedding would provide important information, given that deep sleep enhances growth. Future studies may reveal that for some twins, co-bedding may actually enhance

deep sleep, while for other infants it may result in disturbed sleep patterns and waking each other.

As infants receiving neonatal intensive care approach discharge it is often commented upon that they have their days and nights "mixed up". They often sleep during the day, and are awake and fussing during the night. However, this did not occur with Nathan and Jessan. They tended to sleep for three to four hours at a time, wake up to feed, and fall back to sleep again. One goal of a developmentally supportive caregiving approach is to help an infant "stretch" out his biorhythms to fit a 24 hour cycle, by assisting him to consolidate his sleep cycles (Thomas, 1995); co-bedding certainly helped Nathan and Jessan to achieve this.

Position and Touch

Nathan and Jessan were always positioned in a collective nest. Although they were either swaddled, or loosely covered together during each behavioural observation, at other times they were bundled separately. On occasion, they were separately bundled so snugly, and placed slightly apart from each other that they did not have the opportunity to touch each other, and affect each others motor organization or state control. In fact, on one occasion Nathan was bundled with his arms by his side inhibiting self-regulatory activities. As Nathan stirred, he attempted to free his hands and arms, most likely to bring them to his mouth or his face, in an attempt to self-regulate. However, when he was unable to free his arms he became stressed; he grimaced, shrugged his shoulders, and turned red. His heart rate increased, his respirations became more irregular, and he generally looked uncomfortable.

Nyqvist and Lutes (1998) found that most of the mothers they interviewed thought that their infants preferred to face each other; the family and the nurse

interviewed in this case study did not feel that Nathan and Jessan had a preference for a certain position. It may be however, that Nathan and Jessan preferred to be face to face, as evidence by their increased touching and holding on.

Both the parents and the nurse who was interviewed repeatedly described behaviours of increased facial touching, particularly by one twin, and particularly in the first week of co-bedding. In response to this frequent and persistent facial touching, even grabbing onto one twin's nose by the other, and some facial scratches, the infants were turned away from each other. The nurse commented that they "were at each others face all the time". This activity seemed to disturb the caregivers more than it disturbed the infants themselves, as evidence by a lack of stress behaviours, stable vital signs, state regulation, and a calming effect on each other during similar interactions, recorded during the behavioural observations. It is hypothesized that the amount of facial touching that occurred between Nathan and Jessan may not be any greater than, or different from the amount of touching or intrapair stimulation that occurred in utero.

One could speculate that this increased touching in the first week of co-bedding was a period of reacquaintance with each other. This increased touching, and awareness of each other in the initial days of co-bedding was recently observed in a set of triplets, by the mother, grandmother, and several members of the multidisciplinary team in the SCN. When Triplet B and C were initially placed together the mother commented:

> Justin (Triplet C) was so taken with his sister; he was very wide eyed and alert. . . . he just stared at her and reached out for her.

The grandmother commented:

> They knew each other. As soon as they were put side by side they touched. . . . Rebecca (Triplet B) placed one of her legs across Justin's leg, and they became entwined. They fell asleep with their hands near each other's face.

A nurse commented:

> I'm sure that Justin recognized Rebecca. He was so wide eyed and alert, almost hyperalert. He reached out and touched her face and her hair.

The other health care professionals present at the time shared the same perception as this nurse. A physiotherapist's commented:

> Justin stroked Rebecca's face and she turned and rooted and sucked on his fingers. Rebecca had never been interested in a soother. . . . They calmed each other. Justin slept through his next feed. . . . Both were tachycardic, following co-bedding their heart rates decreased considerably. Rebecca's resting heart rate decreased from 170 - 180 beats per minute to 160 - 170. Justin's heart rate decreased to 139, low 140's. . . .

The finding in this case study, that one infant was often undisturbed by his sibling's care activities, challenges the practice of separating twins who are co-bedded for caregiving, and appears to provide evidence to the contrary. This practice warrants further investigation, particularly when separation for caregiving may actually cause the infants some distress. In the most recently available guidelines for co-bedding (Nyqvist & Lutes, 1998), separation of twins for caregiving was not mentioned. However, the co-bedding guidelines for the SCN, based on the policy from the NICU, St. Mary's Hospital, Duluth, MN (1996) suggest having a cot on standby for emergency situations, and for caregiving if required.

Chart Review

Thermal Synchrony

The thermoregulatory dynamics between Nathan and Jessan were such that, over time, they appeared to demonstrate increased synchrony in their body temperatures (Refer to Figures 1 - 3). By approximately two weeks into the course of co-bedding their body temperatures increasingly coincided. The finding of thermal synchrony between the twins in this case study was also reported in the study by Nyqvist and Lutes (1998). These authors documented that twins who were co-bedded required less thermoregulatory support to maintain their body temperatures. The findings are also consistent with the studies on skin-to-skin cuddling documenting thermal regulatory support through the process of parent-infant co-regulation, mediated by skin-to-skin contact (Acolet et al., 1989; Ludington-Hoe et al., 1991, 1994). In these studies, infant body temperatures were maintained, or actually increased during skin-to-skin cuddling.

Occasionally, Nathan and Jessan were bundled separately. This practice seemed to vary depending on the nurse caring for the infants. The rationale most commonly given by nurses was that one, or both infants were "cool" following their bath. However, capitalizing on the co-bedding situation, mutual body heat, and swaddling them together would likely increase Nathan's and Jessan's body temperatures more quickly than separating them. The findings of Nyqvist and Lutes (1998), as well as the studies on skin-to-skin cuddling cited above, support this intervention.

Physiological Stability

It appears from the data on the infants' behaviours that co-bedding had a positive effect on the physiological stability of both infants. The synchrony in body temperatures, and more calm and restful behaviours exhibited by the

infants contributed to each infant's physiological stability. According to Lutes (1996) and Miller (1998), clinical observations revealed that twins who co-bed experience less vacillations in heart rate, have more stable respiratory control, and lower oxygen requirements. At times, Nathan and Jessan appeared to positively affect each other's heart rate and respiratory patterns, but lower oxygen requirements cannot be substantiated from the data.

