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Briana Ralston

University of Pennsylvania, bralston@nursing.upenn.edu

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Abstract

ABSTRACT

"WE WERE THE EYES AND EARS...": NURSING AND THE DEVELOPMENT OF NEONATAL INTENSIVE CARE UNITS IN THE UNITED STATES, 1955-1982.

Briana Ralston, MS, RN

Julie Fairman, PhD, RN, FAAN

In the 1960s and 1970s, neonatal intensive care units (NICUs) became the standard of care for critically ill newborns in hospitals across the United States. Though work has been done to examine how nurses participated in the development of ICU's for adult populations, scholarship related to the formation of NICUs is sparse. Using historical methodology to examine hospital archival data, oral history interviews, and scholarly literature, this work examines the roles nurses played in the development of NICUs as technological systems between 1955 and 1982 in the United States. By using the lenses of the history of nursing, the history of technology, and the history of children's healthcare, this work contributes to our understanding of the nuanced ways nurses participated in the formation of the NICU - a complex technological system of care - for a vulnerable and medically complicated newborn patient population. The value of newborns as a unique and valued medical population, seen as early the Progressive Era, contributed to the formation of premature infant units and particular nursing care for premature newborns during the first half of the 20th century. This premature infant care in turn influenced the development of later neonatal intensive care units and the ways nurses cared for a broader cadre of sick newborns. Hospitals valued the particular care they gave and made decisions about the dedication of spaces where newborns could be grouped together to receive nursing care. Two case studies of east coast children's hospitals - The Children's Hospital of Philadelphia and Boston Children's Medical Center - shed light on how particular hospitals chose to allocate resources, group patients, and how they made those decisions based on their value of specifically trained nursing staff. The history of NICUs speaks to broader contemporary healthcare themes and issues as we ask questions about who should receive care and precious healthcare resources.

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“WE WERE THE EYES AND EARS...”: NURSING AND THE DEVELOPMENT OF
NEONATAL INTENSIVE CARE UNITS IN THE UNITED STATES, 1955-1982.

Briana Ralston, MS, RN

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Supervisor of Dissertation:

Graduate group Chairperson:

Dr. Julie Fairman, PhD, RN, FAAN
Nightingale Professor of Nursing, Chair,
Department of Biobehavioral Health
Sciences and Director of the Barbara Bates
Center for the Study of the History of
Nursing

Dr. Connie Ulrich, PhD, RN, FAAN
Associate Professor of Nursing; and
Associate Professor of Bioethics,
Department of Medical Ethics, School of
Medicine

Dissertation Committee:

Dr. Cynthia Connolly, PhD, RN, PNP,
FAAN (Committee Member)
Associate Professor of Nursing

Dr. Barbra Medoff-Cooper, PhD, RN,
FAAN (Committee member)
Ruth M. Colket Professor in Pediatric
Nursing

“WE WERE THE EYES AND EARS...”: NURSING AND THE DEVELOPMENT OF
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Mom told me you came in on your days off when I needed you. Dad told me you made sure to remind them I was a 'fighter.' This work is dedicated to you Joan, and the amazing nurses who worked in the NICU at Toronto's Women's College Hospital in September 1984.

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And to the NICU nurses who have worked tirelessly over the past 60 years to care for the smallest and most vulnerable among us. Thank you. Your stories must be told. This is just the beginning.

Psalm 139:13-18

ABSTRACT

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Chapter 1:

Nursing as a part of the Technological System of Neonatal Intensive Care:
Introduction, theoretical framework, and review of literature

Nursing as a part of the Technological System of Neonatal Intensive Care

Leigh weighed 960 grams at birth. Born prematurely, she spent the first three months of her life in a neonatal intensive care unit (NICU). She was placed on a ventilator and given intravenous fluids and medications. Machines to monitor her heart rate and blood oxygen levels were attached to probes placed on her skin in addition to a probe that measured her skin temperature. She was fed through a tube placed into her stomach. Nurses took her vital signs, including heart rate, respiratory rate, and blood pressures every few hours. The isolette that provided the warm and slightly humid environment she needed was carefully monitored by the physicians and nurses who worked in the NICU. Her mother remembered: “We were taken to the neonatal intensive care unit to see our little girl. She was so tiny and hooked up to a lot of machines – frightening in a way but at least we got to touch her....Elizabeth (the nurse on duty Monday and Tuesday) was great. She explained each tube, medication, and treatment.”¹ The nurses played a crucial role in the way this infant’s family experienced and remembered their experience with the NICU. Neonatal intensive care units, as Leigh’s mother remembered, can be incredibly complex and intimidating places where machines can seem to dominate and good nursing care of the patient is directly associated with tubes, medications, and treatments.

Babies, like Leigh, required intensely complex systems of care to survive the effects of prematurity, but they also required nurses who had the skills and knowledge to expertly observe, navigate highly technological medical environments, and incorporate a

¹ Carol Ralston. Diary kept by the author: September-October 1984. (unpublished manuscript in the

plethora of tools and technologies in the process of delivering care to patients and their families. Though the development of neonatal intensive care involved a constantly evolving network, nurses practiced at the bedside made this increasingly complex system work for their patients through their unique role in patient care. Nurses monitored the patients, knew when some method of treatment did or did not work, communicated with other healthcare providers, and when necessary improvised oversized equipment to fit their small patients. Historians must examine how nurses practiced and delivered care between 1955 and 1982, during the transition from premature infant units into the early years of the neonatal intensive care units. The story of the development of the NICU and care delivered there challenges us to better understand how clinicians, specifically nurses, participated in the dynamically changing system of care and provided critical skills that made these systems work. This analysis will also inform our appreciation of the intended and unintended consequences of these systems and the complex decisions and outcomes involved.

Premature infants have been clustered together in premature infant units in hospitals since the 1920s, but it was not until the 1960s that hospitals transitioned from these premature infant units to NICUs; these new NICUs served as reorganized spaces where hospitals grouped together critically ill newborns to receive very specific care unique to their medical, nursing, and developmental needs. The push for better surgical treatments and care of newborn congenital conditions as well as better understanding of newborn medical problems meant a growing number of sick newborns needed a place to receive the intensive care premature infants had been privileged to receive for decades.

Premature infants, grouped together generally by gestational age or weight, formed the dominant patient populations in the early premature infant units; NICUs patient populations included a broader cadre of sick neonates born both prematurely and full term in need of medical and surgical care.² NICUs incorporated a framework of intensive nursing care previously seen in premature infant care that incorporated increasingly complex and new medical equipment, treatments and procedures for different populations.³ Hospitals formed neonatal intensive care units as the need for a special group of nurses to care for these increasingly complex babies, to understand and better treat dominant causes of infant mortality, and attempts to allocate resources for critically ill newborns merged.

These units reflected a growing need for hospitals and healthcare providers to medically define an increasingly vulnerable patient population, a strong desire to decrease infant mortality within a post-war social context that valued children as central to the American dream⁴ as the new norm, and a growing fascination fueled by a vastly

² While this statement is true speaking broadly of NICUs, each hospital and unit did have its own patient makeup influenced by a number of factors including community needs and resources, whether or not the hospital had a surgical team on site, and the personalities and strengths of the hospital administration, physicians, and nurses involved in the unit.

³ I recognize that while broader impacts on children's health absolutely affected the changing nature of the need to address infant mortality and the creative ways healthcare workers and activists sought to do so. Many things tangentially impacted newborn medicine – the story is complicated! New funding streams for hospitals in the post-war era, the baby boom that many scholars argue influenced the post-war “child-centered” society, and the creating of medical subspecialties all impacted newborn medicine and the developments of units where sick newborns received care. I will speak more to this in chapter 2. For now, I will seek to formulate a framework that, while taking children's healthcare into account, will situate neonates and the nurses that cared for them in particular times and places as forms of technology.

⁴ Elaine Tyler May. *Homeward Bound: American Families in the Cold War Era* (New York, NY: Basic Books, 2008).; Steven Mintz. *Huck's Raft: A History of American Childhood* (Cambridge: The Belknap Press of Harvard University Press, 2004).

expanding post-war technological boom that included new and more complex medical equipment.⁵ Analysis of the story of neonatal intensive care units in the United States is important to consider as we continue to face many similar themes today: vulnerable patient populations, increasingly sick patients, and questions concerning limited resource allocation relating to finances, space, and healthcare workforce. In order to fully understand the story, we must understand the role nurses played as they practiced at the bedside with a changing scenario of medical therapeutics, public expectations and the reality of resource allocation; this story is not told in current scholarly literature. We must ask these questions as this analysis will form and influence how we think about current issues in healthcare today.

I raise three particular questions:

1. What was the particular social, medical and nursing context that supported the transition from premature infant units to the establishment and development of neonatal intensive care units?
2. What needs did these NICUs meet that necessitated the establishment of intensive care particularly for neonates?
3. What role did nurses play in the formation and shaping of the NICUs, the

⁵ William Silverman. *Retrolental Fibroplasia: A Modern Parable* (New York: Grune & Stratton, 1980).; Thomas Cone. *History of the Care and Feeding of the Premature Infant* (Boston: Little, Brown and Company, 1985).; Murdina MacFarquhar Desmond. *Newborn Medicine and Society: European Background and American Practice (1750-1975)* (Austin: Eakin Press, 1998).

services and care provided there, and their subsequent early development?

In this study I analyze historical data that sits at the intersection of the history of nursing, the history of children's health particularly as it played out for neonates, and the history of technology. By examining the NICU and considering the neonatal population specifically through the lenses of a history of technology and nursing, I am able to ask broader questions in relation to technology and care, how systems of care develop for particular populations and how nurses play a role in the success and failure of technologies and methods of healthcare delivery; but this story is about more than what worked and what did not, but looks to the underlying political, economic, and cultural context in which decisions about care for particular populations are made.

The historical story will explore how nurses contributed to the development of technological systems in particular times and places. The Institute of Medicine's report on the Future of Nursing emphasizes the need to analyze the ways in which technologies are implemented by nursing staff in patient care, and the processes by which those technologies are tested, developed, and adopted into practice.⁶ To adequately address these research recommendations as we move forward, historical analysis is a critical path

⁶ Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing, at the Institute of Medicine, Institute of Medicine. "7 Recommendations and Research Priorities." *The Future of Nursing: Leading Change, Advancing Health*. (Washington, DC: The National Academies Press, 2011), 275: Specifically, the recommendations include research that addresses: 1. Identification and testing of new and existing technologies intended to support nurses' decision making and care delivery. 2. Capture of the costs and benefits of a range of care technologies intended to support nurses' decision making and care delivery. 3. Identification of the contributions of various health professionals to the design and development, purchase, implementation, and evaluation of devices and information technology products.

for understanding how nurses have been involved in the adoption, standardization, and use of technologies across time and place. This historical work challenges us, within the context of current clinical research priorities, to think about the ways in which nurses are involved/situated in the development of healthcare systems in the United States today, and how the systems, in turn, shape our understanding of the use of technology as well as the value of those whose lives depend upon it.

For the purposes of this study, and to provide clarity for why technology is an important lens, I consider technology to be more than a particular machine, but will use a broader systems approach; I consider technology to be the system of both object and user as well as the social, cultural, and political influences that converge to produce a particular result.⁷ With this framework, I propose the neonatal intensive care unit as a technology system, even a technology itself, in which the nurse, the machines and tools she used, as well as the medical environment, resources, social values, and cultural approach to newborn care are components of the user context.

I begin by using the comparative analysis of two specific hospital case studies, the Children's Hospital of Philadelphia and the Children's Hospital of Boston. These hospitals are two of the major children's hospitals in the northeast that formed NICUs to meet particular needs of newborn care. The political and social environments in which each hospital established its unit will allow for a nuanced study of why units and spaces are created for particular patient populations. The unit at the Children's Hospital of

⁷ This framework will be further outlined and presented later in this chapter to clarify my approach to technology and the scholarship that influenced this framework. Please see later chapter section: "Technology, Neonates, and Nursing History: An analytical approach."

Philadelphia was established with state and federal grant money specifically for the study of neonatal surgical care. Thus, this unit had a post-operative surgical focus spearheaded by influential surgeon and former Surgeon General C.E. Koop. Boston's unit was more focused on a medical patient population that arose out of traditional premature infant care and institutional funding rather than federally funding.⁸ By choosing these two places that have many similarities and discontinuities, we see how politics, hospital culture and specific personalities played roles in the development of these units. Each had a unique medical, cultural and political flavor that was revealed in how neonatal therapeutics developed within each institution.⁹

My study will include the time frame of 1955 to 1982. By beginning in 1955, I will capture the transition from the premature infant units to neonatal intensive care units. An analysis of this transition is critical because it will broadly illustrate the development of a subspecialty as it related to a particular patient population. This time frame will also shed light on how care delivered in NICUs was differentiated into a particularized specialty that met the needs of critically ill newborns during this time. My time period of interest ends in 1982, when both local and national media began to grapple with cases such as Baby Doe as they raised ethical questions concerning the consequences – both positive as well as unintended – of the care developed in NICUs and the social

⁸ These two units were early units, and I acknowledge that units opened across the country during this time period and existed with unique and nuanced contexts. These two units share many similarities that allow for a starting point in my research. My future research trajectory, and one I hope to contribute to establishing for other scholars, will involve understanding how these units formed in the South, in rural areas of the country, and on the West coast.

⁹ Historians must also go where the records are kept, and as two very large institutions with significant pasts both had archives with rich data.

expectations that accompanied progressions in such technology.^{10, 11} During this time period, major challenges and issues in neonatal medicine prompted debates about the development and use of technology.¹² National organizations related to neonatal nursing and medical care also emerged in the 1980s and reflected a progression and shift in neonatal medicine beyond the scope of this work.

Technology, Neonates, and Nursing History: An analytical approach

To properly examine the role nurses played in the development of neonatal intensive care units, data analysis must occur at the point where the lenses of the history of nursing and the history of technology intersect with a particular focus on the neonatal patient population. In this analysis, technology is more than just a machine, but framed as a complex system encompassing tools and the people who use them, and also the social, political, economic, racial, and gendered context in which the worker uses the tool.¹³ A

¹⁰ The surgeon general at the time, C. E. Koop, condemned the failure to treat a newborn infant with Down's syndrome in this case. The case prompted legislation that was passed in 1984, known as the *Baby Doe Law* that dictates specific criteria and guidelines for the treatment of seriously ill newborns.

¹¹ C. Everett Koop, *Koop: The Memoirs of America's Family Doctor* (New York: Harper Collins, 1993); n.a., "Charges Weighed for Parents Who Let Baby Die Untreated." *The New York Times*. New York, April 17, 1982, sec. 1: Baby Doe was a baby born in Bloomington, Indiana in 1982 with Down's Syndrome, esophageal atresia and a tracheoesophageal fistula. The latter two conditions could be fixed via surgery that was withheld due to the judgment that the quality of life for an infant with Down's Syndrome did not warrant the correction of the life threatening congenital conditions. Without the surgery, the infant died. The case eventually reached governmental officials, particularly the Surgeon General at the time, C.E. Koop, and began national debate over withholding lifesaving interventions and who could make those decisions. The case and subsequent legislation is still controversial today.

¹² Though I acknowledge these aspects as consistently present throughout the 20th century as well as being vital to any consideration of neonatal critical care, they are beyond the scope of this work.

¹³ The scholarly literature in the history of technology uses multiple words to label the tools that people use. For the purposes of this proposal, and for clarity, I will consistently use the terms *tool* and

system is more complex than just the tool; we must ask questions of the social and political influences that have an impact on why a worker/user makes decisions regarding the tools he or she uses. This approach is derived from the secondary literature (addressed below) in the history of technology, and offers a broader analysis beyond the machine and user to understand wider socio-medical implications regarding the formation of neonatal intensive care units and ultimately healthcare and nursing practice.

Technology and Technological Systems

When we speak of technology, we find ourselves faced with complex and diverse understandings of the concept. Newspapers such as *The New York Times* include sections on technology, and typically conceptualize it as machines and tools humans use such as smartphones, computer software, and online social media sites.¹⁴ We use technological terms to describe human characteristics when we describe friends, coworkers, and colleagues - ‘She’s hardwired that way!’ Companies sell phones, cars, refrigerators, and even clothing to us based on the unique technological qualities of each. Even scholars vary in their nuanced approaches to the definitions and conceptualizations of what the term ‘technology’ might mean and imply.

So how then do we approach technology? What exactly does it mean for

equipment when referencing the various tools that clinicians used in the healthcare setting. I understand the concept is much broader and the term potentially limiting, but necessary for consistency and flow for my audience.

¹⁴ For an example of this, simply go to the NewYorkTimes.com and find their section devoted to “Technology.” I do not mean to deeply analyze or reflect broader considerations of this categorization, nor do I suggest I have broken down their meaning of the word, but a quick scan of the headlines here is pause for thought.

technology to be developed, changed, adopted, and used within societies and within particular contexts? Historians of technology Wiebe Bijker and John Law postulate, “Our technologies mirror our societies. They reproduce and embody the complex interplay of professional, technical, economic, and political factors.”¹⁵ Technology must not be reduced to the artifact itself for it is always bound up in decisions; political, economic, aesthetic, and theoretic decisions all impact why some artifacts become stable parts of systems and others do not. In other words, technologies are shaped. The artifacts, as much as the professional, economic, technical, and political contexts in which they are a part, are the product of the decisions humans make for an infinite number of reasons. Thus, to study the social history of a technology is to use the history of technology as a lens to study why humans organize societies the ways they do. In order to do this, decisions must be made to focus on particular key players (for example human actors as well as contextual factors) in the story and we must be open to who those players might be.¹⁶

Historians of technology Wiebe Bijker, Thomas Hughes, and Trevor Pinch instituted a layered understanding of the conceptualization of technology that is rooted in

¹⁵ Wiebe E. Bijker and John Law, eds., *Shaping Technology / Building Society: Studies in Sociotechnical Change* (Cambridge, MA: The MIT Press, 1994), 3.

¹⁶ Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, MA: The MIT Press, 1989); Ibid. Bijker and Law, eds. *Shaping Technology*; Donald MacKenzie and Judy Wajcman, eds., *The Social Shaping of Technology*, (New York: McGraw Hill Education/Open University, 1999).

contextual and social constructions of meaning.¹⁷ They began with the physical object or artifact but built on the mere tool by recognizing the process of using a tool to create something within social contexts. The tool requires knowledge regarding how to use it and for what purpose. The user also utilizes the tool within a system of many tools and ways of adopting and making decisions regarding the use of tools.¹⁸ Historian Thomas Hughes suggested technology might also be understood broadly as both artifact and icon. Its tangible characteristics symbolize larger constructs of social value and creativity.¹⁹ He argued that we must understand it appropriately in a multifaceted way, and within the context of the people and societies that shape and use it.²⁰

As historian of technology Ruth Cowan suggested, this analysis can be very complicated. Many different actors can be part of the process of technological development and they can change over time.²¹ Each actor may even enter the process at multiple points under different guises. This complication led her to suggest that the historian view any study of technology from the vantage point of the user as a consumer

¹⁷ Ibid. Bijker, Hughes and Pinch, eds., *The Social Construction of Technological Systems*. Bijker, Hughes, and Pinch are social historians of technology and each in his own right have written extensively on the understanding of technology within the context of the societies and cultures that shaped it. These authors collectively argued that technology was not an external source that exerts power to shape people, but that technology is socially shaped by humans who participate in decisions based on politics, economics, and culture.

¹⁸ Ibid. Bijker, Hughes and Pinch, eds., *The Social Construction of Technological Systems*.

¹⁹ Thomas P. Hughes, *Human-Built World: How to Think About Technology and Culture* (Chicago, IL: University of Chicago Press, 2005).

²⁰ Ruth Schwartz Cowan, *A Social History of American Technology* (New York: Oxford University Press, 1997).

²¹ Ruth Schwartz Cowan, "The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology," in *The Social Construction of Technological Systems*, ed. Wiebe Bijker, Thomas Hughes and Trevor Pinch (Cambridge, MA: The MIT Press, 1987), 261–280.

– at what she labeled the *consumption junction*.²² But she was also careful to remind her readers that within this multitude of possible actors, there may be important actors that are silent and not obvious in the current consideration. The nurse, as an actor who is generally overlooked in the secondary literature regarding the development of neonatal intensive care units between 1955 and 1982, is a non-obvious user that we must consider at the consumption junction where decisions about technology use are made. As Cowan specified, the user can be present at multiple points in the process of technological innovation, adoption, and change and this allows us to consider the nurse not only as a user of the tools but also as a developer of the systems in which those tools were used.²³

Historian of technology Harry Braverman urged other historians to consider that “the technical is never considered purely in its internal relations, but in relation to the worker.”²⁴ Braverman used the model of machinery within a capitalist mode of production that centralizes on the creation of a static product by a labor force. Insofar as a

²² The consumption junction is the point at which a user, in this case a consumer, interacts with a piece of technology. She asserts that the process of contextualizing a piece of technology can be a very complicated process. Many people are involved in a complex matrix of decisions. Her model, the consumption junction, allows for a focal point around which to understand how to build the system that contextualizes a piece of technology by focusing on the consumer and decisions that are made at the point of use. She gives the example of the development of the stove and how innovations in home building and social expectations of use affected the stove as people invented, innovated, and used the object in everyday life. By focusing on how the stove was used by consumers, she addresses the system from a particular vantage point.

²³ Nurses develop the systems in which tools are used, but they also developed the tools. They changed the tools to meet their own goals and needs, both developing the machines to work together in patient care as well as making the machines workable within the larger hospital and medical environments. See: Kathleen Burke. “Trial and Negotiation in a Technological System: Case Study of the Swan-Ganz Catheter,” in *Nursing as Evidence: Nursing Interventions Through Time*, eds. Pat D’Antonio and Sandra Lewenson (New York: Springer Publishing Company, 2011), 139–149.

²⁴ Harry Braverman. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York, NY: Monthly Review Press, 1998), 186.

historian might consider technology to have a social role, that historian must carefully consider the labor force that includes the worker. Braverman's ideas about applying the same notions to professional work as to factory work make sense in healthcare settings, though differ from his model in key areas. For the purposes of my work, I will consider Braverman's "production system of linked machines to be conceived and redesigned as a single, massive, integrated whole" to be a system of machines and tools used in intensive care to be integrated into a single, massive, integrated intensive care unit.²⁵ The nurse works within this integrated technology, the unit itself, and both physically uses the artifacts as well as contributes to the function and development of the technological system known as the neonatal intensive care unit.²⁶

Nurses and the Social Construction of Technological Systems

Nurses are key actors in the understanding of healthcare and technology because they not only use the technologies but are also developers of the systems in which they

²⁵ Ibid. Braverman. *Labor and Monopoly Capital*. 192.

²⁶ Braverman made the assumption that the machines are used in a continuous categorical process, namely assembly lines, to produce consistent and static objects in large quantities. Braverman's concept fails to transfer to the nursing model in healthcare when we examine differences in the nature of the systems. Care within the hospital does not follow the model of an automated plant; the products, or end goals, may not always be the same in each situation when a machine is used in patient care. In the capitalist mode of production, the ability to guide the machine from an external source broadens the possibilities of its use; but there is no way to create a parallel in the ways in which clinicians externally guide the machines in an environment to respond to the infinite number of human malfunctions and changing dynamics that occur in any moment during any given disease process when transferring this model to the healthcare setting. For example, if our goal is to keep the patient breathing, we use ventilators to mechanically ventilate the patient. Taken to the extreme we could sacrifice other organ functions such as cardiac output for respiratory ventilation. If a system is so complexly dynamic, then the workers in the system must retain the flexibility to give up certain skills to acquire new ones to achieve dynamically changing goals and meet socially shifting standards of care.

and others use the tools. When considering the development of healthcare delivery and the spaces in which that care is delivered, there are multiple approaches to placing the nurse within the understanding of the broader context of the story. The discourse between historians of nursing Margarete Sandelowski and Julie Fairman provides a point of reference to begin questioning how nurses might be considered actors in the social construction of technology. One way to frame the nurse as an actor is to understand her within the nurse-machine dyad. Sandelowski argued that nurses used technology and made decisions regarding its adoption and adaptation.^{27, 28} The nurse-technology dyad focuses on the nurse's use of tools. Sandelowski defined technology as the "use of material objects to achieve human ends."²⁹ Like David Edgerton, she framed her approach to technology as the consideration of the everyday use of seemingly mundane things.³⁰ For Edgerton, the consideration of technology as 'thing' avoids the consideration of technology as an independent force and refutes the idea of technological determinism.³¹ Bijker, Hughes, Pinch, Cowan, and Fairman are correct that this idea is

²⁷ Margaret Sandelowski, "Making the Best of Things': Technology in American Nursing 1870-1940," *Nursing History Review* 5 (1997): 3-22; Margaret Sandelowski, *Devices and Desires: Gender, Technology, and American Nursing* (Chapel Hill, NC: The University of North Carolina Press, 2000).

²⁸ I also believe that parents and family are part of the technological and social system for newborn care, but the history of parental influence and participation (or lack thereof) is beyond the scope of this work. Perhaps this would be a fascinating paper for my near future work as it is important to any trajectory of historical understanding of newborn infant care.

²⁹ Ibid. Sandelowski, *Making the Best of Things*, 4.

³⁰ David Edgerton, *The Shock of the Old: Technology and Global History Since 1900* (New York: Oxford University Press, 2011).

³¹ For more in depth analysis of this concept, see Ruth Schwartz Cowan. "In the beginning." *A Social History of American Technology* (New York: Oxford University Press, 1997).; and Ruth Schwartz Cowan, "An Introduction: Housework and it's tools," *More Work For Mother: The Ironies Of*

too reductionist to appropriately examine technology historically; the relationships that societies have with their technologies is a dynamic relationship in which people make decisions regarding the use of technologies and are in turn affected by the technologies they use. The street runs both ways.

Nurses should be considered key actors and Sandelowski correctly placed them as users of tools in the historical study of medical technology; the relationship between nursing and the artifacts they used to care for patients was dynamic. A simple tool did not mean a simple way of performing a task with that tool; nurses adapted and creatively used the tools at their disposal. But Sandelowski's model was limited in its scope and, through its own assumptions, undermined the creativity and ingenuity she ultimately credited nurses with practicing. Her understanding of a user with only a limited tacit relationship to her tools did not fully engage the layered understanding Bijker, Hughes, Pinch, and Cowan formulated where the tool and user function within a system and broader context.³² By limiting technological consideration to a nurse and the artifact, Sandelowski lacked a multifaceted approach to the way nurses used and developed tools. This approach failed to allow for exploration of social construction of technologies, the consideration of the technological systems in which an artifact is a part, and the possibility that nurses might use technologies to assert autonomy within a changing socio-medical environment.³³

Household Technology From The Open Hearth To The Microwave (New York: Basic Books, 1985).

³² Ibid. Bijker, Hughes, and Pinch, eds., *The Social Construction of Technological Systems*.

³³ Ibid. Sandelowski, *Devices and Desires*, 28-30.

In contrast to Sandelowski's focus on the functionality of the tools nurses use, Fairman took a much broader approach to the consideration of the nurse-technology relationship.³⁴ Fairman agreed that nurses were users of artifacts, but she took Sandelowski's model one step further by asserting that, as users, the nurses had an impact on the systems where they used their tools; thus in this way, the nurses became developers of the systems. Fairman's approach allowed for more complex questions and investigation of nursing relationships to technology. She encouraged the exploration of context focusing on the social construction of technologies and the multiple processes that converge to understand why some technologies become stable parts of systems while others do not. Fairman also suggested historians incorporate nurses into the understanding of the development of the current technologically oriented system of healthcare. According to Fairman, technology must be defined within the systems approach. Technology is, at its simplest conception, a tool; but it also must be understood as part of "a political, social, and economic process, influenced by gender, and encompassing more than the individual nurse and a particular machine."³⁵

Ruth Cowan's analysis of household work demonstrated this idea well when she assumed the need for contextualization in her analysis of the adoption of the household utility system of indoor plumbing.³⁶ The system itself was made up of more than just running water, or a toilet, or even an indoor tub. Communities and their decisions

³⁴ Julie Fairman. "Alternative Visions: The Nurse-Technology Relationship in the Context of the History of Technology," *Nursing History Review*. 6. (1998): 129-46.

³⁵ Ibid. Fairman, *Alternative Views*, 131.

³⁶ Ibid. Cowan, *More Work For Mother*. 85-89.

regarding the construction of houses, the development of sewer systems, the production of sanitary fixtures, and the implementation of indoor plumbing inside the home required social changes on a vast scale beyond the mere addition of one or two new ‘bathroom tools.’ The understanding of technologies must acknowledge a complex matrix of relationships are foundational to their definition – economic relationships, interpersonal power relationships, political relationships, and ultimately the decisions bound up in these relationships. Ethnographer and philosopher Annemarie Mol concisely stated this point in her discussion of the analysis of symbolic interactionism in the social interpretation of events. Like sociologists who analyze symbolic interactionism, historians must “show that the thing doesn’t exist by itself, but depends on something else...your object doesn’t rest on sure foundations...”³⁷ but on the complex relationships and decisions that are made around it.

In his examination of cardiac pacing, historian and cardiologist Jeffrey Kirk reminded us that the development of this technology was about the process of pacing the heart rather than on about the pacemaker itself. He focused on the tool only within an understanding of what it could do for the patient when applied within knowledge and social systems such as medical device manufacturing, governmental policies, and medical understanding of cardiac disease and dysrhythmia.³⁸ For Kirk, the study of pacemaker

³⁷ Annemarie Mol and Jessica Mesman, “Neonatal Food and the Politics of Theory: Some Questions of Method,” *Social Studies of Science*. 26 (1996): 419–444.; Although Mol’s assertion applies specifically to symbolic interactionism rather than historical analysis, her comment is a poignant one worthy of application in the understanding of a social history technology.

³⁸ Jeffrey Kirk, “Pacing the Heart: Growth and Redefinition of a Medical Technology, 1952-1975,” *Society for the History of Technology* 36, (1995): 583–624.

technology required a broad approach in which to consider how the tool was developed, introduced for use, given social meaning, and eventually emerged as the pivotal tool in the subspecialty of cardiac pacing. In order to approach such a broad consideration, Kirk contextualized the physicians' and surgeons' decisions within the definitions of cardiac diseases and the value of pharmacologic and electric treatment modalities that influenced the process of pacing and ultimately the tool itself. By broadening his study of the pacemaker within the study of a process of pacing, he addressed a complex group of users and the ways their decisions converged to influence the development of the artifact.

By contrasting how the United States and France used incubators in the care of premature infants between 1880 and 1922, physician and historian Jeffrey Baker aptly showed how two medical and social cultures interpreted the same machine and made decisions about its development and use based on their own cultural assumptions and medical approaches to treatment.³⁹ He did not address how nurses specifically used the machines or were involved in their development, but he framed the physicians as the leading users and decision makers in this technological development. Based on their medical assessments of premature infants, French obstetricians developed the machine to prevent fatal hypothermia. In the United States pediatricians were the dominant physician group making decisions about these machines and their use in caring for premature infants in the United States. Based on their own medical and social values, American pediatricians, together with nurses, used the incubator to treat hypothermia in premature

³⁹ Jeffrey Baker, *The Machine in the Nursery: Incubator Technology and the Origins of Newborn Intensive Care* (Baltimore, MA: The Johns Hopkins University Press, 1996).

infants who were brought to them after delivery and already suffering from severely low body temperatures. The American pediatricians used the machine as a treatment device rather than a prophylactic tool and did not have the same successes their French counterparts did and thus the incubator fell out of favor in American medical circles for a time.⁴⁰

Baker argued that medical values combined with social approaches to newborn infant care resulted in differing uses of the machines, and thus, though the two countries used the machines with the same patient population and the same goal of saving lives, their uses produced different results which in turn affected how they valued the machine and continued to use it. By addressing the social, medical, and political contexts that influenced the use of the incubator within each culture, Baker demonstrated the complexity and interpretive flexibility we should apply when studying the history of technology.

Baker did not directly address the nurse's role in his analysis, but hints at the nurse's importance in the conclusion to his work. He briefly implied the nurse might not necessarily have been at odds with the machine. He stated, "Nurses consolidated control of the premature infant nursery. Their rise to power within this institution was notable," and he proceeded to suggest further research needs to be done.⁴¹ While his work is an important example of the ways historians may analyze technologies and their change over time, he limited his actors to the masculine physicians, and thus indirectly institutes a

⁴⁰ Ibid. Baker, *The Machine in the Nursery*. 50-4, 150-1.

⁴¹ Ibid. Baker, *The Machine in the Nursery*. 180.

gendered approach in his work. Ultimately, the social construction of the technology centers on the connection between technology and its user that is also affected by gendered, racial, and class based understandings of who used the tool. Baker seemed to suggest it was men who used the incubators and does not address the female nurses who cared for the infants. If we are to write nurses into the history of technology and the system of neonatal intensive care, what role should they play?⁴²

Medical historian Charles Rosenberg argued that nurses made the hospitals and medical practices possible, but historians and nurses Julie Fairman and Pat D'Antonio took Rosenberg's conclusions one step farther. They argued nursing should not be a subset of medical history but a lens in and of itself; by using nursing as a lens, historians can shed new light on "personal, political, public, and private activities that constitute medical experiences."⁴³ For D'Antonio and Fairman, examining history by considering nurses as key participants in systems of care provides a different story. This lens allows for the possibility of patient experience as critical to the narrative, the consideration of what it took to make new technologies work for the patients, and keeps what D'Antonio and Fairman call the 'human element' part of the story.⁴⁴ By telling the story of the development of NICUs from the point of intersection of the history of nursing,

⁴² For the purposes of this proposal, I will use the female pronoun for flow. This decision was made due to the dominantly female nursing presence in the early care of premature infants. This does not suggest or argue that men were not involved, but acknowledges the feminine presence and gendered incidence and consideration in the current secondary literature.

⁴³ Julie Fairman and Patricia D'Antonio. "Reimagining Nursing's Place in the History of Clinical Practice," *Journal of the History of Medicine and Allied Sciences* 63, no 4 (2008): 2.

⁴⁴ Ibid. Fairman and D'Antonio. *Reimagining Nursing's Place*. 5.

technology, and children's healthcare, a different story – perhaps a previously untold story – might unfold.

Pediatrics and Age as an Analytical Lens

In this study I will place age as an important lens of analysis. Historians Alexandra Minna and Howard Markel suggest “whether revered or reviled, those who have provided medical care to children have always been involved in social, political, and cultural questions beyond the domain of the sickbed, clinic, and hospital.”⁴⁵ For Stern and Markel, the history of children is a means to examine American society and analyze broader social and cultural concepts, institutions, and medical advances; thus age must be a lens by which we engage the historical data.

Historians Cynthia Connolly, Janet Golden, and Benjamin Schneider argued that we must differentiate between adult and pediatric medical history to adequately analyze changes in the development and delivery of healthcare over time. These authors examined the introduction of sulfonamides using Sydenham Hospital as a case study to illustrate how the development of pharmaceutical sulfa drugs affected children's healthcare. They argued that the development and provision of treatment for

⁴⁵ Alexandra Stern and Howard Markel, eds. *Formative Years: Children's Health in the United States 1880-2000* (Ann Arbor, MI: The University of Michigan Press, 2004).

meningococcal meningitis and bacterial pneumonia included challenges to both physicians and nurses that were unique to the patient populations they served.⁴⁶

Their analysis challenged the assumption that nurses worked the same way with different patient populations, were involved in the same ways with the development of systems of care, and played the same rolls across healthcare populations. Julie Fairman and Joan Lynaugh thoroughly demonstrated an analysis of the ways in which nurses actively participated in the development of the technological systems of intensive care, but they focused on analysis on nurses who cared for adult populations.⁴⁷ In my work, I will consider age as an analytical lens through which I might discover the ways in which nurses who worked with pediatric patients, specifically with the neonatal patient population, might have faced unique challenges in their involvement of technological systems to care for their patients. This will challenge the current literature to think about nurses and technological systems more specifically, as my work will focus on ways in which nurses work with particular patient populations categorized by age.

In her work *A Sound Mind for the Child's Body: The mental health of children and youth*, Kathleen Jones used the history of children's healthcare as a way to examine how society viewed mental health, structured a system to deliver care to mental health

⁴⁶ Cynthia Connolly, Janet Golden, and Benjamin Schneider. "“A Startling New Chemotherapeutic Agent”: Pediatric Infectious Disease and the Introduction of Sulfonamides at Baltimore's Sydenham Hospital," *Bulletin of the History of Medicine* 86 (2012): 66–93.

⁴⁷ Julie Fairman and Joan Lynaugh. *Critical Care Nursing: A History* (Philadelphia, PA: University of Pennsylvania Press, 1998).

patients, and how we define and place value on particular diseases.⁴⁸ Jones used age as a lens to show how social and medical definitions of mental illness were a product of culture in particular times and places. By looking specifically at children, she argued that we know more about children's minds and their emotional needs now than we did in the past and that we often fail to consider how our social structures and cultural values affect our definitions of mental disorders in children. Jones could only make the claims she did by examining children as a particular patient population and recognizing how children, their health, and their history might be different from their adult counterparts; this type of analysis broadens the kinds of questions we can ask of the data and gives us a better picture of the unique ways care is delivered to particular patient populations.

Historian Heather Munro Prescott gave a window into historical analysis of healthcare delivery to a particular population in her work on the history of adolescent medicine.⁴⁹ Prescott argued that the history and sociology of adolescent medicine as a specialty reflected its parent specialty, pediatrics. The existence of adolescent medicine as a specialty devoted to an age group, rather than a medical disease process or particular technology, set it apart with a low degree of 'functional autonomy' insofar as it existed without encroachment on or by other medical specialties. She analyzed the changing approaches to adolescents as an age group and the subsequent orientations and growth of adolescent medicine reflected changing perceptions about adolescents throughout the 20th

⁴⁸ Kathleen Jones. "A Sound Mind for the Child's Body: The Mental Health of Children and Youth," in *Children and Youth: In Sickness and in Health; A Historical Handbook and Guide*, (Westport, CT: Greenwood Press, 2004). 43-65.

⁴⁹ Heather Munro Prescott. *A Doctor of Their Own: The History of Adolescent Medicine* (Cambridge, MA: Harvard University Press, 1998).

century. Prescott demonstrated how adolescent medicine has been and continues to be shaped by adult attitudes toward adolescents and the roles they play in American society.⁵⁰ Her recognition of the unique qualities of age-related sub-specialization within pediatrics allowed for much more nuanced analysis of particular healthcare and social trends. As historians move forward with studying children's healthcare, these kinds of nuances and more complex understandings of precisely *who* we are talking about when we use terminology related to childhood need to be applied.

I propose to center my work considering age an important aspect to my data analysis. While Connolly, Markel and Stern, and Jones made an excellent case for the need to consider children as an analytical category to approach differentiating age groups, they group all children together without acknowledging the ways that children might be broken down into more nuanced groups. We should consider our analysis of infants the same ways Prescott considers adolescents. In what ways might these age groups, both pediatric subsets, be similar, and in what ways might our analysis of these groups need to differ? Historians such as Martin Pernick and Elizabeth Ann Reedy, who write about infants exclusively, did not contextualize the patient populations within the larger context of pediatric history in the same ways other historians who deal with children do. Their method may be for much more complex reasons than simply age, but does suggest that analysis of newborns historically may require the same kind of unique considerations that historians of children argue differentiate histories of adults versus children. Newborns, or neonates, are considered to be children in many ways and broadly speaking, but they do

⁵⁰ Ibid. Prescott. *A Doctor of Their Own*.

differ drastically from their older counterparts.⁵¹ As both the data and scholarly literature delineate the newborn from the general pediatric population, my work will take into account how this separation might be important considering them as overlapping, but in some cases distinct, categories. Thus, my work will not necessarily provide a complete context of the neonatal population within the broader history of pediatrics, but I will position my analysis to a certain extent in relation to the nuanced ways newborns benefitted from broader trends in children's healthcare but remained unique.⁵²

Literature Review of the Histories of Neonatal Intensive Care

Historians of nursing focus on the ways in which nurses adapted and negotiated their roles and skills within the changing environments of hospitals and healthcare in the United States. Julie Fairman and Joan Lynaugh argued that nurses adopted new knowledge and technologies into their practice during the development of adult intensive care units (ICUs) in the 1950s and 1960s.⁵³ Nurses actively adapted to a changing healthcare environment, changes in expectations of ability to address more complex

⁵¹ For more on this approach, see: Martin Pernick. *The Black Stork: Eugenics and the Death of "Defective" Babies in American Medicine and Motion Pictures Since 1915* (New York, NY: Oxford University Press, 1996).; Elizabeth A. Reedy, *American Babies: Their Life and Times in the 20th Century* (Westport, CT: Praeger, 2007); -----, "Ripe too early: The expansion of hospital based premature infant care in the United States, 1922--1950," PhD Diss., University of Pennsylvania, 2000. ProQuest (9965552).

⁵² I would like to acknowledge up front that because I dealt with a children's healthcare lens, I did not take into account or include any significant data regarding the history of maternal health or perinatal trends. This is a limitation to my work, but a required boundary for the purposes of this project. Such work would be absolutely necessary to continue the formation of the history of newborn health in the United States particularly if future work extends time frame of analysis into the mid 1980s.

⁵³ Ibid. Fairman and Lynaugh. *Critical Care Nursing: A History*.

needs, and the need for more knowledgeable and skilled clinicians.⁵⁴ Fairman and Lynaugh argued nurses functioned in intensive care units and played a role in the definition and form of care they delivered, but Fairman and Lynaugh's work focused on nurses who worked with adult patient populations leaving a gap in the consideration of the ways the role of neonatal nurses might have been similar or different to their adult counterparts.

