"Once Seen, Never Forgotten": Nursing, Ethics, and Technology in Early Premature Infant Care in the United States, 1898-1943

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Abstract

No comprehensive account of early twentieth century premature care has been told from a nursing viewpoint, particularly examining the role of agency in the dissemination of incubator technology. Both the Institute of Medicine and National Institute for Nursing Research have highlighted the importance of a nursing perspective in the integration of technologies to improve the delivery of care. Evidence from nursing history can demonstrate how nurses have previously approached and integrated technology into their practice, and offer guidance for addressing current and future concerns in an increasingly high-tech and ethically challenging healthcare system.

The purpose of the study was to examine the role of nursing in the process of technology transfer for advanced care techniques for premature infants in the United States from 1898 to 1943. Traditional historical methods with a blended social history and social construction of technology framework were used. Analysis involved constructing the sociotechnical networks of the Premature Infant Station and the Infant Incubator Company for comparison, and identifying, describing, and evaluating the role of nursing in the transfer of new technologies for premature care during the time period of interest. Critical analysis of social, political, and economic context, as well as the state of the art of nursing and medicine, was also performed.

Primary source data was collected and analyzed from the Julius H. Hess Collection at the University of Chicago's Regenstein Library, the Century of Progress Collection at the University of Illinois at Chicago, the New York World's Fair 1939-

1940 Collection at the New York Public Library, the Pediatric History Center at the American Academy of Pediatrics, and the Coney Island History Project. Secondary sources were also used.

The introduction of the infant incubator in the late nineteenth century symbolized a changing medical attitude toward premature infants. Despite significantly reducing mortality, incubator technology did not become a widespread and integral part of premature care in the United States until the 1930s and 1940s, after Julius Hess, MD demonstrated dramatically improved outcomes with hospital-based care. Interestingly, most of the treatments Hess used were identical to those in use at widely popular incubator-baby sideshow exhibits at world's fairs and amusement parks beginning as early as 1898. Both systems relied on specially trained nurses to provide all treatment to the newborns under their supervision, and these nurses played a significant role in promoting and integrating the incubator and other advanced techniques to enhance the quality of treatment for preterm infants in the early twentieth century. Nursing care was undoubtedly a key factor in the high survival rates experienced by premature babies in their care. The relative success of the Premature Infant Station in elevating public opinion of both premature infants and incubator technology in relation to that of the Infant Incubator Company may have been a result of the status of nurses within the system, the flexibility of power relationships, and the way nursing care itself was communicated to different audiences.

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Dedication

It is with a grateful heart that I dedicate this project to my fellow neonatal nurses, those who devote their lives to healing the smallest and most vulnerable among us with endless grace and humility. May our work always be seen, so that our stories will never be forgotten.

"It is not how much you do, but how much love you put in the doing."

Mother Teresa

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Chapter 1: Introduction and Methods

Introduction

Advances in medical technology aimed at improving the quality, safety, and efficiency of patient care continually change the provision of health services. Particularly in the field of neonatology, where technological developments have been the most transforming force in the evolution of care, nurses struggle to balance the human element of nursing with the ethical use of new equipment and procedures.[1] The unique position these nurses hold, which provides a high level of responsibility and interaction with patients and families but little authority regarding treatment decisions, can lead to moral conflict and feelings of powerlessness.[2] Lack of a nursing viewpoint in ethical debates over the role of technology in premature care further exacerbates the issue.

Prematurity as a public health concern and clinical diagnosis is a fairly recent development within the history of American medicine, having only come to the forefront within the last century. However, the annual rate of preterm birth, which occurs when an infant is born before 37 weeks gestation, has become one of the leading indicators used to calculate the overall health of a nation. Current United States rates of preterm birth have been on a steady decline, hitting a 15-year low in 2012 at 11.5 percent.[3] Despite this sustained decrease, roughly 500,000 babies are born prematurely each year in the United States, earning a worldwide rank of 131st out of 185 countries according to the World Health Organization.[4] The Center for Disease Control and Prevention (CDC) has therefore highlighted prematurity as a

"leading health indicator" and made the reduction of preterm birth a high-priority health issue for the United States.[5]

From a public health standpoint, the increased access to and reliance upon advanced technology in sick neonates has produced unintended yet significant consequences directly resulting from poor health outcomes for many of these infants. Preterm-related sequelae are the single greatest cause of newborn death and a leading cause of long-term neurological disabilities in children. Although they make up less than twelve percent of total births, premature babies account for over half of all medical expenditures on infants, with overall prematurity-related costs to the U.S. health care system estimated at more than $26 billion annually.[6] Even more troubling may be that the majority of spending occurs for infants with low probability of survival "without any such major disability."[7] Neonatal health policy in the last thirty years reflects an almost unrestrained effort to keep all babies alive at any cost, indicative of a greater social importance placed on scientific and technologic possibility than a more socially-minded, economic evaluation of treatment decisions at the edge of viability.

The invention of the infant incubator in the late 1800s effectively initiated premature infant care as a medical specialty by facilitating survival and helping prove that these infants could develop similar to their full-term counterparts.[8] Since then, any dramatic improvement in patient outcome or reduction in mortality for sick neonates has resulted from the application of certain breakthrough technological advances, namely the use of surfactant, steroids, and improved modes of mechanical ventilation. While these medical technologies have undoubtedly

saved lives, they have also substantially altered medical determination of viability and prompted an undeniable technological determinism within neonatal intensive care units (NICUs). Only recently have scholars begun to question whether the potential of technology to decrease mortality is morally justified when significant morbidity is almost certain, as increasingly aggressive perinatal and neonatal treatment has not demonstrated improved outcomes for infants less than 25 weeks' gestation.[9] The current capability of NICUs to promote survivability of these infants sustains a healthcare environment in which health providers, newborns, and their families are often "held hostage" to biomedical technology, frequently creating disagreement about ethically appropriate care.[10]

Increasingly high levels of moral distress among direct care providers in the NICU, particularly in nurses, can often be attributed to the intense conflict experienced when aggressive treatment and extensive resource allocation contradict with individual perceptions of quality nursing care and advocacy.[11] While the literature on moral distress continues to explore the relationship between moral distress, burnout, staff turnover, and patient outcomes, evidence suggests that the experience of moral distress negatively impacts individual nurses and patients, hospital organizations, and the healthcare system as a whole.[12] Nurses who perceive higher levels of peer collaboration and a supportive ethical climate report lower levels of moral distress, reinforcing the importance of nurse involvement in ethical decision-making in the NICU.[13]

Researching the history of the infant incubator in the early twentieth century with a focus on the role of nurses can highlight the primacy and necessity of a

nursing perspective in discussions on the ethical application of new technology for premature infants, as well as provide current nurses with concrete examples that support their inclusion in discussions on morally appropriate care. No comprehensive account of early twentieth century premature care has been told from a nursing viewpoint, particularly examining the contribution of nurses and the role of agency in the standardization of incubator technology. Both the history of the infant incubator and the evolution of early premature infant care have been previously documented.[14] However, much of these narratives focus on the impact and influence of the medical profession, further evidence of the "invisibility of nurses in the gender-technology relationship" within discussions of the technology of medicine.[15]

A substantial gap in the literature exists regarding the vital role nurses played in premature infant care in the first decades of the twentieth century. This research will provide a novel approach to analyzing the history of medical technology by highlighting the power involved in the use and mastery of technology, a position predominantly held by nurses. This emphasis differs substantially from that of the majority of studies to date, which focus primarily on physicians and their control over the design and implementation of technology in the healthcare arena.[16]

Review of Secondary Literature

Despite having origins dating back to the late nineteenth century, neonatology as a specialty is a rather modern addition to the science of medicine in the United States. Officially coined in 1960 by Alexander Schaffer, MD,

"neonatology" refers to a subspecialty of pediatrics that focuses on the treatment of premature and sick newborns.[17] The relative newness of modern neonatology can be deceiving, however, as accounts of the sometimes extensive efforts of families and physicians to preserve the lives of weak or feeble infants across cultures date back hundreds of years.[18] More organized efforts to save premature babies by physicians across the world began in the late nineteenth century, often precipitated by social, economic, or political influences. In the United States, social and public health reform movements during the Progressive Era would alter cultural perceptions of the relative value of children and illuminate alarmingly high rates of infant mortality, eventually drawing attention and visibility to prematurity as a medical issue once the death rate for general infants declined but premature births remained high.[19] However, no medical efforts to improve survivability in premature infants would have been possible, let alone successful, without the development of the enclosed incubator.

The introduction of the infant incubator in the late nineteenth century symbolized a changing medical attitude toward premature infants, and today the incubator remains an essential aspect of neonatal intensive care, a testament to its success in both design and operation. Created in 1880 at Paris' Maternité Hospital, the fully enclosed incubator, along with expert nursing staff, quickly became part of an innovative and successful program of care for premature babies in France. Despite significantly reducing mortality, however, incubator technology and specialized nursing did not become an integral part of premature infant care in the United States until the 1930s and 1940s. Lack of visibility was not the issue, as

incubator-baby sideshow exhibits became popular at world's fairs and amusement parks around the country, beginning as early as 1898 and continuing for nearly 50 years.[20] Indeed, hundreds of thousands of patrons visited the shows during their decades-long run, with the exhibit claiming that "once seen," the premature infants were "never forgotten."[21]

The most comprehensive account of the history of the infant incubator comes from medical historian Jeffrey Baker in *The Machine in the Nursery*. Baker's study provides a rich bicultural comparison of the French and American approaches to premature care, and meticulously details the social, political, and economic forces that shaped the design and acceptance of the earliest incubators in both Europe and the United States. The analysis takes a technological constructionist perspective to explain the United States lag in acceptance of the new technology, with social forces accounting for the nonlinear progression of incubator technology diffusion in early twentieth century America.[22] Baker's study, however, concluded in 1922 when Julius Hess, MD published his seminal text on the care of premature infants, which was years before widespread medical acceptance of Hess' methods across the country. Additionally, Hess and Evelyn Lundeen, RN would not establish their own successful in-hospital premature infant station until the late 1920s, and it was not until the mid-1930s and early 1940s that other hospitals across the country began creating wards specifically for premature infants.

No analysis to date has explored the role of individual agency or persuasion on the transfer of incubator technology, particularly with respect to the incubator sideshows themselves. Despite advocating for and providing strikingly similar

models of nursing care for premature infants, Martin Couney, MD and his incubator shows are remembered mostly as an "odd chapter in medical history," while Julius Hess is credited with revolutionizing the science of premature care.[23] Additionally, few studies within nursing literature have investigated early premature infant care.

Purpose

The purpose of this dissertation study is to examine nurses' involvement in the process of technology transfer for the incubator and other advanced care techniques for premature infants in the United States from 1898 to 1943. This study specifically aims to (1) identify, describe and analyze the role of the nurse in the introduction, promotion, and standardization of new premature care technology in the early twentieth century; (2) explore how the social, cultural, economic, and political realities of the time influenced the acceptance of advanced technologies for premature care; (3) analyze how the differing technological systems of the Infant Incubator Company and Chicago's Premature Infant Station may have affected the integration of the incubator; and (4) describe the ethical issues nurses faced in providing care to premature infants in the early twentieth century and explore the implications for current moral evaluation of the nurse-technology relationship in the NICU.