Studies on skin-to-skin cuddling document enhanced physiologic stability mediated by skin-to-skin contact (Legault & Goulet, 1995; Ludington-Hoe et al., 1991, 1994). Becker et al. (1993) and Stevens et al. (1996) concluded that developmentally supportive care had a positive effect on a preterm infant's physiological stability over time. This author suggests that co-bedding, as one component of a developmentally supportive care protocol, may be associated with greater physiological stability, and more optimal organization of motor and waking behaviours over time. It is conceptualized that physiologic stability is reflective of reduction in stress for infants receiving neonatal intensive care (Stevens et al., 1996). Some authors (Gottfried & Gaiter, 1985; Stevens et al.) further conceptualized that a reduction in stress can be viewed as an indicator of quality of life for these infants.

Increased Weight Gain

The hypothesis that twins who are co-bedded have an improved rate of growth and development is only theoretical to date (Lutes, 1996; Miller, 1998). In this case study, there was a definite trend towards increased weight gain in both Nathan and Jessan following the initiation of co-bedding, lending support to the hypothesis that twins who co-bed have greater weight gain. However, quantification of the infants' weight gain pre- and post- co-bedding would be required to validate this assumption. A plausible rationale for the suggestion of

increased weight gain in twins who co-bed relates to enhanced physiological stability and calmer, content infants, which results in less energy expenditure through activity and increased energy available for growth.

Perceptions of the Co-bedding Experience

Parents' Perceptions

Parent-Infants Attachment

The family, in this case study, was not aware, initially, that they could co-bed their infants while they were in the SCN. However, when the nurses caring for their infants put forth the idea, the parents were very positive and receptive in regards to their infants being offered this experience.

Although one aspect of co-bedding twins is the potential to encourage parents to treat their infants as a unit, this did not appear to be the case with this set of parents. The parents interacted and responded to each infant as an individual. The parents continually commented on the differences between Nathan and Jessan, and their individual preferences, instead of their similarities. Consistent with the findings of Frazer (1977) and Gromada (1981), the parents first identified physical differences between their infants and later, differences in their behaviours and personality. The parents noted differences between Nathan and Jessan in response to their environment, to being alone, and to co-bedding. The parents also described differences in Nathan's and Jessan's temperament, consolability, irritability, and feeding preferences. The parents provided a valuable perspective regarding the responses of their infants to caregiving and co-bedding.

Co-bedding twins may assist a family destabilized by the birth of preterm twins, to focus their energies around caring for their infants, and provide opportunities for parenting. Parents are able to spend time with their infants

together, and be together as a family in the neonatal intensive care unit. In the past, parents who had twins in the SCN expressed feelings of guilt, and felt torn between their two infants when they were separated. One mother described how she tried to divide her time equally between her two infants, who were in two different areas of the nursery. She felt guilty when she spent more time with the infant who was well and learning to breastfeed. Although her other infant was unable to feed, she felt he needed her just as much, "to know she was there for him."

It is this author's perception, as well as the perceptions of the physiotherapist conducting the behavioural observations, that Nathan's and Jessan's father was highly involved in providing care to his twins while they were in the SCN. Feeding was definitely a shared task; the parents had very quickly established a routine whereby the mother breastfed one infant, while the father bottle fed the other infant. It may be purely coincidental that the father, in this case study, was particularly involved. It may also be that because the infants were physically together, and received care together that paternal involvement seemed more evident, when compared to the traditional approach of separating twins, both physically and geographically, in the SCN.

Transition to Home: Six Week Follow-up

Frazer (1977) identified the "work of managing twins" as the second major task for parents following the "work of identification." It appeared that co-bedding assisted these parents in managing care of their infants, and preparing for the realities of family life at home with twin infants. Co-bedding assisted the parents in meeting their infants' physical and emotional needs while in the SCN, in part, by virtue of their close proximity. The parents in this case study, thought it was advantageous that their twin infants slept and woke up together,

and they continued to co-bed their infants at the time of telephone contact, six weeks after discharge.

Nathan and Jessan went home with their parents on the same day, and therefore, issues around discharging one twin home before the other were not relevant to this case study. It is hypothesized that twins who are co-bedded spend less days in hospital (Lutes, 1996). Nathan and Jessan went home almost two weeks prior to their expected due date, at 38 2/7 weeks PCA.

Nurse's Perceptions

Facilitation of Caregiving

The nurse who was interviewed spoke very positively about the experience of co-bedding twins. The nurse commented that she would definitely recommend co-bedding to other parents whose twins are in the SCN. The nurse also felt that co-bedding facilitated caregiving. The nurse cited synchrony in sleep-wake cycles, calmer infants, and close physical proximity to each other as factors facilitating nursing care. Gale et al. (1993) found that nurses' attitudes changed, and became more positive in regards to the role of the parents in the NICU, and to whom the infant belonged following participation in skin-to-skin cuddling by a parent. Thus, providing care to twins who are co-bedding and observing first hand co-regulatory behaviours between the infants may assist nurses and other health care professionals, who are unsure about co-bedding, that close physical contact between twins in a NICU seems to provide therapeutic benefits.

Secondary Findings

Continuity of Care

The parents in this case study, spoke positively about their experience in the SCN, and had relatively little feedback or criticism of the care they received.

This may, in part, be attributed to the co-bedding experience, the relatively few complications of prematurity experienced by their infants, and a good outcome. The parents did suggest that continuity in caregivers could be improved and that primary nurses would have been helpful. A lack of consistency in infant feeding practices amongst staff in the SCN was also a source of frustration for these parents. Although Lutes (1996) suggested that parent-nurse communication improves, and consistency increases because one nurse care for the twins each shift, lack of consistency in care between health care professionals remained an issue for this family.