Physician historians comprise the majority of authors who have written about the development of neonatal medicine, intensive care, and the units where it was delivered. Some histories generally present the development of newborn intensive care as a chronological history while others focus on technological advances and disease processes. Thomas Cone who wrote *The History of the Care and Feeding of the Premature Infant* combined the two approaches by breaking down his historical analysis into general time periods; he then focused on specific diseases and medical issues as well as technological advances predominantly between 1945 and the late 1970s.⁵⁵ While his analysis was broad in scope, he focused on events and machines. Cone ignored the social contexts and healthcare providers who played key roles in the development and advancement of newborn medicine. While his work is important to understanding an overall arch in the trends of what would eventually be labeled neonatal medicine and the

⁵⁴ Ibid., Fairman and Lynaugh. *Critical Care Nursing*. 5.

⁵⁵ Thomas Cone, *History of the Care and Feeding of the Premature Infant* (Boston, MA: Little, Brown and Company, 1985): Thomas Cone was considered by his professional peer William Silverman to be the Dean of Pediatric Historians. In addition to "History of the Care and Feeding of the Premature Infant" he also authored "The History of American Pediatrics." As both a pediatrician and writer of history, his work on premature infants is seminal in the field of history of neonatal intensive care and one of the early syntheses of newborn and premature infant care.

development of intensive care during the 20th century, it did not address the units as systems in which decisions were made by individuals within social and medical contexts to develop and progress the subspecialty of neonatology.

In contrast, historian and physician Murdina Desmond utilized a social history in her work *Newborn Medicine and Society*.⁵⁶ Her history focused on a similar time period as Cone, but she contextualized the development of neonatal intensive care within the social trends and cultural frameworks of American society and medicine. She oriented her work on the physician as a contributing force in the early units, but did not address the nurse in her analysis as a potential actor within a changing healthcare system and increasingly technological environments. In one sense she addressed the social context in which the neonatal intensive care unit as a system could be examined, but overlooked a key factor by omitting the nurses and their role in the stabilization of the unit as a system.

Using yet another approach, William Silverman wove a thorough and fascinating account of a particular period in the development of neonatal care by focusing on a particular disease. He focused on the epidemic of Retrolental Fibroplasia in his work *Retrolental Fibroplasia: A Modern Parable*.⁵⁷ Silverman showed how the focus on a particular disease contributed to a shift in focus on research, changes in medical care, the development of clinical trials, the power and autonomy of those who delivered care to premature infants, and the organization of units themselves between 1950 and the 1970s.

⁵⁶ Desmond, *Newborn Medicine and Society*.

⁵⁷ William Silverman, *Retrolental Fibroplasia: A Modern Parable* (New York, NY: Grune & Stratton, 1980).

He considered the social influences and examined a wide range of decisions that were made by many different actors in the process of technological development in respiratory care and changes to medical treatment during this time period. Silverman's approach allowed for a complex web of actors, decisions, and possibilities, but he was a physician during this time period and consequently his history was physician centric. Though he commented occasionally on the presence of nurses, his work did not consider the nurses as important specifically to the adoption of technologies and the development of the units where newborn critical care developed. He shaped his analysis as a physician who participated in the events and his time period of analysis.

Authors such as Anne Jorgenson⁵⁸ and Alistair Philip⁵⁹ authored articles that organized the general information regarding the progression of newborn medicine and the development of intensive care for neonates in the United States. While their articles are highly informative, they lack a deeper analysis of social trends, examinations of how gender, race, and class might have played out in the larger story of neonatal medicine. They do not address nursing and the complex and varied decisions and events that might be examined through a more historic methodology rather than a clinical timeline approach.

Physician historians with years of clinical background generally focused on the mistakes and times in which technological developments and orientations to patient

⁵⁸ Anne Jorgensen, "Born in the USA - The History of Neonatology in the United States: A Century of Caring," *NICU Currents* 1, no. 1 (June 2010): 8–11.

⁵⁹ Alistair Philip, "The Evolution of Neonatology," *Pediatric Research* 58, no. 4 (October 2005): 799–815.

care proved to do more harm than good.⁶⁰ While we currently continue to ask questions about how we should use technology and knowledge in patient care, this is a question we can specifically ask of neonatal medical history. It is worth discussion, but this approach must only be a piece of a larger examination of neonatal history. Authors such as historian Alex Robertson and historian and physician Jeffrey Baker published histories that focused on the mistakes that have been made and the lessons that need to be learned from failures over the past century. They spoke of the ways that technology, such as the incubator, was not associated with decreases in infant mortality as anticipated by its initial users; Robertson and Baker suggested the possible dangers of changing practice guidelines in tandem with advances in technology without understanding the possible adverse consequences that might later arise.⁶¹ This is an important function of history, but fails to acknowledge more holistically the aspects of the system that did work, and how we might understand both the ‘errors’ and the successes as we seek to make decisions and move forward with neonatal intensive care policy and practice.

Robertson authored a series of articles that addressed how approaches to care of sick newborns during the 20th changed: the ‘hands-off’ years, the heroic years, and the

⁶⁰ For examples see: Alex Robertson, “Reflections on Errors in Neonatology III. The ‘Experienced’ Years, 1970 to 2000,” *Journal of Perinatology* 23, no. 3 (May 2003): 240–249.; ———. “Reflections on Errors in Neonatology: I. The ‘Hands-Off’ Years, 1920 to 1950,” *Journal of Perinatology* 23, no. 1 (January 2003): 48–55.; ———. “Reflections on Errors in Neonatology: II. The ‘Heroic’ Years, 1950 to 1970,” *Journal of Perinatology* 23, no. 2 (March 2003): 154–161.; Alex Robertson, and Jeffrey P. Baker. “Lessons from the Past,” *Seminars in Fetal and Neonatal Medicine* 10 (2005): 23–30.

⁶¹ *Ibid.* Robertson and Baker. *Lessons from the Past.*: Robertson and Baker oriented this piece toward medical errors with a focus on cautioning practitioners against quickly adopting new treatments and fluid fluctuations in changing medical protocol in neonatal care. They address randomized trials and technology and socially contextualize the thermoregulation and the incubator as well as oxygen use throughout the 20th century.

experienced years.⁶² These categorizations seem progressive, but his work highlighted the ways newborn medicine experienced unintentional, and perhaps unavoidable, errors that were influenced by historical developments in medicine and technology; he suggested that the errors are a way of examining unique points in medical history.

These histories focused on definitive understandings of success and failure and ignore the voices of nurses. The experiences of nurses who delivered round-the-clock care to the families and their infants provide a glimpse into the NICU story not accessible via other lenses. By examining what these nurses did, how they provided care, and the roles they played in the process, we can see the relationships between disease process, machines, and their broader contexts in different ways. The story of neonatal intensive care must be more comprehensive than machines and diseases. It must also encompass larger social, political, and economic frameworks. Historical analysis must allow for the nurses to be considered key actors in the decisions regarding the formation of the units as well as identify them as both individuals and a group of people who had dynamic relationships with the technologies, healthcare systems, and ultimately the nursing care they delivered to the patients and their families.

Perhaps the most relevant literature to the nursing role in the development of neonatal intensive care has been written by nursing historian Elizabeth Anne Reedy. Her dissertation described the development of premature infant care between 1920 and 1940. She persuasively argued that nurses were involved in the use of the machines and

⁶² Ibid. Robertson. *The 'Experienced' Years, 1970 to 2000*. 240.; ———. *The 'Hands-Off' Years, 1920 to 1950*. 48.; ———. *The 'Heroic' Years, 1950 to 1970*. 154.

technologies used on premature infant care during this time period and that nurses were necessary to the care of the premature infant population as that care developed during the early decades of the 20th century. For Reedy nurses participated in these new premature infant units, but she did not include them as influencers of the system themselves. While her work took a different angle and time period of focus than I propose, it is important for understanding in what ways nurses were involved in the care of premature infants in early premature infant units. I will take her research a step further by expanding, not only on her approach to the data, but also in the time frame by examining the decades following her time period of interest. Her work predates the development of NICUs and, though it is groundbreaking, I will show how her argument regarding the importance of nursing in the development of premature infant care also holds true beyond her time period of focus. The kind of influence nursing had on premature infant units and the development of premature infant care extended into the context of the development of the specialty of neonatal medicine and neonatal intensive care units in the 1960s and 1970s.⁶³

Overall, what these historical analyses lack is a focus on the nurse as an important actor in the development of a larger system of acute medical care for the newborn infant, or neonatal population. Many of these authors, physicians who lived through some of the time periods of analysis, highlighted the mistakes and failures that occurred in each

⁶³ Elizabeth Reedy, "From Weakling to Fighter: Changing the Image of Premature Infants," *Nursing History Review* 11 (2003): 109–127.; Ibid. Reedy. *Ripe too early*.; Ibid. Reedy. *Infant Incubators Turned 'Weaklings' into 'Fighters'*, 64a.

period.⁶⁴ Others failed to tie the broader picture together and see how the early years of the 20th century provide a very poignant foundation for the care that developed in the 1950s and 1960s; these histories are written to communicate the big moments and important events and people over the course of time but fail to examine the development of neonatal intensive care as a specific and complex technological system. They lack an in-depth analysis of the kinds of healthcare providers that developed the care given, and whose roles were developed within the system that arose as a result of social and technological advances.

Physicians wrote histories through their own lenses and thus put themselves as key actors, failing to consider how nurses might have played important roles in the development of NICUs in the United States during the 20th century. This is one way of examining NICU history. In many ways this approach limits their analysis but it also provides insight regarding how they viewed the development of this specialty and their role in it, as well as how they viewed other important historical actors and the dominance of medicine and science. Their work can be considered data that becomes both a primary as well as a secondary source depending on how we choose to engage it. While their accounts should be critiqued as secondary sources that give accounts and analysis of a particular historical event, their work may also be analyzed as primary sources written by people who wish to communicate a story based on how they remember a story or event.

⁶⁴ Ibid. Robertson. *The 'Experienced' Years, 1970 to 2000.*; ———. *The 'Hands-Off' Years, 1920 to 1950.*; ———. *The 'Heroic' Years, 1950 to 1970.*; Robertson & Baker, "Lessons from the Past"; Silverman, *Retrolental Fibroplasia*.

Significance of this work

Nurses' accounts need to be combined with the analysis we already have to reframe the and enrich our understanding of how NICUs developed. While the history of the development of neonatal intensive care units is scarce in the scholarly literature, this narrative is important for us to understand as we continue to progress in with neonatal intensive care. This story informs more than just our considerations for acute care for newborns. This work is significant because it speaks to our understanding of how and why we allocate resources to particular patient populations and how we develop and adopt technologies for those populations that we value. This work is significant because we continue to invest incredible financial resources in newborn medicine and intensive are amidst current debates surrounding high healthcare expenditures today; this work is an excellent example of how hospitals and local governments allocated resources and organized care to provide highly costly care to highly valued newborns. The ways nurses participated in the formation of NICUs in the 1960s and 1970s is an excellent case study to challenge how we currently think about nurses today who comprise the largest single workforce in our contemporary healthcare system. Thus, my questions particularly focus on nursing's role in the development of NICUs and their transition from previous models of care, developed in premature infant units, helps us understand broader themes regarding healthcare, nursing and technology, and resource allocation for particular populations.

A Tale of Two Units

As there has been little work done examining the development of neonatal intensive care in the United States this work must begin more particularized before I broaden scope. For the purposes of this dissertation, I have chosen to develop a case study comparison between two particular hospitals that have many similarities and developed around the same time period. Using hospital archives, oral histories, and newspapers and city publications from the Children's Hospital of Boston and the Children's Hospital of Philadelphia, I will tell the story of these two units who shared characteristics as well differed in key points. By comparing and contrasting these two units, my analysis will note similarities and differences and begin to formulate themes as I construct the story within a broader national context of sick newborn healthcare and developing trends related to resource allocation and social values.

The use of case studies in the historical research allows for in depth examination of change over time in a particular time period and place. While this approach might not allow for broad generalizations, it does allow for in depth analysis. Historians build the answers to their questions by discovering, and perhaps creating, context and developing an understanding of how that context shapes particular understandings of growth and development in a focused way. By using these separate institutions, I am able to dive into particular cases as well as push this work forward and understand further possible trajectories that will be pursued as I grow and expand this research. This dissertation is only the beginning and requires definite boundaries.

I will start by outlining the ways newborns were delineated as a unique patient population in need of resources tracing that progression from the Progressive Era through the post war years when premature infant units, and later NICUs, were established. I will then argue that the social value and medical understanding of the newborn as a unique patient in need of particular resources and care influenced the formation of spaces where that care could be delivered. My third chapter will focus on the ways NICU nurses functioned in the early NICUs and participated in the care of newborns requiring advanced ventilator support before and during a time when mechanical ventilation was still being developed. I begin by articulating briefly some of the aspects of care nurses who practiced in premature infant units as a foundation for understanding how NICU nurses built on those models of care (as well as others) in their practice.

The fourth and fifth chapters hone in on two units that formed at the Children's Hospital of Philadelphia and the Children's Hospital of Boston. The stories of these units illustrate the importance of recognizing how these units did not form out nowhere, but were built on established models of care, and how hospital administrators and leaders specifically made decisions too allocate resources for sick newborns, and how the early units met the needs of broader newborn populations than just premature infants as nurses continued to work at the bedside and participate in patient care. My last chapter will bring this context and these stories together for synthetic analysis. I will also suggest both limitations to this research as well as suggestions regarding how this work has provided a foundation to move forward as a scholar.

Chapter 2:

Puny waifs as untold treasures:

The value of newborn patient populations as a conceptual foundation

**Puny waifs as untold treasures:
The value of newborn patient populations as a conceptual foundation**

Newborns, or neonates, are considered to be children in many ways, but they do differ drastically from their older counterparts and thus must be understood as unique in order to understand the nuanced ways the consideration of newborns as unique influences how we analyze nurses' role in the formation of technological systems. I will use the lens adopted by historians of children's healthcare to consider newborns as a subset of the pediatric population. Over the course of the 20th century, the delineation of newborns as a distinctive patient population allowed for the rise of premature infants as a subset of sick newborns that, in turn, laid important foundations for the ways newborns broadly speaking received care in the early neonatal intensive care units.

Newborns as unique patients valued by society and in need for particularized medical and nursing care is a constant theme throughout the 20th century, but how newborns are valued changes in nuanced ways between the Progressive Era into the early 1960s when NICUs begin to appear in hospitals. The newborn emerges as a unique and separate entity from children at the turn of the century and into the heyday of the Progressive Era's child saving oriented years. By the 1920s, premature infants were considered a particular subset of newborns for whom mortality rates continued to remain high despite decreases in infant mortality related to other causes. By the post-WWII years premature infants constituted a population with their own units and nursing staff. Such recognition of newborns (and subsequently premature infants) reflected particular nuances in the ways the child saving mentalities begun in the Progressive Era grew and

changed throughout the 20th century. In this chapter, I will provide a context for the delineation of newborns as a particular population of children affected by the foci on ‘child saving’ begun during the Progressive Era. I argue that beginning in the Progressive Era, newborns emerged as a unique population for whom social value manifested in Progressive Era activism that impacted the reduction of infant mortality rates. Amidst the decreases in infant mortality statistics, premature infants emerged as a subset of newborns that required additional resources and social and medical infrastructures to reduce mortality rates unique to them. Out of the framework of care for premature infants arose practices and policies that were later adapted for newborns broadly, including surgical newborn patients and newborns requiring intensive skilled care.

Newborns are needed: The value of newborns and the Progressive Era movement

Premature infants did not suddenly emerge as a unique patient population. “Child saving” programs were established as early as the 1850s, and Progressive Era reform continued focusing such programs (as part of broader child welfare programming) with initiatives that pinpointed newborns as a valued population worthy of investment and resources. Progressive Era reformers incorporated their efforts into a series of campaigns aimed at improving health, education, and urban living conditions more broadly as impetus for child saving programs grew.⁶⁵ Historian Richard Meckel argues Progressive

⁶⁵ Janet Golden, Richard Meckel, and Heather Munro Prescott. *Children and Youth: In Sickness and in Health; A Historical Handbook and Guide*, (Westport: Greenwood Press, 2004).; Richard Meckel. *Classrooms and Clinics: Urban School and the Protection and Promotion of Child Health, 1870-1930* (New Brunswick, NJ: Rutgers University Press, 2013).; ———. *Save the Babies: American*

Era reformers recognized that a healthy and functioning society required healthy children to grow into functioning and contributing adults.⁶⁶ During this time, “children became the symbol of a resurgent reform spirit, the magnet that pulled a diverse collection of causes and their champions into a loose, informal – but very effective – coalition.”⁶⁷

While children’s health and welfare became highly valued and the focal point for many aspects of social change at the turn of the century, some reformers and activists chose to focus particularly on the plight of newborns as a further extension of the child saving programs of the time. Though statistics did not carry the reliability they have today due to incomplete reporting and even lack of reporting in areas of the country, infant mortality was high and the reformers knew they needed to decrease the numbers of infants and newborns dying.

Attendees at the American Association for the Study and Prevention of Infant Mortality’s (AASPIM) first meeting in 1910 recognized the need to focus on newborns specifically. Dr. Abraham Jacobi, the father of American Pediatrics, addressed his fellow physicians:

The watchfulness of a parent over a child is not more justified than the watchfulness of society over its members...I want no...newborn babies to be lost

Public Health Reform and the Prevention of Infant Mortality, 1850-1929 (Baltimore: The Johns Hopkins University Press, 1990).

⁶⁶ Richard Meckel argues two convictions laid the foundation for the focus on children’s health during the Progressive Era: the first was the conviction that children suffered as the chief victims of broader social problems related to familial and social disintegration. The second conviction, and perhaps the more poignant of the time, was the realization that when children were exposed to harmful conditions, they would grow up to become a nation of damaged, dependent adults requiring immense aid to function in society. For further reading see: Meckel. *Classrooms and Clinics*, 38-40.

⁶⁷ Ibid. Meckel. *Classrooms and Clinics*. 2013. 94.

that can be saved, And many, most of them, can now be saved. To give up on the newborn baby merely because it seems feeble and uncompromising is preposterous. Kant, Goeth, and Helmholtz were puny waifs whose lives were despaired of. Being saved, they added untold treasures to the intellectual capital of the human race.^{68,69}

Jacobi's address followed an opening session entitled "Duty of a Nation to its Potential Citizens" that identified newborns, especially those born requiring extra support, as citizens worthy of resources and investment. While children grew to be healthy adults, healthy babies were needed to grow healthy children and garnered their own focus and value as potential citizens should they survive the newborn period that some considered the most dangerous period of life.⁷⁰

The first president of the AASPIM, physician J.H. Mason Knox, initially proposed the collection of accurate data as the first step to attaining preventative welfare to decrease infant mortality. The data pointed to infantile diarrhea, death due to disease and poor hygiene, and prematurity as some of the highest causes of mortality. During the organization's early years, the AASPIM advised that reform activity focus on addressing

⁶⁸ Abraham Jacobi. "Address by Abraham Jacobi, MD at the First Annual Meeting of the American Association for the Study and Prevention of Infant Mortality," (Opening Session, Johns Hopkins University, Baltimore MD: November 9-11, 1910): 43-50.

⁶⁹ While beyond the scope of this paper and my focused time period, we must understand Jacobi's context for this comment was not only within a broad infant welfare movement but also dialogues of eugenics and affirmations of infanticide based on the possibility that for some infants, "medical science indicates, beyond the possibility of a doubt, that it is impossible for them ever to become useful members of society..." For more on this see: Martin Pernick. *The Black Stork: Eugenics and the Death of "Defective" Babies in American Medicine and Motion Pictures since 1915* (New York, NY: Oxford University Press, 1996).

⁷⁰ Dr. Clement Smith, physician and expert on newborn care, would later label the time period of transition from uterine to extra-uterine life "The Valley of the Shadow of Birth." See: Clement Smith. "Progress in Pediatrics: The Valley of The Shadow of Birth," *American Journal of Diseases of Children* 82 (1951): 171-201.

infantile diarrhea, hygiene, and disease prevention as they believed they could make a difference in these areas though they ended up pointing to infants and children rather than neonates.

While improving children's health stood as a major rallying point for Progressive activists, Jacobi urged the medical community to remember the unique place newborn infants occupied in medicine and social value: "Your dealings are not with children but with infants; not with infants only but with the newborn that is just terminating his embryonic and fetal development..."⁷¹ Newborn infant mortality⁷² did overlap with broader children's issues and reaped the rewards of the Progressive activists' milk campaigns and maternal education programs,⁷³ but newborns within the first few weeks of life existed as another subset of the general pediatric population. Healthy newborns that survived the first few weeks of life became a litmus test for national strength and, "conservation of natural resources naturally [began] with the protection of infancy."⁷⁴ Most of the attention on curbing infant mortality stressed maternal education and

⁷¹ Abraham Jacobi. "The Best Means of Combating Infant Mortality," *JAMA* 58, no. 23 (June 8, 1912): 1735–44.

⁷² While birth rates were taken in national statistics and data well prior to the turn of the century, they did not give reliable results until the 1920s. Despite lack of 'reliable' data, physicians and public health workers would have known first hand the incredible mortality rates in their own cities.

⁷³ During the Progressive Era, healthcare activists established stations in urban cities to provide tenement mothers with free or subsidized pasteurized milk as a place where "the poor could buy clean milk at a fair price," in an effort to curb the rates of infantile diarrhea that often reached epidemic proportions during the hot summer months and proved fatal for many infants in the cities' poorest neighborhoods. Many of these stations coincided with maternal education initiatives to teach tenement mothers how to hygienically care for their infants. For more on this topic, see: Richard Meckel. *Save the Babies: American Public Health Reform and the Prevention of Infant Mortality, 1850-1929* (Baltimore: The Johns Hopkins University Press, 1990).

⁷⁴ *Ibid.* Meckel. *Save the Babies*. 103.

environmental sanitation⁷⁵ and newborn issues drew the focus of a few important reformers and activists such as Jacobi.

As the AASIM began their quest to determine the scope of the problem of infant mortality in 1910, The Children's Bureau began by needing to attain appropriate and reliable statistics of newborn and infant mortality rates. As the medical community and activists shifted their efforts to address prematurity as a significant contributor to mortality rates the need to define and attain reliable statistics became a significant issue. Prematurity needed to be more precisely defined for the national reported numbers to be trusted. Though both national statistics (as they were reported)⁷⁶ and social publications at the turn of the century recognized prematurity as a cause of infant mortality, it was far less understood than other major causes of death in newborns and infants.⁷⁷ Physicians and public health activists did not yet readily understand prematurity – its causes and complications - and thus standards of practice and consistent ways to measure the numbers of premature infants did not exist at that time.⁷⁸ Some physicians began to observe infants in tandem with the new incubator technology introduced to the United States in the late 19th century, but these doctors and their published observations were the

⁷⁵ Ibid. Meckel. *Save the Babies*.

⁷⁶ Prematurity was listed among important causes of death in many large cities in national statistics as early as 1890. See: *Report on Vital and Social Statistics in the United States at the Eleventh Census: 1890*. National Census. (Washington D.C.: Department of the Interior Census Office, 1896). http://www.cdc.gov/nchs/data/vsushistorical/vsush_1890_1.pdf; Joseph DeLee. "Infant Incubation, with the Presentation of a New Incubator and a Description of the System at the Chicago Lying-In Hospital," *Chicago Medical Recorder* 22 (1902): 22–40.

⁷⁷ Ibid. Meckel, *Save the Babies*.; For an example of a pop culture publication regarding premature infants, see: Ellis Parker Butler. *The Incubator Baby*, by Ellis Parker Butler, Illustrations by May Wilson Preston (New York: Funk & Wagnalls Company, 1906).

⁷⁸ Ibid. Baker. *The Machine in the Nursery*.

exception at this time, not the norm.⁷⁹ Incubator technology had yet to be used to greatest effect in the United States and very little progress was made for premature newborns during this time period.⁸⁰ By 1910, infant mortality related to prematurity had yet to gain significant footing, as the focus remained strong on children and post-neonatal infants into the war years; but even though premature infants as a subset of newborns might not have yet been center-stage, the recognition of a need to focus on the newborn separately from older infants and children broadly speaking was ingrained into medical and social values in the years leading to the First World War.

With the invention of the incubator and subsequent incubator baby stations that appeared in World's Fairs during the early years of the 20th century, both social fascination and hope in the changing survival rates of premature infants when they received particular care strengthened the hope that these infants could be saved. According to historian Jeffrey Baker, incubator technology in the United States did not immediately change medical outcomes for infants as American physicians did not use them as they had been intended to be used, but medical fervor surrounding incubator technology still continued to progress and gained traction in later years leading up to

⁷⁹ Ibid. Baker. *The Machine in the Nursery*; For examples of such publications, see: Henry Chapin. "The Babies' Wards of the New York Post-Graduate Hospital," *Archives of Pediatrics* 14 (1897): 329.; Adriance Vanderpoel. "Premature Infants," *American Journal of the Medical Sciences* 121 (1901): 410–21.

⁸⁰ Jeffrey Baker. "The Incubator and the Medical Discovery of the Premature Infant," *Journal of Perinatology* 20, no. 5 (2000): 321–28.; ----- *The Machine in the Nursery: Incubator Technology and the Origins of Newborn Intensive Care* (Baltimore: The Johns Hopkins University Press, 1996).

1920.⁸¹ From as early as the 1908 national statistics analysis, experts estimated that 40 out of every 100 deaths related to premature births could be prevented thus reflecting a significant hope that death rates related to prematurity could be significantly changed. Though hope might have been present, healthcare workers and the medical community still had a great deal to learn about prematurity, its causes, and how to treat common complications that occurred when babies entered the world too soon.

Newborns as “National Assets”: The War Years and Infant Mortality

During the early years of the 20th century, social activists, healthcare workers, and government leaders banded together to decrease the incredibly high infant mortality rates that plagued the nation.⁸² As the country entered World War I, the nation’s focus on curbing infant mortality became even more important as broad social movements reflected more intensified value of newborns, infants, and children. In his book, *Save the Babies*, historian Richard Meckel argued that the casualties of World War I heightened American concern for the high infant mortality rates. By 1920, the reported neonatal mortality rate was 41.5 per 1000 live births, a number considered deplorable by government and healthcare leaders.⁸³ The value of infants was reinforced when, in 1921, President Warren G. Harding signed the Sheppard Towner Maternal and Infancy

⁸¹ Jeffrey Baker. “The Incubator and the Medical Discovery of the Premature Infant,” *Journal of Perinatology* 20, no. 5 (2000): 321–28.; Ibid. Baker. *The Machine in the Nursery*.

⁸² Ibid. Meckel. *Save the Babies*.; Murdina MacFarguhar Desmond. *Newborn Medicine and Society: European Background and American Practice (1750-1975)* (Austin: Eakin Press, 1998).

⁸³ Public Health Service. *Vital Statics of the United States, 1920-1940*. Washington D.C.: US Department of Health, Education, and Welfare, 1968: 207.

Protection Act (known as the Sheppard-Towner Act) that allocated federal funds to states for maternal-child health activities dedicated to lowering the incredibly high mortality rates. Though states' rights and government intrusion in private medical practices permeated debate over the law, the Act nonetheless proved to be a major landmark in the American infant welfare movement. With the passing of the Sheppard-Towner Act, the government became actively involved in maternal and infant care.⁸⁴

Like the initiatives of the AASPIM just a decade earlier, this piece of legislation chose to focus more intensely on maternal education and access to healthcare for mothers and infants. The Act provided public health care in the form of public primary care clinics and encouraged education for mothers about how to best care for their babies and children. Nursing historian Beth Anne Reedy notes that though the Sheppard-Towner Act contributed great strides in reducing infant mortality it did not directly affect the plight of premature infants. The Act's programs lowered many post-neonatal causes of infant mortality and illuminated the reported higher rates of prematurity, as those rates changed far less drastically during this time period.⁸⁵

Nonetheless infant mortality did decline quite rapidly due to better sanitation, widespread milk campaigns, and maternal education.⁸⁶ General newborn mortality rates did drop making the slower or stagnant mortality rates of premature infants more compelling. While infant mortality overall decreased, premature births and the need for

⁸⁴ Ibid. Meckel. *Save the Babies.*; Ibid. Desmond. *Newborn Medicine and Society.*

⁸⁵ Elizabeth A. Reedy. "Ripe too early: The expansion of hospital based premature infant care in the United States, 1922—1950," PhD Diss., University of Pennsylvania, 2000. ProQuest (9965552).

⁸⁶ Ibid. Meckel. *Save the Babies.*

intense care for those infants born prematurely declined at a much less drastic rate. The Children's Bureau, one of the fastest growing federal public health agencies during the first half of the 20th century, administered federal matching grants for maternal and child health as part of the initiative to decrease infant mortality rates as part of Social Security Act's Title V passed in 1935.⁸⁷ With a significant decreases in mortality related to infantile diarrhea and better nutrition for infants, prematurity moved up the list as reformers and healthcare activists shifted to allocate resources to premature infants. The Children's Bureau's grant matching contributed to local initiatives to open units where premature infants could receive care in hospitals as early as the 1920s.⁸⁸ Units called premature infant units opened in many hospitals across the country as larger, better-funded hospitals could establish them.

“Child-saving”: Premature infants as a focal point

As reform movements related to maternal, infant, and children's health continued to improve quality of life for women and children across the country, newborns did benefitted from such generalized efforts. But reform movements were not the only driving force behind the recognition of premature infants as a particular patient population; the intersection of child saving reforms, the shift from giving birth at home to giving birth in hospitals, increase trust in and use of incubator technology, and the quest

⁸⁷ Ibid. Meckel. *Save the Babies*. 223.; Marilyn Irvin Holt. *Cold War Kids: Politics and Childhood in Postwar America, 1945-1960*. Kindle (Lawrence, KS: University Press of Kansas, 2014). Ch 4, loc 1996.

⁸⁸ Thomas Cone. *History of the Care and Feeding of the Premature Infant* (Boston, MA: Little, Brown and Company, 1985).

for a clearer understanding of the scope of prematurity contributed to the premature infant as a distinct patient population for whom the formation of specialized care and the creation of unique spaces where that care could be delivered formed.⁸⁹

A perfect storm: Child-saving reform, technology, hospitals, and premature birth

Premature infants gained a footing as a medically unique newborn patient population in need of particularized care and resources by the mid-1930s.⁹⁰ Nursing historian Elizabeth Ann Reedy argues that premature infants received increased attention medically because of a combination of technological advances and public awareness of the number of premature births. While other causes of infant mortality decreased, infant mortality related to prematurity remained constant and became more of a focal point. Reedy shows how the lay press contributed to increased interest in the premature infant by publishing articles that described the premature infant and lauded the types of hospital based care given during the time. Premature infants emerged as a particular facet of a continued and nuanced value of children and newborns. The emergence of incubator technology, increased public awareness, the shift to in hospital birthing processes, and the push to develop national definitions of prematurity all coincided with the creation of premature infant units as spaces and thus to the focus on premature infants as a separate patient population of newborns in need of such space and particularized care.

⁸⁹ Elizabeth Reedy. "From Weakling to Fighter: Changing the Image of Premature Infants," *Nursing History Review* 11 (2003): 109–27.

⁹⁰ "Proceedings: Fifth Annual Meeting of the American Academy of Pediatrics. June 7, 1935," *Journal of Pediatrics* 8, no. 1 (January 1936): 104–21.

Meckel argued the infant mortality movement during the early decades of the 20th century was in reality a white middle-class infant mortality movement.¹ While prematurity did not take center stage in the Progressive Era activists movements to lower infant mortality, any push to curb newborn deaths, including those related to prematurity, would likely have also been a push to save elite white middle class newborns infants as well. Those who could not afford or did not have access to incubator technology or specialized care, such as the poor or those who fell into certain racial groups, probably followed early traditional care techniques related to keeping the infants warm and hoping for the best.

Perhaps one of the biggest medical shifts of the 20th century was the transition of the birthing process from home settings into hospitals that began in the 1920s. With this transference of the mother and her baby into the hospital for delivery came a much higher population of newborns in hospitals. This also meant that newborns requiring extra support and attention were already at the hospital among physicians and nurses who had the potential to deliver such care. Certain larger hospitals grouped premature infants together in separate units from their general newborn nurseries. As early as 1902, physician Joseph DeLee published general care guidelines already in place at the Chicago Lying-In Hospital. Such gathering of patients constituted the first time American hospitals had delineated spaces for sick infants separate from newborn nurseries where healthy babies received care.⁹¹ During this time period units in hospitals were rare. While

⁹¹ In the United States premature newborns had been grouped together in World's Fairs and traveling shows for three decades prior to the opening of the units that appeared in hospitals in the 1920s. These

DeLee's guidelines reflect a vein of medical discourse surrounding premature infant care, premature infant units did not become widespread for another two decades, until the shift of birth into the hospital setting.

Premature infant care involved more than just more mothers and premature infants in the hospital setting. The incubator's invention and subsequent adoption into use drastically affected the premature infant survival rates. Historian Jeffrey Baker identifies the incubator as a technology that aided physicians and nurses in keeping premature infants warm and, when used appropriately, was an invaluable tool. Though the equipment did not initially find favor with American pediatricians, the dominant medical group initially using the incubator in this country, physicians worked diligently to determine how to incorporate incubator technology into general practice and eventually learned to use it effectively.⁹²

While premature infant units created spaces where any infant born prematurely could receive care, the concept of prematurity and who was classified to receive care in these units changed and developed over the following decades as premature infants garnered increasing attention from both public and medical circles. Debates related to the

'incubator babies' received care from trained nursing staff and physicians in the sideshows, but not within what we would consider today traditional hospital environments. For more on these early medical phenomena, see: William Silverman. "Incubator-Baby Side Shows," *Pediatrics* 64, no. 2 (August 1979): 127-41.; Jeffrey Baker, *The Machine in the Nursery: Incubator Technology and the Origins of Newborn Intensive Care*, (Baltimore: The Johns Hopkins University Press, 1996).; ----- "The Incubator and the Medical Discovery of the Premature Infant." *Journal of Perinatology* 20, no. 5 (2000): 321-28.; Alex Robertson and Jeffrey P. Baker. "Lessons from the Past," *Seminars in Fetal and Neonatal Medicine* 10 (2005): 23-30.

⁹² Ibid. Baker. *The Incubator and the Medical Discovery of the Premature Infant*, 321-28; Ibid. Baker. *The Machine in the Nursery*. 129-51.

classification of prematurity reflected continuity in the value of infants and children and the search for a better understanding of the scope of prematurity.

By 1935, the reported statistics for morbidity and mortality related to prematurity showed a decrease as reported at the fifth annual meeting for the American Academy of Pediatrics.⁹³ Though these findings initially seemed encouraging, physicians such as premature infant specialist Ethel Dunham remained skeptical. Other experts present such as physicians Julius Hess, Clifford Stewart, and Emmett Holt understood the dangers to infants that came with prematurity. Dunham believed that better delineation of the definition of prematurity could provide more accurate statistics that could thus be used to better define and describe the scope of this pressing problem, and ultimately be used to combat the high mortality rates associated with these specific newborns.⁹⁴ Dunham presented her concern,

...we are not all really aware of what a problem [prematurity] is. The reduction of mortality from prematurity is of the utmost importance in the reduction of the high rate of neonatal mortality...reports from hospitals...differ widely. The differences may be attributed in part to variability in criteria for the diagnosis of prematurity, in part to the differences in the periods of observation at the end of which the report is made, and in part to the numbers of infants in high or low weight groups.⁹⁵

⁹³ Robert Grove and Alice Hetzel. *Vital Statistics Rates in the United States: 1940-1960*. Washington D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service National Institutes of Health, 1968.; Forest Linder, and Robert Grove. *Vital Statistics Rates in the United States: 1900-1940*. Washington D.C.: United States Public Health Service, Federal Security Agency, 1947.

⁹⁴ "Proceedings: Fifth Annual Meeting of the American Academy of Pediatrics. June 7, 1935," *Journal of Pediatrics* 8, no. 1 (January 1936): 104–21.

⁹⁵ *Ibid. Proceedings: Fifth Annual*. 109.

The concept of prematurity did not hinge on gestation as the defining point for all physicians, and weight was the most generally used delineation for premature infant care prior to the 1940s and a focal point for debate among physicians and researchers. Dunham referenced a report published by a German researcher Dr. A. Ylppo in 1919 that delineated prematurity as any infant weighing <2500 grams, and suggested this classification be established for their purposes of definition.⁹⁶ Not all physicians in the United States used weight. Physicians such as Joseph DeLee and Julius Hess published definitions of prematurity in the early 1920s that used gestational age to delineate premature infants from full term infants⁹⁷ citing premature infants as those, “born three weeks or more before the usual termination of pregnancy.”⁹⁸ While many physicians accepted Hess and DeLee’s definitions, not all of them considered gestation as sound as the ability to scientifically determine gestation resulted in the reliance on maternal reporting. Some physicians and researchers used physical examination as well as weight as considerations for grouping of premature infants at a time when no national universal definition was available. Overall, the parameters of prematurity varied drastically, but at

⁹⁶ I did not read the original article as it is in German, but for informational purposes the article can be found: A. Ylppo. “Pathologisch-anatomische Studien bei Frühgeborenen Makroskopische und mikroskopische Untersuchungen mit Hinweisen auf die Klinik und mit besonderer Berücksichtigung der Hämorrhagien,” *European Journal of Pediatrics* 20, no. 1 (1919): 212-431.

⁹⁷ Joseph DeLee. *Obstetrics for Nurses* (Philadelphia: W.B.Saunders Company, 1920).; Julius Hess. *Premature and Congenitally Diseased Infants* (Philadelphia: Lea & Febiger, 1922).

⁹⁸ *Ibid.* Hess. *Premature and Congenitally Diseased Infants*. 17-8.; Hess’s textbook, *Premature and Congenitally Diseased Infants*, published in 1922 was one of the first texts devoted specifically to premature infants and coincided with the opening of one of the first and largest Premature Infant Units located at Michael Reese Hospital in Chicago.

their fifth annual conference the American Academy of Pediatrics passed a resolution to define prematurity by weight in attempts to gather better morbidity and mortality data.⁹⁹

During the Progressive Era the foundation for the newborn as a separate patient population arose as one facet of the ‘child saving’ mentality as the push for healthy children garnered incredible focus and resources from activists and healthcare reformers. The value of children, and particularly newborns, continued into the post-war years. While premature infants began to receive particular attention prior to World War II, interest in this population group gained significant momentum with the advances in technology and medicine after the war. By the post-WWII era, premature infants were a focal point in the application of technology and medicine and the ways families valued saving sick newborns as an extension of continued child-saving values. These child-saving values continued past the Progressive Era and into the post-war years, but presented in different ways as the value of newborns and children changed in nuanced ways.

Sick newborns and the era of the ‘baby boom ideology’

The prosperity of post-war American society and the focus on healthy families and subsequently health children to combat the threat of communism continued to provide a fertile context for a more focused attempt to continue to save the babies. Like the call to concentrate on newborns as a particular patient population who needed support and resources begun during the Progressive Era, premature infants also garnered

⁹⁹ Ibid. *Proceedings: Fifth Annual Meeting*. 104–21.

significant attention in the post-war era. While Jacobi and Progressive Era reformers chose to focus on newborns particularly, they lacked the medical knowledge and equipment to significantly change mortality rates of premature infants. As children became the focal point for the post-war nuclear family, physicians and public health workers in the 1950s chose to continue to focus on premature infants as a particular newborn patient population.

“A child centered character:” *The social value of the newborn population*

With the end of World War II in 1945, American soldiers returned home to the United States, their wives, and their families. Subsequently the American birth rate increased during the post war years eventually resulting in what would later be labeled as the great ‘baby boom.’ The birth rate not only rose in all social groups, but it rose across all ages of women. According to historian Elaine Tyler May, “what made the baby boom happen was that *everyone* was doing it [having babies] – and at the same time.”¹⁰⁰ The rising birthrate was more than a demographic phenomenon; it reflected the widespread social belief that having children led to personal fulfillment and that parenthood and healthy children were the route to happiness and personal fulfillment as a social and nationalistic ideology. Historian Marilyn Irvin Holt argues the importance of child health reform and that, “having children was an affirmation of life after the terrible destruction

¹⁰⁰ Elaine Tyler May. *Homeward Bound: American Families in the Cold War Era* (New York, Basic Books, 2008).

of the war.”¹⁰¹ What May refers to as the ‘baby boom ideology’ permeated Hollywood, political culture, and prescriptive literature. The baby boom ideology combined with the post war victory to contribute a sense that America was making great technological strides coming out of the world wars. The general prosperity contributed to a reorientation back on the focus of saving babies, and thus producing healthy children and eventually healthy and robust American adults. Thus the concept of the ‘nuclear family’ as a bulwark against Communism became a foundation to the American psyche.

The maternal child and infant bond became a more intense focus in both child rearing and medical diagnosis, as reflected in popular publications such as Dr. Spock’s *Common Sense Book of Baby and Child Care*.^{102, 103} Hollywood reflected society’s value of family and the importance of children in films such as *Cheaper by the Dozen* (1950),¹⁰⁴ a story of a family who faces the adventures of life in a house with twelve children, Disney’s tale of a young boy who was torn between never growing up and the need for a mother (family) in *Peter Pan* (1953),¹⁰⁵ and Bob Hope’s classic about a widowed father who incorporates his seven children into his vaudeville act to keep the

¹⁰¹ Ibid. Holt. *Cold War Kids*. ch 1, loc 135.

¹⁰² Steven Mintz. *Huck’s Raft: A History of American Childhood* (Cambridge: The Belknap Press of Harvard University Press, 2004).

¹⁰³ Benjamin Spock. *The Common Sense Book of Baby and Child Care* (New York, NY: Duell, Sloan, and Pearce, 1957). Please note this is a reprint of the earlier 1947 edition.

¹⁰⁴ *Cheaper by the Dozen*, directed by Walter Lang. (Released April 1950, Twentieth Century Fox Film Corporation, Los Angeles, CA).

¹⁰⁵ *Peter Pan*, produced by Walt Disney (Released February 1953 by Walt Disney Productions, Burbank, CA).

family together in *The Seven Little Foys* (1955).¹⁰⁶ The importance of family reflected in Hollywood also played out in the drastic changes taking place in healthcare. Families then needed to bear healthy newborns who survived the neonatal period.