The study is particularly significant, as both the Institute of Medicine and National Institute for Nursing Research have highlighted the important role of the nursing profession in the advancement and integration of innovative technologies to improve the delivery of care.[24] Nurses will be called upon to fill expanding roles and

to master technological tools and information systems while collaborating and coordinating care across teams of health professionals.[25] While the continual addition of new and improved technology in the healthcare arena undoubtedly improves patient outcomes, it also holds the potential for introducing unforeseen and/or unintended ethical conflicts. In the field of neonatal medicine, where technological advancements have transformed our understanding of the limits of human viability and our interpretation of quality of life, nurses will need to recognize the importance of their perspective as the point of negotiation between technology and the patient. Restructuring our understanding of the nurse-technology relationship through the lens of nursing history may provide compelling examples that empower current nurses to demand a place in ethical discussions as they face an increasingly technology-driven healthcare system.[26] Using historical research to inform current health policy debates is an innovative and meaningful approach for nurse historians, one with the potential to improve the quality and delivery of nursing care.[27]

Research Design and Methodology

Historiography was the chosen methodology for this dissertation study based on the available archival material as it relates to the identified purpose and specific aims. This research method refers to the synthesis of gathering data in a particular period in history in order to analyze and develop theoretical and holistic conclusions on a specific area of interest.[28] Historiography involves the identification of a topic, selection of an appropriate framework, critical examination

of sources, and analysis that focuses on the narrative, interpretation, and use of valid and reliable evidence that supports the study conclusions.[29] Study data comes from both primary and secondary source material; primary sources have a direct connection to their user or originator during the time period in which they were created, whereas secondary sources are items generated from the interpretation and analysis of primary sources.[30] This method is considered a "meta-level, analytical-historical description of the past" that can be used to illuminate understanding of similar issues in the present.[31]

Framework

This dissertation study utilized a blended social history and modified Social Construction of Technology (SCOT) theory framework. Utilizing more than one framework allowed for a broader approach with multiple interpretive lenses.[32] The study timeframe covered from 1898 to 1943, the years in which incubator sideshows were popular across the United States. The corresponding social, political, and economic climates, as well as the state of the science of nursing and medicine, were examined as context for understanding the history of premature infant care and incubator technology.

A social history framework, which possesses an inclusive structure for studying the past experiences and behavior of ordinary people at the margins of society, facilitated the analysis of nurses' work by focusing on themes of race, class, gender, and power.[33] The perspective evaluates the influence of sociocultural,

economic, political, and scientific factors on the identified subject of interest, as well as on one another, to contextualize the time frame of study.

The study framework also borrowed from SCOT theory, which argues that technology develops through an interactive, bi-directional discourse between technologists or engineers and relevant social groups or stakeholders involved in the technology activity. A defining tenet of SCOT is the principle of symmetry, which holds that the success or failure of an artifact cannot solely be ascribed to the technical virtues of the system; that is, equal attention should be given to both technical and sociological factors when analyzing the success of a technology.[34] One approach to SCOT theory utilizes a network metaphor to explain how technologists actively negotiate with stakeholders to persuade them to invest in their technology. Technologists are viewed as system builders who must assimilate various technical, political, social, economic, and scientific factors, all of which are interrelated and potentially malleable.[35] This process of relating disparate elements into a unified network, called heterogeneous engineering, can be difficult to maintain.

Much of this research project involved constructing, describing, and comparing the sociotechnical networks of the Infant Incubator Company, which ran the majority of incubator-baby sideshows in the United States, and the Premature Infant Station at Chicago's Sarah Morris Hospital. Findings about the nurses in incubator sideshows and the in-hospital premature station were contrasted with one another to examine the nursing role within the larger sociotechnical system in which they provide care. These findings were compared to media accounts and professional documentation, both photographic and textual, during the

corresponding time period. Examination of the power structure within each system and the place occupied by nurses became a lens through which to interpret the relative success of the Infant Incubator Company and the Premature Infant Station in the process of heterogeneous engineering.

Definition of Terms

The terms *premature infant* and *technology* are defined here for clarification purposes to help describe how they have been conceptualized in this study. Historically, the English term *premature infant* emerged around 1870, with the French term *les prématurés* first appearing in medical literature around 1880.[36] Literal translation from the Latin *partus praematurus* means only birth before term, but early application of the word prematurity to feeble, sickly, or congenitally debilitated infants, as well as to those born too early, extended the definition until all of these terms were considered virtually synonymous.

The earliest accounts of premature infant care in medical literature used differing methods to diagnose prematurity, with some articles using an often-inaccurate estimation of gestational age by the mother, and others suggesting weight as an objective measure for categorizing these babies. Using a birth weight of less than 2,500 grams as the standard for determining prematurity emerged in Europe in the late nineteenth century, first supported by Pierre Budin in 1888 and becoming routine practice by 1919.[37] In the United States, defining prematurity remained nebulous until 1935 when the American Academy of Pediatrics adopted birth weight classification and defined a premature infant as "one who weighs 2,500

grams or less at birth (not on admission), regardless of the period of gestation."[38] Most of this research utilized the term *premature infant* to describe any newborn requiring specialized care for survival. More specifically, the term applied to any of the infants cared for at the incubator sideshows or within the Premature Infant Station, regardless of their actual or given diagnosis, as this level of detail was either not recorded or not available.

Today, an infant is identified as *premature* when born prior to the completion of 37 weeks gestation. Three subcategories exist under the umbrella of prematurity based on gestational age: extremely preterm is used to describe infants less than 28 weeks gestation; very preterm for infants between 28 and 32 weeks gestation; and moderate to late preterm for those infants 32 to 37 weeks gestation. Colloquially, a premature infant is often referred to as a "preemie."

Throughout history, the word *technology*, which comes from the Greek "techne" meaning art, skill, or a means whereby something is created, and "logos" meaning a discourse or account, has been applied to a broad range of tools, devices, knowledge, skills, and methods. As nursing historian Margarete Sandelowski asserts, "the concept of technology itself is subject to social change," noting that the computer technology of modern times is distinctly different than the manual technology of ancient times, and yet both constitute examples of technology.[39] Particularly within the time frame of interest for this study, the notion of what constituted a medical technology changed dramatically, as hospitals went from facilities that primarily focused on the long-term care of dependent people to institutions that actively marketed to private patients in need of short-term care.

Medical technology originally indicated environmental objects, sanitation, or cleanliness but would come to be associated with machines or devices that were used directly on patients.[40]

Some historians of technology would argue against the need to specifically define the term, citing the flexibility of meaning within the user context; indeed, a major principle of the chosen SCOT theory framework relies on the interpretive flexibility of technology to influence the trajectory of the system. However, clarifying what was considered "technology" within each of the sociotechnical systems facilitated an improved understanding of how the term was outlined and examined. Judith McGaw's definition of technology as a "system of tools, skills, and knowledge needed to make or do things" was chosen for the study.[41] Using this conceptualization, *technology* included all aspects of the process of providing care for premature infants in the incubator exhibits and the Premature Infant Station, which included artifacts such as the incubator and specific feeding tools, specialized medical knowledge, and advanced nursing skills for feeding and handling the newborns.

Data Exploration and Criticism of Sources

To reduce threats to the study's integrity, external and internal criticism of sources was performed. Data corroboration involved the use of multiple primary and secondary sources, as well as enlisting the support of experts across multiple disciplines to evaluate the researcher's assumptions and interpretations. In an attempt to sift through potential biases and form responsible interpretation of data,

the author received constructive feedback from nursing and medical historians through scholarly presentations of early findings at local and national conferences. This process continued through meetings and discussions with dissertation committee members throughout data analysis and chapter development. Both the quality and rigor of the study were improved through this continuous feedback loop.

Strengths and Weaknesses

This study highlights the story of nurses' experiences working at the forefront of scientific knowledge and medical understanding with a vulnerable population that had only begun to be recognized by the medical community and the general public. Additionally, the research not only fills a sizeable gap in the literature about early nursing care of premature infants, but also provides an important opportunity to reshape the historically paradoxical understanding of the nurse-technology relationship within the healthcare system. Throughout the twentieth century, the nursing profession has both lauded and lamented the increased presence of technology in patient care activities, leaving scholars to wonder about this contradictory relationship.[42] In an arena where nurses were traditionally viewed to have little power, this analysis proposes a novel perspective on the influence of nurses on the success of new medical technology as it relates to their control over its use and mastery.

The researcher's experience as a neonatal intensive care nurse offered both a strength and a possible weakness to the study. Firsthand knowledge of the current environment of the NICU provided the researcher with a nuanced understanding of

the relationship between nurses, patients, and technology in today's healthcare system. It also offered a unique opportunity for comparisons between the past and present, and allowed for a more comprehensive interpretation of the connectedness among research variables and themes. As a limitation, the researcher's work experience may have contributed to selection bias during the data collection and analysis process. To help mitigate the influence of bias, the researcher completed an extensive review of secondary literature and plotted a methodical course for archival data collection. Maintaining an awareness of the potential for researcher bias while exploring primary sources, as well as cultivating an open dialogue with committee members throughout the analysis process, helped in the creation of a more thoughtful, objective narrative.

The greatest potential limitation of the study is that it proved difficult to locate primary data sources from the incubator sideshows for a more thorough analysis. Any personal records from Martin Couney, the physician in charge of the majority of sideshow exhibits, either do not exist or have never been found. Much of the information known about the exhibits and those involved has come from extensive popular media accounts of the period, as well as personal reflections from physicians and other individuals who visited the shows, or the premature infants who were displayed in the shows and their family members. Collections at the American Academy of Pediatrics (AAP) contain over 30 years' research into the history of the incubator and the sideshow exhibits compiled by numerous medical historians, and contained an adequate amount of primary data to construct a

rigorous analysis. The archives selected for data collection specific to the sideshows were chosen based on their listed archival materials.

Ethical Conduct of Research

Some ethical issues regarding the acquisition and use of archival data include concern for the safety of collection materials; copying, copyright, and property rights restrictions; and confidentiality of personal records.[43] Data pertinent to the study was obtained in accordance with guidelines established at the various archival centers, all of which allow non-flash photography of materials. A separate piece of paper indicating the source of the document was photographed with each item for accurate citation of references. Publication permission protocols for each archive, or potentially each item depending on copyright ownership, have been strictly followed and were initiated upon the first visit to ensure timely resolution of the process.

The confidentiality of health data has become an issue for historical researchers following the passage and enactment of the Health Insurance Portability and Accountability Act (HIPAA). The part of HIPAA most important to historical researchers is the Privacy Rule, which retroactively protects all individually identifiable health information in existing records, no matter how old or whether the subjects are living or dead.[44] The only HIPAA restricted collection identified as a potential archival source for this dissertation was the Michael Reese Hospital nursing records at the AAP. This researcher did not feel the need to access these materials, as the publicly available data provided a rich narrative.

Approval for the study was granted by the Institutional Review Board (IRB) for Social and Behavioral Sciences (SBS) at the University of Virginia (UVA). A protocol application was submitted to the University's IRB for review and approval in November of 2015. A final decision was received from the SBS committee on November 4, 2015, and the committee ultimately determined that the research did not meet the federal definition of human subject research and was given exempt status. A copy of the protocol application can be found in Appendix C.

Data Sources

Primary Sources

The Julius Hayes Hess Collection at the University of Chicago's Regenstein Library. This collection contains 53 boxes (58.75 linear feet) of the personal and professional documents of Julius Hess, MD, spanning the years 1899 through 1958. Hess was a Chicago-based pediatrician and early pioneer in premature infant care. Widely credited with establishing the field of American neonatology, Hess founded the first successful hospital-based center for the care of sick and preterm infants. Data from this archive include personal letters and family photographs, professional and political correspondence, research articles and publications, newspaper clippings related to his professional career and milestones, and extensive drawings and papers on the design and production of his inventions, including an infant incubator. The collection also contains case studies, research notes and conference presentations, glass lantern slides Hess used for lectures, and drafts and records from the Premature Infant Station at Sarah Morris Hospital in Chicago. One folder in

the collection contains all of the documents and records Hess kept from the 1933-34 *Century of Progress* Exposition, including total births and deaths by month, newspaper clippings about the show, and transcripts from radio publicity programs about the incubator exhibit.