Developmentally Supportive Care Protocol

The care provided to Nathan and Jessan throughout the behavioural observations provided insight into which components of a developmentally supportive care protocol nurses, in the SCN, incorporated into their practice. The nursing care provided to Nathan and Jessan also substantiates the merits of a developmentally supportive care protocol. The baseline observations provided rich descriptions of the infants' capabilities and limitations at the various gestational ages. The first behavioural observations revealed two infants who were transitioning, and attempting to adapt to the extrauterine environment. Although Nathan was described as the feistier of the two, his energy levels, and his endurance during handling was less than Jessan's, when Nathan was on his own. However, once they were co-bedded, Nathan's endurance improved, and it was comparable to Jessan's.

Nathan and Jessan were extremely sensitive to caregiving procedures, and to the light, noise, and activity levels around them, as evidenced by physiologic arousal such as, vacillations in heart rate, colour changes, respiratory pauses, and visceral signs to peaks in noise level. This sensitivity was particularly evident in

the first weeks of life, prior to the infants achieving autoregulation, and related to their immaturity. As well, the peaks in activity and noise levels seemed to disrupt their sleep-wake cycle, and their potential to achieve deep sleep.

Throughout all the behavioural observations, the nests were shallow and not always effective in providing a boundary. For example, when either Nathan or Jessan attempted to leg brace, their legs would extended over the edges of their nest. A deeper nest was required with the infants more securely "tucked in" to help them sustain flexion and containment, facilitate motor control, and self-regulatory behaviours.

Nathan and Jessan frequently received care in the supine position. The literature suggests that supine positioning is stressful for preterm infants (Fox & Molesky, 1990; Masterson et al., 1987). Whenever Nathan and Jessan were turned supine, particularly when they were less mature, they became stressed with significant motor disorganization, and energy depleting behavioural responses such as, salutes, airplane, and sitting on air maneuvers. In the last observation of Jessan at 37 1/7 PCA, he was able to maintain state control and autonomic stability, when he was placed unsupported in a supine position, and he extended his hand up in the air, reflecting his overall maturation. However, this motor activity tired Jessan, and consequently his energy levels were low during breastfeeding.

During the first observation Nathan, had a blood sample taken by heelstick. He was neither contained nor supported for this procedure. He responded with autonomic instability and motor stress. Corff et al. (1996) and Taquino & Blackburn (1994) described improved autonomic regulation, and a quicker recovery to baseline status with containment and facilitated tucking during blood sampling procedures.

Nathan and Jessan were not always provided with the opportunity for NNS on a soother, even though they demonstrated responses such as, suck searching, hand to mouth activity, and transitioning to a drowsy state. Both Nathan and Jessan were generally unsettled after their gavage feedings, during the time of their baseline assessments. The opportunity for NNS, during and after their gavage feeds, may have helped facilitate state transition to a more restful state (Gill, et al., 1988; McCain, 1992). The one exception was when Jessan was offered a soother during the first observation. As a result, he was more settled after feeding compared to the second observation, where he was more mature, but not offered a soother. In both baseline observations, at 31 weeks PCA and 32 6/7 weeks PCA, Nathan did not wake for caregiving. However, during the second baseline observation he was drowsy with caregiving, and he may have benefited from NNS to bring him to an awake state with handling, or to settle him during and after his gavage feeding.

The first baseline assessment of Jessan is particularly noteworthy because the nurse caring for Jessan enacted a developmentally supportive caregiving approach, reading and responding to Jessan's cues. The nurse provided support before, during, and after caregiving to assist Jessan with his autonomic, motor, and state organization. She offered him a soother, facilitating a brief active awake period. The nurse, in this observation, provided some caregiving in prone, but turned Jessan supine for his diaper change. Although Jessan was supine, the nurse tried to contain and flex Jessan's arms and legs. The nurse supported Jessan's emerging self-regulatory efforts of hand to face activity, by placing his hand on the soother that was in his mouth, until he held onto it.

To summarize, close physical contact may provide twin infants with additional opportunities for organization and regulation of their autonomic,

motor, state, regulatory, and interactive subsystems, in the absence of other developmentally supportive caregiving strategies. Notwithstanding, to maximize short and longterm neurodevelopmental outcomes, co-bedding is best viewed as one significant component of a developmentally supportive care protocol for twins.

Summary

The picture of co-regulation that emerged from this case study substantiates the benefits of co-bedding documented in the literature, and the clinical anecdotal information available on co-bedding. The parents' and nurse's perceptions added richness and thickness to the data, which would not have been gleaned from the behavioural observations alone. Reduction in physiological and behavioural stress that occurred through co-regulation, can be viewed as a quality of life issue for the infants while receiving neonatal intensive care. Co-bedding can also be viewed as a quality of life issue for the family, in that they were able to spend time together, with their infants, as a family in the NICU. From a nursing perspective, co-bedding facilitated nursing care activities.

The study findings also revealed information on the importance of a developmentally supportive care protocol, as well as the need for primary nursing, and consistency in care, particularly as it relates to infant feeding practices. The integration of co-bedding as a component of a developmentally supportive care protocol for twins may have been one factor that enabled this set of twins to be discharged home sooner.

CHAPTER SIX:

SUMMARY, CONCLUSIONS AND HEALTH CARE IMPLICATIONS

Summary

Co-bedding twins in the NICU is evolving as a practice which attempts to replicate and capitalize upon the infants' unique prenatal environment and experience. When twins are swaddled together, sharing the same boundaries, they have the opportunity to co-regulate, and to continue to progress in their unique interactive development. The purpose of this descriptive case study was to explore the relatively unknown phenomenon of co-bedding to generate rich, descriptive, contextual knowledge, in order to develop context specific family-centered care interventions. The study focused on the behaviours during co-bedding of one set of twins, born at 30 weeks gestation, and the family's and the consistent nurse's perceptions of the co-bedding experience.