The 1950s and 1960s were a prosperous post-war time as well as a time that also encompassed much turmoil and social frustration. The Cold and Vietnam wars, civil rights struggles, changes in nuclear family norms, and assassination of American leaders contributed to a chaotic social order that coincided with a technologic revolution and an international space race. According to historian Steven Mintz, the era between World War II and the 1960s can be defined in part as having a child-centered character that reflected deeply ingrained hardships of the Depression years, wartime upheavals, and the insecurities of a nation locked in the Cold War.¹⁰⁷

Suburbs grew, contributing to the isolation of families in their individual housing surrounded with grassy yards separating them with their neighbors. As part of the increase in federal funding for healthcare and hospital construction, Hill-Burton funds generously flowed to subsidize the expansion of community hospitals in suburbs.¹⁰⁸ With hospitals expanding, new medical advances changing survival rates for many Americans, and the technology boom drastically overlapping with medical care, families had higher hopes for their children's medical care, situated as they were within a social system that

¹⁰⁶ *The Seven Little Foys*, directed by Melville Shavelson (Released September 1955 by Paramount Studios, Hollywood, CA).

¹⁰⁷ Ibid. Mintz. *Huck's Raft*. 275-8.

¹⁰⁸ Ibid. Desmond. *Newborn Medicine and Society*. 168.

placed the family at the center of a meaningful American life and as a bulwark against communism.

Nuanced value: Premature infants, the American family, and medical advances

The focus on the ways progress in technology and medicine could impact survival for newborns who needed particular care reflected the social value of children as the center of the nuclear family during the post-war years. According to medical historian Paul Starr, the eradication of polio, more than any other disease, poignantly highlights the post war acceptance of the scientific method and the willingness of the public to participate in scientific and medical trials. Such confidence in medical trials also boosted the faith in American medicine. Between 1955 and 1960 congressional support increased funding for the medical and research institution, the National Institute of Health (NIH), from \$81 million to over \$400 million.¹⁰⁹ With immense funding, researchers developed a vaccine to combat polio, a potentially fatal disease for children, and drastically decreased morbidity and mortality rates related to the disease.

Americans had faith that research, technology, and better medicine could eradicate any number of diseases and medical conditions. In the midst of these leaps of faith, premature infants and their medical and nursing care appeared in popular

¹⁰⁹ Paul Starr. *The Social Transformation of American Medicine* (New York, NY: Basic Books, Inc., Publishers, 1982). 348-54.

magazines aimed at parents and families.¹¹⁰ For example, in 1955 *Parents Magazine* published a spread complete with photographs of a Premature Infant Unit in Chicago. The article and photographs described the care physicians and nurses gave, showed the unit, and boasted of the vast array of shiny new equipment used in the unit. With photographs of parents and their small infants lining the magazine's pages,¹¹¹ the hope of the miraculous stories of survival that occurred in the premature infant units was reinforced by the importance of the work done there to support the value of the family. Parents both read about the new techniques and saw photographs of the nurses working with small infants and the complex technological equipment used on the unit. This kind of article would have contributed to the optimistic hopes in medicine and technology that permeated the post war era in general.

Historian Marian Irvin Holt stated that as the nation headed into the Cold War years, the need for psychologically healthy children and teenagers was vital to what Truman called the, "struggle between freedom and communist slavery."¹¹² This was reflected in expansion of dialogue beyond just the survival of premature infants, but their

¹¹⁰ For examples, see: Jean Komaiko. "When a Baby Comes Early," *Parents Magazine*, 1955; "Premature and Past Due," *TIME*, April 20, 1959, <http://www.time.com/time/magazine/article/0,9171,864610,00.html>.

¹¹¹ It is important to note that premature infant units generally did not admit parents into the unit and this was either a unique practice or a public relations (PR) move that put the tiny patients and their families at the philosophical center premature infant care.

¹¹² Ibid. Holt. *Cold War Kids*. Ch 1, loc 494.

ability to function as intact members of society. For example, the ‘blindness epidemics’ of the 1950s commonly appeared in the popular magazine *Time*.¹¹³

Throughout the 1950s, premature infants maintained a solid footing in American medicine. In 1959, premature infant nurse pioneer Evelyn Lundeen referred to changes in premature infant care due to ‘increased interest’ in the premature infant.¹¹⁴ She noted the many articles published in scholarly medical and nursing journals by physicians and nurses relating to the care of premature infants and addressing medical conditions, research studies specifically related to premature infant physiology and medicine, and nursing care. Lundeen reflected that premature infants garnered increased attention, and with that attention came a narrowed focus on how to define the premature infant, standardize models of care, and the creation of spaces where that care could be given.

Conclusion

The consideration of newborns as a unique patient population, that began during the Progressive Era and progressed in nuanced ways through the post-war years, influenced a social context that valued newborns and sought to apply the particular models of care developed for premature infants as sub population of sick newborns to a broader newborn population. By the turn of the century, newborns emerged as a patient

¹¹³ “Battle in the Dark,” *TIME*, April 14, 1952. <http://www.time.com/time/magazine/article/0,9171,857154,00.html>; “Integrating the Blind.” *TIME*, December 10, 1956. <http://www.time.com/time/magazine/article/0,9171,808765,00.html>; “Too Little & Too Much,” *TIME*, September 28, 1953. <http://www.time.com/time/magazine/article/0,9171,818903,00.html>.

¹¹⁴ Evelyn Lundeen. “Newer Trends in the Care of Premature Infants,” *Nursing World* 133 (1959): 9–11.

population separate from children in ways that required particular intervention to decrease mortality rates. Though the Progressive reformers addressed some of the most common causes of infant mortality, prematurity did not receive the same attention infantile diarrhea and disease garnered. By the 1920s, premature infants received particular attention separate from sick newborns in general as infants for whom further child-saving efforts might be beneficial. Having made significant impact on decreasing mortality rates due to infantile diarrhea and disease related to poor hygiene, the medical community shifted their attention to the high mortality rates related to prematurity believing overall infant mortality rates could be further decreased. The first step in determining the scope of the problem of prematurity was defining the disease and the recognition that experts needed to have a constant definition (and thus way to report) prematurity. While infants in the neonatal period became the first subpopulation of children to gain recognition, premature infants then arose as a group of newborns that needed unique focus and resources to further decrease mortality. Through the 1940s and 1950s, premature infants became the largest subpopulation of newborns for whom unique advances in technology and medical and nursing models of care were created.

While the story of neonatal intensive care is not limited to premature infants, historians must understand the recognition of premature infants as a patient population and the care they received to inform how we understand the formation for intensive care for newborns differed from the development of their adult counterparts. As premature infants garnered attention as a unique population, the search began to determine how to best care for them and for their particular needs. In conjunction with the recognized need

to focus on premature infants, premature infant units arose in hospitals as spaces where these infants could receive highly specialized care. As physicians and nurses grouped premature infants together in hospital units beginning in the 1920s, nurses delivered much of the care these infants needed and models of care specifically for premature infants emerged. By the mid-1950s, hospital administrators realized that the nursing care applied to premature infants could be applied to newborns in general. These realizations provided the impetus for a decrease in premature infant units and the establishment of neonatal intensive care units beginning in the early 1960s. Other technological, financial, and medical factors contributed to this shift as well. In the next chapter, I will outline the roles nurses played in premature infant units as they formed during the first half of the 20th century. I will then analyze the roles nurses played in early neonatal intensive care units and consider the ways models of care established in premature infant units influenced the types of care given to newborns more broadly speaking in ICUs.

Chapter 3:

”The nurse still holds an important position”:
Nursing and the development of neonatal intensive care units

**”The nurse still holds an important position”:
Nursing and the development of neonatal intensive care units**

As of 1967, she would be known as a *flying nun* when she became involved in helicopter transport of premature infants, but just a few years earlier she had come by ambulance accompanied only by the ambulance driver. Carrying her portable incubator and a small bag of supplies, nurse Shannon Perry, then Sister M. Andre, walked into a small hospital to pick up the premature infant waiting for her and transport him back to the premature infant center at St Francis Hospital in Peoria, Illinois. Her uniform, a long white dress and jacket with a veil, distinguished her as a Franciscan Sister. A doctor stood waiting for her, protectively guarding a small baby in an incubator. She remembered observing his stance knowing he had been standing guard so no one would touch the prematurely born infant until she got there. Only then and to only nurse Perry would he relinquish the tiny baby.¹¹⁵ After assessing that the baby was stable for transport, Perry then transferred the newborn into her transport incubator for the ride home. Once back at the premature infant unit, a cadre of nurses would take over care and constantly assess and care for the patient.¹¹⁶

The doctor relinquished care only to Perry. He trusted her even though she arrived alone without any physician to oversee her. She assessed the patient, knew how to care for this premature infant, and independently provided care all the way back to her unit.

¹¹⁵ Shannon Perry, Oral History interview by Briana Ralston, December 12, 2012.

¹¹⁶ Transport of premature infants among hospitals and from home births to hospital settings was a common practice between 1920 and the 1960s as it related to premature infant units. Infant transport would later become an important part of sick newborn care known as regionalization associated with NICUs, but prior to the NICUs of the 1960s, many premature infant units either transported or received transported infants into their care. For more see chapters 4 and 5.

Such ingenuity and autonomy were hallmarks of the nurse who worked in the premature infant unit. These skills and qualities would later be found in NICU nurses who built on the models of care established by Perry and other premature infant nurses.

In this chapter, I argue that NICU nurses functioned with expertise, made tools work for their small patients, and integrated constantly changing equipment in their units to provide intensive care to a broad range of sick newborns. Such care coincided with the development of intensive care for adults, but also built on the work of nurses who worked in premature infant units. Nurses like Shannon Perry created and worked within the systems of premature infant care that laid the foundation for the establishment and development of NICUs and the care delivered there. I will outline the themes pertinent to the roles nurses played in premature infant units and then analyze how they laid foundations for the way nurses influenced the formation and models of care in NICUs of the 1960s and 1970s.

Premature Infant Units: Standards of care

The changing social landscape of the first half of the 20th century resulted in shifts in in how newborns were considered a particular patient population who required unique resources and space to receive medical and nursing care. While specialists sought to define prematurity and understand more accurately the scope of the problem, hospitals opened premature infant units to care specifically for the premature infants they received. Nurses influenced the establishment of spaces where they delivered care as well as the models of care given sick newborns. Both premature infant unit nurses and NICU nurses

provided round-the-clock care, worked with patients grouped by severity of illness or need for additional care, practiced with great skill, and learned from and collaborated with physicians to deliver the best care possible. As equipment and medical knowledge changed, these nurses kept pace by incorporating new knowledge and skills into their practice and participating in research to expand that knowledge. They participated in important ways that made the intensive care model work as members of a new cadre of intensive care nurses forming in hospitals beginning in the 1950s.

Adult intensive care units opened in the 1950s as nurses grouped their sickest together and worked closely with physicians and each other to provide care for increasingly medically complex patients.¹¹⁷ According to nursing historians Julie Fairman and Joan Lynaugh, adult intensive care units (ICU's), though built on similar principles as recovery rooms, "emerged as distinctly organized, innovative patient care area[s]."¹¹⁸ Adult ICUs were often make-shift spaces that developed organically in hospitals where patients received care regardless of gender, class or race. The adult units did not initially boast significantly new or complex technology, but Fairman and Lynaugh argue they did have technology. They used the same tools and equipment found on the general units and functioned on the concept of intensive monitoring of vital signs, intake and output, the patient's level of consciousness and "the nurse's sense of hearing, sight, touch, smell, and sometimes her intuition."¹¹⁹ Nurses working in new adult ICUs

¹¹⁷ Julie Fairman and Joan Lynaugh. *Critical Care Nursing: A History* (Philadelphia, PA: University of Pennsylvania Press, 1998).

¹¹⁸ Ibid. Fairman and Lynaugh. *Critical Care Nursing*. 13.

¹¹⁹ Ibid. Fairman and Lynaugh. *Critical Care Nursing*. 16.

learned skills related to intensive patient monitoring, developed intensive relationships with physicians while each taught the other important skills, and learned how to group and care for sick patients requiring round-the-clock care from specially trained nursing personnel.

While the newborn population followed the adults in their occupation of formally labeled ‘intensive care units,’ the models of care delivered by nurses to NICU babies also developed out of premature infant units that predated the NICUs by almost 40 years. Nurses in the early premature infant units established care models and units that resembled what Fairman and Lynaugh would later define as intensive care. To best understand the context that provided the foundation for NICU care in the 1960s, historians must first understand the role nurses played in the premature infant units as early as the 1920s.

Nursing the premature infant: The role nurses played in premature infant units

Premature infant units, often sequestered from other patient areas to minimize cross infection, provided places where nurses practiced with authority and expertise. While many larger hospitals did allocate space for separate premature infant units, other hospitals set aside space in their newborn nurseries where they cared for the sickest patients, a practice that reflected the ways Fairman and Lynaugh nurses organized patients in adult wards while delivering early ICU care.¹²⁰ Without the presence of parents or physicians, the nurses provided the care for infants and inhabited the units

¹²⁰ Ibid. Fairman and Lynaugh. *Critical Care Nursing*.

making decisions regarding patient management. Dr. William Silverman, a pediatrician who specialized in neonatology during the 1950s, remembered the “skilled, highly opinionated nurses [that] dominated the scene in hospital [premature] nurseries... the specialized nurses [made] detailed minute-by-minute decisions concerning clinical management.”¹²¹ These nurses gave care in these units, utilized the incubators, scales, feeding apparatus, and crude respiratory support. They made executive decisions; the units themselves were places where nurses claimed the authority to make decisions in a medical environment where physicians “played a minor role.”¹²² Such descriptions of the units draw attention to the nurses as unique in a world where the gendered hierarchy and physician-nurse relationships traditionally placed the nurse as the one who carried out orders and had little diagnostic and treatment autonomy.

Even as hospitals changed, the nurses continued to hold an important position in patient care and the development and implementation of models of care for acutely ill patients in the premature infant units. The care nurses gave in premature infant units encompassed a wide variety of skills and knowledge as evidenced by textbooks, journal articles, and publications of the time.¹²³ These nurses worked in a world where hospitals

¹²¹ William Silverman. *Retrolental Fibroplasia: A Modern Parable* (New York: Grune & Stratton, 1980). 45.

¹²² Ibid. Silverman. *Retrolental Fibroplasia*. 45.

¹²³ Alan Brown. “The Care and Feeding of the Premature Infant,” *Archives of Pediatrics* 34 (1917): 609–17.; Julius Hess. *Premature and Congenitally Diseased Infants*, (Philadelphia: Lea & Febiger, 1922).; Lyla Olson. *Improvised Equipment in the Home Care of the Sick* (Philadelphia, PA: W.B. Saunders Company, 1931).; Christie Brown and Barton Gilbert, *Midwifery: Principles and Practice for Pupil Midwives, Teacher Midwives, and Obstetric Dressers* (London: Edward Arnold & Co, 1942).; Ethel Dunham. *Standards and Recommendations for Hospital Care of Newborn Infants, Full-Term and Premature*, United States Dept. of labor, Children’s Bureau, 1943.

had grown and were expanding, sicker patients stayed in the hospital for longer amounts of time, and new technologies and equipment were constantly introduced. Premature infant nurse Evelyn Lundeen argued, “The nurse, however, still holds an important position, as she [was] relied upon to establish and maintain aseptic technique in order to prevent infections... observe carefully, assist in research projects, and help simplify all technics and procedures so that handling of the infant be kept at a minimum.”¹²⁴ These nurses needed to know how to care for basic newborn needs, the intricacies of charting and communicating with physicians regarding changes in patient condition, and some participated in research and knowledge development that reflected their commitment to growing knowledge base in good nursing care of the premature infant.

Basic Newborn needs

Nurses’ knowledge related to the care of premature infants required the nurse to understand thermoregulation (maintaining an adequate body temperature), infection control, and nutrition. Once the premature infant is born, one of its first needs is maintenance of body temperature.¹²⁵ By the 1920s, incubators became a standard way to assist a small infant to maintain his body temperature. Incubators came in different models and types, but the primary premise involved monitoring the patient’s body temperature and making adjustments to the temperature of his immediate environment within the incubator to aid the infant in keeping his body temperature warm enough.

¹²⁴ Evelyn Lundeen. “Newer Trends in the Care of Premature Infants,” *Nursing World* 133 (1959): 9–11.

¹²⁵ Body temperature goals depended on the fragility of the patient’s condition. Generally infants were kept at very warm temperatures with body temperatures reading at or around 98 degrees Fahrenheit.

Nurses were expected to know how to take temperatures, provide bathing and weigh the babies while not allowing their body temperatures to fall too low, and to understand the basic mechanisms used to keep the infant warm.¹²⁶ Many hospitals used special incubators for infants; by the 1930s, a variety of incubators were on the market including (but not limited to) Hess beds, Chapple incubators, and the Isolette incubator was also developed in the 1930s.¹²⁷ While some hospitals used individual incubators for babies, others built what were called, ‘cabinet cubicles’ consisting of a completely enclosed cubicle containing an individual air supply for the infant inside that could be heated and humidified as desired.¹²⁸ Such rooms combined maintenance of thermoregulation with the need for infection control.¹²⁹ Nurses needed to know how this equipment worked, how to use it effectively, and how to assess the patient to know if the incubators were indeed keeping the patient warm enough.

While full term newborns are susceptible to infection, their preterm counterparts have an even greater risk for severe infection due to underdeveloped organ and immune systems. Infection control remained an important aspect of appropriate premature infant

¹²⁶ Robert McCombs. *Diseases of Children for Nurses* (Philadelphia, PA: W.B. Saunders Company, 1929).; Julius Hess and Evelyn Lundeen. *The Premature Infant: Its Medical and Nursing Care* (Philadelphia: J.B. Lippincott Company, 1941).; Evelyn Lundeen and Ralph Kunstadter. *Care of the Premature Infant* (Philadelphia: J.B. Lippincott Company, 1958).

¹²⁷ Julius Hess. “Oxygen Unit for Premature and Very Young Infants,” *American Journal of Diseases of Children* 47, no. 4 (1934): 916–17.; Charles Chapple. “A Cabinet Cubicle for Infants, Combining Isolation with Control of Temperature and Humidity,” *Journal of Pediatrics* 16, no. 2 (February 1940): 215–19.; ———. “Controlling the External Environment of Premature Infants in an Incubator,” *American Journal of Diseases of Children* 30 (1938): 459–60.

¹²⁸ *Ibid.* Chapple. *A Cabinet Cubicle for Infants*, 215–19.

¹²⁹ For a more thorough analysis of the development of adequate thermoregulation throughout the 20th century, see S. B. Korones. “An Encapsulated History of Thermoregulation in the Neonate,” *NeoReviews* 5 (March 1, 2004): 78e–85. doi:10.1542/neo.5-3-e78.

care. In their 1941 textbook on premature infant care, Hess and Lundeen listed “special training with a thorough understanding of aseptic nursing,” as their first requirement for successful nursing in any premature infant nursery.¹³⁰ Many premature infant units included areas at the front where healthcare personnel and visitors were required perform extensive hand washing before entering the unit.¹³¹

Feeding and general care also fell under the responsibilities of the nurse. While some premature infants could receive milk – breast milk or early types of formulas – from a bottle or the breast, others did not have the energy or stamina to feed that way. Apparatus such as special feeding spoons and tubing that would be inserted into the baby’s stomach directly were involved in feeding in premature infant units. Nurses used the feeding apparatus when necessary, recorded the type and amounts of food administered, and how well the patient tolerated the feeds.

Charting and communication

Nurse’s charting for premature infants included documentation of vital signs – temperature, heart rate, and respiratory rate – as well as intake and output. Not only did the nurses need to record the temperature of their patients but the temperature inside the incubator as well. Stool amounts, consistency, color and any other abnormal findings

¹³⁰ Ibid. Hess and Lundeen. *The Premature Infant*. 48.

¹³¹ For examples of this, see: Ethel Dunham. *Standards and Recommendations for Hospital Care of Newborn Infants, Full-Term and Premature*, United States Dept. of labor, Children’s bureau, 1943.; -----. *Premature Infants: A Manual for Physicians* (New York, N.Y.: Hoeber-Harper, 1955). 432-444.; Ibid. Lundeen and Kunstadter. *Care of the Premature Infant*.

related to stool or urine output were also meticulously documented, every milliliter accounted for.

Nurses also participated in research and the development of charting records at some hospitals as ways of collecting data on their patients. Nurse Rita Petruska who worked as nursing supervisor in the premature infant nursery at Mount Sinai Hospital in New York City, developed her own nursing form with all the essential information needed for her nurses to chart patient data and assessment. She later published the form in *The American Journal of Nursing* in 1963 with elaborate particulars as to the definition of each section and how the form should be filled out. Such initiation of the development of tools, and thus technology, for patient care shows ingenuity and autonomy many nurses experienced in premature infant units. Historian of technology, Joel Howell, argued that the development of forms of data reflected who cared for the patient as well as changes in organization of hospitals and medical education. Such tools for recording patient assessment, medication administration, as well as other details related to the patient's stay allowed for consistent data collection and served as an important piece of technology.¹³²

Nurses began to publish articles themselves outlining newborn physiology and issues related to more in depth knowledge of the newborn infant – premature and full

¹³² Joel Howell. *Technology in the Hospital: Transforming Patient Care in the Early Twentieth Century* (The Johns Hopkins University Press, 1996). 5, 43-45. ; See quote: "Some of the technology that was new to people in 1925 seems by the 1990s to have disappeared. But not all of it has gone away. Rather, much of the technology has simply blended into the background of the usual. It has been observed that 'the most profound technologies are those that disappear': 'They weave themselves into the fabric of everyday life until they are indistinguishable from it.'" (5)

term.¹³³ Nurses at Colorado General Hospital's Premature Infant Center decided that their ability to assess the patient and notice when something 'wasn't quite right' needed to be better articulated. They shifted from reporting 'a poor night' to reporting more detailed observations to articulate what they previously considered their impressions.¹³⁴

The nurse's ability to observe small changes that can indicate a pending significant change in condition is one of the hallmarks of premature infant nursing. The nurses and physicians realized that this type of assessment reporting and communication contributed greatly to the overall care, earlier diagnosis, and better treatment when the patient's condition changed. "When the nurses in the Colorado General Hospital nursery realized how important articulating their observations were to improving patient care and how much responsibility was theirs, they became eager to define these vague impressions."¹³⁵ While nurses elsewhere in hospitals reported these kinds of in depth patient findings, nurses of premature infants learned to communicate the incredibly nuanced changes in patient condition to physicians that textbooks and articles generally did not address related to particular assessment communication. The nurses learned to articulate what had become second nature in their expertise, what might have been

¹³³ Ethel Dunham and Jesse Bierman. "The Care of the Premature Infant," *JAMA* 115 (1940): 658–62.; Priscilla Parke. "Naso-Gastric Tube Feeding for Premature Infants," *The American Journal of Nursing* 51, no. 8 (August 1951): 517.; Robert Jackson. "Feeding Healthy Infants," *The American Journal of Nursing* 55, no. 9 (1955): 1076–79.; Esther Weidman Ott and Lula Lubchenco. "The Premature Infant's Reaction to Illness," *The American Journal of Nursing* 57, no. 11 (1957): 1431–33.

¹³⁴ Ibid. Weidman Ott and Lubchenco. *The Premature Infant's Reaction to Illness*. 1431–33.

¹³⁵ Ibid. Weidman Ott and Lubchenco. *The Premature Infant's Reaction to Illness*. 1431.

otherwise referred to as intuition, and functioned with physicians and other healthcare providers to use their observational skill to improve diagnosis and treatment.

Nurses became recognized by physicians in the literature as the gatekeepers to their patients as individuals who monitored all aspects of thermoregulation, fed the infants multiple times during the day and night, and played key roles in infection control. These memories echo similar reflections of physicians and nurses who worked together in premature infant units. Such statements coincide with a statement made by physician Kenneth Winters to his pediatric residents, “When a premature nursery nurse says a baby doesn’t look right, cry right, eat right, or act right, don’t ignore her...Check that baby thoroughly because you will usually find something wrong.”¹³⁶ Another nurse who worked in a premature infant unit remembered a bedside encounter where she reported an inguinal hernia to the acting resident. Upon arriving at the bedside the resident could not find the hernia. When the attending physician arrived, he turned to his resident and stated, “...you listen to [the nurse], she knows what she is doing.”¹³⁷

One premature infant textbook specifically for physicians specified the importance of the presence of an experienced nurse to,

...be in constant attendance to assist the physician, to carry out certain treatments, and to observe the infant for any abnormal symptoms...The nurse should be given instructions in regard to her procedure in case the infant has any of these symptoms. A complete understanding between physician and nurse as to procedures in case of emergency is essential. Optimal environmental temperature and humidity should be maintained.¹³⁸

¹³⁶ Helen Callon. “The Premature Infant’s Nurse,” *AJN* 63, no. 2 (February 1963): 103–5.

¹³⁷ Ibid. Perry, *Oral History interview*. 7.

¹³⁸ Ethel Dunham. *Premature Infants: A Manual for Physicians* (New York, N.Y.: Hoeber-Harper, 1955). 104-105.

Such instruction to physicians highlights the prominence of a nurse's constant presence at the bedside, the importance of good communication between the nurse and physician, and an expectation that the nurse would be able to react to administer emergency care in the immediate absence of the physician.

According to typical routines published in a textbook authored by physician Julius Hess and nurse Evelyn Lundeen, nurses in these units did everything from bathe the babies to hang feedings to clean the units. They maintained linens and administered some medications. They were expected to document specific newborn patient care and constant patient assessment and condition in addition to performing bedside tasks, unit maintenance, medication administration, and training of other nursing personnel when required.¹³⁹ During a time when nurses often nursed all over the hospital with generalized knowledge, this recognition of the nurse who could assess the patient and provide specialized emergency care meant that these nurses had particular skills. The physician's role included working closely and communicating thoroughly with the premature infant's nurse.

Nursing, research and knowledge development

Some nurses collected and recorded in the patients' charts data necessary for the investigative projects and research, and worked closely with physicians and researchers

¹³⁹ Ibid. Hess and Lundeen. *The Premature Infant*. 48-51.

to ensure any research procedures and equipment did not interfere with good care.¹⁴⁰

While not common, one nurse developed a research protocol herself. For example, nurse consultant with the National Department of Health, Education and Welfare Eileen Hasselmeyer, published a research study in 1961 carried out between 1958 and 1960, outlining a nurse run research project to study the relationship of nursing practice to general improvement of infants in premature infant units.¹⁴¹ The goal of the study was to standardize certain aspects of nursing care including patient clothing, temperature assessment, techniques of gavage feeding, and skin care. The protocol included forms for gathering data, complete screening tools, and charting instructions. The study resulted in a general observation that the standards of nursing care in twelve premature infant nurseries varied incredibly. While the actual results were important, the study was the groundbreaking in that sought the scientific evidence behind what had long been considered ‘excellent nursing care.’¹⁴²

According to Hasselmeyer, her discussions with nurses in these units revealed a desire to know more about specific aspects of good nursing care of the premature infant

¹⁴⁰ Marvin Cornblath, Evelyn Lundeen, Mary Morrison, and Lester Wishingrad. “Research and Nursing Care in the Premature Nursery,” *AJN* 62, no. 7 (July 1962): 92–96.

¹⁴¹ Established premature infant physician Emmett Holt commented of Hasselmeyer’s study: “Segregated as [the premature infant] is in an antiseptic environment, often in an incubator, he has been relatively inaccessible for study. Even the doctor approaches him as infrequently as possible. His closest companion and in consequence his most interested observer is the nurse, who, however, is seldom equipped by training to make scientific observations. A notable exception is [Hasselmeyer]...skilled in the art of nursing and a meticulous observer, she...has set up a study...so carefully thought out and executed as to be a model.” Eileen Hasselmeyer. *Behavior Patterns of Premature Infants*. Washington D.C.: US Department of Health, Education, and Welfare, 1961.

¹⁴² Eileen Hasselmeyer. *Behavior Patterns of Premature Infants*. Washington D.C.: US Department of Health, Education, and Welfare, 1961.
<https://babel.hathitrust.org/shcgi/pt?id=mdp.39015086810465;view=1up;seq=3>.

so that better care could be given. Hasselmeyer hoped this study would render solid data, but also that it would encourage other nurses, physicians, hospital administrators, and researchers to produce their own studies to answer the plethora of questions yet to be addressed regarding better standards of premature infant care.¹⁴³ These nurses knew how to care for the basic newborn needs as well as unique needs of medically fragile premature infants. These nurses gave constant care through patient assessment and sought to communicate changes in patient condition with physicians. Many of these nurses wanted more knowledge to provide better care and they actively contributed to shaping what that knowledge looked like as they developed research questions, participated in research, and contributed to the introduction of new protocols and treatments as premature infant units continued to be unique spaces in hospitals well into the late 1950s.

No delineated break exists when all premature infant units closed and NICUs became the standard of care for sick newborns, but hospitals stopped opening premature infant units in the early 1960s and established “intensive care units” for newborns. Throughout the 1960s premature units remained in some hospitals while hospitals with financial and spatial resources opened intensive care unit for neonates. For a period of time both existed in separate forms, but by the 1970s most premature infant units had closed and NICUs became the standard in hospitals across the country that could afford to give specialized care to newborn populations. Great advances were made in the ability to combine newborns requiring additional care in the same space without experiencing

¹⁴³ [Memo from Eileen Hasselmeyer to Ethel Dunham, March 7, 1958] Dunham, Ethel C. Papers, 1952-1965. [H MS c158, Box 3: 38]. Harvard Medical Library in the Francis A Countway Library of Medicine, Center for the History of Medicine.

the drastic spread of disease among all patients.¹⁴⁴ Nurses who worked in premature infant units understood particular tenets of sick newborn care that laid foundations for the ways NICU nurses cared for sick newborns. NICU nurses still needed to know the particulars of thermoregulation, infection control, and nutrition, but they also broadened their knowledge base as they needed to know how to care for full term medically fragile infants, and post-operative neonates, as well as the new methods of diagnosis and treatment unique to newborns.

“We were the eyes and ears...”: Nursing in early NICUs

Nurses in neonatal intensive care units addressed the familiar issues of thermoregulation, perinatal infection, and nutrition as they also incorporated equipment related to electronic monitoring and respiratory support into their day-to-day care. With the ability to surgically address congenital malformations, surgeons found there was no place their tiny patients could receive the kind of care they needed from nurses who knew their particular needs and medical conditions. NICUs opened not as ‘new’ places to care for premature infants, but units where all newborns who needed a particular kind of care could receive it. Prior to the 1960s, uninfected sick infants received treatment and care in premature infant nurseries while infants with suspected infections were treated in separate rooms if available. Post-operative neonates were sent to regular post-operative floors where children and adults received care in beds right next to them.¹⁴⁵ NICUs

¹⁴⁴ Ibid. Korones. *High-Risk Newborn Infants*.

¹⁴⁵ Ibid. Korones. *High-Risk Newborn Infants*. 243-4.

became places where newborns could be grouped together based on age and unique medical needs rather than diagnosis. The importance of such grouping is that it allowed for them to receive nursing care from specialized and trained nurses who knew the issues these newborns faced. Nurses who worked in these units had incredible skills and provided care in increasingly complex settings with constantly changing technologies and medical practices. When interviewed, these nurses remembered particular aspects of what these units looked like, what caring meant in these units, and how they interacted with parents and physicians.

NICU nurses participated in drastically changing environments as hospitals established these units and pushed the bounds to deliver care to increasingly sick and complex populations of sick newborns. Nurses worked closely with families who often were excluded from these environments in the early years of NICU care, they collaborated with physicians, and participated in respiratory treatments for newborns.

“We didn’t know what we know today.”: Nursing and the importance of families

Though families were not often allowed in the early units, or their time there was restricted, nurses worked hard to consider the parents and include them when possible. The focus on the ways progress in technology and medicine could impact survival for newborns who needed particular care reflected the social value of children as the center of the nuclear family during the post-war years. Within the post-war conceptualization of the nuclear family, the value of children and newborns supported a medical focus on

ways to lower infant mortality and save sick newborns including premature infants.¹⁴⁶ As hospitals expanded and more critically ill patients survived in hospitals that evidenced the post war technology boom, newborns and children also benefitted from the intersection of social values and medical technology. Families valued the progression in technology that changed treatment and improved survival rates for critically ill newborns and children.

By the early 1960s scholarly literature reflected the importance of contextualizing the newborn within his family. The *American Journal of Nursing* published articles in the 1960s and 1970s educating nurses who cared for and worked with families of sick newborns.¹⁴⁷ Two such articles published the early 1960s took a close look particularly at the effects of separation on the family and their newborn during the infant's hospital stay as well as the nurse's role in supporting parents throughout the process. While units took individual approaches with their policies, these articles and textbooks¹⁴⁸ concentrated on educating nurses who worked with newborns to include the families and provide empathetic care that fostered relationships between the parents and newborns despite periods of separation.

¹⁴⁶ Steven Mintz. *Huck's Raft: A History of American Childhood* (Cambridge, MA: The Belknap Press of Harvard University Press, 2004).

¹⁴⁷ Helen Callon. "The Premature Infant's Nurse," *AJN* 63, no. 2 (February 1963): 103–5.; C. Owens. "Parents' Response to Premature Birth," *The American Journal of Nursing* 60, no. 8 (1960): 1113–18.; C. Miller. "Working with Parents of High-Risk Infants," *The American Journal of Nursing* 78, no. 7 (1978): 1228–30.

¹⁴⁸ For example see: Jean Lancaster. "Impact of intensive care on the maternal-infant relationship," *High-Risk Newborn Infants: The Basis for Intensive Nursing Care*. Ed. Sheldon Korones (Saint Louis, MO: The C.V. Mosby Company, 1976). 236-243.

While the articles focused on educating and encouraging nursing staff to empathetically care for newborns and their families, they also addressed tensions that existed. Nurses functioned as caregivers often in the absence of parents. One article encouraging nurses to understand the effects of separation told the story of one nurse's reaction after her patient's mother called to say she could not take her baby home, "Walking over to Kay's crib, the nurse affectionately looked down at the infant... 'If your mother had worked as hard as I did to keep you alive, she would rush right over here to get you.'"¹⁴⁹ Such sentiments would have contributed to complex attitudes regarding who had the authority to make decisions regarding patient care. While any infant belongs to his family, nurses who cared for these infants might have experienced attachments and tensions when relating to families requiring the types of education made explicit in some articles during the time.

For NICU nurses, the involvement of the parents was an important aspect of their approach to care. The nurses who worked in these units all remembered different aspects of working with families, but they all remembered working with them whether the parents were present in the unit or communicated with the nurses over the phone. Nurses reflected the importance of the family in how they spoke of their practice. One nurse remembered how much she enjoyed educating the parents about their newborns. Nurse Laura Mendell remembered the lack of resources for families back then. In her discussions and involvement with families, Ms. Mendell assessed that these parents had few resources outside the hospital for learning how to care for their infants and preparing

¹⁴⁹ Ibid. Callon. *The Premature Infant's Nurse*. 103–5.

to take them home. She remembered doing a great deal of teaching with the families and working hard to fill in knowledge gaps for parents whether they came in for the day classes or could only come at night. She spoke with intensity regarding the importance of educating and including families as a critical aspect to the nursing care she gave.

The nurses learned to work with families who experienced separation from their newborns during the early weeks of life, a period known to be incredibly important in childhood development today. One nurse remembered, “We always worried about parents who were disconnecting. That was just an informal thing we did.”¹⁵⁰ While no formal system was in place, the nurses noticed and monitored familial involvement even though there may not have been any formal monitoring policy. Nurses interviewed expressed feelings of empathy for parents who were not present to watch the progress their babies made. Some nurses talked about wanting the parents to bond with their newborns, and did what they could to encourage bonding despite the separation, the stress of having a baby in the NICU, and struggles with the sometimes constantly changing medical conditions of the patients. The nurses occasionally experienced situations where they would not hear from parents for days at a time.¹⁵¹ In these cases, if the hospital had adequate social work department, the nursing staff contacted social work to get involved to provide support for families facing a range of challenges ranging from financial to emotional and sometimes physical.

¹⁵⁰ Jane Barnsteiner. Oral History interview by Briana Ralston, January 9, 2014.

¹⁵¹ Ibid. Barnsteiner. *Oral History interview.*; Laura Mendel. Oral History interview by Briana Ralston, January 9, 2014.; Roxanne Geidel Oellrich. Oral History interview by Briana Ralston August 11, 2014.

By the 1970s, textbooks included chapters on caring for families and evidenced a focus on involvement with parents and a working to include them.¹⁵² While the concept of family grew and changed by the 1970s, the necessity to focus on the newborn as part of a family unit became more nuanced. In May 1974, an interdisciplinary group of specialists met to discuss the current ethical issues in neonatal medicine and care. While discussion focused on the decision making processes related to congenital malformations and the resuscitation of extremely preterm infants, discourse came back to the ultimate question of *who* had the authority to make those decisions and clarity about how to navigate tensions when that authority was exercised.¹⁵³ Nurses faced these tensions and had to navigate their role within occasional ambiguity as to who had the authority to make decisions about the babies.

The unique emphasis placed on the consideration of separation of patient from family emerged as an important part of nursing care for the NICU nurses, an aspect not considered with the same intensity in adult populations. Nurses consistently valued the importance of the effects of separation that resulted in a focus on including the families and seeking ways to ensure parents were able to bond with their children. They learned to communicate with non-medical terms and took into consideration their patients' medical state and how that affected the family unit during a time referred to by historian Elaine

¹⁵² C. Miller. "Working with Parents of High-Risk Infants," *The American Journal of Nursing* 78, no. 7 (1978): 1228–30.

¹⁵³ [Ethical Issues in Newborn Intensive Care: A conference report.] Clement Smith (MC 4) Boston Children's Hospital Archives, Boston, Massachusetts. Box 1, folder 40.

Tyler May as a time with a greater focus on the *nuclear family* as an important post-war concept. These nurses worked closely with the families and they also worked in close collaboration with other nurses and physicians when decisions needed to be made regarding patient treatment and day-to-day care.

Highly skilled professionals: Collaboration and trust in the NICU

During this time, there was no standard education tract for nurses who wanted to work in the NICU. While some units allowed nursing students to observe and participate in care in the late 1960s and early 1970s, not all nurses who worked in these units had received any particular training beyond care of the healthy newborn prior to their first day on the job.¹⁵⁴ Similar to the nurses in adult ICUs, many nurses in the new ICUs learned their skills from NICU nurses already experienced on the units as well as nurse managers.¹⁵⁵ By 1972, textbooks for the care of medically fragile newborn infants, such as *High Risk Newborn Infants: The basis for intensive nursing care*, authored by Sheldon Korones appeared for educational purposes.¹⁵⁶ Training programs such as the continuing education program at Michael Reese and in Denver did exist at this time and some nurses would have attended. Overall, the nurses who either chose the NICU or were assigned there needed to be able to learn quickly and creatively as they cared for the medically unstable patients. They needed to work well with other nurses and with physicians on the

¹⁵⁴ Ibid. Barnsteiner. *Oral History interview*, 1-2; Ibid. Oellrich. *Oral History interview*, Pt 2, 1-3.

¹⁵⁵ This reflects the training practices in many premature infant units. Though training programs existed particularly at Michael Reese, usually only nurse managers and head nurses were sent from the nursing staff. They would then return to the units and educate the nursing personnel.

¹⁵⁶ Ibid. Korones. *High-Risk Newborn Infants*; A second edition followed just four years later in 1976.

units who also taught particular skills pertaining to patient assessment, treatment, and equipment.

Collaboration among nurses, and between nurses and physicians played a crucial role in the day-to-day happenings on the units. Nurses remembered being highly valued members of the healthcare team. In interviews, they communicated, “The doctors always valued your opinion,”¹⁵⁷ and “They had to work with us as team members.”¹⁵⁸ One nurse, Roxanne Geidel Oellrich, who worked her way up to supervisor in her NICU in the 1970s, remembered what it was like to function as a “professional,” a term she associated with feelings of being valued by her fellow nurses and the physicians who worked on the unit. Ms. Oellrich remembered, “a lot of respect between the physicians and the nurses.”¹⁵⁹ She spoke of the incredible professionalism of the women she worked with. Her story contrasts the old traditional nursing caps and hierarchical interactions of her nursing school days to her experiences in the NICU where she and her nursing team were considered the eyes and ears of the unit. They knew the condition of their patients. The physicians recognized that, and both worked in intense collaboration.

One such physician, Dr. Don Null who worked in Texas at Wilford Hall, Lackland Air Force Base credited the nurses with intense responsibility and dedication during his NICU days in the 1960s and 1970s. To Dr. Null, the nurses always wanted to see new equipment work for the patient and ultimately they wanted the unit to thrive. He

¹⁵⁷ Laura Mendel. Oral History interview by Briana Ralston, January 9, 2014. 4.

¹⁵⁸ Ibid. Barnsteiner. *Oral History interview January 9, 2014*. 13.

¹⁵⁹ Ibid. Oellrich. *Oral History interview August 11, 2014*. Pt 2, p 13.

remembered, “that is why we were successful because they put their time into it and moved forward with it.” While the nurses would not have been the only factor that ensured the success of the NICU – the story is far more complex than that – the participation of the nurses and the relationships they had with physicians and other healthcare staff ensured an environment where risks could be taken and research and new methods of treatment and care attempted as these units grew and developed. Such relationships were both influential for the patients as well as empowering for the nursing staff. NICU nurses, like their premature infant unit predecessors, had expertise in patient care and the physicians trusted the nurses to perform assessments and to know when their patients’ conditions changed.