The William Silverman Collection at the American Academy of Pediatrics. This collection houses twelve boxes of personal and professional notes and correspondence from William Silverman, MD's career as a neonatologist and researcher. Silverman made important contributions to the science of neonatal care, particularly with respect to the identification of oxygen-related blindness, or retinopathy of prematurity, in premature infants. He advocated for evidence-based medicine and pushed colleagues to consider quality of life when formulating treatment plans for infants on the edge of viability. Silverman was the first medical historian to research the history of incubator-baby sideshows, and three boxes in the collection include all of the data gathered from his over thirty-year research into the phenomenon. The collection also includes final drafts of numerous conference presentations given on the history of neonatology and every publication from his extensive bibliography, many of which discuss issues of technology and morality in the NICU.

The Incubator Collection at the American Academy of Pediatrics. This collection contains data from research into the history of the infant incubator through the efforts of many physician historians active within the AAP. Collection materials include background information about the origin of the incubator, newspaper clippings and popular press articles from the early 1900s, and personal

letters and accounts from individuals who either visited or were part of an incubator-baby sideshow. Hundreds of photographs from the exhibits around the world are also part of this collection, as well as a tape containing video footage from inside the 1939 New York World's Fair incubator show, which showcases nursing care provided to the premature infants on display.

A Century of Progress Records at the University of Illinois at Chicago's Richard J. Daley Library and Special Collections. A Century of Progress International Exposition was held in Chicago during the summers of 1933 and 1934 to commemorate the incorporation of the city in 1833. The Infant Incubator Exhibit at Chicago's *Century of Progress* was a joint venture between the Infant Incubator Company and Hess' Premature Infant Station. This collection, 249 linear feet of documents and items dating from 1927 to 1952, consists of the extant operating records of *A Century Progress* World's Fair. Important contextual information can be gathered from this collection through copies of official publications, press releases, souvenir albums, maps, brochures, photographs, and newspaper articles from the fair. Additionally, this collection houses correspondence between the Infant Incubator Company and exposition developers, transcripts from press releases about the exhibit, and financial records.

The New York World's Fair 1939-1940 Incorporated Records at the New York Public Library. The New York World's Fair of 1939 and 1940 commemorated the 150th anniversary of Washington's inauguration in New York City and took "Building the World of Tomorrow" as its central theme. The records of the New York World's Fair 1939-1940 Incorporated, which total 2508 boxes (1203.48 linear

feet), present a comprehensive view of all aspects of the fair. In addition to official correspondence and memoranda, the collection consists of reports, minutes, financial and legal records, architectural plans, design drawings, sound recordings, brochures, leaflets, press releases and other promotional materials, and includes over 12,000 photographs of the fair, its exhibits, and visitors. The 1939-40 New York World's Fair was the last world's fair in which the Infant Incubator Company sponsored an exhibit, and also the least successful exhibition from a financial standpoint. The archival collection houses the annual contracts for exhibitors signed by Martin Couney, correspondence between the Infant Incubator Company and fair developers, and detailed reports on the outcomes of the infants cared for during the fair, as well as information on their gender, estimated age, and weight. The Digital Collection includes 22 high-resolution photographs from inside the baby-incubator exhibit, showing Couney, many of the nurses who worked in the show, and some of the infants on display.

The Coney Island History Project. The Infant Incubator Company maintained a recurring incubator exhibit at Coney Island from 1902 to 1943 and is part of the History Project's Hall of Fame. The collection includes oral histories from incubator show graduates and family members who recall visiting the exhibit, as well as numerous amateur and professional photographs from the shows.

The published works of Evelyn C. Lundeen. Evelyn Lundeen, RN was head nurse of the Premature Infant Station at Sarah Morris Hospital for nearly forty years. During her long career, Lundeen published extensively in journal articles and books regarding premature infants and the model of care developed in collaboration

with Julius Hess at the Premature Infant Station. The books and articles present many of their research findings, discuss in detail the nursing activities Lundeen performed while head nurse of the station, and provide candid examples of her thoughts and opinions about her experience as nursing director.

Claude Moore Health Sciences Library at the University of Virginia. The University of Virginia Health Sciences Library provides access to an extensive array of current resources, including over 700 electronic books, 120,000 print books, 3000 online journals, 1100 print journals, and over 100 databases. The library also houses Historical Collections and Services, a repository for history of medicine archival data, and has copies of each of the early publications by Julius Hess and Evelyn Lundeen. Archival copies of medical and nursing journals dating back to the time frame of study were also searched for articles on premature care and incubators for information on standard practice and the state of the science of nursing and medicine.

Alderman Library at the University of Virginia. The University of Virginia Alderman Library Albert Small Special Collections has rare book holdings on American History and literature. The collections include almost 300,000 volumes, more than 250,000 photographs and 8,000 reels of microfilm. Alderman Library has one of the largest collections of historical newspapers in the country by state and year of publication. A targeted search of regional newspapers in Chicago, New York, Buffalo, San Francisco, and Atlantic City revealed numerous articles about incubator shows and Martin Couney's Infant Incubator Company. Chicago newspapers were also searched for articles about Julius Hess, Evelyn Lundeen, and the Premature

Infant Station around targeted dates to identify contextual information for social, political, and economic issues and events.

Secondary Sources

Secondary sources related to the history of American premature infant care were discovered through online searches of published manuscripts, as well as texts from nursing, medicine, sociology, anthropology, and history. Sources were evaluated for strength and merit by how well the author utilized primary source material. The selected secondary literature provided a strong foundation for understanding the context and background from which premature nursing emerged, but focus mostly on the physician leaders, technological advances, and social changes that pushed prematurity as a major public health issue. While the nurses who provided care for the infants are credited in nearly all sources for the improvements in outcome and reduction in mortality, few details are known about the nurses' roles, their duties, or their training.

Chapter Overview

Chapter 1: Introduction and Methods

This chapter provides an overview of the research study, identifying the research questions guiding the inquiry and a thorough description of the chosen methodology. A brief review of secondary sources is presented, highlighting a knowledge gap the study aims to fill within scientific literature. Primary data

sources and archival material are identified and described, followed by a summary of each chapter.

Chapter 2: Background and Setting

Chapter two provides a broad introduction to the history of premature infant care, beginning in antiquity and focusing on the late nineteenth and early twentieth century when prematurity came to be regarded as a medical problem in need of intervention. The history of the infant incubator, from its French origins in the late 1800s through its introduction to the United States via incubator-baby sideshows, is also explored. This chapter also briefly describes the changing roles of mothers and children throughout the Progressive Era, as well as some of the health policy reform measures that influenced public perceptions of premature infants. The state of the science of medicine and nursing in the early twentieth century are discussed within the context of organized efforts toward professionalization during the time frame of interest. Finally, this chapter introduces Martin Couney and Julius Hess as the two leaders in the early care of premature infants in the United States who, despite advocating for strikingly similar advanced treatment practices for premature infants, are remembered quite differently within the history of neonatology.

Chapter 3: Nurses as Performers in the Incubator-Baby Sideshows

Martin Couney, MD introduced the United States to incubator technology for premature infants, and brought the French model of advanced nursing care for this vulnerable population to the American public. A true show inventor, he masterfully

utilized the media to generate interest and increase publicity for his incubator-baby exhibits, and capitalized on the rising popularity of leisure activities in Progressive Era America to maintain a long and successful career displaying premature infants at international world's fairs and American amusement parks. Chapter three describes the sociotechnical network of the Infant Incubator Company, evaluating the role of nurses within this technology system. This chapter not only provides a rich description of nursing activities at the incubator-baby sideshows, but also evaluates the persuasive power of the image and actions of nurses in promoting incubator technology and the medical needs of premature infants.

Chapter 4: Nurses as Experts at the Premature Infant Station

The Premature Infant Station at Chicago's Sarah Morris Hospital was the first successful hospital-based unit specializing in the treatment of ailing and premature infants in the United States. The system of care developed by Julius Hess, MD and head nurse Evelyn Lundeen, RN would establish the Premature Station as the preeminent model for healing sick newborns, and confirm Hess as the leading expert on prematurity. In chapter four, the sociotechnical system of the Premature Infant Station is outlined and analyzed, focusing on the role and duties of nurses within the system and the power dynamic between Hess and Lundeen. This chapter examines how the message presented by the Premature Infant Station, which stressed the importance of quality nursing care for increasing survival in preterm infants, influenced the proliferation of hospital-based premature units around the country.

Chapter 5: Analysis and Conclusions

Chapter five presents conclusions drawn from the examination of data within the previous chapters. The experience of premature infant nurses in both sideshow and hospital-based systems of care are compared and contrasted to evaluate the influence of each system on the nursing role and function. Both sociotechnical systems described in the study relied on specially trained nurses to provide all treatment to the newborns under their supervision, and these nurses played a significant part in promoting and integrating the incubator and other advanced techniques to enhance the quality of care for premature infants in the early twentieth century. The relative success of the Premature Infant Station with elevating public opinion for both premature infants and incubator technology, in relation to that of the Infant Incubator Company, may have been a result of the status of nurses within the system, the flexibility of power relationships, and the contrast between performance of duties and individual agency. Finally, this chapter also discusses ethical concerns within current neonatal practice as they relate to the increasing role of technology in NICUs. Findings from the study are used not only to help contextualize the issue, but also lend historical support for increased nurse involvement in the development of health policy guidelines.

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[18] For a more detailed account of very early premature care beginning in antiquity, see Cone, *History of the Care and Feeding of the Premature Infant*; Desmond, *Newborn Medicine and Society;* and William Silverman, *Retrolental Fibroplasia: A Modern Parable* (New York: Grune and Stratton, 1980). Chapter 2 will also provide a more detailed description of the history of care of the premature infant.

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[21] Photographs and video footage from outside the 1939-1940 New York World's Fair Baby Incubator building show the phrase "Once Seen, Never Forgotten" painted on the wall out front. Video courtesy of the Pediatric History Center at the American Academy of Pediatrics.

[22] Baker, *The Machine in the Nursery*.

[23] Silverman, "Incubator-Baby Side Shows," 140.

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[32] Barbara Mann Wall, "Nursing History: Blurring Disciplinary Boundaries," *Nursing History Review* 15 (2007): 5-8.

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the Sociology of History of Technology, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge: MIT Press, 1987): 106.

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[41] Judith McGaw, "Women and the History of Technology," *Signs* 7 (1982): 802.

[42] Sandelowski, *Devices & Desires.* Throughout the text, Sandelowski employs Wanda Orlikowski's adaptation of Anthony Giddens' theory of structuralization to frame her study of the nursing-technology relationship. The model constructs technology as a duality of design and use, its existence both a material force and a socially constructed entity. Sandelowski concludes that the nurse-technology relationship has proven both paradoxical and ironic; that nurses have historically

turned toward and from technology to make their work more visible, but that doing so has not provided nursing with the autonomy and professional distinction it seeks.

[43] Lusk, "Historical Methodology," 357-358.

[44] Mages and Fairman, "Working with Primary Sources," 141-146.