Four behavioural observations, two baseline and two observations during co-bedding, were conducted on each infant using the Neonatal Individualized Developmental Care and Assessment Program (NIDCAP) naturalistic behavioural observations (Als, 1995). Perceptions, thoughts, and insights of the family and a consistent nurse were collected through interviews. The interviews were audio-taped, and transcribed verbatim. A chart review was also conducted. The behavioural observations were analyzed according to the Synactive Theory of Infant Development (Als, 1986). Perceptions of the parents and a consistent nurse were described and analyzed, contributing richness to the picture that emerged of co-regulation.

The picture of co-regulation that emerged from the descriptions of the infants' behaviours, and the parents' and nurse's perceptions, was one of

holding onto, touching, reaching towards, responding to each others stress behaviours, calming each other, and crying when separated. Co-regulation, in this study, was characterized by infants who were calmer and more settled, fell asleep more easily, slept for longer periods, woke together, and whose biorhythms, sleep-wake cycles, and body temperatures became increasingly more synchronous. The development of a mutuality in circadian rhythm between the infants, as well as their close physical proximity to each other, assisted the parents in caring for their infants in the SCN. Co-bedding helped prepare the parents for family life, and the realities of caring for their twins at home. Co-bedding also facilitated nursing care in the SCN.

The findings indicated that co-bedding in the SCN was beneficial to this particular set of twins and their family, and for the nurse providing care. Both the parents and the nurse would recommend co-bedding to other families whose twins require neonatal intensive care. Co-bedding is a developmentally supportive and family-centered care strategy for twins that may contribute to physiological stability, thereby enhancing both shortterm and longterm neurological and developmental outcomes, both in and beyond the NICU, while capitalizing on the unique experience of twinship.

Study Conclusions

The following conclusions are derived from the study findings. The conclusions are based on the experience of this particular set of twins, their family, and a consistent nurse.

1. When twins are initially co-bedded there may be a period of increased touching and need for contact. Health care professionals ought to facilitate this behaviour through appropriate positioning.
2. Face-to-face positioning and close proximity to each other can enhance co-

regulation. In this study, face-to-face positioning facilitated reaching out , touching each other's face, and holding hands.

3. Co-bedding may enhance the sleep-wake cycles of both infants. Nathan and Jessan were calmer, fell asleep more easily, slept for longer periods, woke together, and alerted to each other once they began co-bedding.
4. Twins who are co-bedded may develop synchronous circadian rhythms, waking and falling asleep together. Nathan's and Jessan's sleep-wake cycles became increasingly more synchronous over the course of co-bedding.
5. Twins who are co-bedded may develop thermal synchrony over time. Within hours of co-bedding a rhythm in body temperature emerged between the infants. Within two weeks of co-bedding their body temperatures were increasingly synchronous.
6. Co-bedding twins may contribute to the physiological stability of each infant. Co-regulatory behaviours exhibited by Nathan and Jessan included reduced stress responses, thermal synchrony, and positively affecting each others' autonomic stability, motor organization, and state regulation.
7. Co-bedding twins may provide realistic preparation for family life at home. Co-bedding assisted the parents in organizing and managing care of their infants in the SCN and at home.
8. Co-bedding facilitated the discharge home of both infants at the same time. Nathan's and Jessan's progression off oxygen support and to full nipple feedings was simultaneous as they matured, and while they co-bedded.
9. Co-bedding may facilitate caregiving in the NICU. The nurse who was interviewed found it easier to care for calm, settled infants with

synchronous sleep-wake cycles, and who were in close proximity to each other.

Implications for Health Care Professionals

Little is documented in the literature on the behaviours of preterm twin infants who co-bed. The findings of this case study are consistent with the findings of Nyqvist and Lutes (1998), suggesting that co-bedding is an important advance in caring for preterm twin infants. The case study findings suggest a number of implications for practice, education, and research that will promote a greater understanding of the unique needs of twins, and their family within the NICU.

Implications for Health Care Practice

The study findings raise several implications for health care practice. From a practice perspective, there are several simple changes that can occur to enhance the current co-bedding initiatives in the SCN at C & W. First, infants ought to be covered, or bundled together in order to promote co-regulation; the practice of bundling separately should cease. Secondly, positioning of the twin infants ought to occur in such a way that they maintain close physical contact. Thirdly, ongoing assessment of the infants' behavioural responses to each other is important to avoid routinely separating the infants, for example, during caregiving. Furthermore, if the infants maintain autonomic stability, and they do not display motor stress with increased contact and touching of each other's face, let the infants continue their interactions with each other. The SCN protocol on co-bedding twins suggesting separation for routine caregiving procedures requires re-visiting.

Ongoing assessment and monitoring is also important in the event that the infants do not achieve co-regulation. The close physical contact that occurs

between twins during co-bedding may not enhance their clinical status. If the physiological and behavioural stability of one, or both infants is adversely affected, the infants ought to be separated.

The experience of implementing skin-to-skin cuddling in the SCN provides knowledge and context for the implementation of co-bedding, particularly since the evolution of co-bedding in the SCN seems to be following a similar path to that of skin-to-skin cuddling. Although more research was available on skin-to-skin cuddling, the implementation of this practice began with more stable, mature, and convalescing infants. As knowledge and experience was gained, skin-to-skin cuddling was implemented with less mature and less stable infants, who required ventilator support. Similarly, co-bedding, too, has been implemented initially with more mature, stable, and convalescing twins. As health care professionals gain more experience and knowledge, and as more research is available, co-bedding may be actualized in smaller, less mature twins, and higher order multiples. Therefore, a fourth recommendation for practice is that health care professionals ought to advocate for the implementation of earlier co-bedding, based on an individualized assessment of each set of twins and their families. An example would be when one or both twins were receiving binasal CPAP. It would be timely for the SCN to purchase incubators specifically designed for co-bedding twins.