“So we would MacGyver¹⁶⁰ things”: Making the system work for their tiny patients

Nurses who worked in these units in the 1960s and 1970s remember the drastically changing equipment – monitors, IV set ups, respiratory technologies, and the ways these resources coupled with what was considered more traditional equipment such as the incubator and feeding tubes. For many, the new monitoring and respiratory equipment found in the neonatal intensive care units were what made the units new, different, and truly ICUs: “We truly became a NICU in that we had all the kids on

¹⁶⁰ The term “MacGyver” references a 1980s TV show starring Richard Dean Anderson as a character known only by his last name, MacGyver. He was a jack of all trades and was known not only for getting himself out of sticky situations using his knowledge of biology, physics and chemistry, but for doing it with everyday common tools such as rubber bands, tube socks, and his pocket knife. The nurse’s use of the term “to MacGyver something” reflects the ways she remembered fixing complex problems with her knowledge of the situation and the common tools she had on hand.

ventilators, oxygen, etcetera.”¹⁶¹ The equipment stood out to them as influential to both how they functioned in the space as well as how their care changed during their time in the units.

Neonatal nursing required ingenuity and a constant learning curve for these nurses. Many who worked in these units stepped into worlds where new equipment was constantly integrated into practice, methods of diagnosis and treatment constantly changed, and where they often lacked supplies appropriate in size for their patient population. The 1960s were a time of rapid infusion of new machines and technologies as well as incredible amounts of funding to expand and establish units. This meant these nurses needed to be able to learn quickly, integrate new policies and knowledge into their nursing practice fluidly, and make due with whatever equipment they had on hand. As new treatments became available for patients, much of the equipment to deliver the new interventions did not come in sizes small enough for newborns.

Nurses faced the challenges of trying to make equipment for children and adults work for much smaller bodies. As medical equipment and treatment modalities developed, companies did not initially produce the equipment in sizes and amounts small enough for two to ten pound patients. This meant nurses sometimes needed to devise ways to ensure tools, medications, and equipment made for adults worked for their tiny infants. One nurse remembered beginning peritoneal dialysis on a neonatal patient using adult supplies; she remembered having to measure out very small amounts of the dialysis fluid and concocting her own tray system: “I just remember winging it...chest tubes and

¹⁶¹ Ibid. Oellrich. *Oral History interview*. Pt 1, pg 2.

all that stuff wasn't really made for the size of the babies. So you would MacGyver things."¹⁶² Another nurse described how she and her colleagues used to make their own masks to deliver continuous positive airway pressure (CPAP)¹⁶³ for the infants since they did not come in sizes small enough. They took scalpels and sliced pediatric nasal cannulas down adding stopcocks and tubing where needed to piece together the equipment that would fit their patients. As the nurses constructed the facemasks, they literally made their own CPAP setups.¹⁶⁴ Such practices show how the nurses not only mastered thermoregulation and nutrition, more traditional care practices by that point, they tweaked and adapted new methods of treatment and the equipment to make those treatments work for patients for whom the companies did not traditionally manufacture the equipment. Another nurse remembered using red rubber urethral catheters for chest tubes on the small infants as chest tubes for neonates could not be ordered from any manufacturing company at the time. She attached the red rubber catheters to corrugated oxygen tubing that she connected to a bottle of water with a carefully measured volume of water needed to provide the appropriate water pressure for the system. The nurses did not have what they needed, so they improvised.

Nurses were not the only ones who recognized that some of the equipment needed to be altered for their patients. Throughout the 1960s, respiratory distress continued to be a leading cause of death in premature and sick newborns and the ventilators

¹⁶² Ibid. Mendel. *Oral History interview*. 7.

¹⁶³ CPAP is the administration of positive airway pressure to the patient in an attempt to aid in ventilation and thus respiration.

¹⁶⁴ Ibid. Oellrich. *Oral History interview*. Pt 1, pg 5.

manufactured for adults made no significant clinical differences when used with newborns. With the establishment of these new neonatal intensive care units, more aggressive treatment of newborn diseases and medical problems were used and nurses played integral roles in that process as research progressed and researchers and physicians sought better treatments for respiratory distress.

Keep them breathing: Mechanical Ventilation and Nursing Care.

Artificial ventilation for neonates was not a mid-20th century idea but took over a century to become the standard of practice. Alexander Graham Bell's 1889 invention, a body-enclosing ventilator for newborn infants provided negative pressure ventilatory support. He observed "many children, especially those prematurely born, die from inability to expand their lungs sufficiently when they take their first breath..."¹⁶⁵ The American Association for the Advancement of Science did not accept Bell's apparatus (for reasons unstated in the literature) and the equipment ended up at a museum in Baddeck, Nova Scotia.^{166, 167} Over the next century, physicians and researchers proposed many methods of artificial ventilation. Throughout the 1960s, physicians and researchers

¹⁶⁵ Leo Stern, Angeles Ramos, Eugene Outerbridge, and Pierre Beaudry. "Negative Pressure Artificial Respiration: Use in Treatment of Respiratory Failure of the Newborn," *The Canadian Medical Association Journal* 102, no. 6 (March 28, 1970): 595.

¹⁶⁶ Michael Obladen. "History of Surfactant up to 1980," *Biology of the Neonate* 87 (June 2005): 308–316.; Ibid. Stern, Ramos, Outerbridge, and Beaudry. *Negative Pressure Artificial Respiration*. 595–601.

¹⁶⁷ Negative pressure ventilation was not accepted as a standard of care. A nurse who worked at the Hospital for the University of Pennsylvania in the 1960s remembered an old infant negative pressure ventilator she described as a newborn iron lung that had been left along the back wall of the storage closet. Her manager told her that "it just never worked." While beyond the scope of this dissertation, the reasons negative pressure ventilation did not work would be an interesting future trajectory of research.

continued to organize meetings with greater frequency to attempt to pool knowledge and determine the issues at hand and the best steps to move forward. This led to the utilization of many different forms of treatment and a broad range of research done in this branch of medicine. While attempts to define and understand respiratory distress syndrome continued to be the focus of collaboration, attempts to treat the disease continued to be entrepreneurial and independent.

Clinicians tried many different means to curb the respiratory distress that plagued premature infants. Physicians published in scholarly medical journals regarding their work on inhaled aerosol mists,¹⁶⁸ the Bloxsum Air Lock that altered the atmospheric pressure within the incubator environment,¹⁶⁹ negative pressure ventilation,¹⁷⁰ and metabolic intravenous compensation to address the results of insufficient ventilation.¹⁷¹ Among these approaches, continuous positive airway pressure emerged as the standard of care by the mid 1970s.¹⁷² The developments required for positive pressure ventilation to

¹⁶⁸ Robert Denton and Charles Ross. "Mist-O-Gen Therapy and Postural Drainage for Respiratory Difficulties in the Newborn Infant," *Journal of Pediatrics* 42, no. 5 (May 1953): 551–557.; Joseph Miller, "A New Continuous Nebulizer (Alevizer) for Humidification and Alvaire Therapy," *Journal of Pediatrics* 42, no. 6 (June 1953): 721–725.

¹⁶⁹ Allen Bloxsum, "Newer Therapeutic Procedures Designed to Prevent Abnormal Pulmonary Ventilation in the Newborn Infant," *Journal of Pediatrics* 45, no. 4 (October 1954): 373–392.; Thomas Cone. *History of the Care and Feeding of the Premature Infant* (Boston, MA: Little, Brown and Company, 1985).; Ibid. Silverman. *Retrolental Fibroplasia*.

¹⁷⁰ Eugene Outerbridge, Dietrich Roloff, and Leo Stern. "Continuous Negative Pressure in the Management of Severe Respiratory Distress Syndrome," *The Journal of Pediatrics* 81, no. 2 (August 1972): 384–391.

¹⁷¹ George Brumley, "The Critically Ill Child: The Respiratory Distress Syndrome of the Newborn," *Pediatrics* 47, no. 4 (April 1971): 758–769.

¹⁷² Niloufer Kumarasamy, Rosmarie Nussli, Dieter Vischer, Peter Dangel, and Gabriel Duc. "Artificial Ventilation in Hyaline Membrane Disease: The Use of Positive End-expiratory Pressure and Continuous Positive Airway Pressure," *Pediatrics* 51, no. 4 (April 1973): 629–640.; Ibid.

emerge as standard included the invention and innovation of such parts as endotracheal tubes and facemasks.¹⁷³ These diverse attempts to treat the problem resulted in varying success, but they all arose in tandem with general attempts to improve the administration of positive pressure ventilation (PPV).

Respiratory Distress: Its definition and treatment.

We know today that respiratory distress syndrome (RDS) occurs when infants are born before their lungs have fully developed in utero. Though respiratory distress can be seen in full term infants, RDS predominantly occurs in infants born before 28 weeks gestation.¹⁷⁴ Normally developed lungs produce surfactant, a substance the lungs produce to that protects the air sacs from collapsing and help the lungs inflate with air, but infants who are born before the lungs begin to produce this substance suffer from difficulty breathing. Today, treatments such as the administration of artificial surfactant, the use of oxygen and ventilator support, and in severe cases extracorporeal membrane oxygenation

Silverman. *Retrolental Fibroplasia.*; Ibid. *Cone. History of the Care and Feeding of the Premature Infant.*

¹⁷³ Bruce Ackerman, Michael Stein, Scott Sommer and Marion Schumacher. "Continuous Positive Airway Pressure Applied by Means of a Tight-fitting Face-mask," *The Journal of Pediatrics* 85, no. 3 (September 1974): 408–411.; Dyanne Affonso and Thomas Harris. "Continuous Positive Airway Pressure," *American Journal of Nursing* 76, no. 4 (1976): 570–573.; Ibid. Cumarasamy, Nussli, Vischer, Dangel, and Duc. *Artificial Ventilation in Hyaline Membrane Disease.* 629–40.

¹⁷⁴ Lee, Kimberly. "Neonatal Respiratory Distress Syndrome." *MedlinePlus* (2013).
<http://www.nlm.nih.gov/medlineplus/ency/article/001563.htm>.

(ECMO)¹⁷⁵ may be used, but these treatments are relatively recent phenomena. Before the early 1970s, RDS was associated with extremely high mortality rates.

Initially the administration of oxygen to infants showing signs of respiratory distress became standard practice, as often the infants often showed great signs of clinical improvement with this treatment.¹⁷⁶ Oxygen was administered using various forms of oxygen tents, adapted bassinets or incubators, or some form of chamber into which oxygen would be pumped.¹⁷⁷ Unfortunately, by the late 1940s, researchers and clinicians noted unanticipated consequence of high oxygen administration called *Retrolental Fibroplasia* (RLF). RLF affected the blood vessels of the eyes in prematurely born infants who had received oxygen therapy in relation to respiratory distress.

Researchers and physicians sought to tease out the etiology and best practices for treatment for infants suffering from respiratory issues without predisposing these infants to blindness resulting from RLF. Beginning in the 1950s, published studies examining hyaline membranes of infants who had died after exhibiting severe respiratory distress outlined findings and sought to aid in potential pre-morbid diagnosis.¹⁷⁸ Physicians and

¹⁷⁵ ECMO is a form of respiratory support in which blood is directly oxygenated using a machine that cycles the blood through and then returns it to the patient. This form of life saving support is only used in severe cases.

¹⁷⁶ Ibid. Cone. *History of the Care and Feeding of the Premature Infant.*; Ibid. Dunham. *Premature Infants*, 105-112.; Ibid. Hess and Lundeen. *The Premature Infant*.

¹⁷⁷ Julius Hess, George Mohr, and Phyllis Bartelme. *The Physical and Mental Growth of Prematurely Born Children* (Chicago: University Of Chicago Press, 1934).

¹⁷⁸ Herbert Miller, Franklin Behrle, and Ned Smull. "Respiratory Activity and Function in Newborn Infants Dying with Pulmonary Hyaline Membranes," *Pediatrics* 222 (1958): 665–674.; David Gitlin and John Craig. "The Nature of the Hyaline Membrane in Asphyxia of the Newborn," *Pediatrics* 17 (1956): 64–71.; William Bauman. "The Respiratory Distress Syndrome and Its Significance in Premature Infants," *Pediatrics* 24 (1959): 194–204.; Doris Newman and J. M Sutherland. "Diagnosing Hyaline Membrane Disease," *American Journal of Nursing* 6, no. 1 (1961): 72–75.

nurses were torn between the initial respiratory improvement in infants when given oxygen and the possibility of eventual blindness later thought to be associated with high levels of oxygen administration. Research began internationally and publications ensued on the phenomena and how to prevent the blindness epidemic.¹⁷⁹ Clearly respiratory complications and the best ways to treat babies who suffered from distress also posed a paramount threat to the care of prematurely born infants.

Researchers and clinicians collaborated and came together at conferences, through scholarly communities, and via publication of their findings. At the 1951 M&R (Ross) Pediatric Research Conference pulmonary hyaline membranes and RDS took center stage with research and presentations focused on the issue. The same year a symposium, *Anoxia of the New-Born Infant*, convened under The Council of International Organizations of Medical Sciences (UNESCO and WHO).¹⁸⁰ Researchers and clinicians scrambled to find a way to curb the mortality rates and treat respiratory distress in sick neonates. In 1959, physician Mary Ellen Avery published her groundbreaking research on surfactant. Though surfactant treatment would not become part of standard treatment until the 1980s, her pathological discovery introduced new dimensions to the contemporary state of the science.

Avery's work gave physicians and researchers a cause for RDS, and thus contributed to how physicians thought about the problem as well as how research chose

¹⁷⁹ Ibid. Silverman. *Retrolental Fibroplasia*. 18-22.

¹⁸⁰ Herbert Miller, Franklin Behrle, and Ned Smull. "Respiratory Activity and Function in Newborn Infants Dying with Pulmonary Hyaline Membranes," *Pediatrics* 222 (1958): 665–674.

to study new treatments. South African Researchers Harrison, Heese, and Klein discovered the benefits of “grunting” in infants who suffered from respiratory distress and published findings in 1968.¹⁸¹ Grunting improved infants’ color and oxygenation.¹⁸² Physician George Gregory and his team built on Harrison et al’s research by applying continuous positive airway pressure for intubated infants in an attempt to artificially recreate the same affect that grunting created for the infants. The development of CPAP applied either via a pressure tube or an endotracheal tube resulted in positive effects for the infants in the trial.¹⁸³

Respiratory treatments: Attempts to provide respiratory support

These new NICUs and the need for advances to treat RDS coincided with the post-war increases in research funding, the technology boom, and major medical discoveries and advances.¹⁸⁴ American society became enamored of moon-landings,

¹⁸¹ V.C. Harrison, H de V. Heese, and M. Klein. “The Significance of Grunting in Hyaline Membrane Disease,” *Pediatrics* 41, no. 3 (March 1968): 549–559.; The researchers defined grunting as a partial closure of the glottis during the latter half of expiration and associated it with a raised positive intrathoracic pressure. When infants displaying grunting were intubated, they deteriorated and presented as cyanotic after the tube was inserted. They concluded that, “temporary closure of the glottis appears to be a protective form of breathing aimed at raising the oxygen tension of arterial blood...but the exact mechanism is not known.” (559)

¹⁸² They believed this was because the infants created their own positive end expiratory pressure (PEEP) with the act of grunting. This PEEP is what keeps the alveoli open in the lungs at the end of an expiratory phase of breathing. Without it, the infant’s lungs would collapse after every breath resulting in damage to the lung tissues as well as increased effort to re-expand the lungs.

¹⁸³ George Gregory. “Continuous Positive Airway Pressure,” *NeoReviews* S, no. 1 (January 2004): c1–c4.; George Gregory, J. Kitterman, R. Phibbs, W. Tooley, and W. Hamilton. “Treatment of the Idiopathic Respiratory Distress Syndrome with Continuous Positive Airway Pressure,” *New England Journal of Medicine* 284, no. 24 (June 17, 1971): 1333–1340.

¹⁸⁴ Bruce Alberts, Marc W. Kirschner, Shirley Tilghman, and Harold Varmus. “Rescuing US Biomedical Research from Its Systemic Flaws,” *Proceedings of the National Academy of Sciences* 111, no. 16 (April 22, 2014): 5773–77. doi:10.1073/pnas.1404402111.

computer intelligence, and new understandings of human DNA. Medical discoveries littered the evening news shows and popular magazines such as TIME displayed covers that gave visual representation to the dynamically changing state of science, medicine, and technology in the United States at that time. Even normal newborn nurseries took on an altered look as hospitals changed and reconfigured. The development of ‘high tech’ diagnostic and therapeutic procedures for pregnant women and their infants changed the landscape of labor and delivery and the hospital care newborns received.^{185, 186} Neonatal intensive care units became places where parents could expect the fruit of American ingenuity and medical science to save their infants who just decades before would have died.

The physiologic changes NASA observed in their astronauts translated to newborn infants as both astronauts and infants traversing the events of birth experienced adaptations to gravity and the environment, alterations in blood pressure, blood counts, and electrolyte balances, and fluid retention. Technologies used in space travel and military realms also took on new applications with the neonatal population such as Doppler detection of pulses in newborns and the use of sonar waves as ultrasounds

¹⁸⁵ Murdina MacFarquhar Desmond. *Newborn Medicine and Society: European Background and American Practice (1750-1975)* (Austin: Eakin Press, 1998).

¹⁸⁶ For one such example, see: Valerie Mike, Alfred Krauss, and Gail Ross. “Reflections on a Medical Innovation: Transcutaneous Oxygen Monitoring in Neonatal Intensive Care.” *Technology and Culture* 34, no. 4 (1993): 894–922.; Transcutaneous oxygen monitoring was one such technology adopted rather quickly for newborns. Other historians have addressed similar applications of technology that occurred during this time period for the fetal population. See: B.J. Hoerst, and J. Fairman. “Social and Professional Influences of the Technology of Electronic Fetal Monitoring on Obstetrical Nursing,” *Western Journal of Nursing Research* 22, no. 4 (2000): 475–91.; Ruth Schwartz Cowan. “Prenatal Motives and Prenatal Diagnosis” in *Heredity and Hope*, 71–116. (Cambridge, MA: Harvard University Press, 2008).

became a standard of maternal care leading up to birth. Early forms of respiratory support for fighter pilots became integrated into adult ventilators that were the foundation for positive pressure ventilation in the newborn populations. These technologies made their way into NICUs in the 1960s and 1970s when groups of researchers and clinicians adapted these technologies to their smallest patient populations.

“You would know...you could feel.”: Nursing’s role in respiratory support

Positive pressure ventilators existed for adults, but required modification for the smaller infant populations found in the NICUs. Ventilators used for adults often had tidal volumes that approached up to 1000mL. A ten mL deviation for an adult might not have drastic effects, but ten mL could be a dangerous deviation and damage the lung of a three-pound neonate.¹⁸⁷ Until physicians and nurses could depend on machines to deliver consistently precise volumes of air, they did not fully trust the machines and many found alternative ways to provide positive pressure respiratory support. As neonatologist Dr. George Gregory remembered, “Because the available mechanical ventilators frequently were ineffective, we and others [the nurses] sometimes ventilated neonates who had HMD [hyaline membrane disease] by hand for 48 to 72 hours.”¹⁸⁸ Other nurses remember ‘hand bagging,’ a term they used to describe the act of using an apparatus called an

¹⁸⁷ Donald Null, Bradley Yoder and Robert Geronimo. “Early Neonatal Research at Wilford Hall US Airforce Medical Center,” *Pediatrics* 129 (2012): S20–S26.

¹⁸⁸ George Gregory, “Continuous Positive Airway Pressure,” *NeoReviews* S, no. 1 (January 2004): c1–c4.

Ambu bag that is shaped like a balloon and when squeezed pushes the air into the patients lungs and manually provides breaths for a patient. It took skills to constantly assess the patient's color and condition to know if you were 'bagging' correctly as monitors were just becoming more commonplace in the units at this time. Nurse Roxanne Oellrich remembered,

We would start bagging them until they went into that diuretic phase, where you could feel that they started having increased urine output and you would not have to bag as hard. You could feel the compliancy of their lungs change. You would know when they were getting better. You could feel when they would blow a pneumothorax, just from bagging.¹⁸⁹

For Ms. Oellrich, 'hand bagging' did not only mean knowing how to work with the Ambu bag, but also intimately knowing how that piece of equipment interacted with her patient. Ultimately she had the skills and expertise to know how her patient's condition changed based on how she experienced using the Ambu bag. The attending physician on the unit taught the nurses to bag, how much pressure to create with the way they bagged, and the volume of air they could push into each infant's small lungs. The nurses did not have pulse oximeters to measure oxygen levels in the blood as today's nurses do, so they looked at the baby's color and assessed the baby while bagging to know if they were bagging well. Ms. Oellrich described how she learned to bag with one hand and write nursing notes with the other. Medical students provided short breaks for nurses if needed, but the nurses learned to prepare all medications and supplies they could anticipate prior to starting their shift.

¹⁸⁹ Ibid. Oellrich. *Oral History interview*. Pt 1, pg 5-6.

Another nurse who started her career at a New York City hospital remembered when ventilators were eventually introduced on her unit in the 1970s. On her unit, the infants were placed on eight hour bagging shifts as the nurses bagged for a set amount of time each hour. This meant after bagging for the majority of each hour as little as only five to ten minutes out of every hour was left to hang feeds, take vital signs, and perform hygiene tasks such as changing diapers. As time progressed, physicians began to introduce ventilators to the units. One nurse remembered not necessarily accepting these new tools without question:

[The fellow] began to introduce ventilators into more common practice, not as a last resort. And we [the nurses] had to transition into learning...and at first I didn't like them [the ventilators] because I thought 'That's my job. I can do it better.'¹⁹⁰

These skills required the nurse to be incredibly vigilant, have expert assessment skills, know how to bag well and whether or not how they bagged was working for the patient, and be able to do other jobs accurately and efficiently. They took ownership of the practice of bagging only handing it off when absolutely necessary. Their ability to incorporate good respiratory support into other nursing responsibilities, as Ms. Oellrich remembered bagging while writing notes, shows their ingenuity and intense involvement in patient care in early NICUs.

Mechanical ventilation: Did it work for newborns?

¹⁹⁰ Carroll Kruger. Personal interview with Briana Ralston, November 19, 2010.

By the 1970s, hospitals began to adopt the ventilator machines in greater numbers. During this process, nurses needed to have the skills to both ventilate the infants by hand via bagging as well as the skill to use the ventilator machines adapted for the neonatal population. Articles meant to educate nurses and physicians also began to appear in medical and nursing journals in the 1960s and 1970s that discussed nursing care of the ventilated neonate, and suggested the necessity of good nursing care to provide appropriate respiratory care to this patient population. The *American Journal of Nursing* published multiple articles addressing the advances in positive pressure ventilator technologies and different methods of administering the respiratory support the premature infants needed.¹⁹¹ Articles, published in other disciplinary journals addressed the pieces of equipment needed to deliver the precise volumes of air and concentrations of oxygen as well as the need for adequately trained nursing personnel. Dr. George Brumley, a noted pediatrician, commented:

It is imperative that the physician responsible for such infants be informed as to the competence of the [nursing] personnel and the specific coverage to be provided for the infant in question. Lucey's assessment of the Intensive Care Nursery as a place where "people care intensely" epitomizes this consideration and appropriately relegates facilities and equipment to their proper, necessary, but subordinate role.¹⁹²

¹⁹¹ Ackerman, Bruce, Michael Stein, Scott Sommer, and Marion Schumacher. "Continuous Positive Airway Pressure Applied by Means of a Tight-Fitting Face-Mask," *The Journal of Pediatrics* 85, no. 3 (September 1974): 408–11. ; Dyanne Affonso and Thomas Harris. "Continuous Positive Airway Pressure," *American Journal of Nursing* 76, no. 4 (1976): 570–73.; Judith Garvey, "Infant Respiratory Distress Syndrome," *American Journal of Nursing* 75, no. 4 (April 1975): 614–617.; Claire Naelpka, "The Oxygen Hood for Newborns in Respiratory Distress," *American Journal of Nursing* 75, no. 12 (December 1975): 2185–2187.

¹⁹² George Brumley. "The Critically Ill Child: The Respiratory Distress Syndrome of the Newborn," *Pediatrics* 47, no. 4 (April 1971): 765.

Recognizing the need to make headway in treating respiratory distress in newborns, leading experts in the field of neonatal care gathered at the 1968 Ross Conference on Pediatric Research.¹⁹³ This seminal conference assembled the leading physicians and researchers in the field as well as the latest research in neonatal medicine within the changing scene of neonatal intensive care. The topics included a discussion of the evidence that intensive care units changed survival rates, assessment of artificial respiration, and evidence for monitoring of blood pressure, among other things. The use of artificial ventilation for neonates took center stage at one moderated session as physicians and researchers discussed whether or not ventilators used for newborns actually did save lives.^{194, 195}

Dr. Paul Swyer¹⁹⁶ moderated a session focused on artificial ventilation for critically ill newborns. Physicians present at the conference delineated the hazards,

¹⁹³ The Ross Conferences were a series of conferences on pediatric research designed to connect leading researchers and recent research findings in an effort to stimulate further research by the exchange of information. Ross Laboratories, now known as Abbott Laboratories, funded the conferences with the ultimate goal of improving the care of infants and children. The conferences did not necessarily have the goal of problem solving, but sought to integrate knowledge to stimulate discussion and raise questions among a group of interdisciplinary experts in particular fields. The topics ranged from international child health (1964) to pediatric surgery (1958) to learning disorders in children (1971). Dewey Sehring. "Continuing Physician Education: The Ross Conference Approach," *American Journal of Clinical Nutrition* 46 (1987): 192–197.

¹⁹⁴ *Report of the 59th Ross Conference on Pediatric Research*. Problems of Neonatal Intensive Care Units. (Address given at the University of Vermont College of Medicine, Stowe, VT: Ross Laboratories, August 4, 1968).

¹⁹⁵ This seminal conference was the first time these physicians all gathered in the same place to discuss issues focused on definition of critical care for newborns. This conversation suggested more universal NICU standards be determined regarding what infants received more nationally standardized NICU care. It also points to the end of the premature infant era as the need to identify definitions of 'intensive care' became more important.

¹⁹⁶ Dr. Paul Swyer immigrated to Canada from the UK in 1953 to accept a position at Toronto's Hospital for Sick Children. By 1955 he was the second neonatal fellow employed by the hospital. He played an important role in the establishment of the hospital's neonatal intensive care unit in 1961

benefits, and ultimate assessment of the use of artificial respiration in the newborn.

Ultimately they concluded, in its current state, the use of artificial respiration for neonates was relatively limited and did not provide lavish alterations in the mortality rates for prematurely born neonates. When ventilators *were* used,

...the type of instrument has much less influence on the outcome than the organization behind it. I say organization advisedly, because it is perfectly obvious that the success of artificial ventilation in the newborn, even more than the adult, depends on the service and skills of a team of nurses, physicians, laboratory workers, and technicians applied unremittingly for 24 hours a day, 7 days a week.¹⁹⁷

The experts assembled did not yet know the most effective methods of implementing ventilator use with the newborn patient population, but they recognized the machine was only a small piece of the puzzle. Provider after provider highlighted the need for staffing the unit with skilled personnel that included nurses. While he called the nurses out specifically, first in order, he also affirmed the reality of a team of healthcare providers who worked with those nurses each providing specific aspects of care.

– a unit that consisted of one small cubical referred to by some in the institution as “Swyer’s Vegetable Garden” due to a combination of lack of belief that prematurely born infants could be saved and the research Swyer was doing to try to save these infants. He went on to have a highly successful career both in his medical practice – he trained hundreds of neonatal fellows, in establishing and growing the NICU at Sick Kids, and contributing keystone knowledge through his research in mechanical ventilator for newborns, premature infant nutrition, and neonatal transport and regionalization for newborn services; CN Reese and J Reese. “Reflections on the Early Years of Neonatology: Paul R. Swyer, The Beginnings of Canadian Neonatology at the Hospital for Sick Children in Toronto and Reflections on His Early Career,” *E-Journal of Neonatology Research* 3, no. 2 (Spring 2013): 47–57.

¹⁹⁷ Paul Swyer, Paul. *Report of the 59th Ross Conference on Pediatric Research*. Presentation. Problems of Neonatal Intensive Care Units. “Assessment of Artificial Respirator of the Newborn,” (Address given at the University of Vermont College of Medicine, Stowe, VT: Ross Laboratories, August 4, 1968). 31.

Studies conducted with various methods of mechanical ventilation between 1965 and 1968 presented at the 1968 Ross Conference on Pediatric Research summarized the general conclusion, “the potential for salvage by artificial ventilation [was] relatively limited.”¹⁹⁸ According to the studies done at that time, the ventilator with the best results in ventilation was a negative-pressure ventilator.¹⁹⁹ Even with comparison studies, the experts assembled did not agree the data was solid; populations and studies varied broadly, as did the way physicians used ventilators and the requirements for initiating ventilator therapy. The studies simply highlighted a, “...general impression from going over the literature is that it is not the machine that makes the difference – it is the people that run it, and the organization behind it.”²⁰⁰ Up until this point, no piece of ventilator equipment used by physicians and nurses had proven to be a consistently effective tool.

Ventilators used at the time, initially developed for adults, did not produce significant clinical results and helped only a handful of sick neonates. While some used positive pressure ventilation, no universal standard of care existed. Many used positive pressure ventilation as a last resort or continued to research how to use it to greatest benefit to save lives, and many units had nurses

¹⁹⁸ Ibid. Ross Conference, 1968. *Assessment of Artificial Respirator*. 29.

¹⁹⁹ I have been unable to identify the specific model used as identified in the abstract for the conference where this research was presented does not seem to have the information referenced by the moderator. This could be an interesting vein to explore more, but I have been unable to determine the data.

²⁰⁰ Ibid. Ross Conference, 1968. *Assessment of Artificial Respirator*. 29.

hand bag the newborns they felt could benefit from such treatment and care. Companies such as the Bourns Company produced ventilators they labeled for sale as newborn ventilators, but they produced only a certain amount and did not invest in the market as these machines were not in high demand due to unclear impact on survival rates. The Bourns infant ventilators were cited in studies but did not emerge as a leader in newborn ventilator equipment. NICUs continued to open and were filled with infants requiring additional respiratory support; physicians, researchers, and nurses knew too many infants died and one group, in San Antonio, Texas, pushed the bounds to make newborn incubator technology effective for infants.

The Baby Bird Ventilator

In 1969, a group of physicians and a respiratory therapist at Lackland Air Force Base in San Antonio, Texas developed a pediatric volume ventilator they believed addressed the need for an infant ventilator while taking into consideration the unique physiologic issues researchers had identified and outlined over the course of the preceding two decades. Under the direction of neonatologist Dr. Robert DeLemos, respiratory therapist Jimmy Schultz, and anesthesiologist Dr. Robert Kirby worked together on a prototype ventilator they would later call the Baby Bird Ventilator. Working with a group of fellows, including Dr. Don Null, they decided to see what they could do to address two key limitations of contemporary ventilators: limit of flow only

during inspiratory cycle, and need for what we now know as positive end expiratory pressure (PEEP).

During this time period the ventilators available for use only provided airflow during inspiration of a preset cycle. When the patient breathed in, the ventilator would provide a flow of oxygen-enriched air. What made this problematic for neonates is that they breathe irregularly and would often end up breathing between breaths pre-set by the ventilator. When the infants did this, they would simply rebreathe the carbon dioxide they just exhaled thus impairing oxygenation and ventilation. In addition, the ventilators at this time did not include PEEP²⁰¹ that keeps the alveoli from collapsing. In newborns without the soap-like compound surfactant, their alveoli and consequently their lungs collapsed every time they took a breath, causing trauma to already delicate lung tissue.²⁰² Drs. DeLemos and Kirby wanted a ventilator that had both constant airflow *and* PEEP, but there was not one available.

Respiratory Therapist Jimmy Schultz, described by one of DeLemos's fellows as "innovative," took apart an adult Bird ventilator, the Bird VIII, and reassembled it to the specifications the physicians required. The men tried the new ventilator on a few cases and it worked. After some initial research supporting the ventilator's use, the team approached The Bourns Company. Bourns, a major respiratory therapy company, already

²⁰¹ PEEP is positive end expiratory pressure or the air that is left in the lung's alveoli after the completion of an exhaled breath that prevents the lungs from completely collapsing before inhalation can occur again.

²⁰² Donald Null. Oral History interview by Briana Ralston, July 16, 2013. Pt 1, 1-3.; Donald Null, Bradley Yoder, and Robert Geronimo. "Early Neonatal Research at Wilford Hall US Airforce Medical Center," *Pediatrics* 129 (2012): S20–S26.

manufactured, marketed, and sold, a series of infant ventilators out at the time, but their ventilators failed to provide PEEP and continuous positive pressure. The Bourns Company rejected the team's prototype device citing research they had done and subsequent determination that there were enough infant ventilators on the market that worked. The Company assumed that since the current devices out on the market worked for the number of patients who needed them and reflected an absolute ceiling in the ventilator's usefulness in medical practice for neonates.²⁰³ Kirby, DeLee, and Shultz refused to believe this was the case; they proved their machine worked for newborns and they could save infants that previously did not survive when treated.

Eventually the team approached Dr. Forrest Bird, a bio-engineer for the United States military who developed adult ventilators and had a long-standing history developing medical apparatus with the military. Bird built them a machine that could be more easily used on infants by medical personnel. He adapted knobs so they could be more easily maneuvered. He repackaged the machine to be more accessible to someone who had not built it themselves as Schultz had done for Kirby and his team.²⁰⁴ In 1972, the team outlined their new infant ventilator in a groundbreaking publication, and called the new device the *Baby Bird Ventilator*. According to Kirby's team, the Baby Bird "cost

²⁰³ I attempted to contact the current company who previously were known as Bournes. They denied having records related to their manufacturing of their neonatal ventilators. I also tried to contact Dr. Bird with no success.

²⁰⁴ Ibid. Null. *Oral History interview*. Pt 1, 1-3.

less than \$1,500 and was extremely simple to operate.”²⁰⁵ They believed their new pediatric ventilator for use with neonates was an inspired solution to a drastic problem.

In the team’s article, they outlined the mechanical specifics to their prototype going so far as to provide a list of parts required for assembly of the machine’s system and where to obtain the parts.²⁰⁶ This footnote provides interesting insight into the team’s perception of the emergency nature and need of the device. As Dr. Donald Null later remembered, “if that baby was doing poorly [use of the Baby Bird prototype ventilator] was considered a life saving treatment.”²⁰⁷ Babies died of respiratory distress every day, and these men felt that if someone needed the machine before it could be made available from the Bird Corporation, then that person should obtain the right to build it himself using the same parts Jimmy Schultz used initially in 1969. The machine would not be widely available for purchase by hospitals for another two years, and even then the cost did remain high.

The prototype to the Baby Bird Ventilator initially incorporated the continuous positive pressure ventilation suggested by Gregory in his 1971 article in the *New England Journal of Medicine*. Gregory and his team built on previous observations that infants in respiratory distress who exhibited grunting had higher oxygen levels.²⁰⁸ They concluded

²⁰⁵ Robert Kirby, Elmo Robinson, Jimmy Schultz, and Robert deLemos. “A New Pediatric Volume Ventilator,” *Anesthesia and Analgesia* 50, no. 4 (July 1971): 533.

²⁰⁶ Ibid. Kirby, Robinson, Schultz, and deLemos. *A New Pediatric Volume Ventilator*. 533-7.

²⁰⁷ Ibid. Null. *Oral History interview*. Pt 1, 2-3.

²⁰⁸ This seminal ‘grunting’ observation was published by Harrison, Heese, & Klein in South Africa in 1967. They observed infants in respiratory distress who exhibited grunting quickly deteriorated when intubated with an endotracheal tube (ET tube). After intubation, they observed cyanosis despite increased levels of oxygen in these infants but noted improved color when the ET tube was

that continuous positive airway pressure, or CPAP, would be the answer to this problem. Until the Baby Bird, no ventilator incorporated this aspect into the equipment. After DeLemos, Kirby, and Schultz developed their ventilator with Dr. Bird they proceeded to push the bounds of their work with the device, continuing research with their new machine. In 1973, they published the results of their work detailing the importance of the Baby Bird Ventilator arguing the Baby Bird was successful because it used PEEP and CPAP to treat infants with RDS resulting in decreased mortality rates. Of paramount importance to their work was their conclusion that PEEP should be individualized for each patient in coordination with blood pressure monitoring, chest X-rays, and blood gas measurements. All aspects of monitoring developed in tandem with the Baby Bird allowing for optimal use of the ventilator.²⁰⁹ The adoption of the Baby Bird did not occur without challenges and constant attempts to create better ways to monitor the patients and use the ventilator in the most therapeutic ways for the newborns. This process was not a linear march forward, but one where other types of tools emerged in tandem with the ventilator.

As the Baby Bird developed, so did the assessment tools and machines that contributed to assessment techniques related to whether or not the machine was being used appropriately for the patient. One such example, developed by a fellow under

removed and the infants resumed crying; V.C. Harrison, H de V. Heese, and M. Klein. "The Significance of Grunting in Hyaline Membrane Disease," *Pediatrics* 41, no. 3 (March 1968): 549–559.

²⁰⁹ Ibid. Kirby, Robinson, Schultz, and deLemos. *A New Pediatric Volume Ventilator*. 533.; Ibid. Null. *Oral History interview*.

DeLemos during the development of the Baby Bird ventilator, tackled a tandem issue for premature infant care: the inability to obtain noninvasive blood pressures. Nurses and physicians could not measure blood pressure with the traditional stethoscope and sphygmomanometer because newborn arteries were difficult to auscultate. Among larger infants, and their adult counterparts, indwelling catheters could be placed, but the right size catheter for very small premature infants did not exist. Dr. Gary McLaughlin developed a Doppler ultrasound device to measure blood pressure indirectly.²¹⁰ This non-invasive device provided more consistent blood pressure monitoring to determine basic vital signs for critically ill ventilated neonates. The use of this measurement was critical in understanding the changing intrathoracic pressure resulting from the PEEP of positive pressure ventilation and its affects on cardiac output.²¹¹ Dr. deLemos recognized, using this measurement combined with the blood gases and x-rays that more PEEP was not always better and use of the machine needed to be coupled with intensive monitoring and care. This is where the nursing staff continued to play important roles in the incorporation of ventilators as well as providing continued highly valued patient care.

In an oral history interview with Dr. Null, he credited the physicians with adjusting the parameters of the machine but he recognized the role the nurses played in monitoring the patients. Blood pressure monitoring, blood work or blood gasses, and general assessment of vital signs and patient condition was the role of the nurses. They

²¹⁰ Gary McLaughlin, Robert Kirby, William Kemmerer, and Robert deLemos. "Indirect Measurement of Blood Pressure in Infants Utilizing Doppler Ultrasound," *Journal of Pediatrics* 79, no. 2 (August 1971): 300–302.

²¹¹ Ibid. Null. *Oral History interview*. Pt 1, 1-2.; Ibid. Null, Yoder, and Geronimo. *Early Neonatal Research at Wilford Hall*. S22.

gathered the data and knew how to combine that with the patient's general assessment to determine if the machine worked for the patient and to know when something was wrong.²¹² Dr. Null remembered them as central members of the team of healthcare providers that made the NICU and the development of the Baby Bird a success. He asserted, "that's why we were successful: because [the nurses] they put their time into it and moved forward with it."²¹³ According to Dr. Null they participated in the changes to patient care plans; their focus was on their tiny patients even when the machines came and went and changed.²¹⁴ Nurses continued to keep the patient at the center of a whirlwind of medical research, expanding assessment practices, and changing machines.

While the Baby Bird Ventilator was not the only ventilator that was used, practitioners who worked with the newborn population remember it as a turning point in newborn respiratory care. While it did not have the monopoly, other manufacturers of newborn ventilators such as the Bourns Company did not compete for the market and did not feel, based on contemporary data, that there was a market for increased production of

²¹² I attempted to contact a nurse who worked with Dr. Null but was unable to reach her for an oral history interview.

²¹³ Such a comment raises the question of whether or not the nurses ever acted in ways that were subversive to the physicians' instructions. Scholars who have interviewed adult ICU nurses who practiced during this time period recognized nurses did sometimes alter the machines without "permission" and did not always work with physicians in happy and respectful relationships. While I suspect this is probably true of nurses who worked in NICUs during my time period, I currently have no data to make such claims. The nurses I interviewed so far have not commented on this in their memories. As I continue to collect data, perhaps this theme will emerge, but as of now it is speculation on my part.

²¹⁴ Ibid. Null. *Oral History interview*.

newborn ventilators.²¹⁵ Many factors influenced why the Baby Bird became the standard of care in the memories of so many practitioners, but its emergence required key components. Based on a population of neonates who would benefit from such a machine, a team of (in this case) men took the risk to invent the machine and find out if it worked. Once they had garnered evidence collected by female nurses that their new invention did work and influenced survival rates of neonates, they worked hard to find an engineer and subsequently a company who would take the risk to mass produce it.

Even once the Baby Bird was produced and hospitals began to buy the machine, not all nurses and physicians completely trusted it. One nurse expressed her memories of the machines not always working well and a subsequent mistrust of them: “I remember those Baby Birds...always being nervous about them malfunctioning. We knew how to take them down and put them back together again, but we would learn how to do that and often they were very persnickety...not functioning the way you wanted them to.” She went on to talk about how they used to listen to certain noises the machines made and then problem solve if they did not trust that the machine was working correctly.²¹⁶ While the Baby Birds did eventually become the most remembered neonatal ventilator, some nurses remember them specifically as having glitches in the early years of their use.²¹⁷ The Baby Bird’s rise to fame did not happen suddenly but over the course of years. There is no evidence that the machine immediately became the “go to” ventilator for NICUs

²¹⁵ I attempted to contact the current company that took over the Bourns Company and they do not have records related to the initial infant ventilators. This would be a fascinating work to do, but for the purposes of this work the data was not available.

²¹⁶ Ibid. Barnsteiner. Oral History interview. 11.

²¹⁷ See also: Shannon Perry. Oral History interview by Briana Ralston, December 12, 2012.

across the country, but nurses and physicians remember it while other models have not been so resilient in the collective memory.²¹⁸

The story of the Baby Bird Ventilator placed within the context of attempts to battle respiratory distress in neonates provides an example of why nurses were so important. They provided the critical assessment, communicated with physicians as team members, and worked with drastically changing systems of equipment and personnel to give the best possible care for their patients. The machines were game-changers, but only when coupled with the intensive care delivered in these units by nurses who had the knowledge and skills to make the machines work for the babies and to recognize and take action when they were not working. Nurses were the ones providing the most intensive care available. They provided a hub of communication and were a constant presence for physicians and other healthcare providers. As they provided foundational and central assessment skills to the rest of the healthcare team, they also tweaked and made the equipment they had on hand work for their patients. They delivered the best care they could with the resources available to patients who needed not only their skill and ingenuity but their ability to determine minute yet significant changes in each patient's condition.