Chapter 2: Background and Setting

On July 25, 1934, at the *Century of Progress* Infant Incubator Homecoming celebration, Herman Bundeson, MD, Health Commissioner for the city of Chicago, claimed that, "All the world loves a baby and all the world is particularly interested in the tiny babies who are born prematurely and whose first months of life are a constant struggle to live."[1] The event was conducted to honor the "graduates" of the Infant Incubator Exhibit at Chicago's 1933 World's Fair, those formerly premature babies who had lived for months on display along the popular Midway section of the *Century of Progress* exhibition the previous summer. Housed in an elaborate pink and blue striped building that featured "living babies in incubators," the exhibit allowed fairgoers to come inside and watch trained nurses care for these infants for a small admission fee.[2] The *Century of Progress* incubator-baby sideshow was actually a collaborative effort between two early leaders in American premature care, Martin Couney, MD and Julius Hess, MD, and provided vulnerable newborns with the highest quality care available at a time when advanced treatment for premature infants in United States was essentially nonexistent.

Bundeson's comments referenced a growing awareness of prematurity across the country in the mid to late 1930s, due largely to the efforts of both Couney and Hess to increase the visibility of incubator technology and change public perceptions of premature babies since the beginning of the twentieth century. The process proved to be gradual and tenuous, as efforts to promote premature infants as a cause worthy of medical intervention often fell victim to social, economic, and

political forces. Despite early enthusiasm for the mechanical incubator after its initial introduction to America in 1898, the device fell out of favor with the medical community between 1910 and 1930, and premature infants continued to struggle to improve their perceived value to society.

The Infant Incubator Exhibit at the 1933-34 Chicago World's Fair was remarkable for a number of reasons, including its overwhelming financial success despite being held at the height of the Great Depression.[3] Most importantly, the exhibit showcased the incubator as a life saving technology and generated the positive publicity needed to encourage public acceptance and increase demand for hospital-based premature care. The *Century of Progress* exposition signaled a turning point in the evolution of premature care in the United States, as the number of new hospital wards dedicated to treating sick newborns increased exponentially after the fair concluded.

Success at Chicago's *Century of Progress* also advanced the professional careers and fame of the two physicians involved. Martin Couney, whose Infant Incubator Company brought the incubator-baby sideshow to the United States from Europe in 1898, would eventually be recognized as a "forgotten and lone pioneer of neonatology" who saved the lives of thousands of premature infants in a near fifty-year career running these exhibits.[4] Julius Hess, the first American physician to publish a comprehensive text on premature infants and medical director of the first long-term successful hospital unit specializing in premature care, would come to be regarded as the father of American neonatology. Despite differing approaches to the dissemination of incubator technology and other advanced premature care

techniques, both physicians relied on specially trained nurses to provide all treatment to the newborns under their supervision. While few details are known, the quality care provided by these nurses is often cited as the primary reason for the dramatically increased survival rates experienced by Couney and Hess. The context of time and place, and the position nurses held within the technology system in which they worked, undoubtedly influenced not only *what* care was provided by nurses, but also *how* that care was delivered.

To analyze the role of the nurse within the sociotechnical systems of both the incubator-baby sideshows as well as the in-hospital setting of the Premature Infant Station in the early twentieth century, it is important to examine the social, political, and economic forces behind the evolution of care for premature infants in the United States during that time period, as well as identify and contextualize the relevant social groups interacting with one another within each system. This chapter will provide an overview of historical attitudes toward and early attempts at treatment for premature infants, describe the invention of the incubator and the design modifications that occurred during the transfer of the technology from Europe to the United States, and briefly discuss some of the social and political reform movements during the Progressive Era that helped modify the social value of American children. The state of the art of nursing and medicine in early twentieth century United States will also be examined. Finally, this chapter introduces both Martin Couney and Julius Hess as early experts in the fledgling field of premature infant care who promoted many of the same techniques and specialized treatments for sick babies.

Historical Attitudes and Early Care for Premature Infants

In the ancient world, infants were valued only for their potential to become future members of society. A newborn baby was viewed as "not yet human, *infans nondum homo*, while the fetus was only a hope of life, *spes animatis*."[5] To prevent unrestrained population growth, many philosophers including Aristotle and Plato, supported infanticide as an essential and suitable means for maintaining a strong republic.[6] As a consequence, feeble, deformed, illegitimate, and premature infants were often exposed to death because they were assumed to be of no social value. These small, emaciated, and/or congenitally debilitated infants were all considered "weaklings," and it was not until the late nineteenth century that babies born prior to term gestation were differentiated and the phrase "premature infant" became part of the English vernacular.[7]

The rise of Christianity helped to somewhat elevate the status of children, with the Middle Ages characterized by a growing recognition of the moral duty to provide for sick or abandoned infants. A need to care for these children led to the establishment of foundling homes throughout Europe. While they provided shelter for unwanted infants, the homes unfortunately provided little in the way of hope or protection, as death rates often approached 100 percent. For centuries, these institutions were the only option for children to receive care or shelter, but "the best that could usually be offered was spiritual salvation."[8] As late as the early twentieth century, high mortality for weak or premature infants was often met with a fatalistic attitude. As renowned American pediatrician L. Emmett Holt, MD noted, "visitors to the marasmus wards of a modern infants' hospital often remark upon the

uselessness or futility of saving these infants… that by efforts to keep the feeble alive, degeneration of the race rather than improvement is favored."[9]

If and when families provided care for their sick or premature infants, all responsibility remained with the mother or female family members. Multiple early accounts reflect an understanding of the importance of keeping the child warm to increase survival, as methods utilized to preserve body temperature appear across cultures. Some ancient societies used waddling or sheepskin with the wool adhering for weak newborns to prevent heat loss, while others placed the infant in a jar full of feathers.[10] The Thongas tribe in South Africa would wrap castor oil plant leaves around the feeble newborn and place them in a pot outside to heat in the sun; Asiatic Eskimos placed their premature infants in bird skin sacs hung over an open flame.[11] An 1815 report by Scottish physician John Rodman describes the care of one premature infant who was immediately wrapped in flannel from head to toe after birth, "with only an opening in the dress around his mouth for the admission of air."[12] The child was then placed directly into bed with his mother, where she and two female attendants would alternate lying in bed with him for at least two months to maintain constant warmth.

An overwhelmingly high rate of mortality persisted among premature infants despite these earnest efforts by family members. In addition to the dangers of excessive heat loss, premature newborns would often succumb as a result of inadequate nutrition, susceptibility to infection, or respiratory failure. Since full term infants often fell victim to similar conditions in large numbers, high mortality rates among premature babies were not perceived to be problematic. Lacking a

social imperative, coupled with limited access to newborns since most births occurred at home, little medical attention was given to premature infants prior to the late nineteenth century.[13]

The Invention of the Infant Incubator and the French Model of Care

The earliest organized efforts by medical professionals to improve infant mortality were often precipitated by political or economic necessity, either to support population growth after war or famine, or to increase the available labor force following rapid industrialization.[14] Looking for more practical ways to preserve warmth in weak or premature infants, physicians began to develop technology that would accomplish this goal. The development of a new mechanical device to treat premature and sick newborns initiated a change in the perception that infant care should remain a strictly maternal responsibility. Incubator technology facilitated improved survival rates for premature newborns, and was the focus of the first physician efforts at treating this vulnerable population.

Some disagreement exists regarding the first appearance of a mechanical device used to keep premature infants warm, but the first published account came in 1857 from French physician Jean-Louis-Paul Denucé describing the *warmwännen* (Figure 1, Appendix A).[15] The device consisted of a double-walled metal warming tub, and warm water was poured between the inner and outer tub walls. Infants placed in the bottom of the tub could be kept warm by frequently draining and replacing the warm water. The original invention has been traced to a warming tub described in 1837 by Johann Georg von Reuhl in the Imperial Foundling Hospital in

St. Petersburg.[16] Carl Credé, chief of obstetrics at the Leipzig Maternity Hospital in Moscow asserted in 1894 that a similar device had been used successfully for premature infants for over twenty years at both the Imperial Foundling Hospital and Leipzig Maternity (Figure 2, Appendix A).[17]

Credit for the invention of the first fully enclosed incubator for premature infants belongs to Étienne Stéphane Tarnier, MD while he was the obstetrician in charge of Paris' Maternité hospital. After being inspired by the poultry exhibit at the Paris zoo, he designed the first warm-air incubators for premature infants in 1880.[18] Tarnier's original design was a large, plain rectangular wooden box containing a double wall filled with sawdust to retain heat. The device, large enough to house two or more infants at a time, featured a large internal reservoir for circulating water that had been heated in an outside boiler called a *thermosiphon* (Figure 3, Appendix A).[19] In addition to being too large and cumbersome, the incubator was almost too successful at maintaining heat, as infants could literally be baked inside without proper attention.

In 1883, Tarnier and his intern Alfred Auvard greatly simplified the design after noting improved success when nursing staff routinely warmed and changed the water in the reservoir, rather than relying on the thermosiphon.[20] The Tarnier-Auvard incubator featured a wooden box divided into two compartments: hot water bottles were placed along the lower compartment, and an incomplete partition allowed warm air to circulate up and around the infant lying in the upper compartment (Figure 4, Appendix A).[21] Nursing care of these infants was intensive and time consuming, as the bottles needed to be changed at least every two hours to

maintain adequate temperatures (Figure 5, Appendix A). Tarnier reported that use of the incubator at the Maternité hospital reduced premature infant mortality by almost half, convincing both his colleagues and competitors that the use of the technology could increase survival rates and improve outcomes with premature infants.[22]

Despite this success, Tarnier recognized that his system of care for premature infants was available only to those who were born inside a maternity hospital, and as such, was limited in scope. Like the rest of the world, home births predominated in Paris, and by the end of the nineteenth century less than a quarter of all births occurred in the hospital.[23] In 1885 Tarnier wrote, "All the world knows that premature infants die in great numbers… to give them any chance to live they need special care."[24] Aiding Tarnier's quest to reach more preterm infants was a new interest in infant mortality by French politicians. After the massive loss of life incurred during the Franco-Prussian war, a French "depopulation" movement arose in an attempt to restore the country's falling birth rate.[25] To expand aid to premature infants, several Paris maternity hospitals established *services des débiles* ("hospital services for weaklings"), special nurseries dedicated to treating any sick or premature baby born at home.