Based on the study findings, this author also recommends consideration of co-bedding as a standard component of a developmentally supportive care protocol in the SCN, that parents may choose for their clinically stable, convalescing preterm twins. Furthermore, the implications for changes in practice ought not be limited to twins only, but include higher order multiples.

It is important to avoid treating or relating to twin infants as a unit when

they co-bed. Consequently, our interactions, our way of being with infants and families, and the meaning of the language we use ought to nurture the individuality, and the unique behaviours and personality characteristics of each twin.

The findings from the case study add support for a shift in practice to a primary nursing model to enhance continuity of care. Congruent with the recommendations of Bosque et al. (1995), that implementation of a skin-to-skin cuddling program for preterm infants required primary nursing, this author recommends that a similar approach be taken with co-bedding twins. The recommendation is based on the assumption that the primary nurse's relationship with the infants and family enables judgments about physiologic stability of the infants, including subtle changes assessed through intuitive knowledge, and knowing the infants' pattern of responses.

The eight behavioural observations provided documentation that components of a developmental care protocol are not always incorporated into nurses' daily practice. Furthermore, health care providers ought to become more cognizant of the relational aspect of developmentally supportive caregiving, entering into a dialogue with the infants of reading and responding to their behavioural cues.

The last recommendation for practice is in relation to documentation. In this case study, there was relatively little documentation in the charts on either the infants' positioning in relation to each other, or their responses to one another during co-bedding. This may, in part, be due to nurses unfamiliarity with what constitutes co-regulation activities and, therefore, has implications for nursing education. A lack of journalling for this case study may reflect the absence of documentation on co-bedding behaviours, in general. However, this

author recommends that as part of the overall shift assessment, and ongoing charting that documentation include infant-infant interaction, positioning, and rationale for periods of separation.

Implications for Health Education

Co-bedding is still a relatively new initiative in the SCN at C & W, and consequently, there is a significant knowledge deficit, and lack of understanding of the concept of co-regulation. Education of all health care professionals is required in regards to the potential benefits that co-bedding has to offer twin infants and their families in the NICU, and on the concept of co-regulation. More specifically, knowledge on approaches to care that enhance or facilitate co-regulation and those that impede co-regulation is required, including an understanding of appropriate positioning of the infants in a shared nest, and the facilitation of touching and holding. There may be more support for co-bedding, in general, and for earlier co-bedding, if health care professionals were aware that twin infants who co-bed are often calmer, and easier to care for than if they were separated.

Currently, the neonatal nursing speciality curriculum, British Columbia Institute of Technology, constitutes the nursing staff orientation to the SCN at C & W, for nurses who have less than one year of neonatal intensive care experience. Core curriculum threads include the philosophies of family-centered care and developmentally supportive caregiving; however, there has been considerably less emphasis on content specific to multiples and their families. Therefore, given the increasing number of multiples and their families who are beginning life in a NICU, a shift in thinking is required, and specific content on the needs of multiples, and their families ought to be included.

The behavioural observations in this study revealed an inconsistency in

the application of components of a developmentally supportive caregiving protocol in daily nursing practice. Strategies such as containment and positional support, reduction in noise and light levels, offering the infants the opportunity for NNS, and avoiding the supine position for caregiving were inconsistently implemented, and not always effective. In particular, although nests were consistently implemented, and provided some motor containment, they could have been much deeper to enhance motor control, and facilitate self-regulatory behaviours. Ongoing education is required to keep nurses and other health care professionals knowledgeable and familiar with the components of a developmentally supportive care protocol. Furthermore, ongoing education, discussion, and sharing experiences, are important to assist nurses and other health care professionals in transitioning from philosophical acceptance to enacting a developmentally supportive, family-centered care approach, in their way of being with infants and families.

Implications for Health Care Research

Some authors believe that the window of opportunity to test the effectiveness of a developmentally supportive care protocol in a large, high quality, multi-site, randomized controlled trial has been missed (Ohlsson, 1995). Similarly, the window of opportunity to test co-bedding in randomized controlled trials is also closing. Increasingly, as more NICUs are implementing co-bedding prior to the establishment of its effectiveness through scientific evaluation, the accumulating anecdotal narratives of its success, coupled with the attention co-bedding twins has received in the media, makes it unlikely that parents would consent to be randomized to a control group. However, given the paucity of research on co-bedding twins in the NICU a number of concepts are worthy of exploration.

Perceptions and assumptions about co-bedding currently held by many health care professionals who work in a NICU, include an increased risk of infection in twins who co-bed, the dislodgement of lines or tubings required for intravenous access or respiratory support, and unnecessarily disturbing one twin as the other infant receives care. Thus, health care professionals are reluctant to implement co-bedding until twins are stable and convalescing. This reluctance is understandable in the absence of research studies on the efficacy of co-bedding. Thus, further research is required to either substantiate or disprove these key assumptions.

When co-bedding is initiated in a set of twins there seems to be a period of increased reaching out, touching, holding on, and alerting to each other. One possible interpretation of this behaviour is a period of reacquaintance following separation. It would be worth exploring the behaviours of twins in the first few hours of co-bedding, and throughout the first days, to document whether this period of increased touching and alerting to each other is a common phenomenon. The behaviours during early co-bedding could be compared to behaviours later in the course of co-bedding.

The infants in this case study began co-bedding at 29 days, which is an earlier chronological age than for several other sets of twins who co-bedded in the SCN. However, in other NICUs twin infants often begin co-bedding much sooner. Although most of the infants in the study by Nyqvist and Lutes (1998) began co-bedding within the first week of life, their gestational ages were not provided by the authors; these infants may have been healthy premature infants. Therefore, does the length of time infants are separated prior to co-bedding affect their responses to each other, and their co-regulation behaviours?