²¹⁸ While I have attempted to give an overview of the emergence of what is often remembered as the standard of neonatal positive pressure ventilation, I by no means claim to have given a thorough analysis of the history of this piece of technology. It was a piece of the technological system I consider the NICU and thus is addressed in this dissertation, but not the primary focus of my work. Future scholars might choose to focus solely on this apparatus and its history as a piece of technology, but such focus is beyond the scope of this work and considered a possibility for future scholarship.

Expenses and cost-effectiveness: Financial challenges of a new technological system

The equipment and manpower needed to run these units did not come without a significant financial cost. Historian Rosemary Stevens argued the 1960s dawned on a period in American medicine where the creation of private insurance as third-party payers “encouraged hospitals to respond to the market incentives of increased demand by providing more, more expensive, and better care, in areas that were most likely to be reimbursed.”²¹⁹ By 1960 Blue Cross and other insurance plans covered almost two thirds of non-governmental hospital expenditures. By 1966, Medicaid roared into action, a form of insurance that covered newborn in hospital care and proved to be incredibly expansive as hospitals incurred increasing expenditures only to receive financial reimbursement through the 1970s; in the face of what came to be considered as extensive spending in hospitals, the system was eventually changed in the early 1980s as part of audits to control increased spending.²²⁰

Within this expansion of hospital-based services and the financial restructuring of American medicine, neonatal intensive care became a focal point for cost-effect analysis as part of a medical system-wide analysis, *Implication of Cost-Effectiveness Analysis of*

²¹⁹ Rosemary Stevens. *In Sickness and in Wealth: American Hospitals in the Twentieth Century* (Baltimore, MD: The Johns Hopkins University Press, 1989). 257.

²²⁰ Ibid. Stevens. *In Sickness and in Wealth*. 256-284.

Medical Technology.²²¹ This study identified neonatal intensive care as one of the most expensive reasons for patient hospitalization exceeding neoplastic and circulatory diseases as well as end-stage renal disease and coronary bypass surgery (all among the most expensive adult in-patient areas). The report cited a range in NICU care from \$1,800 to \$40,000 per patient with average determinable expenditures to fall around \$8,000 per patient. Such expenditures resulted in national expense of \$1.5 billion in 1978 alone.²²² The study's authors to break down expenditures within hospitals due to the changes in the ways hospitals charged insurance plans for patient care in the 1960s.²²³ Among studies that analyzed payment practices, third party payers (private and federal) paid the highest percentage of costs, between 80-85%. Direct costs from individual payers accounted for about 5% of payments received. The remaining 10-15% were uncollectible. Of the fifteen percent of patients in NICUs on Medicaid, they accounted for 51% of the uncollectible or write-off funds.²²⁴

The study cites challenges to determining actual cost per patient and per procedures due to multiple factors. Though NICUs did function as unique units, they did not function as separate cost centers when billing and charges were negotiated with the costs often being reported in tandem with adult ICUs. In the rare cases when the NICUs could be separated out, ancillary costs (laboratory tests, x-ray, and physician fees) were

²²¹ Budetti, Peter, Nancy Barrand, Peggy McManus, and Lu Ann Heinen. *Case Study #10: The Cost and Effectiveness of Neonatal Intensive Care*. The Implications of Cost-Effective Analysis of Medical Technology. San Francisco, California: University of California, August 1981.

²²² Ibid. Budetti, Barrand, McManus, and Heinen. *Case Study #10*. 27.

²²³ Ibid. Budetti, Barrand, McManus, and Heinen. *Case Study #10*. 19-26.

²²⁴ Ibid. Budetti, Barrand, McManus, and Heinen. *Case Study #10*. 24.

not included. Due to both formal and informal regionalization, hospitals often transferred patients between institutions and thus complicated the billing process. While the details were hard to tease out, three consistent findings emerged: 1) total costs for survivors are higher than for non-survivors; 2) as birth weights decreased, costs increased; and 3) total costs increased with complications such as hyaline membrane disease (HMD).²²⁵ The study cited the changes in hospital billing procedures such as “cross-subsidizing”²²⁶ and changes in Medicaid and insurance reimbursement.

While specific challenges did create problems with breaking down particular costs, the study ultimately reinforced NICU care as the most expensive type of care delivered in hospitals by the early 1980s. The cost-effectiveness of using such an expensive technological system to care for patients drew incredible scrutiny, particularly as it related to issues of long term care for some of the neonates that survived but with chronic medical conditions and some dependent on technologies such as ventilator support. The financial cost could not be separated from the moral and ethical questions regarding whether or not the ICU model of care should be used even at such an incredible financial cost.

²²⁵ Ibid. Budetti, Barrand, McManus, and Heinen. *Case Study #10*. 30.

²²⁶ “Hospital charges for neonatal intensive care are often not fully reimbursed by Medicaid or by insurance plans that pay only for “allowable” costs. This situation creates incentives for hospitals to adjust charges to cover their expenditures by cross-subsidizing among payers. Moreover because it is difficult to adjust charges continuously with varying levels of care, expected revenues often are below costs at the beginning of a stay and exceed costs at the end, allowing for cross-subsidies based on variations in the length of stay. Problems created by cross-subsidies include encouraging NICU admission of infants with less serious problems and extending stays after treatment when it would be adequate to continue care in a lower level and less costly setting.” Ibid. Budetti, Barrand, McManus, and Heinen. *Case Study #10* 32.

Conclusion

Historians of technology consistently ask why one tool became the standard of care while another possibility did not. An understanding of the role nurses played in premature infant units provides us with insight as to why the units themselves, as technological systems, formed and grew as they did. Premature infant units were a dominant forerunner to the models of care we find in NICUs today and the nurses who worked in these units provided very similar types of care their premature infant unit nurses did before. Perhaps sick newborns could have been simply cared for grouped together with well newborns, or premature infant units might have remained standard throughout the latter half of the 20th century, but they did not. Neonatal intensive care units became standard technological systems where sick newborns specifically received care and had round-the-clock access to laboratory and diagnostic equipment. The changing nature of increased social expectation of families to save their babies in the post war society combined with changes in insurance and third-party payers found newborns in the perfect place to reap the benefits of social value, medical tenacity, and technological advances.

NICU nurses found themselves doing many of the same things their adult critical care counterparts did, including developing close professional relationships with the physicians and other members of the healthcare team, garnering greater responsibility as sicker patients stayed longer in their units, and working with new equipment that became commonplace in these units. They also built on skills that were central to the care nurses

in premature infant units gave. As equipment changed and the physiological and psychosocial needs of newborns (and their families) were better understood, NICU nurses sometimes needed to make the tools and treatment devices work for their tiny patients as it took time for manufacturing companies to produce equipment small enough for newborns and then for hospitals to allocate financial resources to purchase such equipment.

While neonatal intensive care units became the focal point for the intersection of data collection and research, and new equipment for the treatment of disease, nurses functioned as the hub of a complex system of patient care. Whether working at the bedside assessing the patient and gathering data to document the patient's condition, working with the families and physicians, or making the equipment work to fit their patients these nurses garnered a great deal of power. They became the center of a complex and dynamic system where their observation skills, ingenuity, and knowledge about the patient's condition meant they were needed and valued. The physicians recognized this and worked with these nurses to push the boundaries of NICU care.

The next two chapters will provide case studies of two particular neonatal intensive care units and specific instances where these units were established and developed. While this chapter has focused on the ways nurses worked in intensively caring for sick newborns, the next two chapters will give particular examples of how units formed and were influenced by particular contexts, people, and communities. Understanding why these units formed where and when they did will also aid analysis of

why alternative ways to care for sick neonates did not become standard and why NICUs emerged as the spaces where care is delivered today.

Chapter 4:

“We needed a place to put the babies...”:
Infant Intensive Care and The Children’s Hospital of Philadelphia

**“We needed a place to put the babies...”: Infant Intensive Care and The Children’s
Hospital of Philadelphia**

The eight person surgical team waited at the Children’s Hospital of Philadelphia on the morning of August 27th, 1959 prepared to receive baby Anthony born just two days earlier without a connection between his mouth and stomach, a condition known as esophageal atresia. In order for Anthony to survive, he needed immediate surgery. The team worked together to ensure their patient survived the surgery where his esophagus would be reconstructed and the upper esophageal segment would be connected to the lower segment allowing nutrients to enter the stomach when swallowed.²²⁷

After the surgery, Anthony’s diminished coughing reflexes and inability to clear his own throat of mucus and secretions put him at increased risk for choking. He needed someone else to help him keep his airway clear. The physicians saw Anthony on an average of every 20 minutes, but the nurses took Anthony’s vital signs and stayed at his bedside adjusting the temperature in his isolette around the clock, “minute by minute care twenty four hours a day” for the next two weeks.²²⁸ The hospital released photographs of baby Anthony at the end of his hospital stay in their 1959 annual report. In these photographs, a nurse in her starched white uniform cradles tiny Anthony. He gazes up at her and she, instead of looking at the camera, gazes back at him presenting him to the audience with a Madonna and child-like aura. Infants like Anthony required constant

²²⁷ [Children’s Hospital Annual Report, 1959] Box 4, Folder 7, MSS 6/0013-01, Children’s Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

²²⁸ Ibid. *CHOP Annual Report, 1959*.

nursing care and a space where that care could be given. While CHOP apparently provided intensive nursing care to newborns prior to the establishment of a separate ICU devoted to newborns specifically, hospital administrators, researchers, and healthcare staff believed a unit needed to be formed as a place where such intensive nursing care could be consistently given. This belief influenced the allocation of space, financial resources, and research projects supported by visual representations of the new unit and nursing workforce who worked there in hospital publications.

In this chapter, I argue the infant intensive care unit (IICU) at CHOP formed out of the necessity for a distinct place where essential resources were allocated and particularized nursing care could be given in tandem with the rise of the hospital's surgical department. Nurses contributed to the organization of the environments where they practiced, supported by the trust and confidence of hospital administrators and physicians, and they became a focal point in the visual representation of the unit that communicated the human component of intensive care and the consistent presence of nurses. CHOP's public relations department and administration used the nurses as the face of the infant intensive care unit, an increasingly complicated technological system that included patient care, complicated equipment, and progressive surgical and medical treatment. In an attempt to allocate precious intensive care resources, including good nursing care, the unit at CHOP eventually functioned within a network of units that reflects a complex technological system of care. By the early 1980s, the broader social and medical dialogue relating to who should receive care and to what extent intensive

care should be allocated became a focal point for ICU nurses and physicians reflecting dialogue about unintended consequences of highly complex and skilled care.

A city, a hospital, and the development of a surgical department

Upon his 1842 visit to Philadelphia, famous author Charles Dickens remarked of Philadelphia, “It is a handsome city, but distractingly regular...Philadelphia is most bountifully provided with fresh water...[and] There are various public institutions. Among them a most excellent hospital...”²²⁹ He spoke of Pennsylvania Hospital founded by Benjamin Franklin in 1751. The hospital, considered the nation’s first hospital, was just one of the many that emerged within the city limits as Philadelphia grew. Just years after Dickens’ visit, the Children’s Hospital of Philadelphia was established in 1855 as the nation’s first hospital devoted specifically to the care of children.

Francis W. Lewis, a physician at Pennsylvania Hospital, visited London’s Hospital for Sick Children on Great Ormond Street during his travels abroad before returning home to the city of Philadelphia where the mortality rates for infants and children were abysmally high. With fellow physicians T. Hewson Bache and R.A.F. Penrose, he campaigned and eventually established the Children’s Hospital of Philadelphia that opened its doors in 1855, treating 63 patients in its first year. During its

²²⁹ Charles Dickens. *Charles Dickens: American Notes* (New York, NY: The Modern Library, 1996): 129-130.

early years CHOP served the city of Philadelphia's poor and impoverished children as was standard of many hospitals during that time period. The charter specified that the hospital opened for "...children suffering from Acute Diseases and Accidents" who would receive care free of charge.²³⁰ The hospital's first patient, James Boyle, came to the hospital suffering from what was called 'hip-joint discourse.' The three-year-old boy received the care he needed free of pay and was discharged home 'cured.'²³¹

Prior to the transformation of the hospital into what historian Rosemary Stevens refers to as the "modern scientific institution," many hospitals served only the poorest populations who lacked the financial and family resources to receive in home care.²³² With the post Civil War principles of scientific charity that held economic self-reliance as the standard, particularly in hospitals, patients were expected to pay whatever they could whenever possible. By 1879, the hospital administration expressed concern over the appropriate usage of the institution and the abuse of its resources by what were labeled as *unworthy people*. The January 1879 Manager's Report echoed concern over the misuse of the hospital's resources by members of the community who were not poor enough, and thus considered 'unworthy' to receive care paid for by the community, who consisted of private citizens, donors, and businesses.²³³

²³⁰ *The Children's Hospital of Philadelphia in Perspective: 1855-1974* (Philadelphia, PA, 1974). Printed for the dedication observance of the Children's Hospital and Guidance Center Philadelphia, Pennsylvania May 6, 1974. Children's Hospital Of Philadelphia School of Nursing records, Barbara Bates Center for The Study of The History of Nursing, University of Pennsylvania.

²³¹ "World's Famous Physicians Gather Here in 3-Day Meet," *Philadelphia Tribune*. May 21, 1955.

²³² Rosemary Stevens. *In Sickness and in Wealth: American Hospitals in the Twentieth Century* (Baltimore, MD: The Johns Hopkins University Press, 1989). 17.

²³³ *Ibid.* *The Children's Hospital of Philadelphia in Perspective: 1855-1974*.

The first building to house CHOP, located on Blight Street (currently known as Watts street), quickly proved to be too small and by 1866 the young hospital moved into its second building on 22nd street between Walnut and Locust.²³⁴ Over the next few decades, the hospital grew and expanded, adding a new physician residency program as well as establishing the Ingersoll Training School for nurses by 1895. This program became one of the most prominent nursing programs in the country for nurses specifically interested in training for the care of children. By 1916, the hospital had again outgrown its facility and moved to a third building at 18th and Bainbridge Streets. Such growth reflected the general trends in hospital expansion at the turn of the century as hospitals grew and began to compete to attract patients within changing social considerations of the role of hospitals at the time. The move also reflected the social focus on health issues faced by children such as malnutrition, disease, and (as it related to infants) clean milk supplies that would have impacted a focus on children's healthcare more broadly including hospital care for those who needed it.²³⁵ By 1917, the hospital reflected the developing model of cleanliness, efficiency, and expertise valued at the time and aimed at the care of children.²³⁶

²³⁴ "150th Celebration Timeline: The Children's Hospital of Philadelphia," Accessed December 11, 2013. <http://www.chop.edu/flash/150-year-timeline-2005.html>.

²³⁵ For more see: Charles King. *Children's Health in America: A History* (New York: Maxwell MacMillan International, 1993).; Alexandra Stern and Howard Markel, eds. *Formative Years: Children's Health in the United States 1880-2000* (Ann Arbor, MI: The University of Michigan Press, 2004).; Richard Meckel. *Classrooms and Clinics: Urban School and the Protection and Promotion of Child Health, 1870-1930* (New Brunswick, NJ: Rutgers University Press, 2013).

²³⁶ Ibid. Stevens. *In Sickness and in Wealth*.

The great migration: The changing face of Philadelphia and the health of it's smallest

By the 1920s, the “great migration” brought hundreds of thousands of southern families – both white and black – who moved into northern cities in search of work. This “Southern Diaspora,” as historian James Gregory calls it, transformed the American social landscape across the country.²³⁷ Most obviously affected were the large cities of the north like Philadelphia. By the 1950s, the transformation of the Philadelphia social and economic landscape by these migrants positioned it as an important center for the northern civil rights movement.

Between 1940 and 1950, the Black population in the city of Philadelphia increased by 50%. In 1940, the city noted 251,000 Black residents, but by 1950 those numbers had grown to over 376,000. Toward the end of World War II, the government invested \$131 million in the expansion of defense plants in Philadelphia that brought thousands of jobs to the city. Philadelphia’s black workforce experienced all too common discriminatory hiring practices. White workers still unofficially had greater opportunity and held precedence when it came to filling the job market. Blacks also faced discrimination in the housing markets and education opportunities.²³⁸ Inequality in civil rights, labor, socio-economic status, education, and healthcare all affected access to care

²³⁷ James Gregory. *The Southern Diaspora: How the Great Migrations of Black and White Southerners Transformed America* (Chapel Hill, North Carolina: The University of North Carolina Press, 2005).

²³⁸ Thomas Sugrue. *Sweet Land of Liberty: The Forgotten Struggle for Civil Rights in the North* (New York, NY: Random House, 2008).; Ibid. Countryman. *Up South*.

and health disparities. All strata of life – infants, children and adults-- faced the effects of socio-economic and healthcare issues.²³⁹

Differences in infant mortality rates revealed unequal access and treatment not only in Pennsylvania, but across the country as well. The national neonatal mortality rate in 1960 hit 18.9%. Although mortality rates were high, Philadelphia's white newborns fared better than the national average with a mortality rate of 17.7%. Their non-white counterparts²⁴⁰ experienced a higher, 29.5% mortality rate.²⁴¹ Pennsylvania was one of fourteen states that failed to show any decrease in neonatal mortality for either white or nonwhite newborns between 1958 and 1961.^{242, 243} In 1961, in the US congenital malformations, ranging from issues such esophageal atresia to cardiac malformations, comprised almost 40% of neonatal deaths reported, second only to prematurity and respiratory distress associated with premature birth.²⁴⁴ These numbers reinforced the need to focus attention and resources on the development of better care for sick newborns, particularly newborns needing surgical treatments for congenital malformations.

²³⁹ Matthew Delmont. *The Nicest Kids in Town: American Bandstand, Rock 'N Roll, and the Struggle for Civil Rights in 1950s Philadelphia* (Los Angeles, CA: University of California Press, 2012).

²⁴⁰ Neonates are considered infants within the first 40 days of life. Infants broadly defined as less than one year of age.

²⁴¹ *Vital Statics of the United States, 1960*. (Washington D.C.: US Department of Health, Education, and Welfare, 1963): Section 3, Table 3-F.

²⁴² Eleanor Hunt and Stanley Goldstein. *Trends in Infant and Childhood Mortality, 1961*. Children's Bureau Statistical Series. (U.S. Department of Health, Education, and Welfare, Public Health Service National Institutes of Health, Children's Bureau, 1961). 12, 45.

²⁴³ Please note, that while race is an important part of the story of Philadelphia's newborn healthcare, after much research I did not ultimately choose to address how race played out in these units. This is an important piece of the story that should be addressed in future scholarship.

²⁴⁴ *Ibid.* Hunt and Goldstein. *Trends in Infant and Childhood Mortality*. 28.

Physicians in Philadelphia recognized the need to do more for infants born with complex problems that required complex treatments.

Over the previous two decades, surgical treatments for some common congenital malformations had been pioneered and physicians, such as C. Everett Koop at CHOP, argued the importance of good pre- and post-operative care. Such advances coincided with increased hope that infant mortality rates related to congenital malformations could indeed decrease infant mortality rates further. The story of how pediatric surgery came to CHOP and the particular ways surgical care for newborns developed at this institution illustrates the hope that these mortality rates could be decreased.

Pediatric surgery and neonates at CHOP

The Children's Hospital of Philadelphia (CHOP) responded to the need to lower the mortality rate for infants born with congenital malformations by making changes in the care of newborns who specifically required surgical intervention and subsequent intensive care. The hospital proposed important and innovative changes as they further expanded on good nursing care, and challenged current models of postoperative care particularly for infants born with life threatening congenital malformations. Physicians and hospital staff at CHOP sought to create adequate spaces where such care could be given and the particular needs of post-operative and medically fragile infants could be researched and better understood.

Prior to the innovation of better surgical technique and a better understanding of neonatal post-operative needs, many infants born with malformations received what we

would consider today as palliative care - physicians and nurses made the newborns as comfortable as possible until they died.²⁴⁵ Prior to the development of particular surgical methods to correct malformations, a thorough understanding of what constituted good post-operative care, and units where post-operative newborns could receive care from staff trained in newborn physiology and care needs, very little could be done to consistently ensure better outcomes or change the mortality rates for infants born with congenital malformations.

In the 1940s, pediatric surgery and training for physicians still remained in their infancy. Boston Children's Hospital, under the guidance of Dr. Robert Gross, shone as the epicenter of pediatric surgical training in the US. Gross's textbook *The Surgery of Infancy and Childhood*, published in 1953, became the seminal training manual for physicians interested in surgical interventions specifically related to children and infants. It provided foundational knowledge on surgical treatment of problems such as esophageal atresia, intestinal obstructions, surgery on premature infants, and new material on the heart and great vessels. In 1953, Dr. Gross described the field of pediatric surgery as having few delineated boundaries, lacking in appropriate training, and in need of development and formation in the ways already seen in adult surgical specialties.²⁴⁶

²⁴⁵ J. Randolph. "Notes on the early development of pediatric surgery in the United States," *Journal of Pediatric Surgery* 47 (2012): 10–16.; John Raffensperger. "Pediatric Surgery Comes of Age" in *Children's Surgery: A Worldwide History* (Jefferson, NC: McFarland and Company Publishers, 2012).

²⁴⁶ Ibid. Raffensperger. *Pediatric Surgery Comes of Age*.

Needs for equipment that ‘fit’ the smaller patients became a primary challenge, particularly for surgeons who operated on newborns.²⁴⁷ For example, the development of intravenous catheters for smaller patients and better protocols for providing intravenous fluids for infants needed to coincide with emerging surgical technique. Physicians and nurses also demanded better ways to provide post operatively ventilator support for infants. Equipment better suited for newborns needed to be developed in tandem with education and development of assessment skills for the practitioners who cared for these infants. Both the education and training lacked formal channels in organized programs, and happened in a more apprenticeship fashion. Surgeons operated on their pediatric and newborn patients in operative suites in hospitals across the country while they attempted to determine the best surgical technique and care despite the fact that scholarly journals devoted to the generation of new knowledge did not exist.²⁴⁸ These challenges did not mean physicians and nurses failed to see the need for better surgical technique, care, and tools. They did, and they attempted to meet those needs in innovative ways that included pushing vehemently to change the current system when necessary.

Dr. C. Everett Koop, founder of the pediatric surgical department at CHOP, credited nurses for bringing the pediatric surgical department to the Hospital of the University of Pennsylvania and subsequently to CHOP. In an interview Koop recalled the story of a child admitted to the Children’s Hospital by one of the hospital’s medical

²⁴⁷ This is a recurring theme in the literature and in the oral history interviews. For more on this see Ch 3.

²⁴⁸ John Raffensperger. “Pediatric Surgery Comes of Age” in *Children’s Surgery: A Worldwide History* (Jefferson, NC: McFarland and Company Publishers, 2012).

residents. The resident examined the child and determined his symptoms of abdominal pain, distension, and bloody stools as evidence that the child suffered from intussusception.²⁴⁹ He determined the child would need surgery, but like many early children's institutions, the Children's Hospital had no surgical team. The resident called the Hospital of the University of Pennsylvania's surgeon on call. Despite repeated calls to Penn's surgical service, the surgeon on call did not arrive to CHOP to examine the child until the next morning but by then, "the child had already died with a surgical problem unattended by a surgeon on the wards of the oldest children's hospital in America."²⁵⁰

At the time, Ms. Francis Clyde was CHOP's head nurse. She came to Philadelphia from Boston Children's Hospital and had worked in Boston's operating room with the physician considered the father of American Pediatric Surgery, William Ladd. According to Koop, she was furious that the child had not received the surgical care he needed, care she knew he could have received if he had been seen by a surgeon in a timely manner. She went to Joseph Stokes, the Physician in Chief at the Children's Hospital and the Bennet professor of Pediatrics at the University of Pennsylvania, demanding that CHOP take the steps necessary to install a pediatric surgical service. If he failed to do so, "...she and her staff would leave and she further emphasized this by saying, 'And when I say my

²⁴⁹ This condition occurs when part of the intestine slides into another similarly to the way parts of a telescope slide into one another when collapsed. This can result in intestinal obstruction requiring immediate surgery and, if not treated, can be fatal.

²⁵⁰ C.E. Koop. Interview with Dr. CE Koop, June 11, 2002. Private Collection.; This account is also published in Koop's memoir and should be understood as his remembrance and one account. Nonetheless, this story as he remembers it reiterates his overall value of the nursing personnel.

staff, I mean *all* of us.”²⁵¹ Upon being presented with the ultimatum of losing his entire nursing staff, Stokes took the matter to I.S. Ravdin, Chief of Surgery at the Hospital of the University of Pennsylvania, and Joseph Stokes, Physician-in-chief of CHOP, who determined that they needed to send a surgical resident to Boston for training and that this could significantly contribute to a solution for their problem – a solution that required both surgical knowledge and a system that enabled that knowledge to be put into practice; in short, a surgical department at CHOP. Knowing Boston Children’s Hospital had a high reputation for pediatric surgery, Stokes sent the only resident who would accept the position, Koop, to Boston in 1946. There Koop studied under pediatric surgical pioneers William Ladd and Robert Gross who had the sole training program for child surgery in 1946.²⁵²

Koop remembered that four other residents were offered the opportunity to go to Boston to study with Ladd and Gross in return for a guaranteed position of chief of surgery at CHOP upon their return. They all turned down the position as the consideration of ‘limiting’ your surgical expertise only to children undermined their training as general surgeons. Koop felt that knowing how to perform excellent surgery on

²⁵¹ Ibid. Koop. *Interview, June 11, 2002.*

²⁵² William Ladd and Robert Gross. *Abdominal Surgery of Infancy and Childhood* (Philadelphia: W.B. Saunders Company, 1941).; J Randolph. “Notes on the early development of pediatric surgery in the United States,” *Journal of Pediatric Surgery* 47 (2012): 10–16.; In 1941, Boston surgeons William Ladd and Robert Gross published what became the national standard for pediatric surgical procedure for decades to come. While Ladd and Gross authored their textbook with the surgeon in mind, they provided great detail regarding pre and post-operative care in addition to detailed surgical procedural directions. Such detailed directions involving post-operative care outline detailed feeding instructions and medication administration that would have fallen to the responsibility of the nurse based on what we know of nursing roles related to pediatric and infant care elsewhere in the hospitals at the time. Nurses would have been involved in complex patient management and post-operative care of infants and children.

the smallest patients would only make him a better adult surgeon if the position and long term offer at CHOP fell through.²⁵³ While adult surgical skill was valued during this time, the importance of trained surgeons who knew how to work with pediatric patients had yet to become a widespread value among surgical circles.

Dr. C. Everett Koop: Bringing newborn surgery to CHOP

Upon his return to Philadelphia in 1946, now fully trained, stepped into his post as the surgeon in chief at CHOP and head of what was then known as ‘child surgery’. He considered his new specialty at CHOP *pediatric surgery* and began to call it such, though he never claimed to invent the term. Pediatric surgery was not a recognized specialty at the time and the *Journal of Pediatric Surgery* would not be published until 1967.

Despite his newly appointed position, skills, and desire to move pediatric surgery forward, he encountered several challenges during the beginning years. Koop remembered resistance to his new subspecialty and resistance of other physicians to relinquish their patients to his service.^{254, 255} For example, Stokes made it very clear to Koop on his first day back that he retained all diagnostic rights and would refer his

²⁵³ C. Everett Koop. *Koop: The Memoirs of America's Family Doctor* (Grand Rapids, MI: Zondervan Publishing Company, 1992): 104-106.

²⁵⁴ Koop recounts in his memoir that he had been neither IS Ravdin's (Chief of Surgery at the Hospital of the University of Pennsylvania) nor Joseph Stokes's (Physician-in-chief of CHOP) top candidate for the position.

²⁵⁵ The infrastructure at CHOP seemed to be that there were no pediatricians who specialized in surgery at this time. The Hospital of the University of Pennsylvania had an adult surgical department where surgical pediatric patients from CHOP would be treated. The idea that CHOP would have its own pediatric trained surgical personnel was revolutionary at CHOP and probably in general as many hospitals lacked pediatric surgical departments. The only hospital that would have had pediatric surgical specialists at this time (to my knowledge) would have been Boston, where they sent Koop to study under Ladd and Gross.

patients only to the care of Koop for the surgery itself, after which the patient would return to Stokes's care. Koop insisted and mandated that he retain responsibility for patients from diagnosis through follow-up care after discharge from CHOP. Stokes agreed to Koop's terms only after a call to Ravdin made it clear that he supported Koop's mandate.²⁵⁶ Other physicians in the hospital also resisted relinquishing their patients to Koop and, as he remembered, made it very clear they neither desired his presence nor felt he and the pediatric surgical department were needed.²⁵⁷ Resistance probably related to financial loss as physicians were paid for the patients under their care, and to sign their surgical patients over meant losing those payments. Koop was also a young and relatively new physician who had yet to gain respect from the long-standing house staff at CHOP (though he did eventually establish himself and garner such esteem).

After nine months as head of pediatric surgery at CHOP, Dr. Koop received an office and moved into a small cubical found for him on the fifth floor (Koop's first office consisted of a table in the hospital library – no walls and no support staff).²⁵⁸ He shared a waiting room and secretary with five other physicians. Koop's lack of an office and adequate support staff reflects the lack of focus on pediatric surgery from hospital administration. Koop worked as surgeon-in-chief and accomplished the leg work for starting his department without expansive support to achieve the goal with which he had been tasked. Without established protocols, a scholarly community producing knowledge

²⁵⁶ Ibid. Koop. *America's Family Doctor*. 104-106.

²⁵⁷ C.E. Koop. "Pediatric Surgery: The Long Road to Recognition," *Pediatrics* 92 (1993): 618-621.

²⁵⁸ Ibid. Koop. *America's Family Doctor*. 105.

and research, basic administrative resources, or appropriate equipment physicians such as Koop and his staff exhibited a great deal of tenacity and fortitude to push ahead regardless and worked with what they had.

As Koop began to perform surgeries on smaller patients into the early 1950s, he recognized many infants could be saved with surgical intervention made possible by his training, the homemade equipment he and his team made, and good nursing care. Dr. Koop placed increasing focus on newborns and their responses to surgery. Not only did he lack administrative space and resources, he and his team lacked some of the necessary pre-made equipment to perform their surgeries on their newborn patients. As mechanical ventilation for newborns was not yet a standard practice, endotracheal tubes used with mechanical ventilation would not have been easily on the market in the 1950s. Thus Koop and his team needed to make such equipment for their smallest surgical patients:

There was no equipment to be bought; we made our own. The night before surgery, we would fashion endotracheal tubes out of red rubber catheters, file the edges with emery boards to prevent injury to the tracheal mucosa, boil them over bent wire...and then begin to experiment with anesthetic gases as well as preoperative medication.²⁵⁹

In the early 1950s, the pediatric surgical department at CHOP began at a time when few resources existed. The lack of scholarly literature, textbooks, adequate training programs for physicians, and major research programs all contributed to a fledgling beginning. Programs to train nurses in the specific care of post-operative newborns also did not exist. The ability to make some of their own tools solved one problem, but Dr. Koop became convinced very early in the process that right-sized equipment was not enough -

²⁵⁹ Ibid. Koop. *The Long Road to Recognition*. 620.

he needed specialized nurses to care for these neonates. CHOP's nurses, as was common in other hospitals at this time, often cared for patients all over the hospital and traveled through the wards on rotation where needed. Student nurses also provided much of the nursing work supervised by graduate nurses at this time. The hospital hired private duty nurses on occasion to care for some patients who needed more intensive care. Koop pushed back on this idea. He believed that the best post-operative care could not save his patients without the expertise of good nurses who knew how to assess the patients for post-operative complications and use the home made equipment effectively.²⁶⁰ Koop and his staff performed surgeries, refined the tools they needed, and worked to determine what the best post-operative care looked like for their neonatal and pediatric patients. While Koop was one of the early pediatric surgeons concerned with neonatal surgery, he was not the only physician working in this area. Another surgical resident from England spent time studying under Ladd and Gross training in the 1940s; his name was Peter P. Rickham (also known as P.P. Rickham).²⁶¹

Following his five years of training in Boston, Rickham returned to his native England to pursue the development of scientific approaches to the care of post-operative surgical neonates. In 1953, he established a neonatal surgical intensive care unit at Alder Hey Children's Hospital in Liverpool, England where he operated and conducted the research he needed to determine a scientific basis for newborn post-operative care. In

²⁶⁰ Ibid. Koop. *America's Family Doctor*.

²⁶¹ Peter P. Rickham. "Thoughts about the Past and Future of Neonatal Surgery," *Journal of Pediatric Surgery* 27, no. 1 (January 1992): 1-6.

1957, Rickham published a textbook on the metabolic responses of newborns to surgery. He reflected on operative mortality and believed the declining operative mortality rates could not, “be ascribed to improvements in the actual surgical technique, as there [were] few technical advances during the last ten years. It should be credited, rather, to more efficient pre- and post-operative management.”²⁶² Nurses provided such pre and post-operative management to Rickham’s patients.

Rickham’s nursing staff oversaw patient assessment²⁶³ and worked with the Oxygenaire surgical incubator.²⁶⁴ The nurses devised methods for urine collection, the development of charting forms specifically for this research, intravenous and oral intake methods, and the use of gastric suctioning. The nurses made the equipment work for the patient and then organized the relevant data for doctors and nurses to use in decisions related to the progression of care. Rickham acknowledged many members of the medical laboratory staff regarding the study, but paid particular attention to the nursing staff,

²⁶² P.P. Rickham. *The Metabolic Response to Neonatal Surgery* (Cambridge: Harvard University Press, 1957). 1.

²⁶³ For more on the nurse’s role in newborn assessment at this time, see Chapter 3.

²⁶⁴ The Oxygenaire surgical incubator was an incubator that particularly allowed for optimal humidity temperature conditions so that post-operative surgical neonates could be watched through a clear partition that enclosed the infant and allowed for the newborn to wear only a diaper as needed. There was a place where x-ray plates could be slid under the newborn without maneuvering the patient. A built in scale was used that allowed for weight to be taken without removing the infant from the incubator. Rickham believed that the incubators made for premature infants were not suitable for surgical neonates and so he and his team modified a Mark IV Oxygenaire incubator. Based on his article published in 1960, nurses would have needed to know how to assess their patients, weigh, position, provide basic newborn care, feed, and aid in procedures while never removing the infant from the incubator. More research into this particular machine and those who used it would be a fascinating vein of study, but beyond the scope of this work. For more see: Rickham, P.P. and Jean Jenkins. “Incubator for Infants Undergoing Surgery,” *Archives of the Diseases of Children* 35 (1960): 71–75. doi: 10.1136/adc.35.179.71.

I should like, however, to mention with gratitude the devoted care given to the patients by the nursing staff of the neonatal surgical unit of the hospital; without their conscientious attention to detail in the pre- and post-operative treatment, this investigation would have been impossible.²⁶⁵

While this was a hopeful time for newborn surgery, Rickham's study highlighted the continued need to differentiate newborns from their older counterparts – infants, children, and adults. Growing scientific evidence noted newborns' different physiology and metabolic responses to the stresses surgery places on the body. Building on the work of surgeons like William Ladd and Robert Gross who laid the foundation for pediatric surgery, Rickham and other surgeons of the time gradually learned to respond to and identify and respond to the unique needs of post-operative newborns.²⁶⁶

Rickham published his groundbreaking findings in an article in the *Lancet* in 1960 arguing the need for good nursing personnel as well as the need for broader infrastructure that included pediatricians, anesthesiologists, lab workers, and researchers needed to influence and grow the field – in short, he recognized the need for a system of support for the unit itself. While Rickham acknowledged that surgical infants could receive good care in general surgical wards, he argued these types of neonatal surgical intensive care units provided a place to focus the research as well as train physicians and nurses to care for these infants particularly. Koop would likely have known of the work done on Rickham's London unit.²⁶⁷ The groundbreaking article in the *Lancet* gave great detail

²⁶⁵ Ibid. Rickham. *The Metabolic Response to Neonatal Surgery*. viii.

²⁶⁶ Ibid. Raffensperger. *Pediatric Surgery Comes of Age*. 121.

²⁶⁷ Isabella Forshall and P.P. Rickham. "Experience of a Neonatal Surgical Unit: The First Six Years," *The Lancet* 261, no. 7153 (October 1960): 751–54.; While I have no evidence that Koop knew of or referenced Rickham's work early on in the process, I think it unlikely that Koop would have not

about the type of care, necessities, and methods used in the unit by Rickham and his staff. Koop's assertion that highly skilled nurses and round-the-clock intensive care were needed coincides with Rickham's statements. While there is no evidence the two ever spoke nor any tangible indication of the degree to which Rickham's work influenced Koop, both physicians shared common themes in the care of post-operative neonates including the cornerstones of good nursing care, the need for proper equipment, and the creation of separate spaces where this care could be focused and given.

Koop's vision and a strong nursing workforce.

The forerunner to the formal infant intensive care unit at CHOP consisted of three incubators set along a wall in one of the children's units that were reserved for sick infants. The hospital staffed these initial beds with private duty nurses hired by the hospital to care for these infants.²⁶⁸ Koop believed there was a better way to provide nursing care to this population. Beginning in 1956, Dr. Koop started to gather preliminary data related to improving outcomes for post-op surgical neonates, and then set out to obtain funding to continue his research and establish a separate space where he

known the current literature (in lieu of the lack literature) related to the surgical neonate. I believe he would have, at some point, known of Rickham's work as it only slightly pre-dated his own and Rickham published as Koop was seeking funding, and would have been cutting edge at the time.

²⁶⁸ Erna Goulding. Personal conversation by Briana Ralston with Erna Goulding, March 2007.; Ibid. Koop. *America's Family Doctor*.

could provide better care with specially trained nursing personnel.²⁶⁹ He spent a great deal of time convincing the hospital administration to allow him specific specialized nurses to provide specific care and arguing that he needed a designated space where his post-operative neonatal patients could receive this care. He wrote three grant applications before one was funded, finally allowing him to establish his neonatal surgical intensive care unit and progress research.²⁷⁰

With this funding, received from the United States Children's Bureau in Washington, D.C. as well as the Department of Public Health of the Commonwealth of Pennsylvania, CHOP launched a five-year pilot study beginning in 1957. This study²⁷¹ was based on the premise that in ideal conditions the survival rates of newborns could be improved with a focus on five particular types of surgery regarding congenital malformations.²⁷² The Children's Hospital received \$375,000 over a five-year period to pay hospital costs associated with the demands of providing care, including nursing care, for medically fragile post-operative newborns and to develop a prearranged formula to determine staffing needs for nursing and for the hospital allocated nurses particular to this

²⁶⁹ Koop states in his memoir that he opened a unit in 1956, though the hospital documents present the IICU as opening in 1962. Koop was probably referring to the three incubators the hospital had prior to the grant-funded unit that included a greater number of beds and specific nursing staff.

²⁷⁰ This information is primarily from secondary sources particularly Koop's memoir and publications. Neither the Children's Bureau nor the Commonwealth of PA have archives that contain old grants. None of the Koop papers (at the College of Physicians, the NLM, or at Wheaton College) contain primary documents.

²⁷¹ I contacted both the Commonwealth of Pennsylvania archives and the National Library of Medicine where the Children's Bureau archives are held but was unable to determine the name of the study or any copies of the original grant. Neither Koop's personal papers from this time period at the College of Physicians nor the CHOP archives contain them to my knowledge.

²⁷² Ibid. Koop. *America's Family Doctor*.

unit.²⁷³ The hospital labeled the unit their *infant intensive care unit* and it is also commonly also referred to as CHOP's neonatal surgical intensive care unit in the literature today, as Dr. Koop used the terms interchangeably in subsequent publications and interviews over the following years.²⁷⁴

Dr. Koop remembered “learn[ing] very early that the best surgery would accomplish little without proper postoperative care...Great technical surgical skill would come to nothing without the complete dedication of the nurses charged with the care of our tiny patients.”²⁷⁵ In his memoir he fondly reminisced on his relationship with the nurses who he credited as vital to his surgical work. He remembered one nurse in particular, Erna Goulding, who would later work with him to establish the hospital's groundbreaking IICU as CHOP's chief nursing officer at the time.

After an initial period, CHOP publically delineated particular characteristics to be true of their IICU nursing staff: a consistent nursing staff – when nurses had no other responsibilities elsewhere in the hospital and could devote themselves to the expertise of this particular patient population, when the same nurses worked with the same patients over the course of the patient's stay, and when this exclusivity existed, the morale of the healthcare team could be bolstered in allowing for interrelationships in which constant

²⁷³ [“The Children's Hospital of Philadelphia”] Box 84, Folder 3, MSS 6/0014-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; The archive does not specify what factors influenced this “formula.”

²⁷⁴ The documents in the archives themselves as well as the nursing personnel interviewed refer to the unit as the infant intensive care unit, or IICU.

²⁷⁵ Ibid. Koop. *America's Family Doctor*.

teaching and learning and comradery could occur. During this time nurses were more generally staffed rather than being assigned to particular units, so having a specific nursing staff would have been an important distinction in considering these IICU nurses as a strength of the unit.²⁷⁶

Dr. Koop emphasized that post-operative care was just as important as good surgical technique and echoed the assertions of earlier pioneers in newborn care such as Julius Hess, Evelyn Lundeen and Geddes. All agreed that nurses were vital to good care for critically ill newborns. In the midst of a time when the biggest and newest machines and groundbreaking medical techniques were given great weight in changing American medicine, these physicians never shied away from championing the foundational need for good nursing care. Koop emphasized that nurses were able to ‘keep all the balls in the air,’ in an environment where intense concentration was mandatory.²⁷⁷ As Koop and his surgical residents performed the surgeries and followed up with their tiny patients, they worked in close proximity with the nurses who constantly stayed at the bedside. Koop based his care on consultation with the nursing staff and relied on them to physically assess the patients, collect data, and manage the bedside equipment at all hours of the day and night. In this way, the nurses participated in the data collection that determined care for each patient. For physicians like Koop, the need for skilled nursing care informed and influenced resource allocation of space, nurses, and the infrastructure of a separate unit.