The results were disastrous, as most of the infants arrived to these wards in unrecoverable conditions. Parents often waited days to bring newborns to the hospital, and by the time treatment was begun there was no hope for recovery. Mortality rates at the *services des débiles* soared to over 75 percent, and these totals already excluded any infant who died within 2 days of admission.[26] Pierre Constant

Budin, MD, who succeeded Tarnier at the Maternité hospital, remarked that the wards "served only as a mortuary depot" and strove to develop a system of premature care that actively recruited maternal participation.[27] He soon changed positions to become the head of obstetrics at the Clinique Tarnier, which would come to be known as a "school for mothers."[28]

Budin's approach to premature care focused on integrating the mother into the process. He advocated lower technology incubators and altered the design so that the infant chamber was constructed almost entirely of glass, allowing for constant observation. Incubators were placed at the mother's bedside in the maternity hospital, and nurses encouraged close attention to reinforce maternal responsibility for the care of her infant.[29] Budin actively participated in French infant welfare campaigns, arguing for government sponsored maternity leave, pregnancy rest homes, follow-up services for newborns discharged from the hospital, and financial compensation for families needing incubator care for their premature infants, both in the home or in the hospital.[30] His textbook *Le Nourrisson* ("The Nursling") dedicated a significant portion of its content to problems specific to premature infants and promoted Budin to the level of international authority in premature care.[31]

Not all French physicians practiced in an environment as supportive as the Clinique Tarnier, both financially and in terms of specially trained nursing staff. As increased enthusiasm for technology swept the globe in the late nineteenth century, physicians in both Europe and the United States either collaborated with or became inventors themselves, attempting to alter the incubator design to meet their own

specific needs. The most successful and technologically advanced of these designs was created in Nice in in 1891 by Alexandre Lion, MD, the physician son of an inventor. Made completely of iron, the design featured glass front doors and was heated by a spiral pipe along the bottom that circulated hot water. External air was drawn in and filtered through a separate pipe and a fan at the top indicated the rate of air circulation. Infants were placed inside a mattress-padded basket suspended by springs.[32] Lion's incubator featured automatic heat regulation via an attached thermostat as well as independent forced ventilation for the infant inside (Figure 6, Appendix A).[33]

In direct opposition to the support system necessary for success with the Tarnier incubator, Lion's design was intended for use where quality nursing care was lacking. The *Lancet* described its main feature as "the fact that it requires no constant and skilled care. . . the only attendance necessary is that needed for feeding and washing the infants."[34] Unfortunately, the design enhancements made Lion's incubator large, heavy, expensive, and difficult to operate, as it required installation into buildings for proper use. To fund the use and expansion of his incubator services, Lion established his own *oeuvres maternelles des couveuses d'enfants* ("incubator charities"), which displayed a working nursery located in a busy storefront, and charged admission.[35] Lion heavily marketed both the stations and his incubator design to the popular press, and by 1896 had established branches of his incubator charities in Bordeaux, Marseilles, Lyons, and Nice, with plans for more in Brussels and London.[36] Expanding on Lion's system of incubator charities, incubator sideshows developed and were quickly popularized as world's fairs and

exhibitions became venues where technological advances and cultural standards could be presented to the masses.

World's Fairs as Settings for Cultural and Technological Transfer

The Great Exhibition of the Works of Industry of All Nations, held in London's Hyde Park in the summer of 1851, is widely regarded as the first modern world's fair. Created by Queen Victoria's husband Prince Albert and cultural reformer Henry Cole, the fair built upon the art and trade exhibitions popular in France in the eighteenth century, but reimagined them on a much larger scale. The Great Fair, also known as the Crystal Palace Exhibition in honor of the enormous iron and glass structure where the fair was held, showcased the technological achievements of the modern industrial world. Over the five and a half months the exposition was open, it hosted more than six million visitors and generated nearly two hundred thousand pounds in profit.[37] The design and success of the Crystal Palace Exhibition would serve as the model for future world's fairs around the world, inspiring more than one hundred twenty such expositions over the next century.

Inspired by the success of the Crystal Palace Exhibition, and hoping to inspire a sense of nationalism to unite a divided country, a group of wealthy New Yorkers organized the first world's fair in the United States at the 1853-54 New York Crystal Palace Exhibition. Unfortunately the fair proved financially disastrous, and low overall attendance during both seasons resulted in total losses of more than 300,000 dollars for the exhibition sponsors.[38] Twenty-three years would pass before the United States hosted another exhibition, during which time Americans

would fight the Civil War and experience political and economic uncertainty throughout the Reconstruction era. By 1876, wealthy American capitalists and political leaders once again looked to an international exhibition as a way to rebuild confidence in the strength of the nation and showcase the social and technological progress made in the 100 years since the Declaration of Independence. The International Exhibition of Arts, Manufactures and Products of the Soil and Mine, more commonly known as "The Centennial," was held in Philadelphia in the summer of 1876. In stark contrast to the 1853 Crystal Palace Exhibition in New York, Philadelphia's Centennial fair drew nearly ten million visitors during its six-month run and left organizers with a near two million dollar profit.[39] Displays of technology and industrial innovation from around the world dominated many of the buildings, and inventors took advantage of a growing consumer and leisure culture to showcase and sell their products. The world's fair would become an ideal medium for reaching the general public, providing cultural education, mass entertainment, and a vision of progress synonymous with technological advancement.

Infant Incubator Exhibits Begin

The 1896 Berlin Exposition marked the first display featuring live premature infants in incubators at fairs and exhibitions around the world. Here, Lion showcased his *Kinderbrutenstalt* ("child hatchery") and the exhibit was an immediate success, attracting over one hundred thousand visitors during its two month run.[40] The display featured six premature infants on loan from the Berlin

charity hospital, whose director released the infants because he was convinced they would most likely perish anyway. To everyone's amazement, all six of the infants survived, and over the course of the exposition, several more premature babies were successfully cared for without a single loss.

Although Martin Couney, MD claimed to have been responsible for the Berlin exhibit, presumably he worked with Lion at the exposition and was recruited by Samuel Schenkein, a British showman, to create a similar display the following year in London at the Victorian Era Exhibition at Earl's Court.[41] Couney, encouraged by the show's popularity, brought the incubators to the United States for the 1898 Trans-Mississippi and International Exposition in Omaha, Nebraska. He worked with Lion again at the Paris Exposition Universelle in 1900, but would return to the U.S. for the 1901 Pan-American Exposition in Buffalo, New York.[42]

Success in Buffalo prompted Couney to stay in the United States and continue presenting infant incubator shows at expositions throughout the country. He founded the Infant Incubator Company and opened a permanent concession on the boardwalk in Atlantic City in 1902 and at Luna Park on Coney Island in 1903, where he would hold exhibits nearly every summer for the next forty years. Beginning in 1905, Couney also set up a recurring exhibit at Chicago's White City Amusement Park, although the exact dates of his run there are unknown.[43] Additionally, he presented in Portland Oregon in 1906, at international expositions in Mexico City, Mexico in 1908 and Rio De Janeiro, Brazil in 1910, at Denver Colorado's Lakeside Amusement Park in 1913, and at the Panama Pacific International Exposition in San Francisco in 1915.[44] The final two expositions the Infant Incubator Company

participated in, the 1933-34 Chicago Century of Progress World's Fair and the 1939-40 New York World's Fair, brought Couney the most notoriety. At the conclusion of his career in 1943 with the closure of his Coney Island concession, Couney claimed to have participated in a total of twenty-three expositions worldwide.

Few American competitors arose despite Couney's apparent entrepreneurial success. One notable exception came in 1904 when a group of businessmen from St. Louis, intrigued by the popularity and commercial potential of an incubator sideshow, formed the Imperial Concession Company and planned a grand infant incubator exhibit at the Louisiana Purchase Exposition. Despite hiring an experienced trained nurse and physician consultant, a rash of summer diarrhea hit both the infants inside the show and the recent graduates, skyrocketing their death rate to 50 percent.[45] Dr. John Zahorsky, a prominent St. Louis pediatrician, took charge of the exhibit after the first medical consultant resigned under pressure. Zahorsky meticulously documented the experience, including the high cost, which he estimated to be about 15 dollars per infant each day.[46] Presumably this prohibitively large expense, as well as the potential for widespread negative press in the event of poor infant outcomes, as occurred at the 1904 Louisiana Purchase Exposition, contributed to the lack of incubator show imitators within the United States.

Almost from their inception, incubator baby shows posed an ethical dilemma for medical professionals, particularly with respect to the carnival atmosphere present at world's fairs and expositions. An editorial in the *Lancet* in 1898 following the incubator exhibit at the Victorian Era Exhibition at Earl's Court warned the

medical community of the dangers of supporting and promoting future incubator shows without incorporating skilled nurses and attendants.[47] The article appeared to send mixed messages, however, claiming there was "nothing derogatory to the dignity of the healing art in the exhibition of incubators at Earl's Court," but that "human infirmities do not constitute a fit subject for the public showman to exploit."[48] Much of the critique focused on shows where the atmosphere was not "suitable for prematurely born infants," in which the incubator exhibits were situated near caged animals or the vulgarities of a traditional fair.[49] Acceptance of the incubator shows within the medical and nursing communities rested solely on the inclusion of skilled nursing staff to attend to the premature infants involved in the exhibits.

The general public, however, demonstrated almost no objection to having live premature infants on display at the incubator sideshows. Continued popularity throughout the nearly fifty years the exhibits were held in America reflected the rise of mass culture entertainments in the early twentieth century, which included amusement parks, carnivals, melodrama theaters, movie houses, dance halls, brothels, and saloons.[50] Urban crowding and long, repetitive hours of modern work pushed working class Americans toward these commercialized amusements "hoping to be amused and diverted from humdrum routine existence by dreams of fantasy."[51]

The Rise of Scientific Medicine and Professional Standardization

During the colonial period in the United States, few legal or social obstacles existed for those desiring to practice medicine. Individuals with or without formal education or specialized training could present themselves as healers without consequence.[52] As late as the mid nineteenth century, medicine was viewed as an inferior career with limited prospects. Physicians had little political influence, only modest income, and limited social prestige, with some doctors lamenting their position in "the most despised of all the professions which liberally educated men are expected to enter."[53]

The second half of the eighteenth century saw beginning efforts toward standardization and refinement of the medical profession. The American Medical Association (AMA), created in 1848 to raise professional standards for doctors, made little progress in regulating and influencing medical practice across the country prior to the twentieth century. Until the 1870s, wide variation in training standards for medical education persisted in the United States and few states had licensing laws for physicians. Consequently, medical treatments did little to impact prevailing diseases, infant and child mortality rates remained high, and poor hospital conditions decreased their popularity and usage within the general public.[54]

The development and application of the scientific method to medicine resulted in a number of medical discoveries in bacteriology, asepsis, immunology, anesthesia, and medical instruments during the last quarter of the nineteenth century. Germ theory and antiseptic practices revolutionized medical

understanding of disease and the application of advanced diagnostic instruments began to improve national health.[55] Recognizing a need to reform medical education to a level in accordance with contemporary scientific discovery, the AMA created a Council on Medical Education in 1904 with the goal of standardizing training programs for physicians. As one of its first acts, the council created a minimum standard for physicians calling for four years of medical school and the passage of a licensing exam.[56] In 1909, the AMA would ask the Carnegie Foundation for the Advancement of Teaching to perform a survey of American medical schools, with Abraham Flexner in charge of the process. Flexner's assigned duty was to assess the compliance of schools with the required minimum standards outlined by the AMA. The resulting Flexner Report of 1910 standardized American medical training by discarding numerous small medical schools and focusing national funds, resources, and prestige on larger, professionalized medical schools associated with universities.[57]

The reformed medical education system greatly increased the homogeneity and cohesiveness of the profession. Backed by scientific victory over many diseases, physicians began to enjoy a new level of social prestige that had previously eluded the profession. Medical leaders used their newfound social standing to further elevate their authority over health practice, bringing the ability to prescribe, diagnose, and treat under the exclusive control of the medical profession.[58] Moreover, the medical profession was able to "turn its authority not just into social privilege, but also economic power and political influence," eventually dictating the country's response to issues of infant health and welfare.[59]

Early Twentieth Century Nursing

The first training schools for nurses opened in the United States in the 1870s modeled after Florence Nightingale's school at the famous St. Thomas' Hospital in London. The need for "trained" nurses had recently been recognized by the AMA, whose president Dr. Samuel D. Gross believed it "just as necessary to have well trained, well instructed nurses as to have intelligent and skillful physicians." [60] Disorganized, haphazard nursing services typified hospital care at that time, and the women employed as nurses were often uneducated, unmotivated, and morally questionable. Inability to read printed directions on medication bottles occasionally caused patient injury or even death.[61] Inadequate staffing and horrible working conditions discouraged many women from becoming, or even remaining, nurses. Stories of public drunkenness and sexual promiscuity lowered the social image of nursing, with middle- and upper-class individuals believing the hospital to be no place for a respectable woman to visit, let alone work. Training schools endeavored not only to improve the quality of nursing care provided to the sick, but also elevate the dignity of nursing through acceptance of applicants with a "higher moral standing."[62]