Another dimension of co-bedding worthy of research is the notion of

increased physiological stability in twins who co-bed. A study could be designed to examine whether close physical contact with a twin stabilizes the respiratory pattern, decreases episodes of apnea and bradycardia, and improves oxygenation in the twin requiring respiratory support with nasal CPAP, for example. Potentially, co-bedding and co-regulation activities could moderate infant behavioural responses to environmental disturbances. Activity level, behavioural state, and heart rate are indicators of energy expenditure that can be measured to test the effectiveness of co-bedding.

Co-bedding appears to have a significant impact on the sleep-wake cycles of infants. Knowledge is required on the concepts of synchronous sleep-wake cycles, and mutuality in circadian rhythm between twins. This synchrony may be an important component of co-regulation that promotes physiological stability and behavioural organization. The development of synchronous sleep-wake cycles between twins has implications for caregiving in the NICU, and for family life. In addition to exploring synchrony in sleep-wake cycles, two questions for further research emerge: "Do twins who co-bed spend more time in deep sleep or light sleep compared to twins who do not co-bed, or to singletons at the same gestational age?" and "Do infants who are co-bedded cry less than those infants who are not co-bedded?"

The finding of thermal synchrony in the set of twins in this case study warrants further investigation. Thermal synchrony between twins is likely the process whereby thermoregulation is enhanced each infant. The concept of thermal synchrony, and the reduced need for thermoregulatory support in twins who co-bed is highly significant because of the contribution of this process to overall physiological stability in the infant, and a reduction in energy expenditure. Thus, research is required to gain knowledge and understanding of

phenomenon of thermal synchrony, and to discover the potential benefits it may hold for clinical practice. Additionally, testing the hypothesis that infants who co-bed require less thermoregulatory support may enable these infants to progress from an incubator to a cot, at lower weights and gestational ages than is the currently accepted practice with singletons. Replicated studies are required in order to generate thermoregulatory guidelines for twins who are co-bedding, for use in daily clinical practice.

Also worthy of further exploration and documentation is the notion of increased weight gain in infants who co-bed. In relation to feeding, there was a perception that the infants in this study transitioned more quickly to full nipple feeding. Therefore, another area of further research is whether twin infants who are co-bedded transition to total oral feedings sooner. Given the paucity of research on co-bedding the need for research and knowledge is infinite.

The practice of co-bedding has raised new issues in regards to transition to home. Are twin infants who are co-bedded discharged home earlier? Are twin infants who are co-bedded more likely ready for discharge home together? Should infants who are co-bedded be separated if one is ready to go home prior to the other? What is the impact of this separation on the twin infants? Virtually nothing is known of the impact of co-bedding in the NICU on infants and families once they are home. Does co-bedding facilitate the transition to home for infants and parents? Once home, for how long do the infants co-bed? On what criteria do the parents base their decision to stop co-bedding?

It is difficult to conclude or extrapolate which behaviours can be attributed to maturation, to various components of a developmentally supportive care protocol, to co-bedding and the close physical contact between twins, or to the synergistic effects of the fore-mentioned. There is a paucity in the literature on

behavioural descriptions of infant behaviours at the various gestation ages; a data base defining "normals" is notably absent in the literature. It seems reasonable to conclude that a certain number of stress responses with handling, are inevitable in an infant born at 30 weeks gestation. However, what would be considered normal or age-related requires systematic documentation through research. Revision of the NIDCAP behavioural observation to a more simplified form may produce a more practical, and less time consuming tool for future research. Additionally, refinement of the NIDCAP behavioural observation tool to include co-regulatory behaviours, and to capture the essence of the interactions between twins is also required.

In summary, the research into the phenomenon of co-bedding twins in the NICU is virtually untapped. The safety and benefits of co-bedding with selected groups of twins, and higher order multiples, requires documentation through replicated studies. Research into developmentally supportive and family-centered caregiving approaches within the NICU are paramount in response to consumer demands, and the changing face of health care in Canada. The conclusions of this case study are offered for critical testing, and can be evaluated only after application to a large number of twin infants who are co-bedded.

Conclusion

This researcher explored the concept of co-bedding as it pertained to twin infants and their family in a NICU, as one effort towards developing a substantive knowledge base. The behavioural descriptions of one set of twins who co-bedded while in a NICU are unique and significant in their own right. "Detailed studies of individual cases can make an important contribution to the design and evaluation of efforts to alter the course of experience in individual

lives" (Runyan, 1982, p.443). In depth, descriptive knowledge of the behaviours of infants during co-bedding may begin to sensitize, and raise the level of awareness of health care professionals, to some of the unique needs of twins and their families, while in a neonatal intensive care unit. It is hoped that this case study will generate debate leading to improved care for twin infants and their families receiving neonatal intensive care. Nursing care of twins and their families that incorporates co-bedding into a developmentally supportive care protocol will contribute to true family-centered care, while also capitalizing on the unique experience of being born a twin.

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British Columbia's Children's Hospital

APPENDIX A

Feb 26, 1996

B.C.'s Children's Hospital
Special Care Nursery
Co-bedding Guidelines

Although little formal research has been completed to date, clinical observations of twins and multiples who are co-bedded reveal many benefits. These include co-regulation (or balancing and supporting one another) by:

- promoting physiologic stability: stable heart rate, respiratory control, and oxygen saturations
- facilitating motor control and organization
- facilitating state control. in that infants may cry less, have longer sleep cycles and help each other achieve and maintain quiet alert states.
- thermal synchrony between twins or multiples

Other benefits documented include improved weight gain, and decreased length of hospital stay.
It has also been observed that some twins/multiples do not like being bedded together.