²⁷⁶ [CHOP Press Surgery/Transplants] Box 84, Folder 3, MSS 6/0014-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

²⁷⁷ Ibid. Koop. *America's Family Doctor*. 135.

“We needed a place to put the babies!”²⁷⁸: The IICU at the Children’s Hospital of Philadelphia

Dr. Koop performed many high profile surgeries and his desire to push the boundaries and discover better models of care for newborns fit with CHOP’s long-standing focus on research that included nurses as an important part of a broader cadre of healthcare personnel in conjunction with pediatricians, anesthesiologists, and respiratory pathologists and therapists. Though the care providers were not limited to nurses and physicians, these nurses served a unique function at the bedside that situated them as a crucial component of the system necessary to intensive care.²⁷⁹ No one doubted the need for nurses in patient care at this time, but this grant and the subsequent space it allocated for a distinctive unit focused in on the foundation of good nursing care, the question of what that meant for patients, and the expectation that these nurses were part of the team in ways unique to intensive patient care at the time. No matter what the nurse staffing was like elsewhere in the hospital, the grant provided that the unit’s nurse to patient ratio would never fall below one nurse to four patients (with a higher nurse to patient ratio when patient acuity increased in the unit).

Nurse Jane Barnsteiner remembered a typical day involved many components of patient care, preparation and time management, and collaboration with other nurses and

²⁷⁸ From a personal conversation with Erna Goulding, RN who was the Chief Nursing Officer at the Children’s Hospital of Philadelphia when C.E. Koop established his post-surgical neonatal intensive care unit. March 2007. Philadelphia, PA. I asked her why they opened the IICU, and her reply was an emphatic: “Well, we needed a place to put the babies!”

²⁷⁹ [Children’s Hospital Annual Report, 1962] Box 4, Folder 7, MSS 6/0014-01, Children’s Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

physicians. Before entering the unit, each nurse was required to scrub in²⁸⁰ and don an isolation gown in an ante chamber outside the unit; this chamber provided a space where those who were not involved in patient care were forbidden, and where physicians, nurses, and (on rare occasions) family members could prepare for entering the unit. Nurses read the charts and became familiar with their patients' medications, gathered supplies, and drew up any medications needed before receiving the patient report from the previous nurse. Upon receiving report, each nurse performed a detailed patient assessment that included assembling vital signs, daily weights, and general patient condition, and then continued with needed surgical dressing changes, hanging any intravenous fluids or medications, and assisting any physicians in procedures as needed.²⁸¹ This type of environment required consistent communication among the nurses and physicians. Barnsteiner remembered, "Well, we really had to trust each other and develop a level of respect."²⁸² Not only did the nurses work closely with each other in the space, but they also worked closely with the physicians on a level that required the same high level of two-way communication. Nurse Jane Barnsteiner remembered that physicians communicated with her and the nursing staff in a way that she felt was different than elsewhere in the hospital:

They had to depend on us and they had to communicate. They had to work with us as team members. So it set up a different kind of working relationship that I

²⁸⁰ To 'scrub in' meant to follow strict hand washing procedures akin to what would be required before entering an operating room. Anyone who entered would have had to wash with particular soap up to the elbows and do so for a set amount of time.

²⁸¹ Jane Barnsteiner. Oral History interview by Briana Ralston, January 9, 2014.

²⁸² Ibid. Barnsteiner. *Oral History*. 5.

think...[was]a different kind than they might have had on a different unit...they encouraged us to call them if anything came up...I know what they [pediatric surgeons C.E. Koop and Harry Bishop] were like...they were not like that working with us in the IICU. They treated us with the utmost respect and as equals.²⁸³

Such working relationships, consistent with the oral history themes from newborn intensive care nurses who practiced during this time (see chapter 3), supported both the transfer of knowledge, the building of trust as the nurses were valued and continued to be highly valued in the unit, and as such intensive and critical care emerged as uniquely effective at CHOP.

When Dr. Koop opened the grant-funded unit in 1962, the neonatal surgical intensive unit contained eight beds located in a large open room surrounded by windows, with a smaller two bed isolation room off to the side. Infants with potentially contagious diseases were cared for in a side room where they could be kept in isolation from the rest of the newborns. The initial unit was ‘close quarters’ as one nurse remembered. The patient beds, largely isolettes, were sometimes only a foot or two apart. She recalled the ability to stand in the middle of the unit and be able to see all the babies, as well as the ones in a small side room reserved for isolation cases.²⁸⁴ Such an allocation of resources, particularly space - to neonatal surgical patients emphasizes the growing importance of caring for sick newborns, and might also have been related to Koop’s success in the field as well as his growing power in the institution as he obtained outside grant funding. At a

²⁸³ Ibid. Barnsteiner. *Oral History*. 13.

²⁸⁴ Dr Barnsteiner commented this room had the feeling of an old closet but was used for patient care when needed. Despite its ‘separate’ situation the nurses could still see inside the room when standing in the middle of the unit.

time when hospitals were growing, subspecialties expanding, and bigger and more complex medical equipment became more commonplace, the importance of creating a space to care for vulnerable newborns carried a great deal of significance.

In 1962, when the unit opened, photographs released in hospital publications reveal a room with a mixture of isolettes and bassinets for infants at different stages of recovery and with varying physiologic needs. While the impetus for the unit's existence in the 1950s was the need for better surgical care for newborns, medically fragile newborns with a wide range of needs were also treated in the unit beginning in its early days.²⁸⁵ The hospital portrayed this unit and the care nurses gave there in their annual reports and hospital publications between 1955 and 1975.

Nursing care in black and white: CHOP's images of their IICU and good nursing care

When the unit was opened in 1962, the hospital presented it to their funders, patrons, and the medical community with a multi-page spread in that year's annual report showing the hospital's pride in the unit and their value of these newborn patients. These images would have been taken by a hired photographer and sanctioned by the public relations department for publication. The photographs of the unit that opened in 1962 did not reveal a room overtaken with machines as we often see in neonatal nurseries today. Though nurses and physicians worked together and used isolettes and ventilators with some of the patients, the early unit more closely resembled the well baby nurseries that were commonplace in hospitals by 1960. The pictures of nurses in CHOP's annual

²⁸⁵ Ibid. Barnsteiner. *Oral History interview*. 1.

reports from the early 1960s were of women who actively participated in developing a system of care, shown in the spaces where that care was given, as they exercised incredible skill and were part of a trusted team of healthcare providers. These women were depicted as a vital part of a new technological system – a system we know as the hospital's infant intensive care unit. These nurses stand at the forefront of the many points in healthcare where patient care and increasingly complex equipment intersected.

The hospital's sanction and publication of images highlighting nurses in the infant intensive care unit in their annual reports reinforce Koop's assertions that the nurse played an important role in this environment and the care given there. The way the nurses are positioned indicate that the equipment was not the initial driving force behind the establishment of the unit. Instead, the nurses represent a very human factor in the care of newborns. Over time, the machines became a much more dominant aspect of the photographs, as the hospital showed images of nurses working with larger and seemingly more complex machines while delivering patient care. By the mid-1970s, the photographs revealed nurses focusing on their tiny patients while manipulating the machines – pumps, tubing, ventilators, and infant bed warmers – necessary for the care they delivered. Even so, the machines do not overshadow the nurses in these images. The nurses continue to be shown delivering patient care while working with the machines, and they continue to be a dominant human presence in the increasingly mechanical and technological system that makes up neonatal intensive care and the units where it was delivered. Even as the machines and equipment became more complex, the mandatory foundation is still good nursing care. The photographs visually build on the writings the

hospital released at the time describing the everyday occurrences of the unit by measuring and detailing how nurses specifically cared for the patients.

In one photograph of the unit, the audience looks over the nurse's shoulder as she walks into the unit. Your gaze cannot miss her starched white uniform and cap. Her arm is outstretched both to hold open the door for you and lingers as if to remind you that you may *not* dart around her into the environment beyond. She will lead you in. This is her space. Beyond her you can see the isolettes lining the glass walls and a cluster of bassinets. Three nurses work diligently with their tiny patients – none of them seem to be distracted by your entrance. The patients are their focus. In this particular photograph, there are no physicians present, only the nurses. While this photograph might have been only one snapshot of a point in time, it does reinforce the assertions of Dr. Koop and the hospital administration: the nurses were vital to the care delivered in this space. The administrators could have focused their visual portrayal on the machines – the incubators, ventilators, and feeding tools – that would have been used in this unit. The PR department could have shown the physicians and introduced their audience to the architecture of the space. Though these tools and the physicians do appear in the photographs, when they are taken as a whole we see nursing as a consistent presence and the nurses as key figures in each image.²⁸⁶

That the nurses and their patients are the focal point of the photos and coincides with Koop's account of his value of the nursing personnel as well as what we know of the

²⁸⁶ The photographs included the way the unit was laid out, there are numerous photographs of Dr. Koop holding his patients, and we see pieces of the machines, isolettes, and other tools the healthcare staff would have used.

role nurses played in caring for critically ill and prematurely born infants in hospitals across the country during the 1950s and 1960s. Though the unit only had a small percentage of the total number of beds in the hospital, it reflected increasing resource allocation devoted to newborns as a particular patient population in need of intensive care given by specially trained nurses.

Growing and changing

Both the hospital and the infant intensive care unit continued to grow. By 1972, CHOP was in the middle of preparations to move from their building on Bainbridge streets to a new location, where the hospital still stands to this day, at 34th and Civic Center Boulevard in the part of Philadelphia now known as University City. The new building more than tripled the hospital's space, increasing it from 240,000 square feet to a spacious 800,000 square feet. Since WWII, subspecialties in medicine have grown at incredible rates and specialists and subspecialties for children emerged as well. By the mid 1970s, pediatric specialty certificates were available in cardiology, hematology, oncology, nephrology, and neonatal and perinatal medicine.²⁸⁷ With advances in medical treatments and technologies as well as broader trends in hospital organization, care for children who required particular treatment in hospitals contributed to hospital expansion.

The new building, a mahogany toned glazed brick included bronze-tinted glass and a twelve foot overhang protecting the front entrance. A spacious entry way and large

²⁸⁷ Sydney Halpern. *American Pediatrics: The Social Dynamics of Professionalism, 1880-1980* (Los Angeles, CA: University of California Press, 1988). 110-1.

landscaped courtyard reaching 134 feet to a glass enclosed roof provided a sunny and luxurious atmosphere to children and their families entering through the front doors. Teaching and research facilities increased greatly as did the numbers of beds across the hospital. The move allowed for an additional 108 beds, bringing the hospital's full capacity to 262 beds.²⁸⁸ The infant intensive care unit also dramatically increased in size. A new infant intensive care unit was built on the fourth floor adjacent to the surgical suite. The old unit held 12 infants at full capacity, and averaged approximately 10 patients at a time, but the unit in the new hospital had space for up to 20 infants.²⁸⁹ The new unit included a waiting area that opened into a gowning room where visitors would wash and apply gowns before entering. From the nursing station, all isolettes could be seen in the ward-like single room.²⁹⁰

The infant intensive care unit also expanded as sicker patients occupied the hospital beds. As more critically ill patients filled the units, the considerations for who required the most intensive ICU care changed. Patients who might have been the sickest just a decade earlier no longer held the delineation of the sickest and thus in need of the most intensive care. CHOP created 'step down' units, where patients who still required more intensive care than they would receive on general floors but were less medically

²⁸⁸ ["The Children's Hospital of Philadelphia Fact Sheet: 1972] Box 21, Folder 11, MSS 6/0014-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

²⁸⁹ [Section 1: Nursing hours per patient per day (cont). CHOP, August 31, 1973] Box 48, Folder 10, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

²⁹⁰ [Memorandum from Martha Walters to Warren Falberg, August 31, 1973] Box 48, Folder 10, MSS 6/0014-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

fragile, might transition out of the IICU into a less critical part of the unit. This transition and patient placement allowed for the IICU to function as a unit devoted only to the sickest and most medically fragile patients.

The hospital changed how they billed their ICU patients in ways that coincided with longer-term stays for previously acute patients who still needed to be in the hospital, but might not need the ICU beds devoted to the sickest newborns. Historian Rosemary Stevens argued that medical insurance impacted the ways hospitals billed patients and removed considerations of cost constraints from the ways hospitals chose to bill based on each patient.²⁹¹ President Johnson signed the Medicaid legislation into action in 1965, and the late 1960s and early 1970s witnessed an expansion of services and increasingly long term in-patient hospital care that also occurred in step down units. CHOP's creation of step down units occurred at a time when they realized they needed to reserve their ICU beds for their sickest patients, so they created step down units during the 1970s as places where chronically ill patients could still receive more intensive (but not as intense) nursing care that could be billed to insurance payers (government and private).

These patients in step down units did not require the nurse to patient ratios and level of care the IICU had, and thus were staffed and managed accordingly. In this way, the infant intensive care unit became a piece of a much larger system of care as some of these infants became chronic patients and required both intensive and chronic care

²⁹¹ Ibid. Stevens. *In sickness and in Wealth*. 257.

beyond the neonatal period.²⁹² Infants needing greater levels of long term care such that they could not be discharged home or to the general wards across the hospital, necessitated the creation of different types of units where they could be cared for by nurses and healthcare personnel trained to care for their specific needs. While the IICU became the place for the sickest newborns in the hospital, it simultaneously became a part of a broader inter-hospital system of intensive care units devoted to newborn care throughout the city and local regions.

Beyond the IICU's walls: The NICU as a focal point for a regionalized system of care.

Regionalization of newborn critical care became an important aspect of the development of neonatal critical care and the units in which it was delivered. Since the turn of the century physicians and hospital administrators struggled with the expense of caring for sick newborns; these units were expensive as they were nurse intensive, equipment intensive, and the beds were specific to a very niched group of patients such that that overflow from other units where older children were cared for could not take these IICU beds. To mitigate this, many smaller areas coordinated their own networks of care in the 1940s and 1950s, transporting prematurely born infants from smaller

²⁹² As infants became triaged throughout the hospital as to who was sick enough to remain in the IICU and who could move to what was called a 'transitional unit' for patients who still needed particular care, but did not need it as acutely.

community hospitals to larger ones that had centers for premature infant care.²⁹³ While these attempts were grassroots in nature, the formalization of regionalized care was not a revolutionary idea unique to sick newborn care. In 1965, the Regionalized Medical Programs signed into law by President Lyndon B. Johnson, created funding for a system of cooperative arrangements among medical schools, research institutions, and hospitals to further education and patient care related to three key areas: heart disease, cancer, and stroke.²⁹⁴

Despite the history of more informal forms of regionalization for newborns, some physicians and healthcare administrators were hesitant to make this practice widespread. George A Little, a neonatologist in New Hampshire, remembered, “people needed to be convinced about applying care in a regional fashion. It was not the way acute care was practiced.”²⁹⁵ While some communities formed regional networks for premature infant and acute newborn care complete with transportation systems, others expressed hesitancy to formalize such an approach when facing new unfamiliar models of acute care and uncertainty about who would pay for it.

In 1972, The Children’s Hospital of Philadelphia started an emergency transportation system to move sick infants from outlying hospitals that did not have

²⁹³ New York and Chicago were two such places that established successful transportation systems between smaller hospitals and larger medical centers equipped to care for the sickest premature infants. For more information see: G.M. Oppenheimer. “Prematurity as a Public Health Problem: US Policy from the 1920s to the 1960s,” *American Journal of Public Health* 86, no. 6 (1996): 870.

²⁹⁴ “The Regional Medical Program: Brief History.” U.S. Library of Medicine, 2013. <http://profiles.nlm.nih.gov/ps/retrieve/Narrative/RM/p-nid/94>.

²⁹⁵ Marguerite Holloway. “The Regionalized Perinatal Care Program” in *To Improve Health and Healthcare 2001: The Robert Wood Johnson Foundation Anthology*. Accessed November 7, 2013. <http://www.rwjf.org/content/dam/web-assets/2001/01/the-regionalized-perinatal-care-program>.

newborn ICU's to meet the needs of their sickest patients. CHOP had long been one of the largest children's hospitals in the area and by 1973 had garnered recognition for their expertise in the care of sick children and infants (though St. Christopher's Hospital would join CHOP within the next year as another local hospital devoted solely to the care of children). Philadelphia pediatricians²⁹⁶ and the Children's Hospital of Philadelphia met to discuss the ways CHOP could help meet the needs of area children. Physicians at the meeting identified the need for a regional transportation system so that newborns and children at area hospitals could be transferred to CHOP for aid during the most acute stage of illness when community hospitals were unable to provide the acute services some newborns needed. CHOP worked with a local ambulance company to establish a Regional Infant Intensive Care Program. This made CHOP's unit the central hub in a broader connection of hospitals that enabled all infants born in an eight county concentration to have access to the level of acute care they needed. By 1974, St. Christopher's Hospital for children also had resource services to dispatch an ambulance with equipment and personnel to transport sick newborns and receive them in their own infant intensive care unit.

The general outline of the program consisted of three main pieces: the notification process at CHOP for transfer, the equipment and tools needed to transport the newborn, and the establishment of criterion for the need of this program. CHOP's goal was to transfer the infants for treatment at CHOP until their need for acute care had passed upon

²⁹⁶ Archival documents do not specify exactly which local physicians were present at this meeting but they were a group of local pediatricians practicing in the Philadelphia area.

which they would be transferred back to their hospital of origin. The service covered eight counties including Philadelphia, Chester, Bucks, Delaware, and Montgomery in Pennsylvania and Burlington, Camden, and Gloucester in New Jersey.²⁹⁷

CHOP agreed to open their unit as the center and arrangements were made with an ambulance company that transportation between outlying hospitals and CHOP would be carried out. The ambulance would cost the parents a flat fee of \$30 for hospitals within the city limits, with out of city transports costing an additional \$1.00 per mile. Upon notification for need for transportation, the ambulance would drop by CHOP to pick up the necessary equipment and the personnel needed: a physician and nurse team “prepared for any contingency affecting the baby.”²⁹⁸ The physician and nurse worked together and both would have needed to understand emergency resuscitation, how to run and troubleshoot any problems with the equipment used during transport, as well as any issues related to newborns that might arise due to medical complications. The nurse would have been trained in the equipment and life-saving measure that might be needed en route. The equipment loaded into the ambulance included an electrocardiogram machine, resuscitation equipment, heart rate monitor, and an incubator designed for emergency transport creating what CHOP referred to as the infant’s own carefully regulated mini-environment. Infants suffering from ten different medical and surgical

²⁹⁷ [General Outline of Transportation Program, March 3, 1972.] Box 46, Folder 11, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

²⁹⁸ [General Outline of Transportation Program, March 3, 1972, page 2] Box 46, Folder 11, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library

categories could be transferred including low birth weight infants, infants with respiratory distress infants and infants with suspected surgical problems.²⁹⁹ The range of both medical and surgical patients was broad, but their classification as neonates unified them all.

After an initial pilot period of one year, St. Christopher's Hospital joined the partnership and served as another center where physicians, nurses and a transport team would be located.³⁰⁰ Newspaper articles lauded the program as a solution to the problem of scarce resources in the region for critical care for extremely sick neonates, labeling the regional transport program as having incredible "life-saving potential."³⁰¹ This put the infant intensive care unit at CHOP at the center of a broader matrix of hospitals and patients who needed treatment and could be transferred to one of the city's two children's hospital to receive it. Newborn critical care did not function as individual units in the

²⁹⁹ [Philadelphia Medicine, Critical Care Nurseries for Optimal Care of the High Risk Neonate, June 5, 1971] Box 79, Folder 1, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; The list included: "...any neonate who presents with diagnostic or therapeutic problem, low birth weight infants requiring intensive care, low birth weight infants or full term infants with respiratory distress, infants with hyperbilirubinemia, infants of diabetic or pre-diabetic mothers, infants with cardiac problems, infants with seizures, infants of heroin addicts or drug abusers, infant with suspected surgical problems, infants with infections..."

³⁰⁰ [Press Release: Sunday February 11, 1973] Box 46, Folder 11, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

³⁰¹ [Newspaper clipping: Infant Intensive Care is Saving Newborns by Patricia McBroom] Box 46, Folder 11, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; [Newspaper clipping: Children's, St Joseph's Hospitals share infant transport] Box 46, Folder 11, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; [Newspaper clipping: Hospital starts program to save stricken infants] Box 46, Folder 11, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; [Newspaper clipping: Mobile care system saves lives of many critically ill infants] Box 46, Folder 11, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

separate hospitals. Physicians and hospital administration transferred sick newborns between each location when neonates needed care that could not be given at a particular institution. Thus NICU care became a system of care that was broader than just the individual units, but functioned as a network of units that shared resources. Considered one of three infant intensive care units in Philadelphia at this time, CHOP was poised as a hospital with trained personnel, beds for the most critically ill, and advanced equipment and technologies to care for these newborns

“Keeping infants alive is only half the battle...”³⁰².

Ventilator-dependent pediatric patients and the chronicity of unintended consequences

By the late 1970s, both the accomplishments of intensive care for newborns as well as unintended consequences emerged in tandem with increased attention on the cost-effectiveness of such highly technological environments. While more critically ill newborns survived, they did not always make full recoveries and some remained dependent on certain technologies their entire lives. As physicians and nurses progressively saved sicker patients, they contributed to the growing issues of chronicity as these patients survived but, in some cases, never left the units. Wayne Hayman was one of those children. Newspaper articles described him as a vibrant and special little boy. Wayne was born with VATER syndrome (also known as VACTERL syndrome).³⁰³

³⁰² [“Keeping infants alive is only half the battle”, Philadelphia Inquirer, September 24, 1978] Box 84, Folder 5, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

³⁰³ Benjamin D. Solomon. “VACTERL/VATER Association.” *Orphanet Journal of Rare Diseases* 6 (August 16, 2011): 56. doi:10.1186/1750-1172-6-56.; VATER syndrome is used to define the presence of at least three congenital malformations that include, but are not limited to, vertebral

Little Wayne underwent 30 life-saving operations before turning three years old. He never left the NICU, though he eventually graduated to the pediatric intensive care unit. By his fourth birthday he had a tracheostomy, was ventilator dependent, had a colostomy, and required a feeding tube to help him eat. Surgical intervention had saved Wayne's life, but he still required intensive medical and nursing care.

Wayne had no family to care for him, so he was made a ward of the state of Pennsylvania and local newspaper columns describe the physicians, nurses, and social workers that cared for him during his tenure at CHOP as "the closest thing he had to a family."³⁰⁴ Wayne's chubby cheeks and bright eyes set him apart from the other patients at CHOP, particularly when coupled with his spunky and joyful attitude. The nurses remembered him as a bit of a jokester, stealing their supplies and playing tricks on them when he could. Due to his tracheostomy, Wayne could not speak, but communicated through American Sign Language and knew over 300 signs that he used to convey his wants, emotions, and needs. Wayne was the longest continual patient CHOP had ever had up until that point. The surgical and daily care over his short life totaled over \$2 million dollars, an unprecedented amount at that time for the children's hospital. By his sixth birthday, Wayne had become the focal point of a discussion about the worth of using technology to save lives.

defects, anal atresia, cardiac defects, trachea-esophageal fistula, renal anomalies, and limb abnormalities. Due to the nature of the congenital abnormalities, surgical intervention is almost always required during infancy.

³⁰⁴ "Little Wayne Gets Pauper's Grave at the End of His Tragic Life." *Associated Press*. February 27, 1985. <http://www.apnewsarchive.com/1985/Little-Wayne-Gets-Pauper-s-Grave-At-End-Of-His-Tragic-Life/id-7f974143319ac5687fbf564195a4a3d9>; "The Only Family He Knew: Hospital Staff Mourns Boy's Death." *Observer Reporter*. February 28, 1985.

The consequences of more invasive and intense medical interventions helped newborns survive but left children dependent on ventilators for their entire lives. These ‘vent dependent’ kids became important aspects of the continual examination of the ongoing care newborn ICU’s delivered. Such scrutiny was not confined to the United States. Canada also experienced extensively long ICU stays as a result of better ability to save the lives of sicker patients and deliver more intensive care. One such example was a little boy named Kevin Keough, a nine year old who resided in the ICU at Winnipeg General Hospital and was ventilator dependent and a quadriplegic.^{305, 306}

The need to keep healthcare spending in check and ensure these units were cost-effective rubbed up against the ethics of who could receive care, what kinds of treatment were offered, and to what extent treatment could go to save a life. Koop organized a national workshop in 1983 hosted by the Children’s Hospital of Philadelphia to discuss national approaches to care for the growing number handicapped children, many of whom would not have survived prior to the establishment of neonatal intensive care and ICUs in hospitals.³⁰⁷ Though the workshop did not focus on NICU patients exclusively, it created a dialogue that considered intensive care for infants and children to be part of a multi-faceted approach to care, and it concentrated on vent-dependent children as an avenue to approach broader fiscal and ethical issues in care. Dr. Koop invited over 170

³⁰⁵ Brandi Vanderspank. “The Social Construction of Intensive Care Nursing, 1960-2002: Canadian Historical Perspectives,” PhD Diss. University of Ottawa, 2014.

³⁰⁶ A quadriplegic is someone who by either illness or injury has decreased or no use of all four limbs.

³⁰⁷ *Surgeon General’s Workshop on Children with Handicaps and Their Families: Case Example: The Ventilator*. Philadelphia, PA: The US Department of Health and Human Services, December 13, 1982. <http://profiles.nlm.nih.gov/ps/access/NNBCGM.ocr>.

people, including healthcare providers, legislative aides, financial executives, and parents and advocates from all over the country. Koop opened the meeting presenting a holistic approach:

Our task at this Workshop is not an easy one. We are asking each other to deal with very complex issues as we keep in mind the many levels of complexity: the emotional and the moral, the medical and the technological, the social, the psychological, and the financial... When we talk about "cost-effective life-support systems," we are implicitly putting some dollar value on a human life. So the moral and the technological and the economic do come together, whether or not we feel comfortable about it.³⁰⁸

Koop rightly acknowledged the complexity of making decisions regarding care and allocation of resources. Medicaid spending had grown exponentially and by the 1980s both private and governmental spending on healthcare had increased drastically. Many aspects of healthcare spending came under scrutiny, including systems such as the NICU.³⁰⁹ One such governmental report, framed as a series of case studies examined the ethical considerations and cost-effectiveness of the NICU. The authors came to the conclusion that with the inability to clearly determine, "factual information, clearer concepts [of neonatal intensive care], and a firmer grasp of the values which public policy does and should promote" were needed to determine more clearly any benefit analysis of the NICU.³¹⁰

³⁰⁸ Ibid. *Surgeon General's Workshop on Children with Handicaps*.

³⁰⁹ Peter Budetti, Nancy Barrand, Peggy McManus, and Lu Ann Heinen. *Case Study #10: The Cost and Effectiveness of Neonatal Intensive Care*. The Implications of Cost-Effective Analysis of Medical Technology. (San Francisco, California: University of California, August 1981).

³¹⁰ Ibid. Budetti, Barrand, McManus, and Heinen. *Case Study #10*. 3.

The concerns surrounding technology dependent patients were not unique to Wayne Hayman nor to Philadelphia; it was a national debate that arose from a recognition that, “the price to pay for the miracles in the intensive care unit turned out to be simultaneous survival of a small number of infants and children who could not be removed from medical technology.”³¹¹ The invention of respiratory ventilator therapies for newborns contributed to increased survival rates, and some infants grew too old to inhabit units for neonates. The CHOP IICU sent some patients to the hospital’s Pediatric Intensive Care Unit (PICU) if required while sending others to step down units within the hospital where physicians and nurses knew how to care for their unique needs. By the mid-1980s, these units became places where families could be intricately involved in patient care learning skills, participating in management decisions, and providing care to their children with the possibility that if they chose to eventually take their child home, they could. Thus the IICU environment changed as it responded to broader trends in patient care. These units became places where the unintended consequences of saving critically ill babies raise the ethical questions of how far to go.

Physicians and nurses and the team of specialists and hospital administrators learned how to save these babies in Philadelphia and the surrounding region, but they did not anticipate the continued dependence these infants might have on the technologies used in their care. Public opinion and debate in Philadelphia swelled on both sides of the

³¹¹ John Monagle and David Thomasma. *Health Care Ethics: Critical Issues for the 21st Century* (Sudbury, MA: Jones and Bartlett Publishers, 2005). 150.

issue.³¹² Stances that chose to focus on the value of these newborns and the hope that they could be saved and fully functional if they received excellent care lauded the units and those who cared for the tiny patients.³¹³ Other writers questioned the long term effects on the newborns who could never successfully be weaned off the equipment and thus required extensive financial and support services for their long-term care.³¹⁴ By the early 1980s, the unintentional consequences of a life-saving system of care became a new key discussion point surrounding the use and continuing development of neonatal intensive care and the associated commitment of resources. Whether or not the type of intensive care that saved lives needed to be allocated so intensely became increasingly scrutinized in the early 1980s, as the issue of technology dependent children became a more dominant theme in pediatric healthcare.

³¹²[Donald Drake. "The Ethics of 'Halfway' Technology." *The Philadelphia Inquirer*. September 26, 1978.] Box 84, Folder 6, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; Linda Herzkowitz. "A Gap in the Medical System." *The Philadelphia Inquirer*. December 14, 1982.; [Marc Kaufman. "A Damaged Life in Intensive Care." *The Philadelphia Inquirer*. December 5, 1983. and ———. Caring for the Impaired: Boy's Death Highlights a Costly Caseload. *Philadelphia Inquirer*. March 3, 1985, sec. C.] Box 84, Folder 7, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; Pat McKeown. "It's a Child's Life Machine and All." *The Philadelphia Daily News*. December 14, 1982.; "The Only Family He Knew: Hospital Staff Mourns Boy's Death." *Observer Reporter*. February 28, 1982

³¹³ One such example: [Article "Life is precious to hospital staff, *The Bulletin*, D5(C), 1981. *The Bulletin*.] Box 79, Folder 1, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; This article was published in the *Bulletin*, Philadelphia's largest circulating newspaper between 1847 and 1982. The newspaper closed temporarily and is has now been reestablished. See also: "It's a child's life machine and all." *The Philadelphia Daily News*, December 14, 1982.

³¹⁴ For an example of such an article: Article "Machine saves babies but then dooms them, *Post Dispatch*. St. Louis, MO, October 10, 1978." Box 84, Folder 5, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.; See also: "Baby's breath: Life on a machine, *Philadelphia Inquirer*. September 26, 1978, 5-A" Box 84, Folder 5, MSS 6/0013-01, Children's Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

Dialogue particularly focused on how the technology was used, on whom it should be used, when and for how long, and who paid for the expensive care surrounding its use. Interestingly newspaper and scholarly articles collectively speak to equipment, but they almost always contextualize it within the units, the ways we choose to treat particular patients, and the broader implications for the unintended consequences of how such care is delivered. Articles from Philadelphia's newspapers, and others from across the state focused on ventilator dependent children but understood the ventilator as part of a broader approach to care. In short, the debate surrounding the long term effects of extensive measures to save newborns overlapped with a growing number of infants who survived critical illness and were living longer lives as chronically ill older children who were very expensive to maintain. This reflects the complexity of a the system of neonatal intensive care, and is just another check point as the 20th century progressed where society questioned their choices of intervention and investment with sick infants who previously would not have survived.

The IICU at CHOP began as a unit that grew in tandem and, in some ways, out of the development of a surgical specialty. As it grew, the unit became part of a network of other hospitals and units that provided intensive care for newborns through a regional transportation system. By the 1980s, the ethical repercussions came into question for the newborns that grew into childhood and continued to require costly treatment and support. Though beyond the scope of this work, the unintended consequences of ICU care for newborns emerged in the

literature and influenced the development of infrastructure as the need for step down units and systems to support the care of some of these children in their homes grew

In some ways, Wayne Hayman's story at CHOP shows how costly intensive care was for newborns and children, but Wayne was also in a unique place in the debates as he lacked a family to care for him at home. The social workers at the Children's Hospital worked diligently to find Wayne a foster family that could handle his particular needs. After months of searching, they finally found a retired practical nurse, Ms. Betty Lamar, who would take in the little boy. The hospital staff felt it could be risky to send Wayne into a Foster home, due to his distance from the hospital setting. But they knew he could not stay in intensive care, so they agreed to train Ms. Lamar to handle his care. Though it had taken a team of physicians and nurses to provide care to Wayne for five years, they hoped he could have a better quality of life outside of the hospital setting. On December 5th, after a year living in foster care with Ms. Lamar, the tracheostomy tube through which the little boy breathed clogged. Despite Ms. Lamar's immediate instigation of CPR, Wayne fell into a coma, and after six weeks died at a pediatric nursing home in New Jersey. His case raised questions about the very personal nature of the growing problem of chronically ill children who had survived the neonatal period to live life dependent on complex and intense care. Wayne needed intense resources that, in his case, highlighted the complexity of caring for children like him. A reporter for the Philadelphia Inquirer posed the questions:

Was it worth it – financially, emotionally and in terms of Wayne’s own suffering – to keep him alive so much longer than we would have without medical technology? Should the same be done for the Wayne’s of the future? No one knows what Wayne would say, but those closest to the case clearly think so.³¹⁵

Wayne’s life and death, the memories of this little boy, and the city’s financial commitment to his care, brought meaning to this boy’s story for the city of Philadelphia. CHOP founded their neonatal intensive care unit particularly to care for post-operative infants, like Wayne, who received initial surgical care. As Wayne grew, he became part of a growing population of children who survived previously fatal congenital conditions only to become patients with chronic health issues. Some children, like Wayne, became ventilator dependent never able to fully be weaned off of the machines. His life and story raised questions about ethics and newborn care as well as questions about the increasingly complex system of support required to keep him alive.

While similar questions occurred in adult units, those who debated the decisions of life and death in newborn intensive care units often had to do so without any direct information about what the long-term consequences would be. Newborns could have 60 to 70 years as productive members of society should they survive intact, but unlike particular determinants for adults, including knowing the wishes of the adult, there were no immediate measures to determine quality or longevity of life for neonates. Until the Baby Doe case in 1981,

³¹⁵ [Marc Kaufman. “Caring for the Impaired: Boy’s Death Highlights a Costly Caseload.” *Philadelphia Inquirer*. March 3, 1985, sec. C.] Box 84, Folder 7, MSS 6/0013-01, Children’s Hospital of Philadelphia, 1855-2006, The College of Physicians of Philadelphia Historical Medical Library.

government and legislative officials had largely left the decision-making process regarding patient care and life support to physicians, nurses and the families. With the introduction the Baby Doe cases in the early 1980s, the government passed a law known as the Baby Doe law that began debates about who could and should be saved and who decided what potentially lifesaving treatments to give.

The reality of the extent that neonates born with particular congenital abnormalities or at very low birth weights could survive had been proven to some extent in the NICUs of the 1960s and early 1970s. The Baby Doe cases became the public and legal arena for debates about whether or not the newborns *should* be saved and who made that decision.³¹⁶ One Baby Doe in particular, a little boy born in Indiana in 1982, greatly influenced the debates. Baby Doe was born with Down's Syndrome and a trachea-esophageal atresia. His parents, in conjunction with their obstetrician, believed that even if the baby boy received lifesaving surgical correction of the trachea-esophageal atresia, he would have little quality of life and food; water and surgical intervention were withheld until death. The baby died when he was six days old. Legal debates as to the degree that the parents could decide to withhold 'life saving treatments' were initiated but not completed prior to the infant's death and eventually reached the Surgeon

³¹⁶ Jon Tyson. "The Baby Doe Regulations in the United States: A Controversial and Uncertain Legacy," *Low Birth Weight* 5, no. 1 (Spring 1995).
<http://futureofchildren.org/publications/journals/article/index.xml?journalid=60&articleid=380§ionid=2566&submit>.

General's office.³¹⁷ This case, in conjunction with other legal cases heard at both the state and federal levels throughout the 1970s and early 1980s placed the intensive care units for newborns in the middle of intense and complicated debates about who should receive care and who could make those decisions.³¹⁸ Physicians, nurses, and families at CHOP, as one of 600 NICUs in the country,³¹⁹ entered the 1980s facing these legal and ethical questions.

Conclusion:

As lifesaving medical and surgical techniques expanded for the newborn population, so did the variety of healthcare professionals, equipment, and systems needed to change the mortality rates. Koop knew he needed expert and skilled nurses to work with his surgical patients, but Koop's recognition of good nursing care would not have been revolutionary in and of itself. He understood that these nurses could better care for the babies if they were supported by creating a dedicated space, given consistent and adequate staff, supplying appropriate tools, and giving them the authority to make decisions and "do something" to protect and care for these infants. A highly technological system developed that not only included pediatric surgery and a space to put the infants post-operatively, it involved decisions that affirmed nursing care as central to patient survival. This assumption of good nursing care, among other factors, fueled the creation

³¹⁷ John Britton. "'Baby Doe' Rulings: Review and Comment," *West Journal of Medicine* 140, no. 2 (February 1984): 303–7.

³¹⁸ I acknowledge this to be true and a book end to my time period of interest, though the ethical debates and implications are beyond the scope of my work to be addressed further here.

³¹⁹ Ibid. Budetti, Barrand, McManus, and Heinen. *Case Study #10*. 4.

of an infant intensive care unit where the sick and surgical newborn patients could receive the care they needed. The Children's Hospital of Philadelphia serves as an example of the growth a neonatal ICU heavily influenced by the development of a surgical specialty, and demonstrated the value of an infrastructure that supported good nursing care and expertise. Regionalization of neonatal intensive care in the Philadelphia area meant that the hospital and its healthcare staff transported and cared for infants from around the region providing sophisticated care that many hospitals could not afford to provide. Like their adult counterparts in adult ICUs, the neonatal nurses proved central to the idea of intensive care as well as to the care these infants needed as they became chronically ill.

The Children's Hospital of Philadelphia highlights the ways nursing influenced the need to establish an infrastructure for caring for a particularly vulnerable population. Good nursing care was widely acknowledged as needed, but a dedicated space at CHOP was implemented so that the nursing care could be optimized. Once the IICU was established and grew, physicians and nurses began to discover that though many newborns "graduated" from the unit without significant chronic impairment, a growing population of ventilator dependent chronically ill children became part of the IICU legacy. Society lacked resources for their long-term care and there were no long term plans for paying for the extensive and expensive therapies these children needed. As the early 1980s dawned, the use of highly complex treatments and technologies came under scrutiny as the Baby Doe cases raised questions about the ethical use of machines and technology.

While CHOP clearly highlights the ways intensive care for newborns arose in one hospital as a way to meet the need for surgical patients, the establishment and evolution of newborn care at Boston Children's Medical Center shows a very different story of how their unit formed. In the next chapter, I will explore how another children's hospital in a large northeastern city met the need for particularized care for critically ill newborns.

Chapter 5:

Complex roots of influence:
Nursing and the NICU at Boston Children's Hospital

Complex roots of influence: Newborn ICU care at Boston Children's Hospital

On August 8, 1963 a cadre of presidential physicians and secret service personnel rushed Jacqueline Kennedy to Otis Air Force Base where she gave birth to her second son, Patrick, born five and a half weeks early.³²⁰ Immediately following his birth, physicians diagnosed Patrick with respiratory distress syndrome and transferred him by ambulance to Boston Children's Medical Center (BCMC)³²¹ for treatment. Chief of Pediatrics at Boston Children's Medical Center, Dr. James E Drorbaugh, accompanied the baby for the one and a half hour ambulance ride.³²² By the time Patrick arrived at BCMC, the pediatrics team who transferred him knew something was seriously wrong.³²³ Physicians and nurses admitted him to the hospital's newborn intensive care unit placing him in an Isolette and providing intensive care and support.

Despite skilled care, Patrick's condition did not improve, so the medical team decided to offer him a new form of treatment known at the time as hyperbaric medicine. They placed him in the hospital's hyperbaric chamber where he experienced an

³²⁰ "August 7, 1963 – Press Secretary Peirre Salinger announces the birth of Patrick Bouvier Kennedy" YouTube video. :32, posted by "HelmerReenberg," February 26, 2013, <http://www.youtube.com/watch?v=dU7z7KOeizM>.

³²¹ The hospital was originally referred to as Boston Children's Hospital, but for clarity and flow I will consistently refer to it by its current name that was used upon its establishment as a "medical center" in the annual reports in the 1950s. Subsequent abbreviations for Boston Children's Medical Center will appear as BCMC.

³²² William Blair. "2nd Son Born To Kennedy's Has Lung Illness; Child Transferred to Boston After Birth at Cape Hospital," *New York Times*, August 8, 1963. ProQuest.; "Kennedy's Baby Taken Ill: Kennedy's Baby Born Prematurely, Taken Ill," *Los Angeles Times*. August 8, 1963. ProQuest.; Laurence Burd. "Newborn Kennedy Son Ill: Name, Baptize Infant Suffering Lung Ailment," *Chicago Tribune*, August 8, 1963. ProQuest.; "Kennedy Baby Dies at Boston Hospital; President at Hand," *New York Times*, August 9, 1963. ProQuest.; Lawrence Altman. "A Kennedy Baby's Life and Death," *New York Times*, July 29, 2013. http://www.nytimes.com/2013/07/30/health/a-kennedy-babys-life-and-death.html?pagewanted=all&_r=0.