As physicians embraced new advances in science and technology, the work of nursing became more complex. Nursing leaders in the early twentieth century focused their efforts on improving the social image of trained nursing and pushing toward professionalization. The original purposes of the American Nurses' Association (ANA; previously known as the Nurses' Associated Alumnae of the United States and Canada), as outlined in their first convention in 1898, were to

improve educational requirements for training programs and to establish a code of ethics.[63] During the 1910s and 1920s, the ANA worked with individual state nurses' associations to legislate the registration of graduate nurses, and the curriculum committee concentrated on standardization of curricula throughout existing nurse training schools. Creation of a code of ethics proved to be more difficult, as disagreement over content and wording arose from a general feeling of ethical uncertainty within both the profession and society at large.[64]

Many of the early nursing leaders internalized Victorian gender norms and sexual stereotypes rampant among society as well as the male-dominated medical profession. In order to raise the status of nursing and earn a decent living, nurses would not only need to demonstrate their usefulness, but also convince their superiors, the physicians, that they could conduct themselves in a manner both professional and womanly. Most importantly, the ideal nurse would be loyal and faithfully obedient to physicians. Consistent with the belief that nurses were skilled assistants, the physician was "primarily and ultimately responsible for the life and health of the patient" with the nurse's sole duty "to obey orders, and so long as she does this, she is not to be held responsible for untoward results."[65]

Medical leaders continually reinforced this tradition through endless papers, lectures, and even nursing graduation speeches outlining the role of nurses in relation to her superiors. Particularly as nursing leaders began pushing toward professional distinction from medicine, physician leaders quickly dismissed the assertion as ludicrous. An article in the *Western Medical Journal* in March 1900 describes the medical response:

> These ladies claim that the medical and nursing professions are entirely distinct, and that a doctor cannot possibly understand nurses or nursing, this proposition is so absurd that it is difficult to realize how an intelligent woman can believe it…one of the cardinal principles of nursing ethics is, that the nurse must always be subordinate to the doctor, the nursing being part of his treatment. She is trained to be his assistant- an instrument to an end, and is employed for the purpose of carrying out the doctor's orders.[66]

A deferential attitude toward physicians would prevail among nurses well after the Progressive Era. Truly collaborative relationships between physicians and their nurses were unique during this time, and instances of nurses delivering care autonomously were nearly nonexistent.

In 1926, the *American Journal of Nursing* published the ANA's Suggested Code of Ethics, which had been presented and discussed at the annual convention. The stated purpose was to "create a sensitiveness to ethical situations… and create the individual habit of forming conscious and critical judgment resulting in action in specific situations."[67] As nursing asserted itself as a true profession, it progressed from stressing customs and etiquette to a need for a formal expression of ethical considerations. The 1926 suggested Code of Ethics outlined a nurse's relationship to society, the patient, physicians, other allied health professionals, and to other nurses. First and foremost, the nurse should serve society as a model citizen, and could achieve this by finding happiness, economic independence, and self-realization.[68] Interactions with physicians and other health professionals should be mutually respectful, and nurses should remain loyal to one another and the

profession. Patients should expect that nurses would bring "all of the knowledge, skill, and devotion" required to guard their health, all while respecting his relationship with family and community.[69] The code initiated a reciprocal relationship between nursing and society and demonstrated an increasing emphasis on making good judgments rather than strict obedience.

Progressive Era America

At the turn of the twentieth century, America was experiencing swift and dramatic industrial growth and urbanization. Large numbers of immigrants were arriving, many from southeastern Europe. A host of new social problems arose as a direct result, including overcrowding and violence in cities, high rates of communicable diseases from an increasingly polluted environment, unsafe working conditions, widespread political corruption, and untamed business practices. Additionally, the rising women's movement and modernism challenged traditional Victorian norms about gender roles, sexuality, and the nature of the American family.[70]

Between 1890 and 1920, groups of educated middle-class men and women were inspired to social activism and sought to reform the nation at the local, state, and national level by regaining control of their lives and their government. These reformers believed that social problems such as poverty, violence, corporate greed, and racism could best be addressed by providing good education, a clean living environment, and a safe workplace for all Americans. Viewing the government as a tool to be utilized for change, Progressives fought for housing and sanitation reform,

federal inspection and regulation guidelines for consumer products, government oversight and intervention in big business, and an overhaul of labor practices that improved safety and decreased exploitation of workers, particularly women and children. While a number of Progressive era initiatives undoubtedly influenced public perceptions of premature infants, the most relevant reforms include the shifting social roles of women, the changing and somewhat conflicting cultural value of children, the establishment of the Children's Bureau, and the rise in awareness of infant mortality as a major public health concern.

Changing Childbirth Practices

For the overwhelming majority of human history, pregnancy, birth, and newborn care have primarily been viewed as women's work, privilege, and civic or marital duty. Traditionally, women controlled all aspects of the birth procedure because men were excluded from childbirth rooms. The process carried a high level of danger, as maternal and infant mortality rates remained high well into the twentieth century. For most women, however, fears about the potential for future debility were greater than any fear of death.[71] Postpartum infections, fistulas, and poorly healed perineal tears brought constant pain and irritation to sufferers. Since women had not yet gained control over their reproductive futures, the reality of multiple pregnancies and confinements carried a near certain prospect for permanent physical limitations.

Searching for ways to make the birth process safer and less painful led upper- and middle-class women to seek out male physician attendants for childbirth

in the nineteenth century. The introduction of new obstetrical techniques, including forceps and anesthesia, became advantageous to physicians, who held monopoly over their use.[72] Additionally, physicians carried with them the status advantages of their gender and of the popular image of superior education. Births attended by physicians tended to follow a more interventionist pattern than those attended by midwives. As obstetrician Walter Channing stated, a physician, "must do something. He cannot remain a spectator merely."[73] Women began to view labor and birth as a less natural occurrence, and more as a pathological process necessitating medical intervention.

Home births continued to predominate well into the twentieth century, despite increasing utilization of physicians for childbirth. It was not until the transformation of hospitals from charity-based institutions to an emphasis on private paying patients that women began to appreciate and demand hospital childbirth. The mobility and urbanization of the nineteenth century also increased the popularity of hospital confinements by disrupting the traditional social networks necessary for successful home birth. Finally, the rise of germ theory and public awareness of surgical asepsis made the prospect of a sterile, scientific birth more attractive. The year 1938 was a turning point in American childbirth history, as hospital births accounted for half of all births in the country and would begin to supplant the home as the preferred location for confinement. As historian Judith Walzer Leavitt notes, "by 1940, 55 percent of America's births took place within hospitals; by 1950, hospital births had increased to 88 percent of the total; and by 1960, outside of some isolated rural areas, it was almost unheard of for American

women to deliver their babies at home."[74] This phenomenon is significant in the current discussion of premature infant care for consequently increasing physician access to newborns directly after birth.

It is worth mentioning that increasing physician involvement and intervention in childbirth, as well as the move from home to hospital for labor and delivery, did not significantly improve maternal mortality rates. In fact, death rates stayed the same, and in some years even increased, well after hospital birth predominated. As late as 1940, maternal death rates from all childbirth-related causes remained above 25 per 10,000 births.[75] While a desire to increase safety had originally motivated women to seek out physician assistance with childbirth, moving the delivery process out of the home only succeeded in transferring complete authority over birth practices to medical professionals.

Altering the Role of Women and Mothers

A female's biological capacity to bear children historically translated into life's destiny for most women, and the traditional gender roles characteristic of the Victorian era reinforced these beliefs.[76] The Progressive Era, however, ushered in a dramatic change with respect to the role of women and mothers in a modern society. New national interest in maternal and child welfare in the early twentieth century, and the subsequent public health campaigns to address this need, changed the responsibilities and social standing for the modern American mother.[77] The women's suffrage movement and the expanding presence of women in professional roles elevated the public standing of women, so long as they maintained the

gendered positions that society deemed morally acceptable, like participating in charitable societies, teaching children, safeguarding knowledge in a library, or promoting health as a nurse. Additionally, the rise of industrialization and advances in scientific theory brought new understanding and appreciation for technology and good health as a measure of a modern society.[78]

As birth records became more common across the country in the 1910s, actual numbers could be attributed to infant and early childhood death rates, highlighting the scope of a widespread and alarmingly high level of mortality in the first year of life. Additionally, the persistently high rates of communicable diseases ran counter to Progressive ideals of modernity and frustrated health reformers who believed both issues to be largely preventable. As women continued to manage household duties and family health complaints, they became the targeted audience of most public health campaigns in the 1910s and 1920s.[79] With a rise in the social status of women came additional domestic responsibilities. Not only were the health and well being of her own family considered her obligation, but the general health of her community was now also a mother's concern.[80] This began a remarkable shift in American understanding of successful mothering, from that of tacit feminine knowledge to something that must be learned and studied.

The ideology of "scientific motherhood" spread throughout the United States as women looked for expert guidance in fulfilling their primary familial responsibility of raising healthy children.[81] The Industrial Revolution had created a more mobile society, and consequently the traditional support systems for information and advice were no longer in place for a number of new mothers.

Immigrant women were also targeted for "Americanization" and encouraged to rely on professional expertise rather than familial or cultural customs.[82] A number of factors increased the need, availability, and utilization of childcare literature by mothers around the country, and included the growing awareness of the scope of infant and child mortality, emerging child welfare agencies, national public health campaigns, rising numbers of physicians specializing in pediatrics, and the expansion of print media.

The most popular scientific motherhood text of the time was a pamphlet published in 1914 by the U.S. Children's Bureau titled *Infant Care*, and nearly 1.5 million copies of the instructional pamphlet had been distributed by 1921.[83] While the booklet claimed to offer "such statements regarding hygiene and normal living as every mother has a right to possess in the interest of herself and her children," the material was geared toward women of a higher economic status.[84] In addition to universally applicable recommendations for plenty of nurturing and the removal of harsh punishments for children, the booklet also suggested that women not work outside the household, exclusively breastfeed, and avoid tenements as they "are not fit homes for children."[85] While more desirable and perhaps better for the overall health of the family, these latter recommendations were simply not feasible for poor immigrant mothers and children. Information was also geared toward healthy, full-term infants. Care of premature infants was first discussed in a section for the "small or delicate infant" in the 1921 edition, in which instructions for maintaining body temperature and feeding are presented in a total of two pages.[86] By 1938, an entire chapter of *Infant Care* outlined detailed methods for maintaining warmth

with or without the use of an incubator, the delicate process of feeding infants with prescribed schedules and amounts, and the importance of eliminating visitors to prevent infection in premature infants.[87] The book remained on the federal government's bestseller list for decades, and would reach a distribution level of 59 million copies by 1970.

Childhood Becomes a Period Worth Protecting

A profound transformation in the social value of children also occurred during the Progressive Era in the United States. Rapid industrialization in the late nineteenth century had afforded numerous job opportunities for children, providing working-class families with an added economic buffer during uncertain financial times. United States Census estimates show an increase of over one million child workers between 1870 and 1900.[88] Industrial work, particularly in textile mills, generated unique job opportunities for young children whose little hands and smaller stature allowed them to perform duties that would be difficult or more dangerous for adult workers to accomplish. Using children as active participants in the family economy was not a nineteenth century invention, however, as American children had always worked.[89] Large families often became a financial necessity in "an attempt to pool risks in what was experienced as a very uncertain world.[90] Women were also expected to bear numerous children to compensate for the high probability of infant loss in the first year of life.