INITIAL PREPARATION

- Ideally, one nurse cares for both infants.
- All equipment (suction apparatus, monitors, bag and mask system, soothers, diapers etc...) and documentation (charts, medication cards etc..) should be labelled and colour coded, clearly identifying to which twin it belongs.
- Ensure two ID bands are on infants at all times (colour code these too)!
- The challenge is that the infants be clearly identifiable at all times
- Have an unoccupied cot/incubator on standby at the bedside (or the adjacent bedside), in case infants require separation in a hurry, or for procedures, or for caregiving activities, thus allowing the remaining twin to be undisturbed, if needed.

CAREGIVING

- Attempt to keep infants on the same feeding schedule. Encourage simultaneous breastfeeding to facilitate longer sleeps cycles and rest periods.
- This will also help to organize discharge planning and coordinate caregiving activities at home.

1. POSITIONING

- Maintain infants in a single nest
- Lightly swaddle infants with one blanket.
- Position them close to each other but let them choose to touch each other and snuggle.
- Keep their hands free for hands to face activity and for touching each other.
- They can either face each other or face the other one's back, in a tucked position.
- To facilitate moulding and change in head position, while still enabling infants to face each other if they so choose, alternate the side of the bed infants are placed.

2. INFECTION CONTROL

Continue to wash hands between procedures and diaper changes, but for other caregiving activities such as cuddling, breastfeeding, play, positioning and comforting this is not necessary or even practical.

3. ASSESSMENT

- NIDCAP assessment prior to co-bedding for baseline if possible
- Assess each infant's behavioural reactions to each other:
  - How do they impact on each others' state control, motor organization, self-calming abilities and ability to calm each other?
  - Do they alert or attend to each other?
  - Does close contact with each other cause any distress?
- Observe transition to a sleep state, length of sleep cycle, & time spent in deep sleep.

4. CONSISTENCY

- Co-bedding is most beneficial if it occurs on a consistent basis.
- Spending short times together may not be of benefit physiologically and developmentally, as the infants need to learn about each others sleep/ wake cycles and behaviors in order to co-regulate.
- Continue co-bedding until discharge of one or both twins.

CONTRAINDICATIONS

Separate infants if:

1. One infant becomes unstable. Indicators include:
   - frequent periods of apnea/bradycardia or desaturation
   - increasing oxygen needs
   - signs of sepsis

   When stable resume co-bedding.

2. Continued signs of behavioural distress
    - decreased sleep
    - persistent motor disorganization, restlessness
    - disturbing effect on each other as opposed to calming each other
    - a change from either infant's normal behavioral or physiological patterns.

DOCUMENTATION

The nursing flow sheet will capture physiological data.
A journal has been left at the bedside for parents and caregivers to write about their experiences, observations, thoughts and feelings around co-bedding..
This will provide us with a rich source of information for future co-bedding opportunities.

The information is evolving and will be gained through the experience of co-bedding infants. Feel free to add your comments, suggestions and expertise. I will add to and revise the information as I receive feedback.
Thank-you. Jan Moreau

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COMMENTS/ FEEDBACK:

APPENDIX B

CASE STUDY PROTOCOL

BEHAVIOURAL OBSERVATIONS:		Pre-Co-Bedding		Co-Bedding	
		1	2	3	4
Twin A	Age: days	7	20	33	48
	weeks (PCA)	31	32 6/7	34 5/7	36 6/7
	weight (grams)	1235	1555	1935	2435
	days co-bedding			5	20
Twin B	Age: days	6	20	33	50
	weeks (PCA)	30 6/7	32 6/7	34 5/7	37 1/7
	weight (grams)	1300	1625	2085	2730
	days co-bedding			5	22

DATA SOURCE	TIMING OF DATA COLLECTION
Interview: Parents Nurse	 25th day of co-bedding 5 days following discharge home
Chart Review	One week after discharge home
Follow-up telephone call	6 weeks following discharge Infants one month corrected age

NIDCAP
OBSERVATION SHEET Name:_____ Date:_____ Sheet Number_____

		Time:	0-2	3-4	5-6	7-8	9-10
p:	Regular						
	Irregular						
Resp:	Slow						
	Fast						
	Pause						
Color:	Jaundice						
	Pink						
	Pale						
	Webb						
	Red						
	Dusky						
	Blue						
	Tremor						
	Startle						
	Twitch Face						
	Twitch Body						
	Twitch Extremities						
Visceral/ Resp:	Spit up						
	Gag						
	Burp						
	Hiccough						
	BM Grunt						
	Sounds						
	Sigh						
	Gasp						
Motor:	Flaccid Arm(s)						
	Flaccid leg(s)						
	Flexed/ Tucked Arms	Act.					
		Post.					
	Flexed/ Tucked Legs	Act.					
		Post.					
	Extend Arms	Act.					
		Post.					
	Extend Legs	Act.					
		Post.					
	Smooth Mvmt Arms						
	Smooth Mvmt Legs						
	Smooth Mvmt Trunk						
	Stretch/Drown						
	Diffuse Squirm						
	Arch						
	Tuck Trunk						
	Leg Brace						
ace:	Tongue Extension						
Face:	Hand on Face						
	Gape Face						
	Grimace						
	Smile						

		Time:	0-2	3-4	5-6	7-8	9-10
State:	1A						
	1B						
	2A						
	2B						
	3A						
	3B						
	4A						
	4B						
	5A						
	5B						
	6A						
	6B						
	AA						
Face (cont.):	Mouthing						
	Suck Search						
	Sucking						
Extrem.:	Finger Splay						
	Airplane						
	Salute						
	Sitting On Air						
	Hand Clasp						
	Foot Clasp						
	Hand to Mouth						
	Grasping						
	Holding On						
	Fisting						
Attention:	Fuss						
	Yawn						
	Sneeze						
	Face Open						
	Eye Floating						
	Avert						
	Frown						
	Ooh Face						
	Locking						
	Cooing						
	Speech Mvmt.						
Posture:	(Prone, Supine, Side)						
Head:	(Right, Left, Middle)						
Location:	(Crib, Isolette, Held)						
Manipulation:							
	Heart Rate						
	Respiration Rate						
	$TcPO_2$						

APPENDIX D: INTERVIEW GUIDE

Study: Co-bedding twins in a neonatal intensive care unit: A descriptive case study.