³²³ Ibid. Burd. *Newborn Kennedy Son Ill: Name, Baptize Infant Suffering Lung Ailment*.

atmospheric pressure environment up to four times greater than normal. The physicians believed that this change in environmental pressure allowed for an increase in the newborn's tissue oxygen levels. Unfortunately the treatment did not work. Patrick succumbed to respiratory distress and died the morning of August 9, 1963.^{324,325}

The American people adored the Kennedy family. When the Kennedy's second son Patrick died, that admiration intensely focused the nation's value of newborns, and the need to improve mortality rates associated with respiratory distress. Patrick Kennedy's story resonates in the memories of many Americans as one of the major events that drastically affected not only the Kennedy family but the nation. As previously noted the post-war 1950s was built partly upon the framework of the importance of the family; thus the grief and loss experienced by the President's family resonated with all families and reinforced the need to battle the devastating effects of RDS. BCMC chose to offer a highly experimental form of treatment that few other babies experienced—hyperbaric medicine - to baby Patrick, perhaps in an attempt to save the baby's life when nothing else worked. Though the chamber was located outside of the newborn intensive care nursery, it was an extension of the desperate attempts to treat RDS and care for medically fragile and prematurely born infants. The story painted a broader picture of neonatal intensive care and its possibilities as a technical system beyond the unit as a

³²⁴ "Press Conference at 04:26 a.m., Friday 8/9." Children's Hospital Medical Center, June 4, 1964. Celebrity Files. (AC 1) Boston Children's Hospital Archives, Boston, Massachusetts. Box 12.5, folder 188.; "Kennedy Baby Dies at Boston Hospital; President at Hand." *New York Times*. August 9, 1963.

³²⁵ "High Hopes for High O2 Therapy: Medical World News, March 13, 1964." Facilities Planning. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 10, folder 23.

focal point for care. In this chapter I will argue that newborn intensive care at Boston Children's Medical Center emerged because the hospital administration made decisions to allocate space and nursing personnel based on the value of caring for all critically ill newborns, and with the impact of emerging technology and therapeutics - particularly skilled nursing care. These influences did not result in the immediate establishment of an ICU at BCMC, but influenced the creation of units that over time laid the foundation for what became the Neonatal Intensive Care Unit.

Boston, premature newborns, and the shared mission of two hospitals

BCMC's neonatal intensive care unit grew out of the approach the hospital had previously taken to care for sick newborns. Boston Children's Medical Center had a critical care unit for newborns by the 1960s, and the unit had roots deeply embedded in the hospital's premature infant nursery, established at their sister institution Infants' Hospital, in the 1930s. Between BCMC's 1889 establishment and the 1950s, the hospital did not care for infants less than two years of age. Eventually recognizing the need to encompass newborns and young infants, the hospital chose to form a relationship with the Infants' Hospital in 1922 in an attempt to share limited financial resources, skilled manpower, and precious hospital space to extend hospital care to sick infants.³²⁶ To allow for closer proximity and sharing of resources, Infants' Hospital sold their original property and moved into a new building adjacent to the Children's Medical Center. The

³²⁶ "The Children's Hospital and the Infants' Hospital, Boston, Massachusetts. By Kenneth Blackfan" Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 7, folder 90.; "Infants Hospital Annual Report, 1922" Internet Archive. Retrieved from <https://ia600706.us.archive.org/7/items/infantshospital33140infa/infantshospital33140infa.pdf>.

two hospitals shared nursing staff and administrative organization with the intention of allowing Infants' Hospital to function more economically, for BCMC to have access to medical and nursing care for newborns and infants, and to improve efficiency for both institutions.³²⁷

A Premature Infant Unit

As early as the 1930s BCMC and Infants' Hospital recognized the need to group prematurely born newborns together to provide specific care for them. According to national and state census data for 1925, the mortality rate related to neonatal prematurity was by far the highest cause of death for infants less than one year of age. More infants in the state of Massachusetts died of prematurity than all the other causes of death in early infancy combined.³²⁸ By this time, decreases had been made in many causes of death for older infants, but prematurity did not experience a significant similar decrease in mortality rates. In light of national attention on premature infants and a recognized need to lower premature infant mortality (see chapter 2 for discussion of national trends)

³²⁷ One data source suggests the discussion might have been broader than resources. Despite the unified administration an administrative manager at the Children's Hospital denied that these attempts at efficiency and more fiscally wise management of resources did not lead to financial savings as, "...the better a hospital, the more it costs; and these costs, dependent...on ever increasing demands for...studies and more intensive nursing, far outweigh the saving in unified administration." For more see: Clement Smith. "The Children's Hospital of Boston: Built Better than They Knew" (Boston, MA: Little Brown and Company, 1983). 5-7.

³²⁸ *Mortality Statistics: 1925*. Washington D.C.: Department of Commerce and Labor Bureau of the Census, 1925. 200. http://www.cdc.gov/nchs/data/vsushistorical/mortstatsh_1925.pdf.

particularly within the state of Massachusetts, Boston Children's Medical Center and the Infants' Hospital collaborated to open a Premature Infant Nursery in 1932.³²⁹

The Infants' Hospital opened its unit just prior to the initiation of a broader public health movement in 1937 aimed at creating an infrastructure to address the needs of premature infants in the state of Massachusetts that included: establishment of premature infant centers (units) in 48 hospitals across the state, the development of educational materials for physicians and nurses (both premature infant unit nurses and public health nurses), and the passing of a "Premature Infant Law" aimed at eliminating economic barriers families might have faced in transferring their babies to the hospital.³³⁰ As part of a push to get newborns born prematurely at home into hospitals for the care they needed, Massachusetts created centers in hospitals that could receive and care for the newborns. The state Board of Health developed educational materials for public health nurses related to the appropriate care of premature infants prior to transfer and follow-up care once the infant returned home, and created 'institutes' for the training of nurses by other nurses. This program was not the only program of its kind in the United States at this

³²⁹ Though the premature unit is credited as established in 1932 by hospital historians and secondary sources, the hospital's annual reports did mention care of premature infants as early as their 1896 annual report though no details are given as to how and where they cared for these infants.; "West End Nursery, Annual Report, 1896." Retrieved from <https://archive.org/details/infantshospital31421infa>.

³³⁰ Florence McKay. "Massachusetts State Program for the Care of Prematures," *American Journal of Public Health* 31, no. 1 (January 1941): 72-78.

time as other large cities such as Chicago and New York also published their attempts to create citywide infrastructures to battle the problem of prematurity.³³¹

In 1937, Massachusetts initiated their premature infant program due to their belief that premature infants who received hospital care had higher survival rates than those born and cared for at home. The program was based on the tenet of transferring premature infants from home into the approximately 50 hospitals in the state to receive care in these specialized premature infant units. Hospitals that opened these units provided their own financial and spatial resources.³³² Infant's Hospital was one such premature infant center, and most likely one of the largest.

Physician and historian Clement Smith³³³ described the premature infant unit of the Infant's Hospital as a separate unit enclosed within the larger hospital where both mechanical complexity and the unit census grew steadily throughout the 1930s and into the 1940s.³³⁴ The unit, distinct from the other areas of the hospital, organized care primarily around prematurely born infants defined as “weighing less than 5 ½ pounds.”^{335, 336} As the hospital did not have a maternity service, all patients were

³³¹ G.M. Oppenheimer. “Prematurity as a Public Health Problem: US Policy from the 1920s to the 1960s,” *American Journal of Public Health* 86, no. 6 (1996): 870.; Helen Wallace, Margaret Losty, and Samuel Wishik. “Prematurity as a Public Health Problem: Administration of a Public Health Program for the Care of Premature Infants,” *American Journal of Public Health* 40 (January 1950): 41–47.

³³² Ibid. McKay. *Massachusetts State Program for the Care of Prematures*, 72–78.

³³³ Clement Smith is considered by many to be the father of modern neonatal medicine in the United States. He published prolifically between 1950 and 1980.

³³⁴ Ibid. Smith. *Built Better than They Knew*. 121.

³³⁵ For more on discussions regarding prematurity defined by birth weight rather than gestation at this time, see Chapter 2.

transferred from homes or other hospitals, and nursing staff kept careful records upon patient intake as to demographic data, from where the infant was transferred, diagnosis, and referring physician.³³⁷

Both administration for Boston Children's and the Infant's Hospital weighed in on the building of the premature infant unit. The hospital built the unit with a focus on basic tenets of thermoregulation needed for newborn infants. The initial unit consisted of two air-conditioned rooms one above the other. Kenneth Blackfan, Physician-in-Chief of the Children's Medical Center, believed air maintained at particular temperatures would help with the temperature regulation critical to the care of premature infants, a primary concern for nurses and physicians caring for prematurely born infants. Since the unit was divided between two separate floors, nursing staff often had to walk through other wards when traveling between the two parts of the unit, thus increasing potential for bringing infection into the premature infant nursery. Dr. Stewart Clifford, head of the premature infant service, remembered the unit's arrangement was sound from a technical point of view as it made the engineering of the space more efficient when considering the process of pumping temperature controlled air into the unit; but he bemoaned the medical repercussions as this arrangement did little to prevent the spread of infection, and perhaps enhanced the spread, as the nurses and aids had to travel elsewhere through the hospital

³³⁶ As patient records are kept confidential and not accessible by the CHOB archives, I cannot comment on race or class issues based on this data. I do know from where infants were transferred generally speaking, and will comment on this phenomenon later in the chapter.

³³⁷ "Infants' Hospital Patient Forms." Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 7, folder 92.

should they need to enter the other half of the divided unit.³³⁸ As infection risk was one of the most important considerations in the premature infant units, particularly because all of their patients were admitted from other hospitals or home births, the control of infection remained paramount to the prevention of the spread of disease.

Infection Issues:

Hospital-acquired infectious disease was a long-standing problem particularly for maternal and newborn hospital wards. Outbreaks of staphylococcal infections in hospitals, both in adult wards and in newborn nurseries - well baby nurseries and premature infant units - arose as a major health problem. Hospital-acquired staph infections manifested ranging from skin lesions filled with pus in areas where skin folds occur to pneumonia and septicemia.^{339, 340} Many medical practitioners and researchers tried to understand how to prevent the spread of disease among hospital patients, particularly newborns, and their case studies and essays fill the disciplinary literature well into the 1960s.³⁴¹ Sulfonamides, and later antibiotics, for children and adults were

³³⁸ "Report on Premature Infant Services: Report by Steward Clifford, MD., 1955" Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³³⁹ Septicemia, also known today as sepsis, is a complication of widespread infection that can result in that patient going into shock and ultimately death. Newborns are particularly prone to shock and can deteriorate very quickly requiring intense support.

³⁴⁰ Thomas Shaffer, Robert Sylvester, Jack Baldwin, and Melvin Rheins. "Staphylococcal Infections in Newborn Infants," *American Journal of Public Health* 47 (August 1957): 992-3.

³⁴¹ For examples see: Ibid. Shaffer, Sylvester, Baldwin, and Rheins. *Staphylococcal Infections in Newborn Infants*, 990-994.; Dean Clark, William Altemeier, C.P. Cardwell, Maxwell Finland, Horace Hodes, Martha Johnson, and Alexander Langmuir. "The American Hospital Association's Report on 'Prevention and Control of Staphylococcal Infections in Hospitals,'" *American Journal of Public Health* 48, no. 8 (August 1958): 1071-74.; Heinz Eichenwald and Henry Shinefield. "The Problem of Staphylococcal Infection in Newborn Infants," *Journal of Pediatrics* 56 (May 1960):

developed and used throughout the 1930s and 1940s, but physicians did not have sound guidelines for dosing children, much less sick newborns or premature infants.³⁴² Even a decade later into the late 1950s, reports and research focused on the prevention and control (versus treatment) of infection when it appeared in newborn and premature infant nurseries.³⁴³ According to historian and physician Clement Smith, The Infant's Hospital attempted to decrease infection rates by preventing the spread of infection. One way they attempted to address this issue was to change the premature infant unit's physical layout to provide each patient with his own incubator. The hospital also changed policies requiring nurses to put on special gowns before handling patients. Special gowns for nurses and physicians who cared for premature infants had been used for years and commonly appear in photographs of early premature infant units.³⁴⁴

665–74.; Horace Gezon, Donovan Thompson, Kenneth Rogers, Theodore Hatch, Russell Rycheck, and Kenneth Yee. "Control of Staphylococcal Infections and Disease in the Newborn through the Use of Hexachlorophene Bathing," *Pediatrics* 51, no. 2 (February 1973): 331–44.; Louis Gluck and HF Wood. "Effect of an Antiseptic Skin-Care Regimen in Reducing Staphylococcal Skin Infections in the Nursery," *New England Journal of Medicine* 265 (1961): 1177–81.; Guy Lavoipierre, Kenneth Newell, Margaret Smith, and Dorothy Le Blanc. "A Vaccine Trial for Neonatal Staphylococcal Disease," *American Journal of Diseases of Children* 122 (November 1971): 377–85.; E.A. Mortimer, P. Fischer, N. Jenkins, and D. McGirr. "Staphylococcus in the Nurse," *The American Journal of Nursing* 61, no. 10 (1961): 56–59.; Thomas Shaffer, Robert Sylvester, Jack Baldwin, and Melvin Rheins. "Staphylococcal Infections in Newborn Infants," *American Journal of Public Health* 47 (August 1957): 990–94.; Margaret Thomas. "Nursing Procedures in the Management of Staphylococcal Infections," *American Journal of Public Health* 50, no. 4 (April 1960): 497–503.

³⁴² Cynthia Connolly, Cynthia, Janet Golden, and Benjamin Schneider. "'A Startling New Chemotherapeutic Agent': Pediatric Infectious Disease and the Introduction of Sulfonamides at Baltimore's Sydenham Hospital," *Bulletin of the History of Medicine* 86 (2012): 66–93.

³⁴³ Dean Clark, William Altemeier, C.P. Cardwell, Maxwell Finland, Horace Hodes, Martha Johnson, and Alexander Langmuir. "The American Hospital Association's Report on 'Prevention and Control of Staphylococcal Infections in Hospitals,'" *American Journal of Public Health* 48, no. 8 (August 1958): 1071–4.

³⁴⁴ "Sixty second annual report: Report of the Physician and Chief" Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 6, folder 77.

Dr. Clifford reported that in 1945, the unit had a mortality rate of 60% among the premature infants admitted, with a large number of these deaths due to infection. Clifford and Charles Janeway, Physician-in-Chief of the Infants' Hospital, considered advising the hospital trustees to close the unit all together due to the high mortality rates, believing that these newborns could not be safely cared for together in one room. Malfunctioning air conditioning equipment in 1946 forced the institution's hand, and instead of repairing it, the unit relocated to a larger unified (single room) nursery isolated from all other units. With the addition of a steam autoclave and individually air-conditioned incubators, as well as changing their gowning policies, the hospital implemented multiple strategies to decrease their mortality rates.³⁴⁵

Initially, the hospital chose to prevent the spread of infection by reserving the right to refuse admissions to premature infants who might have been an infection risk. Almost all of the infants the hospital received were transferred from other institutions or homes as the children's hospital had no maternity service. The physicians originally believed that some of these transfers from other hospitals or homes increased the risk of introducing the healthy premature infants to potentially fatal infections and thus complications. This issue was not just in the premature infant unit, but also seen across the hospital wards as well. In an attempt to curb broader hospital problems with the spread of infection, hospital policy mandated that all nursing personnel wear gowns over their nursing uniforms. Hess and Lundeen outlined this gowning practice in great detail in

³⁴⁵ "Report on Premature Infant Services: Report by Steward Clifford, MD., 1955" Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

their 1941 textbook, explaining the procedure for putting the gowns on and taking them off; such education probably reflected either the belief that this practice should be common, or that it already was common in newborn units around the country.³⁴⁶, ³⁴⁷ Each gown was left next to each patient's bedside under the belief that when gowns were worn, infection could not be easily spread on the clothes of nurses and physicians. Not all physicians were happy with the practices and pediatric surgeon, Robert Gross, weighed in on the issue when he wrote to Dr. Clifford,

... the gowns which hang in the cubicles are the surest method of spreading infection from one patient to another! I do not believe it is possible for a number of individuals – nurses or doctors – to get in and out of a single gown without getting everything pretty much smeared up with whatever germs are on the gown...³⁴⁸

The hospital changed their gowning policy and, effective June 1951, all nurses wore simple aprons over their nursing uniforms when caring for patients coupled with standard practice of rigorous hand-washing techniques. Within two years, the infection rate had indeed decreased, proving to Clifford and Smith, head of Infants Service at the Infant's Hospital, that with careful attention and simple protocol changes, and proper infectious control practices, newborns could be cared for in wards together with other newborns without spreading infection

³⁴⁶ Julius Hess and Evelyn Lundeen. *The Premature Infant: Its Medical and Nursing Care*. (Philadelphia: J.B. Lippincott Company, 1941).

³⁴⁷ Despite the common appearance of gowning in early photographs of premature infant units, publications in the scholarly literature (other than Hess and Lundeen's 1941 textbook) do not evidence any research or common protocols related to gowning. Gloves were never mentioned in articles or textbooks and seem to not have been common practice in premature infant units of the time.

³⁴⁸ "Letter to Dr. Clement Smith from Dr. Robert Gross, June 24, 1950." Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

rapidly among the patients.³⁴⁹ Such evidence reinforces the notion that highly technological strategies, though absolutely profound, do not undermine or overshadow the importance of faithful adherence to simple strategies and problem solving.

Nurses played a role in this decrease in hospital-acquired infection rates as they vigilantly worked at the bedside with the patients, providing care and critical assessment and surveillance as well as monitoring who had access to the patients and when. When nurses did not follow proper technique, they risked spreading infectious disease throughout the units. In their textbook, published in 1942, Julius Hess and Evelyn Lundeen³⁵⁰ credited the nursing personnel with, “the fact that the responsibilities for infections occurring in the nursery rests with them. They must constantly be alert for breaks in technique...the nursing standards must be carried out during the entire 24 hours.” While the hospital documents do not blame the nursing staff for issues in infection outbreak, they make it clear that nurses functioned within broader policies and infrastructure to achieve and to oversee proper infection control. Clifford and Smith sought to support the nursing personnel and provide the best possible nursery arrangements (broadly speaking) so that proper technique could be consistently practiced. Proper technique

³⁴⁹ “Report on Premature Infant Services: Report by Steward Clifford, MD., 1955” Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁵⁰ As referenced in Chapter 2 and 3, Hess and Lundeen were the physician and nurse team who established the most famous premature infant unit in Chicago's Michael Reese Hospital and published the first seminal textbook on the nursing care of premature infants.

included vigorous hand washing³⁵¹ before and after contact with the patient (or donning the gown, as some hospitals still did), and included considerations about when and where to care for a baby that might be infectious.³⁵² Hess and Lundeen did not consider keeping isolation patients in the same room as non-infectious patients inappropriate as long as nurses were careful to follow technique. Proper technique included wearing the appropriate protective gear such as gowns and masks as well as washing hands, keeping the patients' belongings and equipment clean, and making sure each patient had his or her own supplies and equipment.³⁵³

Based on the hospital's decrease in hospital-acquired infection, particularly in the premature infant unit, Smith pushed back against the notion that infants with any consideration of infection should be excluded; he argued that with good nursing care, correct hand washing and appropriate use of anti-bacterial scrubbing agents, and careful attention to unit policies that spelled out infection control, the spread of infection could be avoided.³⁵⁴ The hospital's ability to combine infectious and non-infectious patients in

³⁵¹ The documents specify anti-bacterial scrubs that might have included early formulations of what is now known as phisoHex, but I am unsure the particular antibacterial agent used and thus cannot specify.

³⁵² Interestingly, the discussion of the use of gloves when caring for patients does not appear in the literature or textbooks of the 1940s and 1950s. I cannot comment that this was or was not a part of the protocol, but recognize that it does not appear in the literature or documents.

³⁵³ Ibid. Hess and Lundeen. *The Premature Infant: Its Medical and Nursing Care*.; "Proceedings: Fifth Annual Meeting of the American Academy of Pediatrics. June 7, 1935," *Journal of Pediatrics* 8, no. 1 (January 1936): 104–21.; Ethel Dunham. *Standards and Recommendations for Hospital Care of Newborn Infants, Full-Term and Premature*. United States Dept. of labor, Children's bureau, 1943.

³⁵⁴ This stance is supported in two separate documents: "Letter from Dr. Stewart Clifford to Miss Vesey, Head of Nursing Service at the Infants' Hospital, June 28, 1955." Infants' Hospital (AC 3) The Children's Hospital of Boston, Boston, Massachusetts, Box 8, folder 107.3.; "Conclusions reached on Procedures for Newborn Nursery – Infants' Hospital, Children's Medical Center, June 7, 1955" Infants' Hospital (AC 3) B 8, folder 107.3.

one unit proved to be critical to the future formation of spaces where all neonates could be cared for in one unit.

An expensive unit to run...

As the units saved lives, costs also rose. Premature infant centers incurred great costs for hospitals and the Infants' Hospital unit was no exception. The increased costs of equipment, such as incubators,³⁵⁵ rose in the years just after World War II and, coupled with increases in wages for hospital employees, including nurses, combined to create one of the most expensive units in the hospital, contributing heavily to deficits in the hospital's operating budget by the late 1940s. With hospital-wide costs increasing, the incredible financial resources needed for the premature infant nursery became more prominent in the hospital administrative records.

To help alleviate the cost of overall increased hospital overhead the 'incubator patients' in the premature infant nursery were charged \$15.00 per day, almost twice that of the \$8.00 per day patients in other areas of the hospital were charged. Hospital Director Dr. Charles Branch referred to the disparity being due to, "the exceptional nature of the care required and given in the Premature Nursery."³⁵⁶ Such exceptional care encompassed the particular nursing care required as well as the equipment such as

³⁵⁵ While I do not have exact data pertaining to the cost of incubators during this time period, articles were published that articulated the specific requirements of incubators and articles that included instructions how to build them. Instructions on how to build portable incubators also appeared in the literature. One possible interpretation here is that the incubators were expensive enough to buy that makeshift ones could be assembled by hospitals who might not be able to afford the ones on the market.

³⁵⁶ "The Infant's Hospital: Report of the Director for the year 1946." Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 6, folder 77.

oxygen systems, medications, and incubators needed for each newborn in the unit. Financial costs related to the establishment of premature infant units encompassed the initial cost of construction, the ongoing reservation of space for those beds when other paying patients might fill them, and the cost to purchase and repair and equipment³⁵⁷ in addition to the 24 hour a day concentrated nursing care the patients received.

Dr. Smith commented, “Many hospitals held back from establishing adequate nurseries for their premature infants because of the great cost to the hospital in providing care for these infants...,” but he added, “...two factors have now made the hospital willing to assume this risk.”³⁵⁸ These two factors addressed payment issues. The first was the growing membership in Blue Cross Insurance group. Blue Cross plans were a third party payment plan developed in the 1930s to address the increasing costs of hospital care that the majority of patients were unable to afford. Such programs were intended to alleviate financial stress on individuals and families in times of sickness and fill the hospitals with more paying patients. Historian Rosemary Stevens particularizes that such payment plans were not meant to provide hospital access to everyone, as eligibility for obstetrics took one year to go into effect and the plans did not include payment for mental health services.³⁵⁹ While more people were insured and the Blue Cross programs did provide certain funding to pay for services, Massachusetts also

³⁵⁷ Ibid. Wallace, Losty, and Wishik. *Prematurity as a Public Health Problem*, 41–47.

³⁵⁸ “Report on Premature Infant Services: Report by Steward Clifford, MD, 1954-1955” Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁵⁹ Rosemary Stevens. *In Sickness and in Wealth: American Hospitals in the Twentieth Century*. (Baltimore, MD: The Johns Hopkins University Press, 1989). 185-188.

enacted a law in 1949 that made the local Board of Health financially responsible for the care of infants born below 4 ½ pounds.³⁶⁰ Such funding made the hospital administration willing to keep the unit open because they believed they could cover the costs, but reimbursement only came when patients were admitted to the unit.

During the 1950s, many smaller hospitals opened or expanded existing premature infant units as premature infant care became more commonplace and Massachusetts funding laws covered premature infant care. Dr. Clifford and his team determined that as outlying hospitals opened premature infant units and were able to care for the less acutely ill premature infants, they would only transfer the sickest, and most expensive to the Infants' Hospital premature unit. According to one report, fifty-two hospitals transferred premature infants needing longer term and more critical care to Infants' Hospital in 1954, in addition to the premature infants received from home deliveries.³⁶¹ Infants' Hospital became the main support for smaller community hospitals without the expensive resources needed to care for smaller premature infants who developed complications. The Infant's Hospital was important not only to the city of Boston, but the provision of its resources also reached beyond the city limits into four neighboring states.³⁶² This also meant that the more expensive patients requiring more complex care ended up at Infant's

³⁶⁰ "Report on Premature Infant Services: Report by Steward Clifford, MD, 1954-1955" Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁶¹ "Report of the Premature Infant Unit Service Hospital, Children's Medical Center, 1955." Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁶² This is an example of a type of non-formalized regionalization commonly seen in premature infant care in the 1950s as regionalized neonatal care networks would not formalize until the early 1970s. This regionalization is discussed further in chapter 3.

Hospital thus saving the suburban hospitals the higher costs of patient care. Between 1951 and 1954, Infant's Hospital census remained consistent at approximately 100 newborns admitted each year with a high patient acuity, meaning the hospital admitted the sickest patients and provided the most intensive and expensive care to them.³⁶³ More stable patients who would have been less expensive to care for remained in their hospitals of birth; during the 1950s specialized training was becoming more common for physicians and nursing staff and smaller hospitals would have been more likely to have physicians and nurses who knew how to care for more stable premature infants as well as sick full term infants.³⁶⁴ Despite the consistency of higher acuity patients admitted to the Infant's Hospital, the census remained too low to make the increasingly high cost of care financially feasible for the hospital.

“Incubator patients” and a broader newborn population: Ideas for a newborn nursery

The Infant's Hospital did not have the resources to continue allocating skilled nursing personnel and precious hospital space with fewer beds filled on average; thus the need to determine how best to provide particular care to premature infants became an important issue for the administration who oversaw both BCMC and the Infant's Hospital (as they still shared administrators and staff). While the Infants' Hospital boasted successful care and decreased premature infant mortality during the early years of the

³⁶³ “Table 1, Report on Premature Infant Services: Report by Steward Clifford, MD, 1954-1955” Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁶⁴ Articles appeared with greater frequency in the literature and textbooks began to be published in the 1940s that encompassed the premature and sick infant.

1950s, both administrators at Infant's Hospital and Boston Children's Medical Center recognized a dire lack of resources. As the Infant's Hospital functioned at its capacity to provide care to premature infants, they searched for a better solution to the high costs of care.

The cost of nursing personnel was one of the highest costs in critical care units during this time period. Unlike many of the general units, these intensive care facilities required full graduate nursing personnel around the clock.³⁶⁵ While students might have provided some care, they always needed to be supervised by a graduate nurse who monitored their technique and practice very closely. Worried about the costs, Clement Smith conducted a study to understand where the expenses were concentrated and analyzed the arrangement of nursing personnel in respect to per capita occupancy. His results showed that the premature infant unit required at least three graduate nursing personnel - in addition to any nursing students assigned to the unit -for each 24 hour period, and covered eight to twelve premature infants at any given time (though the census rarely filled the 12 beds isolettes available). Smith identified the periods when only a few babies occupied the premature infant nursery as time when the hospital experienced "wastage of valuable nursing skill."³⁶⁶ He considered the skill the premature infant nurses demonstrated mandatory to premature infant care as well as beneficial to the

³⁶⁵ Julie Fairman and Joan Lynaugh. *Critical Care Nursing: A History*. (Philadelphia, PA: University of Pennsylvania Press, 1998).

³⁶⁶ "Report on Premature Infant Services: Report by Steward Clifford, MD, 1954-1955" Infants Hospital (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3. p 3.

broader neonatal population. These nurses were too precious a resource to use elsewhere in the hospital.

Unlike elsewhere in the hospital, only nurses particularly trained to work in the premature infant unit could work there, unlike the rest of the hospital where nurses generally could work in any of the units as needed as patient census increased or decreased. Clement Smith recognized, “a staff of nurses particularly skilled in the care of premature (and, therefore newborn) infants must consistently be assigned to the Children’s Hospital Premature Nursery.”³⁶⁷ On the one hand, nurses established in the intensive and expert care required for premature infants had skills that enabled them to provide quality care to a broader patient population of newborns; but this skill and expertise also earmarked them as unique to this unit.

With the shortage of nurses and of space, and the inefficiency of operative far below capacity, and with the technical improvements brought about principally by the Isolette, the question arises whether the care of prematures in the Infants’ Hospital could not be consolidate with the care of sick infants so as to make more effective use of space and manpower. A tentative proposal would be to place the Isolettes on one side of Infants’ Upper and make this area for care of premature *and* newborns infants.³⁶⁸

The physicians and hospital administrators valued the ways the premature infant nurses might meet broader demands throughout the hospital and, in an attempt to prevent

³⁶⁷ “Correspondence between Dr. Clement Smith and Dr. David Rubenstein. January 27, 1955.” Infants’ Hospital. (AC 3) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁶⁸ “Possible reorganization of premature division of Infants’ Hospital, September 28, 1954.” Infants’ Hospital. (AC 3) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

wasting expensive and valuable nursing skill, responded with changes to their premature infant unit. Ultimately the hospital reached an ingenious solution to their problem: they recognized specialized skills in the premature infant nurses and enlarged the population of the units thus broadening the types of patients for whom the nurses could provide care.

A Time of Transition to the Newborn Nursery

On June 29, 1955, the hospital closed their premature nursery and opened a “Newborn Nursery” with the purpose of providing more economical and practical intensive patient coverage to all newborns, premature as well as full-term sick and surgical neonates.³⁶⁹ This occurred after a committee met and drafted a report to Dr. David Rubenstein, head of department services that concluded the premature infant unit was too costly to maintain. The committee, consisting of two physicians and one nurse, recommended that the hospital reorganize their approach to newborn care to use limited resources to the most efficient advantage. Sick newborns already occupied the premature infant unit as well as filling beds throughout the rest of the hospital. Correspondence between Smith and Rubenstein provides insight into the possible ways the hospital could continue to provide specialized and skilled round-the-clock intensive care to their newborn population.

The hospital admitted increasing numbers of sick and surgical newborns that required intensive care beyond the more traditional premature infant care. Smith

³⁶⁹ “Subject: Neonatal Nursery. June 29, 1955” (AC 3) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3

proposed the formation of a new nursery that could include any newborn patient who needed a particular kind of intensive care. Smith believed that by combining both premature infants and sick full-term infants, they could use their nursing staff more efficiently and maximize precious space to keep costs down for the hospital.³⁷⁰ Smith articulated,

I have agreed that a change in our nursery arrangements would allow much more efficient use of nurses' time... An increasing proportion of the babies on these wards are newborn ones, with erythroblastosis,³⁷¹ respiratory distress syndrome, congenital malformations, and so forth.³⁷²

While premature infants occupied a particular unit, newborns with congenital malformations, blood disorders, and respiratory distress syndrome were admitted to other parts of the hospital. By 1955, the surgical endeavors of Gross and Ladd on smaller infants meant that occasionally surgical newborns would be shuffled off to post-operative units elsewhere in the hospital as they initially would not have been considered

³⁷⁰ "Report on Premature Infant Services, 1954-1955" Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3. ; "Conclusions reached on procedures for Newborn Nursery – Infants' Hospital, Children's Medical Center, June 7, 1955." Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁷¹ Erythroblastosis fetalis, or hemolytic disease of the newborn, occurs when an Rh positive mother's blood crosses the placenta and mixes with her Rh negative baby's blood resulting in neonatal jaundice and high bilirubin levels that can cause severe damage to the brain and internal organs. The result can be fatal. Much scholarly literature came out during the 1950s as researchers sought to decrease mortality rates related to this condition; the treatment of choice at this time included complete blood transfusions of the infants. Much more could be said about this disease and its implications, but is beyond the scope of this particular work.

³⁷² "Newborn Nursery, July 1955." Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

candidates for beds in the premature infant unit (as they were not premature but surgical infants).³⁷³

According to hospital memos, the new unit located in the Infants' Hospital would be a general newborn nursery that was set to occupy half of the second floor ward space of the Infant's Hospital. The nurses that occupied the positions in the premature unit became the nucleus of the nursing staff on the new newborn unit. Nurses were added to their numbers so that the nursing staff that worked in the newborn nursery did not have responsibilities elsewhere in the hospital and other nurses would not need to be brought in to cover during times of higher unit census.³⁷⁴ The hospital chose to use particular nurses who had specialized skills to care for this now broadened patient population.

With the goal of keeping a census at approximately 12 infants (and more if possible), the patient population encompassed any infant less than one month of age not suffering from diarrhea.³⁷⁵ The four priority patient populations included (in order of priority of admission): prematures, erythroblastotics,³⁷⁶ congenital heart disease,³⁷⁷ and

³⁷³ "Correspondence between Dr. Clement Smith and Dr. David Rubenstein. January 27, 1955." Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁷⁴ "Conclusions reached on Procedures for Newborn Nursery – Infants' Hospital, Children's Medical Center, June 7, 1955." Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁷⁵ Sick newborns can become dehydrated incredibly quickly and succumb to the effects of severe diarrhea – electrolyte imbalances, hypovolemia, and low glucose levels – much more quickly and acutely than their older pediatric counterparts in part because of their immature systems. Epidemics of diarrheal disease could wipe out large portions of newborn nurseries within days. Newborn nurseries struggled to combat these diseases as, at this time, IV's to replace fluid for newborns were yet to be perfected and rehydrating these infants orally could become increasingly difficult.

³⁷⁶ For examples of in the literature see: Fred Allen, Louis Diamond, and Victor Vaughan. "Erythroblastosis Fetalis: VI Prevention of Kernicterus," *American Journal of Diseases of Children* 80, no. 5 (1950): 779–91.; A.H. Tuttle. "Serum Pigment Studies in Newborn Infants:

non-infections medical cases. General priority for admission was given to infants with more chronic conditions most likely with the intent that they ensured adequate census (and thus filled the beds) and had higher survival rates than their more medically fragile and ill counterparts.³⁷⁸ Interestingly, this consideration of who would be allowed into the unit reflects both the recognition of who could be saved and the focus on who was valued, but also took into consideration how the hospital would meet their census requirements and remain financially viable.

A series of memos among hospital administration, physicians, and nursing staff, established regulations and suggestions to shape the organization of the newborn nursery.³⁷⁹ These matters of policy included the organization and assignment of space, nursing practices, admission regulations, the use of various pieces of equipment necessary to the medical care, and defining patient population. The committee developed policies and protocols that restricted entrance to The Newborn Nursery to nursing and

Erythroblastosis Fetalis,” *JAMA Pediatrics* 89, no. 5 (1955): 544–52.; “Hemolytic Disease of the Newborn,” *Lancet* 272, no. 7041 (August 9, 1958): 303–4.

³⁷⁷ P.P. Rickham. “Neonatal Surgery: Early Treatment of Congenital Malformations,” *Lancet* 259, no. 6703 (February 16, 1952): 332–39.; Patrick Ongley, Alexander Nadas, Milton Paul, Abraham Rudolph, and George Starkley. “Aortic Stenosis in Infants and Children,” *Pediatrics* 21, no. 2 (1958): 207–21.; Congenital heart disease still remained a leading cause of death in babies, but as Gross and Ladd (among others) pioneered better surgical methods for smaller patients great strides were made in the treatment of some congenital heart defects.

³⁷⁸ “Conclusions reached on Procedures for Newborn Nursery – Infants’ Hospital, Children’s Medical Center, June 7, 1955.” Infants’ Hospital. (AC 3) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁷⁹ “Memo from Dr. Steward Clifford to Miss Vesey, June 28, 1955.” Infants’ Hospital. (AC 3) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.; “Conclusions reached on Procedures for Newborn Nursery – Infants’ Hospital, Children’s Medical Center, June 7, 1955.” Infants’ Hospital. (AC 3) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.; “Memo and drawing of Newborn Nursery, March 23, 1955, from Dr. Charles Janeway to Dr. Daniel Rubenstein et al.” Infants’ Hospital. (AC 3) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3

hospital staff assigned to the unit, effectively sealing off the unit to the curious, while also establishing the particular domain of the realm of sick newborn care. House officers and medical staff rounded on the newborn patients first before rounding on any other hospital ward. Anyone wearing street clothes was required to don a hospital gown over their clothing and adhere to vigorous hand washing protocols prior to entering the unit.³⁸⁰

The new nursery was located in the South Wing of the Infants' Hospital and only accessible via the set of small side doors past the sinks. A general sketch of the potential set up of the unit reveals aspects of the unit that the committee considered important, including Isolettes and oxygen setup, the unit's strict entrance and exits, and the possibility of rearrangement of space should the census exceed 12 patients at any given time. The large double doors that were to remain closed distinctly separated the unit from another area designated for procedures such as weighing, supply storage, and treatment procedures as well as separating the unit from the rest of the hospital. The area itself was 46' by 20' for a total of 920 square feet. The side door where physicians and nurses entered the unit opened to a separate small room with its own sink, presumably for the hand washing procedures laid out in the committee's initial report.³⁸¹ This arrangement provided flexibility of space arrangement, selected access, and the use of particular

³⁸⁰ Ibid. *Memo from Dr. Steward Clifford to Miss Vesey, June 28, 1955.*; Ibid. *Conclusions reached on Procedures for Newborn Nursery – Infants' Hospital, Children's Medical Center.*

³⁸¹ "Memo and drawing of Newborn Nursery, March 23, 1955, from Dr. Charles Janeway to Dr. Daniel Rubenstein et al." Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3; Interestingly, though the unit seems outfitted for 12 babies, the author included a note in the center of the page that up to 30 babies could be cared for in this space – more than twice the original intent.

equipment and machinery including incubators and oxygen equipment for basic respiratory support.

During the 1950s, hospital construction moved toward more private rooms or smaller wards as patient privacy and hospital amenities became a bigger driving force behind where patients chose to go for care. Elsewhere in the Infants' Hospital, patients occupied cubicles where each patient would have an area set apart. While this practice reflected trends in broader hospital construction, it also contributed to the hospitals' attempts to prevent infection by separating patients from each other. The Newborn Nursery had a ward layout where the nurses could see all of the patients throughout the room at any given time, as it still does today. According to the hospital's plans for the newborn nursery, the Infants' Hospital did not feel the need to create private spaces for each newborn, though the emphasis on the use of Isolettes delineated more 'privatize' space for each infant within a mini-environment that separated each from his or her neighbors.³⁸²

Nurses had complete visual access to their patients, but did not have unlimited physical access to their patients. They learned to perform their skills through small portholes in the sides of the Isolettes.³⁸³ One of the more common incubators used at the time, the Isolette, incorporated a Plexiglass box with holes on the side of the incubator

³⁸² "Conclusions reached on Procedures for Newborn Nursery – Infants' Hospital, Children's Medical Center, June 7, 1955." Infants' Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 8, folder 107.3.

³⁸³ This had always been an aspect of practice for nurses caring for premature infants. Though it is unknown whether they had the same policies specifically, they were almost always depicted during this time period working through the portholes as the nurses at CHOB had been instructed to do.

through which a nurse could put her hands to provide care. Photographs from hospitals across the country beginning in the 1940s reveal the act of nurses caring for their patients while separated from them by Plexiglass. The nurses learned to provide an incredible amount of care through these ‘portholes’ and would have done everything from changing diapers and weighing the patient, to learning to reposition the patient for assessment. Even today, this practice is a hallmark skill learned by new NICU nurses; the experience can be cumbersome initially but it served (and still does) to maintain a temperature and humidity regulated environment for each patient. This porthole policy reinforced the careful intentionality of safe practices for avoiding hospital-acquired infections, as well as dictated how the nurses could provide care. Hospital administration valued the skill the nurses who worked in premature infant units brought to the intensive care.

Even as the Boston Children’s and the Infants’ Hospital consolidated the care of sick newborns, the institutions still struggled to meet the rising expenditures of patient care, and for the fiscal years 1961 and 1962, the hospitals experienced deficits in their annual budgets across the hospital. They shifted their focus to increasing occupancy³⁸⁴ in a healthcare world where patients could choose where they wanted to go and hospitals were only paid for the beds they filled.³⁸⁵ By 1963, the hospital made drastic changes in their infrastructure by closing of the Infants’ Hospital. The newborn nursery was

³⁸⁴ “Annual Report Boston Children’s Hospital, 1962.” Boston Children’s Hospital Archives, Boston, Massachusetts. Retrieved online: <https://archive.org/details/1962annualreport1962chil>.

³⁸⁵ Ibid. Fairman and Lynaugh. *Critical Care Nursing*. 36-7.; Ibid. Stevens. *In Sickness and in Wealth*.

completely moved into Boston Children's Medical Center (BCMC) and within two years of this shift BCMC was referring to the unit as their neonatal intensive care (NICU).³⁸⁶

While what we label a space matters, it might not necessarily clearly define points when a particular type of care was given. The care provided in the Newborn Nursery in the Infant's Hospital reflected early tenets of what we consider 'intensive care' today. Fairman and Lynaugh argue that although "critical care" is a more modern concept, its roots lie in established and older practice that sick patients be grouped together with hope of survival. While the label *critical* or *intensive care* defines what we consider to occur in ICUs today, the concept of a place where skilled caregivers "kept watch by intensive observation" evolved in settings that included a variety of names.³⁸⁷ The newborn nursery's move into the hospital's main building and the renaming of the unit as an ICU reflect the degree of value placed on this particular patient population. There is no evidence in the hospital archival documents that any significant changes occurred during the transition from "Newborn Nursery" to NICU – the equipment, though it continued to grow and change, still included the same basic machines, the specialized nursing staff continued to provide intensive constant care, and the hospital continued to keep space set apart for their newborns. Both the premature infant unit and the newborn nursery were intensive care units in their own right, and delivered particular types of care that were intensive in nature. The transition to NICU reflected the emerging state of intensive care medicine that had already been labeled in adult units beginning in the 1950s. By 1963

³⁸⁶ "Infants' Hospital Annual Report, 1961." Infant's Hospital. (AC 3) Boston Children's Hospital Archives, Boston, Massachusetts. Box 6, folder 54.

³⁸⁷ Ibid. Fairman and Lynaugh. *Critical Care Nursing*. 3.

and the birth and transfer of Patrick Kennedy to BCMC, the unit was introduced as a “neonatal intensive care unit” establishing importance and garnering confidence in the public eye.