The Industrial Revolution dramatically altered the structure of the American family, but resulted in starkly differing outcomes depending on race and class.

Perhaps the most striking representation of these socioeconomic differences can be seen in comparisons of the lives of children. The departure from agrarian life for middle- and upper-class, predominantly white families and the creation of a family wage meant that fathers alone would head to work to support their dependent families. Without an economic or labor need for large families, middle class couples began having fewer children and the cultivation of affective relationships became the principal function of the family unit. Expertly managing the home and raising babies became a symbol of successful womanhood, and children were freed from the responsibilities of contributing economically to the family's survival. For the wealthy, childhood became a precious period in need of protection, with attention given to play and education rather than work or chores.[91]

In contrast, poor working-class families, many of which were European immigrants seeking a better life in the United States, ended up working in factories or textile mills together, with children right alongside their parents. Data from the 1900 census show nearly one in five children aged 10 to 15 were employed, amounting to over two million child laborers.[92] Consequently, very few of these children attended school, and many suffered from poor health as a result of crowded living conditions, bad sanitation, and work-related injuries.

Child labor gradually gained national attention in the early twentieth century as middle-class Progressive social reformers pushed labor reform to the top of their political agenda.[93] The economic participation of children was viewed as sheer exploitation by parents. For reformers, true parental love could only exist if the child was defined exclusively as an object of sentiment and not as an agent of

production. The first chairman of the National Child Labor Committee, Felix Adler, MD argued that "childhood shall be sacred… commercialism shall not be allowed beyond this point."[94] As children became more emotionally valuable to their parents, the death of a child came to be regarded as both a heartbreaking and intolerable event. Families and communities began to express their emotional investment in children through outrage over preventable child deaths, holding expensive funerals for deceased children, and purchasing children's insurance. By the 1930s, the "economically useless but emotionally priceless child… occupied a special and separate world, regulated by affection and education, not work or profit."[95]

Improvements in child labor practices were only one of the many reform movements directed at children during the Progressive era. Reformers saw a nation in turmoil, but believed that the construction of welfare institutions could ameliorate many of the prevailing social problems faced by the nation's children, such as high mortality rates and lack of access to proper housing, sanitation, and education. In addition to providing much needed assistance, activists believed these institutions would diffuse middle-class values and ideals to the poor immigrant children they served. As a result, the late nineteenth and early twentieth centuries saw a proliferation of privately funded orphanages, foundling homes, hospitals for children, infant welfare centers, and settlement houses. These philanthropic ventures eventually gave rise to national child welfare reform through the establishment of a juvenile court system, publicly funded primary education, and the United States Children's Bureau.

The Eugenics Movement

Modern eugenic philosophy in the United States, which peaked in popularity in the early decades of the twentieth century, encompassed a broad range of ideals and activities whose common goal was to improve human heredity. Similar to many other progressive reform movements, eugenics arose in response to the many social and cultural problems resulting from rapid urbanization during the Industrial Revolution. In contrast to Social Darwinism, which implied that nature would weed out the weakest members of society, the eugenic movement "favored active intervention to assist natural selection, to offset medical and charitable activities that had artificially preserved the unfit, and to streamline the slow, wasteful, and cruel aspects of natural competition."[96] Ideas about the value of individual contributions to the nation focused on the ethnic composition of the population and the perfection of its physical, mental, and moral health.[97] With its emphasis on education and public health measures, eugenics had a significant influence on the infant health movement, sponsoring a number of activities that included statistical analyses of family pedigrees to determine disease inheritance and the "better baby contests" popular among women's organizations attempting to access rural children at state fairs.[98] In its most extreme form, eugenics was used to justify forced sterilization, restriction of immigration for specific races, and the withholding of treatment for babies born with certain ailments or deformities.

Many eugenic sympathizers believed that science could provide objective solutions to social and ethical conflict. By applying eugenic philosophy to questions about which individuals were fit to live and which individuals were better off dead,

supporters turned subjective and value-laden determinations into impartial judgments through the use of "science." The problem with this view centers on the nebulous definition of heredity at the time. As historian Martin Pernick writes, "scientists and lay people still shared a much broader language in which 'heredity' encompassed everything obtained from one's forbearers, no matter how they conveyed it."[99] This included not only genetic traits, but also the ability to be a good parent and a productive member of society. Almost any difference could be classified as a hereditary trait, and eugenic supporters often associated social class, race, ethnicity, and deformity with genetic defects. Classification as unfit expanded to include not only those suffering from mental illness and physical handicaps, but dark-skinned European immigrants, blacks, and Jewish individuals as well.

While premature babies were not specifically targeted, the rising popularity of eugenic philosophy in the Progressive Era may have negatively affected their perceived value to society. The increased prevalence of premature birth among poor immigrant populations caused some to fear that these "puny, ill-conditioned babies," if they survived into adulthood, would later become "the progenitors of weaklings like themselves."[100] This statement, given in a 1915 public address, was actually made by Mary Mills West, the author commissioned by Julia Lathrop of the U.S. Children's Bureau to create a series of educational pamphlets for women on topics related to pregnancy, birth, and childcare, including the widely popular *Infant Care*. Not surprisingly, early editions of these manuals had very little information on preterm labor or how to care for a premature infant.

The language used during the time period also deserves consideration, not just as context but also as a potential link between eugenics and prematurity. As Pernick notes, the scientific community used terms like "moron," "cripple," and "defective," words considered highly derogatory today, as acceptable labels that each conveyed a specific technical meaning.[101] Small, sickly, or premature infants were referred to as "weaklings" by physicians at a time when little was understood about their physiology, and determining gestational age was based solely on maternal report. They were often grouped together with congenitally diseased infants, which often carried a poor prognosis. It would appear that in the early twentieth century, premature infants found themselves caught in a conflicting narrative, struggling to find their value within a culture that began to glorify the life of a child, but only for those that had been deemed worthy of survival.

The Children's Bureau and Infant Mortality

Responding to the appalling conditions experienced by poor families in large urban areas, the Settlement Movement gained popularity among progressives and social workers during this time. Philanthropists and reformers began to establish "settlement houses" in poor neighborhoods, where volunteers would live and provide social services like health care, education, foster care, and play activities to working-class families free of charge.[102] Two leaders within the settlement movement, Lillian Wald and Florence Kelley, were the first to envision a federal agency whose sole focus would be the health and well-being of the nation's children. Years of activism and a strong lobby by Wald, Kelley, and other progressive

reformers would eventually push President William Howard Taft to create the United States Federal Children's Bureau in 1912.[103]

The new legislation called upon the Children's Bureau to "investigate and report upon all matters pertaining to the welfare of children and child life among all classes of our people." [104] Julia Lathrop, the first Chief of the U.S. Children's Bureau, searched for a manageable first project that would address a "pressing need" and establish "the scientific character of the Bureau's work and its usefulness to the public."[105] After consulting with a number of influential reformers, including Lillian Wald, Jane Addams, and Edward Devine, Lathrop chose to focus the Bureau's initial efforts on reducing infant mortality. A strong infant welfare campaign, which included advocating for comprehensive birth registration, publishing baby care pamphlets for parents, and conducting research on infant mortality, would provide the Children's Bureau with numerous opportunities for concrete action on behalf of children and results that could be easily communicated to the public.[106] Additionally, infant mortality proved to be a much less controversial choice than child labor reform, despite the latter being the impetus behind the original establishment of the Bureau.

An awareness of infant mortality as a social issue had developed in the mid- to late nineteenth century as a consequence of urban sanitary reform movements across the United States. The problem was initially discovered as sanitation investigators in large cities began using newly compiled vital statistics to proclaim that overcrowding from rapid urbanization caused higher overall mortality rates, particularly among infants and children. In 1857, the AMA presented a special

report on infant mortality in New York City at its tenth annual meeting, defining the term as "the *mortality of childhood*… which records the appalling fact that nearly ONE-HALF of the *whole number of deaths*, especially in large cities, occur in infancy, and before the subjects have reached the *fifth anniversary of their birth*" [emphasis in original text].[107] Over the next few decades, as health inspectors collected even more detailed statistics on mortality, a trend emerged that demonstrated a much higher percentage of childhood deaths occurring in the first year of life. These findings eventually restructured the definition of infant mortality to include only deaths occurring in children under the age of one.[108]

In addition to its conceptualization as a primarily urban problem, the highest rates of infant mortality were largely ascribed to the immigrant poor. While the AMA's 1857 report had acknowledged that high infant mortality affected city residents of all socioeconomic classes, it also proclaimed that, "among the suffering poor in our large cities, a fearful ratio of our infant mortality is found."[109] Initial research by the Children's Bureau on the social and environmental aspects of infant mortality reaffirmed earlier conclusions on the relationships among race, class, and high rates of infant death.

Results from the Bureau's first study, published in 1915, presented data on all children born in Johnstown, Pennsylvania in 1911.[110] In addition to finding an overall infant mortality rate of 134 deaths per 1,000 live births, a number slightly higher than national estimates at the time, the study also discovered a much higher incidence of infant death among the immigrant population (171.3 per 1,000) in comparison to "native mothers" (104.3 per 1,000).[111] Other socioeconomic factors

influenced the rate of infant mortality, with maternal illiteracy, low paternal income, single motherhood, and a mother working outside the home all increasing the likelihood of infant death in the first year. Despite the admittedly "restricted and tentative character" of the initial survey, the results provided Lathrop with concrete evidence to support her requests for more funding to combat the "preventable waste" that was infant mortality.[112] As annual appropriations grew, so did Bureau staffing, increasing from 15 to 76 people by 1915.[113] A larger budget and improved staff capacity enabled the Bureau to broaden its focus to include other issues, including child labor, public education, special needs children, and establishing child welfare standards.

Specialization in Obstetrics and Pediatrics

Similar to a number of different professions in the Progressive era, American physicians became part of a larger cultural trend toward increasing specialization. Scientific advancements in the late nineteenth century had improved medical knowledge and diagnostic capabilities. A new conceptualization of disease emerged as physicians began correlating clinical and pathologic findings, which challenged the prevailing unitary notion of illness.[114] By linking distinct disease processes with localized pathology, physicians could focus their diagnostic and treatment efforts on specific areas of the body. As historian Sydney Halpern notes, "specialization provided a new basis for gradients of occupational prestige because of its perceived link to progress in medical research and the growing legitimacy of the scientific method."[115]

As the practice of medicine became more complex, a rise in the number of medical fields occurred as physicians sought control over a specific disease process, organ system, or medical technology. By 1880, specialty societies had been established in America for physicians practicing ophthalmology, otology, neurology, dermatology, laryngology, surgery, and gynecology. Specialization in obstetrics and pediatrics quickly followed, although the path toward professional legitimacy for these fields proved more complex. The earlier established specialties share a conceptual basis in a circumscribed organ system and are called upon when an individual experiences disease and/or dysfunction. In contrast, both obstetrics and pediatrics have roots in health-related social problems and faced the difficult task of proving their need for specialty recognition. For obstetricians, this meant transforming cultural notions of the birth process from that of a normal occurrence into a pathological condition; for pediatrics, this involved convincing the public that normal child rearing needed medical management and that children were physiologically distinct from adults.