The interview was open ended and constructed as dialogue or interactions rather than as a structured process. However, the following questions served as a guide and prompts.

Tell me about the behaviours of your babies during co-bedding.
You may want to talk about their sleeping patterns.

Do your babies get more or less sleep/ rest while they are together?

How do they respond to each other while they are awake?

How do your babies respond to physical contact in the same bed compared to when they were in separate incubators or beds?

Do you notice any behaviours during co-bedding that you did not notice when your babies were separated?

Do your babies have a preference for a certain position?

Do you notice any differences in behaviours between each baby?

Would you recommend to other parents that they co-bed their twins or multiples?

How has co-bedding your babies affected your experience as a parent in the Special Care Nursery?

How can we support parents of twins in a neonatal intensive care unit?

APPENDIX F

CONSENT TO PARTICIPATE IN A RESEARCH PROJECT: FAMILY CONSENT FORM

UBC School of Nursing Letterhead

Project Title:
Co-bedding twins in a neonatal intensive care unit: A descriptive case study.

Purpose:
Jan Moreau, RN, BSN, student in the Masters of Nursing Program, at the University of British Columbia, is conducting a study on co-bedding twins together while in an intensive care nursery. Our family is being asked to participate in this study.

Procedures:
If we agree to participate in this study, Jan and physiotherapist, Linda Williams will complete a behavioural assessment on our babies each week for approximately four weeks. This will involve observations of our babies during normal caregiving activities. Jan will talk with us about our thoughts, feelings, insights, and observations as our babies are co-bedding. The timing and length of the conversations will be mutually agreed upon. Most of our conversations will be tape recorded so that they can be transcribed at a later time. Approximately one hour of our time is required for the study.

Risks or Discomforts:
We understand that the behavioural assessments of our babies do not require Jan or Linda to disturb or handle our babies during this time, and it does not result in any extra handling or activities for our babies. We may refuse to answer any questions at any time, without repercussions to our family.

The behavioural assessments become part of our babies' legal charts. A photocopy of the behavioural assessments will be made as a working copy for research purposes, however, names or any other form of identification will be blocked to protect our identity and maintain anonymity. Confidentiality will be maintained in handling all of the data collected.

Behavioural assessments, and transcriptions will be shared with Jan's thesis committee, but will never be identified directly with our family. We may request to be given some of the data to see or keep, such as, a copy of the behavioural assessments, written summaries, or tapes.

APPENDIX G: EXPLANATORY LETTER

UBC School of Nursing Letterhead

Co-bedding twins in a neonatal intensive care unit: A descriptive case study

Date:

Dear Family;

The purpose of this study is to gain an understanding of what it is like for your babies to co-bed while in the SCN. This information is gained through observing and recording your babies' behaviours. Also important are your thoughts, feelings, and perceptions in regard to your babies opportunities to co-bed, and about being parents of twins or multiples while your babies are in the SCN.

If your family agrees to participate in the study, the following would be involved. Myself and a physiotherapist, Linda Williams will complete a behavioural assessment on your babies each week while they are co-bedding. This will involve observations of your babies during normal caregiving activities. Neither Linda nor myself need to handle or disturb your babies to do these assessments.

On at least two occasions, I will talk with you about your thoughts, feelings, insights, and observations as your babies are co-bedding. These conversations will be audio-taped to ensure accurate recording of the information, and will be transcribed at a later time. You will also be asked to keep a diary. The timing and length of the conversations will be mutually agreed upon, and should not take longer than one hour. A total of about two to three hours of your time will be required.

You may refuse to answer any of my questions or withdraw from the study, at any time, without your babies care being affected in any way. Your family identity will not be disclosed to others. Confidentiality, privacy and anonymity will be maintained at all times. The information will be used to provide a picture of the behaviours of twins who are co-bedding, as well as family perceptions while in the SCN. The information will be used for my thesis, educational purposes and a possible publication in a professional journal.

APPENDIX H

PARTICIPANT INFORMATION LETTER: HEALTH CARE PROFESSIONAL

UBC School of Nursing Letterhead

Co-bedding twins in a neonatal intensive care unit: A descriptive case study

For my thesis, towards a graduate degree, at the University of British Columbia, I am conducting an in-depth case study to learn more about the behaviours of twins who are co-bedding while in an intensive care nursery. An important aspect of the study is to gain insight into of the perceptions of the family, and the meaning of this experience for them. Another important aspect is the perception of primary nurses in supporting this newer and relatively unexplored initiative. The goal of the study is to gain a holistic, and contextual understanding of this family-centered and developmentally supportive caregiving initiative.

This letter is to request your participation in the study. Participation would involve sharing your thoughts, feelings, insights, observations, and learnings as you care for a set of twins who are co-bedding, and their family. You will be asked to write occasionally in a journal and participate in one interview of approximately one hour in length. You will also be asked to clarify and validate my descriptions and interpretations of the results.

The interview will be tape recorded to ensure accurate data collection. Confidentiality will be maintained. Participants will not be identified by name or inference in any reporting. The audio-tape recordings will be identified by number codes, and only I will be aware of the tapes corresponding to each participant. All tapes, transcriptions, and journal entries will be handled in a confidential manner. The tapes will be heard by myself, a typist and two professors who are supervising my research.

Your participation in this study is completely voluntary. Participation is in no way part of employment at B.C.'s Children's Hospital. You will be asked to sign a consent form during our first meeting to indicate your willingness to participate. You are free to refuse to participate in specific parts of the interview, or withdraw from the study at any time without repercussion. There may be no direct benefits to yourself for participating in this study. You may gain information related to the co-bedding behaviours of infants, and awareness and insight into aspects of your nursing practice.