Diving Babies: Critical Care and Hyperbaric treatments

In 1963, President John F. Kennedy’s son Patrick arrived at Boston Children’s Hospital from Cape Cod, Massachusetts suffering from severe respiratory distress secondary to his prematurity. He was so ill the neonatal specialists offered him a treatment still considered highly experimental: hyperbaric oxygen therapy.³⁸⁸ Hyperbaric oxygen therapy had proven in some studies to be of value when oxygenating tissue as well as for treating ‘the bends’ - a common problem among SCUBA divers.³⁸⁹

Hyperbaric oxygen therapy was based on a limited body of research suggesting its use with neonates requiring respiratory support. As of November 1962, the Boston Lying-In Hospital, a sister hospital of Boston Children’s, did consider the use of hyperbaric medicine for newborns and purchased “a small hyperbaric tank” the size of most incubators of the time for use in research related to hyperbaric medicine used for

³⁸⁸ “Background of Hyperbaric Therapy, n.d.” Boston Children’s Hospital Office of Facility Planning Records. (AC 10) Boston Children’s Hospital Archives, Boston, Massachusetts. Box 4, folder 23.; Committee on Hyperbaric Oxygenation. *Fundamentals of Hyperbaric Medicine*. Washington D.C.: National Academy of the Sciences, 1966. 1.

³⁸⁹ SCUBA diving is Self Contained Underwater Breathing Apparatus diving. It occurs when someone dons breathing apparatus and descends below the surface of the water. The diver is capable of breathing underwater for a set amount of time depending on the volume of breathing gas he takes with him and the depth to which he wishes to descend. The bends occurs when divers ascend from underwater too quickly and the change in atmospheric pressure causes the gases in their blood stream to expand forming larger bubbles of air that can cause pain, and in some cases, death.

neonates.³⁹⁰ The hospital used the chambers, produced by the Emerson Company, with newborn and prematurely born infants suffering from severe hypoxia.³⁹¹ The basic premise suggested that since many infants struggled with oxygen intake, the hyperbaric oxygenation would allow for optimal oxygen transfer for these infants who often presented with severe cyanosis.³⁹² Dr. William Bernhard, physician at Boston Children's, considered hyperbaric medicine for use in studies related to long-term therapy for infants with hyaline membrane disease.³⁹³ Boston Children's did not have the hyperbaric isolettes that Boston Lying-In had, but they used a large chamber on site that fit multiple adults and was used for broader research purposes.

When Baby Kennedy arrived the physicians were desperate. The life of the President's son was on the line and they were willing to do whatever they could, even if it was not a standard practice at the time, particularly since he was a famous baby; such treatments would probably not have been afforded to other less high profile patients admitted. While Baby Kennedy was treated in the hospital's newborn intensive care nursery, the physicians made a critical decision to transport him through the hospital to

³⁹⁰ This information suggests that Boston Children's was not the only hospital in the area thinking about the uses of hyperbaric medicine with neonates; though I came across this data in a document I have no further information. This would be a strong piece of data and worthy of further investigation for further research related to hyperbaric medicine and neonatal patients.

³⁹¹ "Letter from Dr. Leonard Cronkhite to Mr. Wayne McRae, November 9, 1962" Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 22.

³⁹² Cyanosis occurs when a patient's skin and mucous membranes turn blue or grey in color as a result of decreased blood oxygenation.

³⁹³ "Letter from Dr. William Bernhard to Dr. Leonard Cronkhite, November 21, 1962" Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 22.

the facility's hyperbaric chamber in a desperate attempt to save his life.³⁹⁴ When baby Kennedy entered the chamber, a cadre of specialists accompanied him, including two nurses.³⁹⁵ They aimed to increase his oxygenation with the hope that given extra time, his breathing could improve. Other researchers were doing studies on hyperbaric medicine and newborns in 1963; a seminal article published just a year later did achieve limited success using hyperbaric treatments with neonates.

Researcher and physician James Hutchison and his team in Glasgow achieved limited success in newborn resuscitation by exposing asphyxiated newborns to greater atmospheric pressures.³⁹⁶ Using Perspex pressure chambers,³⁹⁷ designed by the Vickers Group Research Establishment, infants who did not respond to traditional positive pressure ventilatory interventions were placed in a small pressure chamber and immersed in pure oxygen at 2-4 atmospheres of pressure.³⁹⁸ Slightly over half of the infants who received this intervention survived; such statistics were comparable, if not slightly better,

³⁹⁴ "List of staff and personnel who participated in the care of Patrick Kennedy, August 13, 1963" Boston Children's Hospital, Celebrity Files (AC 1) Boston Children's Hospital Archives, Boston, Massachusetts. Box 12.5, folder 188.

³⁹⁵ Though these nurses participated in delivering care to the infant, neither was listed in hospital documents as being present in the chamber when baby Patrick passed away.

³⁹⁶ J. Hutchison, M Kerr, K.G. Williams, and W. I. Hopkinson. "Hyperbaric Oxygen in the Resuscitation of the Newborn," *The Lancet* 282, no. 7316 (November 16, 1963): 1019–22.; ———. "Letter to the Editor: Hyperbaric Oxygenation in Resuscitation of the Newborn," *Lancet* 283, no. 7326 (January 25, 1964): 225.

³⁹⁷ This machine was built by the Vickers Group Research Establishment to research the therapeutic effects of high pressure oxygenation on the neonate. It was built in 1960 using the same basic tenants used for similar machines used with adults. The machine included a double layered clear tube into which the infant could be slid inside through an opening at one end. The other end contained a series of electric connecting ends to which monitoring leads could be attached to the infant.; J. Hutchison, M Kerr, K.G. Williams, and W. I. Hopkinson. "Hyperbaric Oxygen in the Resuscitation of the Newborn," *The Lancet* 282, no. 7316 (November 1963): 1019–22.

³⁹⁸ *Ibid.* Hutchison, Kerr, Williams, and Hopkinson. *Hyperbaric Oxygen in the Resuscitation of the Newborn*, 1019–22.

than contemporary modes of positive pressure ventilation used with neonates during this time period. Hyperbaric medicine did not carry the same risks such as pneumothorax³⁹⁹ (though it carried other risks), and was based off of the concept of using the oxygen already in the blood stream to optimal effect.

Hyperbaric Medicine and newborn physiology

Hyperbaric oxygenation works on the physics of Henry's Law. Hemoglobin, located in red blood cells, binds to oxygen in the blood that transports it to body tissue as needed, but oxygen can also be transported, though much less efficiently, when the gas is dissolved in the blood. At one atmosphere of pressure (the state we function in every day) not enough oxygen can be dissolved in the blood to meet body requirements. When the atmospheric pressure on the body is increased, greater amounts of oxygen can be dissolved in the blood and thus transported to the tissues. When the oxygen concentration in breathed air increases from 20.9% to 100%, the amount of oxygen dissolved into the blood increases proportional to the increase in atmospheric pressure.

During the early 1960s, respiratory distress plagued newborn populations with no viable treatment methods or standards of care for newborns with respiratory distress as premature infants' lungs are incompletely developed. Positive pressure ventilation had not yet become the standard of practice and in lieu of the abysmal survival rates for newborns with respiratory distress researchers attempted other ways to treat respiratory distress among newborns. Ultimately the goal remained the same: to get much needed

³⁹⁹ Pneumothorax occurs when the lung tissue is punctured or bursts causing the lung to collapse.

oxygen to the tissues of infants whose lungs did not work properly yet. Physicians and researchers at Boston Children's Hospital focused their efforts and resources on hyperbaric medicine - a branch of therapy and medical specialty that some believed might be a viable approach to making strides in the treatment of hyaline membrane disease⁴⁰⁰ and respiratory distress.

Hutchinson and his team were careful to articulate the importance of understanding his negative pressure resuscitation method not as a response to RDS, as it could not treat respiratory acidosis, but as a possible method of treating newborns for whom they could not establish initial breathing patterns.⁴⁰¹ Hutchinson argued that placing an infant in a chamber might be a better alternative to positive pressure ventilation, as tracheal intubation as part of PPV "requires a degrees of skill not always easily at hand in smaller maternity units and in areas where paediatricians have far-flung commitments. Hyperbaric oxygen can be used by any doctor after a brief course of instruction."⁴⁰² Hutchinson believed this technological innovation required less skill than that required to intubate and establish positive pressure ventilation in newborns.

The idea of treating patients under hyperbaric conditions was not new, but came as a piece of a larger general interest in hyperbaric medicine.⁴⁰³ Harvard School of Public

⁴⁰⁰ For more on this disease and its impact see Chapter 2.

⁴⁰¹ Ibid. Hutchison, Kerr, Williams, and Hopkinson. *Hyperbaric Oxygen in the Resuscitation of the Newborn*, 1019–22.

⁴⁰² J.H. Hutchinson, M. Kerr, John Inall, and Robert Shanks. "Controlled Trials of Hyperbaric Oxygen and Tracheal Intubation in Asphyxia Neonatorum," *Lancet* 287, no. 7444 (April 30, 1966): 935–39.

⁴⁰³ A short video of the chamber located at Harvard's School of Public Health exists online. "Cardiac Surgery in Old Hyperbaric Chamber at Children's Hospital Boston, circa 1964," YouTube video,

Health owned a hyperbaric chamber available for research purposes. Newborns joined a long and varied list of the chamber's occupants. Because the chamber existed as the only one of its kind at an academic institution in the United States, both governmental and private agencies used the chamber for an array of research.⁴⁰⁴ The U.S. Navy researched the physiological effects of high atmospheric pressure on the human body.⁴⁰⁵ In September 1962, the newborn surgical service at Boston Children's received permission from the trustees at the Harvard School of Public Health to use the hyperbaric oxygen chamber to research on the effects of hyperbaric oxygenation on newborns undergoing cardiovascular surgery.⁴⁰⁶ Before July of the following year, they proceeded to perform 21 successful cardiovascular operations in the chamber on infants less than 6 months of age who would have died without the procedures.⁴⁰⁷

On August 5, 1963, just days before Baby Kennedy arrived to Boston for treatment, doctors at Boston Children's successfully performed open-heart surgery on a baby who suffered from aortic stenosis, a condition in which the aorta carrying blood from the heart to the body is narrowed, preventing oxygenated blood from entering

posted by "BCH Archives." Accessed April 15, 2014, http://www.youtube.com/watch?v=d9m-SYHQrgg&feature=youtube_gdata_player.

⁴⁰⁴ "Letter from Leslie Silverman to Miss Nancy Faber, February 25, 1963" Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 23.

⁴⁰⁵ "Letter from Leslie Silverman to Miss Nancy Faber, February 25, 1963" Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 23.

⁴⁰⁶ "Letter from the Trustees of Harvard to Drs. William Bernhard and Leonard Cronkhite, September 5, 1962." Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 22

⁴⁰⁷ "Pamphlet: The Hyperbaric Chamber." Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 22

systematic circulation and often leaving the heart overworked. Inside the chamber, the doctors proceeded to successfully repair the newborn's cardiac condition under a pressure of 3.4 atmospheres (over three times the usual limit).⁴⁰⁸ Blue babies, a common name for a group of infants born with a complex cardiac malformation that impaired their blood oxygen levels leaving them severely cyanotic, comprised the largest group of infants who received surgical treatment in the chamber.

According to a memo sent in 1962 from Murial Vesey, head of nursing at Boston Children's at the time, nurses were not required to be present in the hyperbaric chamber during surgical procedures, though they accompanied the infant before the procedure. A team of nurses were trained to work in the chamber and often did, but were not always required. Documents specify that nursing roles were performed by one of the surgeons or physicians in the chamber: "Since there is no nurse in there [the chamber] as a rule, this would mean that either the surgeon or the anesthetist would have to take the responsibility..."⁴⁰⁹ Such a 'rule' highlights both a gendered and power tension as to who was important to enter the chamber even when a particular job needed to be done. The surgeons and other physicians would not have easily taken over the role of the nurse in a ward or unit setting during this time, but their power over the technology trumped their need for a nurse present and made them willing to perform a job otherwise not theirs.

⁴⁰⁸ "Press Release, August 5, 1963: The Children's Hospital Medical Center." Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 4.

⁴⁰⁹ "Letter from Miss Vesey to Dr. Leonard Cronkhite, December 13, 1962" Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 22

Another possible reason for nurse exclusion might have been related to the mechanics of how the chamber and pressurization worked. Each person who entered the chamber when it was in use would have been put at risk for the bends. The hospital took out an additional insurance policy for those staff that were trained and approved to work in the chamber, a costly addition to overall expenditures related to the chamber. In addition, each person who entered the chamber would have had to experience a period of decompression lasting from 15 to 45 minutes depending on the duration of time spent in the chamber; this would have meant anyone who entered the chamber would have not been available to care for patients for a significant amount of time.⁴¹⁰

Even so, Miss Vesey still participated in the preparation of the policies as the head of nursing by initiating memos outlining aspects of patient care and the process that traditionally would have fallen on nurses present in the surgical suit. We still might consider the chamber's use as an extension of the care delivered in the intensive care unit even if it did not become standard treatment, and it is important to consider that the value placed on nursing staff in the units by the hospital did not fully translate to the chamber setting.

The chamber itself had a separate and fascinating history that has yet to be explored in the scholarly literature. The hyperbaric chamber was just one treatment modality in the story of Boston's NICU in the early 1960s affected by the intense search for a solution to the problem of RDS. The use of hyperbaric medicine with newborn

⁴¹⁰ "Letter to Drs. Leonard Cronkite and William Bernard, September 5, 1962." Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 22.

infants for both surgical and respiratory issues might have stayed a footnote in a letter buried in the archives were it not for its use with baby Patrick Kennedy. The willingness of his physicians to use this highly experimental form of treatment fits with what we know of the broader story of newborn medicine; traditional options of the time did not reliably work, so they were willing to try even a highly experimental treatment in the hope it would. There is no proof in the archives that BCMC placed any other prematurely born infants in the chamber or offered this care to other premature patients, so this treatment given to Baby Patrick raises a complicated dilemma.

We usually consider those on whom extremely experimental treatments are performed to be the marginalized and vulnerable, but Patrick came from a powerful family and these physicians knew the entire country was watching what they did. On the other hand, these physicians and hospital team would have wanted to offer Patrick whatever they thought might benefit him, and consequently he might have had access to what they thought of as a life saving device (even if the chance of it working was small). An oral history with a neonatal physician Dr. Don Null⁴¹¹ who practiced in the NICU setting in the 1960s as part of the team working with the early prototypes of the BabyBird Ventilator suggests a broader theme. Null believed their early prototype ventilator was indeed a life saving device even if it was only a prototype. Null spoke of the process of putting the infants on ventilators and how the parents were approached (when possible) about the process: "...if that baby was doing poorly, then it [using the ventilator] was

⁴¹¹ For more on Dr. Null and the BabyBird, see Chapter 3.

considered a life saving treatment just like you can in an emergency room today.”⁴¹² He articulated a thought process that considered life-saving treatments - even if they were still in the research and prototype stages - the only alternative to death and operated on the premise that these newborns could be saved. Perhaps the physicians caring for Patrick felt the hyperbaric chamber fell into the category of lifesaving treatment and chose to offer the state of the art therapy to him simply because it was available. In this sense, Patrick was both a research subject like many newborns during this time period *and* a patient for whom the most advanced and expensive therapies medicine had to offer were attempted.⁴¹³ The Patrick Kennedy case fueled the impetus to save prematurely born babies and broaden NICU infrastructure across the country.

“One Nursery in Three Locations”: A Joint Neonatology Program

Throughout the 1960s and 1970s several factors contributed to the increases in numbers of newborns requiring intensive care as well as the patient acuity among those admitted to the units. The increased use of drugs and medications as well as the ability to treat infection and respiratory distress were just some of the larger factors contributing to the increased survival and acuity of the neonatal population. Beginning in the 1950s, the production of medications by the pharmaceutical industry increased drastically; Americans medicated to treat everything from slight discomfort and pain to infection and

⁴¹² Donald Null. Oral History with Briana Ralston, July 16, 2013.

⁴¹³ The concept of research and ethical considerations is beyond the scope of this work, but I acknowledge is an important facet of the broader story of newborn intensive care and therapies in the 20th century. This research vein would be an excellent study for the purposes of future research.

sepsis. Pregnant women also participated in this increase in medication use. By the 1970s, America was overmedicated and the abuse of addictive drugs had become a growing problem particularly as it related to neonatology.⁴¹⁴

One such example cited by historian Murdina Desmond is Thalidomide, a sedative that gained popularity in the late 1950s whose use proved to be associated with malformations of the skeleton, external ear, heart and gastrointestinal tract. While the drug was eventually withdrawn from the market, extensive litigation ultimately resulted in monetary compensation to affected children and their families. This legal case laid precedence for a massive body of literature that emerged relating to perinatal pharmacology, and the NIH establishing a branch devoted to testing the effects of certain drugs during the perinatal period.⁴¹⁵ While congenital malformations had always been a concern for those focused on decreasing infant mortality rates, the increased use of drugs for which physicians had little understanding of their fetal side effects played an increasing role in the emergence of congenital malformations that, if they did not prove fatal, had life-long side effects and implications. With increases in the numbers of people using ‘street drugs’ neonatal nurses had to learn to manage newborns suffering from drug withdrawal. These newborns required intensive monitoring and, if they survived, could have potentially drastic lifelong conditions. Drug effects emerged as a condition that contributed to morbidity and the need for critical care beds.⁴¹⁶

⁴¹⁴ Murdina MacFarquhar Desmond. *Newborn Medicine and Society: European Background and American Practice (1750-1975)*. (Austin: Eakin Press, 1998). 198-203.

⁴¹⁵ Desmond. *Newborn Medicine and Society*. 201-2.

⁴¹⁶ Desmond. *Newborn Medicine and Society*. 198-203.

Advances were made in the treatment of neonatal sepsis and respiratory distress. The changes in surgical interventions for previously fatal neonatal congenital malformations also increased the numbers of newborns requiring intensive pre and post-operative monitoring and management. During the early days of the use of sulfonamides and antibacterial agents, little was known about the effects of drugs developed for adults had on children, much less newborns.⁴¹⁷ While sulfonamides and later antibiotics contributed to decreases in maternal infection and thus in neonatal mortality, they did not initially appear in the literature as a common treatment modality in early premature infant units or newborn nurseries. By the mid-1970s antibiotics such as ampicillin and gentamicin were used on sick newborns to treat sepsis and thus contributed to decreases in death due to infection.⁴¹⁸ Both babies who contracted infections in the hospital as well as infants who were exposed in utero survived in greater numbers as antibiotics came onto the market and both medical and surgical patients would have benefitted from their use of antibiotics.⁴¹⁹ By the 1970s, strides were being made in the treatment of respiratory illness for newborns. Infants who died of RDS just a decade before, had better chances

⁴¹⁷ Cynthia Connolly, Janet Golden, and Benjamin Schneider. “‘A Startling New Chemotherapeutic Agent’: Pediatric Infectious Disease and the Introduction of Sulfonamides at Baltimore’s Sydenham Hospital,” *Bulletin of the History of Medicine* 86 (2012): 66–93.

⁴¹⁸ Desmond. *Newborn Medicine and Society*. 198-201.

⁴¹⁹ While much treatment did help decrease deaths due to sepsis, treatments with some drugs such as Chloramphenicol, resulted in unintended consequences. Chloramphenicol caused *grey baby syndrome* when it reached toxic levels in the baby’s blood causing body limpness, ashen grey skin tone, cyanosis, low blood pressure, low body temperatures, and vomiting.

for survival by the mid-1970s with the improvement of the understanding of newborn respiratory physiology and adoption of ventilators made for the neonatal population.⁴²⁰

With increases in the projected rates of sick newborns requiring care,⁴²¹ Boston Children's found their resources were inadequate to meet the need for the number of patients transferred to them. As intensive care units continued to be costly to hospitals, not all hospitals in the Boston area could afford to establish units. While some community hospitals did, they may or may not have had sufficient resources to care for the sickest infants born there and were unable to give the highest level of critical care. They would have kept the more stable patients that they could manage and transferred the sickest to BCMC for care as the numbers of more medically fragile newborns grew – those suffering from respiratory distress, infection, and requiring complex surgical treatments. With a limited number of NICU beds available across the state, the beds for the most critically ill, located at BCMC became important to the state's ability to provide NICU care and decisions about how many beds were needed and who would fill them became critical aspects of the Boston Children's considerations regarding their unit.

The state of Massachusetts only had eighty-seven NICU beds among its hospitals, far below the projected need for 141 NICU beds determined by the state's department of public health. Boston Children's Hospital refused beds to an average of five newborns a

⁴²⁰ For more on antibiotic use as well as RDS, see Chapter 3.

⁴²¹ "Division 30, July 1, 1975 – May 31, 1975." Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 37-39.

week due to lack of space in their 12 bed unit.⁴²² By 1976 the hospital applied for a certificate of need⁴²³ with the Public Health Department to add six beds to their NICU. They did not ask for additional beds added to the overall hospital census, but for the purposes of consolidating their newborn patients who were sent to other units throughout the hospital when the NICU could not accept further patients.⁴²⁴ The specialization of care for neonates again became an important factor in the creation of the NICU and space needed for these newborns to receive such particularized care from trained nursing and medical staff.

With lack of space in the NICU, infants occupied beds throughout the hospital necessitating they receive care from nursing personnel who might or might not understand their unique physiologic needs. Neonates were cared for in departments such as neurosurgery, cardiology, and surgery and such spreading of this patient population

⁴²² “Memo to Ms. Elaine Shepard Ulliam, May 13, 1976.” Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 3, folder 9

⁴²³ Paul Starr. *The Social Transformation of American Medicine*. (New York, NY: Basic Books, Inc., Publishers, 1982). 398-400.; Faced with rising healthcare costs, many states attempted to regulate hospital expenditures to control the soaring healthcare costs. By 1972, twenty states implemented a “certificate of need” program whereby medical institutions who desired to initiate construction projects or other capital improvements applied for approval from the state. Boston Children’s Medical Center applied for a certificate of need to move beds from elsewhere in the hospital to their NICU so all newborns could be cared for, and though this did not increase the number of beds in the institution, it would have mandated a certain amount of construction on their existing space.

⁴²⁴ “Children’s Hospital Medical Center Proposed Hospital Bed Redistribution.” Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 3, folder 9. ; “Memo to Ms. Elaine Shepard Ulliam, May 13, 1976.” Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 3, folder 9.

was considered a problem by hospital administrative teams who believed the newborns received the best care when cared for in a unit by specialized nurses and physicians.⁴²⁵

Consolidating newborn patients throughout the hospitals while continuing to manage those transported to the hospital became a challenge for BCMC's administration. Boston Hospital for Women, located less than a mile from the Children's Medical Center, was one such hospital that sent their sickest newborns to BCMC. Their special care nursery lacked the resources to treat for the infants requiring the most intensive care such as those needing extensive ventilator support and between 1970 and 1972 they transferred an average of 21 infants annually to the Children's Medical Center, mostly surgical and cardiac patients requiring advanced treatment and post-operative care⁴²⁶. Physicians and hospital administrators decided to form a Joint Program in Neonatology through collaboration among Harvard Medical School, Boston Hospital for Women, the Boston Children's Medical Center, and Beth Israel Hospital.⁴²⁷ The three hospitals considered their program "one nursery in three locations"⁴²⁸ with the purpose of triaging infants needing care among three hospitals with varying degrees of intensive care capabilities. Infants needing general newborn care could be cared for in the general nursery at Beth Israel, while those who required more specialized care were transferred to Boston

⁴²⁵ "Memo to Ms. Elaine Shepard Ulliam, May 13, 1976." Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 3, folder 9.

⁴²⁶ While this might not seem to be many transfer patients (averaging out to approximately 2 a month), this was just one of almost 20 hospitals that would have transferred patients.

⁴²⁷ "Report of Joint Program in Neonatology, July 1, 1974-April 1, 1975" Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 3, folder 7.

⁴²⁸ *Ibid.* *Report of Joint Program in Neonatology.*

Women's Hospital that had a basic neonatal intensive care unit capable of providing care for more stable newborns that still required close monitoring. The sickest of the sick were transferred to Boston Children's. This relationship allowed for the management of newborn care based on acuity and enabled the hospitals to allocate beds and resources – financial and personnel – to most appropriately and efficiently care for the greatest number of newborns.

A senior neonatologist with five neonatal fellows rotated through the units supervising and training residents. Dr. William Taeusch, Jr. served as the program's first director. Within the first year, the program grew exponentially and required additional instructors and neonatal fellows before the end of the first year. The program served as an organization point for the training of fellows and opportunities for funded research project related to neonatal medicine. The National Institute of Health (NIH), and the American Thoracic Society funded the fellows during the initial year, and research money came from NIH as well as the Charles Hood Foundation.^{429, 430} The program attempted to provide efficient resource allocation in care of patients, but it also sought to provide intensive and quality education to a cadre of burgeoning neonatologists. As the specialty of neonatology gained momentum in the 1970s, demands for training programs grew in tandem with demands for care.

Despite this strategic combination of resources, by 1975 Boston Children's faced serious challenges in caring for the numbers of critically ill newborns; advances in

⁴²⁹ Ibid. *Report of Joint Program in Neonatology*.

⁴³⁰ The Charles Hood Foundation was established in 1942 to provide support to New England based researchers of pediatric medicine and healthcare.

respiratory treatments improved and surgical interventions for more complex congenital malformations became widespread, resulting in the survival of sicker patients. Initially the hospital did not have the equipment or nursing staff to adequately care for the numbers of infants who needed the highest levels of acute BCMC could give. In the month of June 1975, the census of the unit was at maximum with no room for more admissions. Over the summer months records were not kept, but by October, not only was space at a premium but inadequate number of nursing staff and respiratory ventilators also contributed to their inability to receive further patients even if beds were free in the event that the unit experienced higher acuity than its nursing staff could cover.^{431, 432} BCMC refused greater and greater numbers of patients. Tausch recorded by date the reasons for refusal for patients applying to transfer to Boston Children's, where the joining neurology program served the sickest of the infants. The reasons for refusing admission fell into two categories: lack of an adequate nursing workforce and technology.

The analysis of expenditures for expanding BCMC's neonatal intensive care unit covered a long list that still included the Isolettes and oxygen equipment, bilirubin lights,

⁴³¹ "Memorandum, November 18, 1975." Boston Children's Hospital Office of Facility Planning Records. (AC 10) Boston Children's Hospital Archives, Boston, Massachusetts. Box 4, folder 37-39.

⁴³² Fairman and Lynaugh talk about the nursing shortage during this time period within the context of professionalism and shift from nursing being a largely private duty profession to an institutional one (Fairman and Lynaugh, *Critical Care*. 66-9). In addition to the national nursing shortage trends, the transience of nurses during this time period might have played into the hospital's inability to staff the unit. This highlights an interesting phenomenon in neonatal intensive care nursing – longevity. The early generations of NICU nurses are unofficially known to work for most of their careers in these units (versus transferring to other types of nursing or units throughout the hospital). This is an area not particularly covered by this work, but perhaps should be addressed in future research.

and new EKG recorders, but also listed a variety of monitors now standard at each patient's bedside. For the addition of six beds to the unit the hospital needed an additional \$117,000 for equipment alone.⁴³³ Interestingly, even as nursing care remained one of the largest expenditures, it was not included in the lists of increased cost of care most likely because by this time, though the hospital documented increasing costs for new and complex equipment, the necessity of nursing staff was assumed and a non-negotiable expense. Though hospital documents do not reference nurses directly in the increased cost demands, they would have become a part of the assumed necessary infrastructure. The theme of resource allocation and the importance of grouping infants together to receive care required the hospital to make decisions about their unit and how to best organize it whether they were debating closing the premature infant unit, or creating an infrastructure of individual units connected by established programming for triage purposes.

Conclusion

The Neonatal Intensive Care Unit at Boston Children's Medical Center emerged in the 1960s as the culmination of a series of decisions that established sick newborns as valued and in need of particular intensive care. The premature infant unit, established by BCMC's sister institution in the 1930s, proved that care for prematurely born neonates could be given effectively, and influenced the creation of a broader space where the

⁴³³ This did not include staffing or any costs related to renovation of the hospital unit.

hospital's newborn population could receive the skilled and intensive care premature infants had previously received. The unit, named an ICU by the early 1960s, accepted Patrick Kennedy whose story highlights the aspects of a complex system of care that included a unit, advanced medical technology, and desperate attempts to save a baby who suffered from RDS. While the Baby Kennedy case shows us the complexities of a unit where intensive care could be given, it raises questions about the use of unproven methods of treatment and who could receive them. Newspaper clippings, press reports, and hospital documents do not highlight nursing as a foundational aspect of his care perhaps because nurses were understood to be necessary and foundational to NICU care and thus an assumed part of the infrastructure.

Like the Children's Hospital of Philadelphia, Boston placed importance on their nursing personnel when forming the unit; they consistently attempted to organize the patients together where specific specially trained nurses could give the care the newborns needed. Nursing was an incredible cost for these units and the hospitals made critical decisions to commit financial resources to ensuring the presence of nursing personnel. Once demand outpaced their ability to provide care to the many infants who needed it, like CHOP, Boston Children's recognized the need to partner with other units to provide acute care to the sickest of patients through a transfer agreement among hospitals. BCMC specifically focused on the multifaceted care they could give and formalized a program that also functioned to educate residents and nursing personnel as part of the partnerships among hospitals through their Joint Neonatology Program.

What BCMC uniquely shows us is the progression of the care models that eventually contributed to the establishment of an ICU. While adult ICUs might have progressed out of a grassroots movement, not all ICU spaces followed this model. BCMC's NICU emerged as a premature infant unit, then a newborn nursery where similar care could be given to all neonatal patients, then was labeled an ICU by the mid 1960s. Nurses played key roles that necessitated the allocation of spatial and financial resources so good nursing care could be delivered. This case study reminds us that premature infant units and the specific care newborns require contributed to the nuanced ways ICU spaces develop. These decisions are not necessarily made in a traditionally rational manner, but encompass complex combinations of values, external limitations and trends, and developing technologies.

Chapter 6:

Conclusion

Conclusion

Newborns are a unique patient population with particular needs and physiology, and thus require unique nursing care. Early models of intensive care in the 1960s built on the premise of special environments and particular nursing care. These factors were historically continuous as ideas about how and where to care for sick newborns formed and were broadened from premature infants to sick newborns in general. I argue the social value of newborns as a unique patient population fueled the establishment of premature infant units that in turn influenced the later development of neonatal intensive care units. Hospital administrators recognized the importance of particularly trained nursing workforce; the nurses and their skill both influenced how the hospitals grouped patients based on their need for nursing care as well as how they allocated space to units within the hospitals.

Nurses who worked in NICUs demonstrated similar skills the nurses in premature infant units did, but they built on those skills as increasingly complex equipment and more medically fragile patients filled their ICUs. The nurses in the early NICUs believed they knew when changes in care, treatment, equipment helped or hindered their patients and served as the gateways and gatekeepers to their severely ill patients. When the machines such as the ventilators did not work, the nurses were the frontline of defense communicating to the physicians and researchers what worked and what did not work for the patients. Nurses were integral to the formation of neonatal intensive care units at both the Boston Children's Medical Center and the Children's Hospital of Philadelphia.

Nurses were not the only influential force in these developments, but they were ever present when everyone else was busy or went home.

Both Boston Children's Medical Center and The Children's Hospital of Philadelphia opened their intensive care units during a time when foundations had been laid for grouping newborns together to receive particular nursing care. Both hospitals received infants transferred from a broader network of NICUs, and thus they relied on these transfers to keep their beds filled. Both hospitals had hospital administration that valued good nursing care and made decisions about how to group patients in units based on the value of good nursing care particular to these patients. But the impetus for the formation of units at each hospital differed. BCMC had a unique track record of developing a unit rooted in past premature infant nursing care, influenced by economic decisions and the social value of sick newborns. CHOP formed their unit through Koop's tenacity and a hospital administration that valued the nurses and used them to portray the human element of intensive care.

Innovators who invent technologies do not solely determine if that technology works. Demonstration that the technology is valuable requires what historian Jeffrey Baker calls "system builders"⁴³⁴ who are people other than inventors that address barriers. They contribute to the process of growth. By the late 1970s, neonatal intensive care units had grown in part because hospital administrators, physicians, and nurses thought creatively and hospitals reflected the social value of the patient population. The

⁴³⁴ Jeffrey Baker. "The Incubator and the Medical Discovery of the Premature Infant," *Journal of Perinatology* 20, no. 5 (2000): 321–28.

NICUs of the early 1960s did not emerge because of decisions made in the 1960s, but built on decisions made about the social value of newborns as early as the Progressive Era and the tenacity of physicians, nurses, activists and researchers who made a million small decisions along the way that influenced why NICUs emerged as they did and when they did.

Eugene Peters wrote, “Every complex problem has an answer that is clear, simple, and wrong.”⁴³⁵ The data does not suggest the nurses were the only reason the NICU worked. They were part of a system, a complicated system, and a system that this work has only begun to define; much more work is needed, but in the midst of the complexity, the data is clear that the nurses were vital contributors among other economic, social, and technological factors that influenced why the NICU worked and developed when it did.

A nuanced view of the development of intensive care:

This work builds off of the work of nursing historians Julie Fairman and Joan Lynaugh that outlined the ways that critical care for adult populations developed. My research on neonates, combined with Fairman and Lynaugh’s analysis, informs a history of critical care spaces in hospitals. In the development of adult ICU’s nurses made decisions about who required particular types of care and closer observation. The process did not happen the same ways for all patient populations and we must consider the newborn population as a unique population that had its own trajectory in how ICUs

⁴³⁵ Eugene Peterson. *The Pastor: A Memoir*. (New York, NY: HarperCollins, 2011). 59.

formed to meet newborns' particular needs. Spaces at the CHOP and BCMC formed, in part, because hospital administrators and physicians believed nurses were a critical piece of the system required for good patient care. Fairman and Lynaugh argue that nurses created grassroots influences within adult ICUs. The data related to newborn intensive care units reveals particular confidence of hospital administrators, researchers, and physicians in nursing staff that suggests NICUs involved significant administrative influence as they formed.

Alternative possibilities:

The neonatal intensive care unit progressed to become the standard of care during a time when sicker patients could be saved with intensive care and more complex treatment. Other options could have become standard – surgical infants could have been cared for in general post-operative units or in available beds throughout the hospitals. Premature infant units could have remained the standard. But neither of these ways of caring for sick newborns remained standard. NICUs emerged, admitted sick newborns, either surgical or medical, and included premature infants in their ranks. How we group sick patients in hospitals today is not just based on social value placed on a particular patient population, the equipment and technology we have at our disposal, or the most fiscally efficient way to provide care. Our decisions about the creation of units where certain patients receive care and who has access to that care rest on the convergence of all of these factors. In a medical environment where healthcare costs were increasing, premature infant units such as the one at Boston Children's Medical Center chose to

balance the increased costs of patient care in a premature infant unit where census did not always remain high enough, by grouping all newborns together. In this new unit, all sick newborns received the kinds of nursing care the premature infants had received. It worked because both premature infants and newborn infants had the unique physiology and required the same basic newborn care, and thus the nurses who had the knowledge to work with premature newborns could also easily transfer their knowledge (and build on it) to care for medically fragile full term newborns.

Limitations to this study:

This work only speaks to general trends in the literature and the voices of particular people and is not meant to be a complete nor generalizable account of what happened in all NICUs across the country. My work only speaks to the broad trends in the scholarly literature, and to what was happening in two children's hospitals on the east coast in the United States. Though race is an important factor when we ask any questions about systems and historical analysis, as I worked with scholars and mentors to ask questions about race, I did not ultimately choose to focus on it in this work. Though I did include families and the ways nurses worked with parents in the early units in this analysis, this work does not seek to expound upon the roles families played nor is it meant to be a critical analysis of family centered care throughout the 20th century. This work is based on an analysis of scholarly literature, general oral histories, and hospital archives that focus on administrative documentation and records and thus the data must

be understood to speak only to those arenas and not to the patient and family experiences that undoubtedly would be a rich vein of future work.

Future work to be done:

This work has laid a foundation for future scholarship and the necessity to ask further questions to gain a broader picture. More work needs to be done to understand what influences played key roles in community hospitals. Since my work focuses on two children's hospitals, more work should be done to understand how hospitals with maternity services worked out the challenges of establishing these units and what roles nurses played in those environments. More work needs to be done to understand more fully how hospitals elsewhere in the country formed their units and what key influencers converged in the establishment of NICUs in Denver, Seattle, and Dallas or other larger cities in different parts of the country.

This future work should include examining the relation of the development of neonatal care within the context of maternal and perinatal care. Due to the nature of my historical lens using the history of pediatrics as an influencing framework, I did not address the ways perinatal units emerged in the late 1970s nor the experiences families had with the care given in these units. This work would be critical to understanding a broader conception of the development of the NICU and the ways we formed what we know today as family centered care.

Further work also needs to be done to better understand the unintended consequences and how society, legislators, families, and physicians and nurses chose to

meet those concerns on the ground. While I acknowledged that important ethical issues emerged in the late 1970s, due to the nature of this work I chose to end my time period just prior to the Baby Doe legislation and the public, legislative, and broad ethical dialogue during the 1980s.

While I did begin to collect oral histories for this project, I believe more oral histories should be collected and a more encompassing oral history database of nurses and physicians who worked in these units, remember the environment, tensions, and decisions that were made. This would provide a strong historical database of experience from which future researchers could mine data and themes for further work.

Informing our current understanding:

Neonatal Intensive Care Units today still face many of the same issues the early units faced – increasing costs, infection rates resulting in sepsis, and nurse staffing issues. Infants requiring intensive care are among the most nurse-intensive patients in hospitals today. They require skilled nurses who know how to assess the patients, work with the plethora of increasingly complex bedside equipment, and function as collectors and communicators of vital patient data. Recent studies done by nursing researchers suggest that NICUs today are not staffed to guidelines and associate inadequate staffing rates with increased infection rates.⁴³⁶ Bedside nursing continues to be an important factor in

⁴³⁶ J.A. Rogowski, D. Staiger, T. Patrick, J. Horbar, M. Kenny, and E.T. Lake. “Nurse Staffing and NICU Infection Rates,” *JAMA* 167, no. 5 (March 18, 2013): 444–50. doi:10.1001/jamapediatrics.2013.18.

patient outcomes and remains a central aspect of the intensive care environment for critically ill newborns.⁴³⁷

This work challenges us to think about how we develop systems of care for vulnerable patient populations and how we group patients with particular needs. In a healthcare system where specialization creates intensely fragmented and compartmentalized healthcare, we must be cognizant of how we group patients; highly trained nurses can be utilized in traditional and nuanced ways, and do make a difference. We also might think how we make those decisions based on the knowledge and expertise nurses have and how that might be used with particular patient populations to optimal effect within highly complicated technological systems that require extensive financial and caregiver resources. When we consider the NICU a technological system of care, we recognize a model that required complex equipment and broader infrastructure consisting of relationships among units. It also was influenced by economic factors, social values, and complex decisions made by an array of hospital administrators and influencers, as well as the nurses who functioned at the bedside at the heart of the system – next to their patients.

With the recent edition of TIME magazine, on May 22, 2014 neonatal intensive care was once again thrust into the spotlight and America was introduced to a tiny baby boy named David.⁴³⁸ He was born 2 pounds 11 ounces at 29 weeks gestation (11 weeks

⁴³⁷ Douglas Staiger. “Association Between Hospital Recognition for Nursing Excellence and Outcomes of Very Low-Birth-Weight Infants,” *JAMA* 307, no. 16 (April 25, 2012): 1709. doi:10.1001/jama.2012.504.

⁴³⁸ Jeffrey Kluger. “Saving Premies,” *TIME*, May 22, 2014.

premature). He fought hard and took on the surmountable task of survival when, even by today's standards, the odds were stacked against him; but this tenacious little baby boy was not alone in his fight.⁴³⁹ As we learn more and more about David, we learn about all of the pieces of equipment, the healthcare workers, the diseases and health issues he faced secondary to his prematurity, and the factors that influenced the kinds of care and medicine he received. Photographs of David include his parents and often the nurses, similar to those published by the Children's Hospital of Philadelphia just decades before. The nurses care for tiny David amidst a plethora of machines. They bring the human element to his story in a world where the equipment and intensity of his medically fragile state can sometimes seem overwhelming. His story is familiar. Fifty years ago, we heard a similar story when Patrick Kennedy was born and his family experienced the early days of neonatal intensive care; now we marvel at a small 'normal' little boy benefits from this care. Both stories present the same infrastructure and both remind the American society of the how far we have come, but also about the challenges posed by that progress.

On one hand, this patient population can be used as a case study to explore a plethora of healthcare problems today and challenge us to think in different ways. On the other hand we have not yet preserved the stories of these nurses, the technological systems where they worked, and the patients whose lives they played a role in saving. If we really do value the work they did, we must continue to value their stories, the meaning

⁴³⁹ Ibid. Kluger. *Saving Premies*. "David's story began with an introduction to the baby himself: "...Immediately he began learning a lot of things – about bright lights and cold hands, needle sticks, and loud noises. He learned what it feels like to be hungry, to be frightened, to be unable to breathe."

they gave their work, and the ways that work impacted the lives of countless newborns over the second half of the 20th century.

If we are to build on our current infrastructure of critical care for newborns, we must continue to think about the NICU as a technology and how it developed, grew, and changed over its short fifty-year history in the American healthcare system. We must understand its roots, how nurses have contributed to and played an important role in shaping it, and how it reflects our social values. We will continue to formulate care for vulnerable newborn patient populations in the midst of economic factors, social values, and increasingly complex medical conditions and treatments. The story of the NICU should also challenge us to think about broader patient populations and what influences the decisions we make that create and influence the technologic systems we create. We continue to value and care for infants like David, and we imagine his struggles and how we might contribute to the reduction of morbidity and mortality among critically ill newborns as well as other established and developing vulnerable patient populations. The NICU is a complex technological system composed of, ‘an army of people and a mountain of infrastructure caring for a pound of life,’ that has made a world of difference to our society’s tiniest babies.⁴⁴⁰

⁴⁴⁰ Ibid. Kluger. *Saving Premies*.

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