The process of professional legitimization for obstetrics occurred slowly, as male physicians challenged historical notions of childbirth as a natural experience to be shared among women and their female attendants. High rates of maternal mortality continued throughout the first decades of the twentieth century, which climbed as high as 92 per 10,000 live births at the height of the flu epidemic in 1918.[116] The prospect of facing multiple pregnancies and confinements persuaded middle-class women to look for safer methods of delivery. Bolstered by the promise of scientific knowledge and medical advancements such as forceps, anesthesia, and

drugs to prevent postpartum hemorrhage, obstetricians declared labor and delivery as potentially pathogenic and asserted that only trained physicians held the authoritative knowledge to safely guide women through birth. One of the most well-known figures in obstetric medicine, Joseph Bolivar DeLee, MD, was "convinced that not the majority, but the minority, of labor cases is normal, and that not until the pathologic dignity of obstetrics is fully recognized may we hope for any considerable reduction of the mortality and morbidity of childbirth."[117]

DeLee and other prominent obstetricians recognized that the overall quality of obstetric care being offered to American women needed improvement, and believed that this would best be accomplished by establishing themselves as the preferred birth attendant. Better obstetric training for medical students was seen as an absolute necessity, followed by an elimination of untrained or lesser skilled birth providers such as midwives and general practitioners. Abraham Flexner's 1910 report highlighted an appalling lack of practical obstetric experience throughout medical education, stating:

> …the very worst showing is made in the matter of obstetrics. Didactic lectures are utterly worthless… The safety and comfort of both patients- mother and child- depend on the trained care and dexterity of the physician. The practice is a fine art which cannot be picked up in the exigencies of out-patient work, poorly unsupervised at that.[118]

Upon the recommendation of the AMA's Council on Medical Education, students began completing a one-year internship following graduation from medical school. New graduates gained more practical experience by either focusing the entire year

on a chosen specialty, or in all areas of medicine by choosing a rotating internship. By 1914, approximately seventy-five percent of all graduates finished an intern year.[119] Similar to student nurses, interns lived and worked in the hospital in exchange for their education and training. A White House Conference in 1930 concluded that hospitals with internship programs experienced enough deliveries to sufficiently meet the training needs of their interns and adequately prepare them for private practice.[120]

A new obstetric ideal emerged that conceptualized the specialty as a surgical discipline, which better reflected the increase in operative deliveries performed by physicians. Hospitals were promoted as the preferred location for labor and delivery, as they had immediate access to the safeguards of a surgical suite. General practitioners were encouraged to seek obstetric specialists for the management of birth and confinement, and midwives were pushed out of the new system almost entirely. DeLee saw the midwife as "a relic of barbarism… a drag on our progress as a science and an art." Systematically devaluing the contributions of lay and trained midwives served both to elevate the status of obstetrics in American society as well as eliminate economic competitors. Despite numerous studies showing significantly lower maternal mortality rates for midwife attended births, the percentage of deliveries performed by midwives dropped from fifty percent in 1900 to only fifteen percent in 1930.[121]

For the majority of medical schools, training and education in pediatrics had historically been offered within courses on obstetrics. In fact, prominent obstetricians had written many of the early American publications on pediatric

subjects. A growing national awareness of childhood as a unique period also permeated the medical community, and physicians primarily interested in pediatrics understood the need to break from obstetrics in order to become a legitimate specialty. At the first meeting of the AMA Section on Diseases of Children, Abraham Jacobi, MD, firmly declared that pediatrics had no place being attached to obstetrics or the diseases of women, as "it has nothing whatever in common with these branches."[122] By 1888, pediatrics began the process of specialization through the formation of two professional societies, the AMA Section on Diseases of Children and the American Pediatric Society (APS), and the initiation of its own scientific journal, the *Archives of Pediatrics*.

Early pediatric specialists recognized the need to distinguish children as physiologically and developmentally distinct from adults, as well as convince the American public that specialized knowledge was needed to ensure a healthy childhood. As L. Emmett Holt, MD, an early leader in American pediatrics, explained, it was "not so much that the diseases of early life are peculiar, as that the patients themselves are peculiar."[123] By conceptualizing pediatrics as an age-specific discipline, pediatricians claimed expertise in the management of infancy and childhood, areas that had traditionally been overseen by mothers. To convince women of the need for medical advice in childrearing and further cement their authority, early pediatricians focused most of their attention on artificial infant feeding, advocating for an intricate process called the percentage method that attempted to recreate the chemical composition of breast milk in cow's milk. Infant feeding recommendations became the central focus of pediatric study in the early

twentieth century, with over 90 papers delivered on the subject at annual APS meetings between 1900 and 1915.[124]

As obstetrics and pediatrics continued toward individual specialization, the newborn period became a point of confusion among providers and mothers regarding treatment authority. Obstetricians tended to maintain control over their nurseries for births that occurred in the hospital, while mothers retained sole responsibility for newborn care when infants were born at home. As greater percentages of women began to choose hospital births, managing labor and delivery became more challenging, particularly as the number of operative births increased. Obstetricians tended to focus their efforts on mothers, with newborn infants as their secondary concern. Published accounts from prominent obstetricians demonstrate this apathy toward treating sick newborns, as infant deaths occurring as late as two weeks after delivery were sometimes classified as a stillbirth.[125] National infant and child welfare campaigns had begun promoting the need for pediatric consultation throughout childhood, but pediatricians had little access to infants immediately after delivery regardless of where the birth took place. Determining responsibility for newborn care became a struggle among three interested parties- obstetricians, pediatricians, and mothers- and treatment of premature and sick infants may have been lost in the shuffle.

Premature Infant Care in the United States 1890-1920

Despite the emergence of a strong campaign for infant and maternal welfare in France in the late 1800s, the United States lagged behind Europe in the care of

premature infants. The attitude may have stemmed from a lack of national urgency and awareness; prior to the establishment of the U.S. Children's Bureau in 1912 and improvements in reports on birth statistics, the true scope of high infant mortality rates was probably unknown for most Americans.[126] The majority of births still occurred in the home and the burden of newborn care remained mostly in the hands of mothers. Additionally, the term "premature" referred to any infant small or congenitally debilitated and their deaths were likely regarded as an expected and insignificant occurrence.

Following the dissemination of Tarnier's achievements treating premature infants in France and the debut of the incubator exhibit at the 1896 Berlin Exposition, international interest for the mechanical incubator increased, particularly in the United States. Opinions regarding the utility of mechanical incubators were initially favorable, generating excitement over the possibility of saving premature infants, a subject many physicians felt had been "inadvertently neglected."[127] Journal articles and society presentations began to focus on the symptomology and clinical management of prematurity, with varying results reported. Nursing journals followed suit, and began outlining the necessary care for attending these newborns either in hospitals or private homes.[128] A burgeoning fascination with science and technology led a number of American physicians to try their hand at invention, many of whom published instructions for the construction and use of modified incubators for premature infants.[129]

Early medical publications discussed in detail the physical appearance of premature infants, presumably as a way of assisting physicians in identifying

newborns in need of specialized care. In addition to numerous remarks on their "generally diminutive characteristics," authors noted that the majority of premature infants shared specific features: a large skull in relation to body size with wide fontanelles, the presence of lanugo (fine hairs on the body), soft nails that did not reach the end of the digits, delicate, almost transparent skin, and a marked lack of subcutaneous tissue.[130] Physicians generally conceded the difficulty in accurately determining gestational age, as well as the broad range in physical development found in newborns, both term and preterm. Discussions about the limits of viability began as the medical community attempted to define prematurity. Internationally renowned obstetrician John W. Ballantyne, MD opposed setting strict limits on the determinants of viability, noting that:

> Even if the exact uterine age of the premature infant could be determined with sufficient accuracy, there would still be the varying factor of the infants(sic) vitality as influenced by the varying circumstances of intrauterine health; the viability of the child depends, therefore, not only upon the number of months spent in the uterus, but also upon the character of the life of these months… it is a fact of prime importance to remember that the age of viability is not a fixed but variable date.[131]

Clearly defining prematurity or the age of viability proved elusive, and American physicians argued for decades in favor of using any number of criteria, usually based on birth weight or height cutoffs. Many articles include testimonials from physicians about premature infants they had delivered or cared for with initial heights or weights outside the suggested limitations that had survived. No

consensus was reached until 1935 when the American Academy of Pediatrics adopted the birth weight classification utilized in Europe, designating any infant weighing less than 2,500 grams at birth as premature.

Recommendations for the care of premature infants during the first decades of the twentieth century focused on four identified special needs: keeping the baby warm, giving proper and sufficient feedings, providing careful and minimal handling, and preventing infection. Journal articles emphasized the importance of giving breast milk whenever possible, and while the recommended schedule for feedings and the amounts to be given varied with each account, mother's milk was viewed as "a necessity."[132] Many believed premature infants had little vitality, so individuals were cautioned to handle them infrequently and cluster caretaking activities together. Such treatment would also reduce the likelihood of exposure and help protect the vulnerable infants from disease.

A variety of recommendations were offered for maintaining the temperature of a premature infant. Earlier publications encouraged environmental intervention, with multiple layers of clothing applied as soon as possible, and the baby's room "chosen with reference to its heating capacity."[133] Since the majority of babies were still born at home, a few articles included directions for homemade construction of an incubator, which was sometimes believed to function as well as, if not better than, its mechanical counterpart. Celebrated American pediatrician L. Emmett Holt, MD also began endorsing the use of "incubator rooms" in children's hospitals as a means for treating premature infants, where an entire room was sectioned off to

house five cribs and maintained at high temperature (usually 90 degrees Farenheight).[134]

The earliest hospital-based incubator station in the United States opened in 1899, under the direction of obstetrician Joseph Bolivar DeLee at Chicago's Lying-In Hospital. DeLee's station integrated the advanced technology of a modified Lion incubator with the supportive nursing care promoted in Paris by Pierre Budin. Believing the first few hours after birth to be the most crucial for survival, DeLee established an infant transport service, equipped with travel incubator and a trained physician and nurse, to pick up premature babies born around the city. His efforts paid off, demonstrating improved premature infant survival in the first two years of the station's utilization of incubators.[135] Unfortunately DeLee's station at the Lying-In hospital survived only ten years, its demise attributed to a lack of charitable financial support and waning interest by DeLee's successor, Isaac Abt, MD.[136]

Unfortunately, the mechanical incubator fell out of favor with the medical community between 1910 and 1920, and the plight of premature infants received little attention. This gap in progress appears more surprising given the increased focus on infant welfare campaigns across the country after the establishment of the Children's Bureau and national attempts to reduce infant mortality. Medical historian Jeffrey Baker attributes the pause to a combination of forces that include the high percentage of home births, the rising popularity of eugenics, and the clash between obstetrics and pediatrics about which specialty should retain control of the newborn period. As previously noted, labor and delivery occurred primarily in the home until the late 1930s in the United States, and the responsibility for newborn

care remained with the mother. The eugenics movement also experienced its peak popularity during this time period. Highly publicized cases of a eugenic physician allowing sick or debilitated infants to die began circulating in mass media, and these cases may have influenced public perceptions about which babies were worth saving and which should be permitted to perish.[137] Finally, increasing specialization in both obstetrics and pediatrics caused confusion surrounding which physicians held authority over the newborn period. Responsibility for premature infants was even more unclear, and may have negatively impacted the amount of medical attention given to this population.

The incubator itself may have also significantly contributed to medical apathy regarding prematurity during that time. Many found fault either with the design or with their overall effectiveness, particularly considering the high costs associated with installation and maintenance. As L.E. La Fétra, MD, visiting pediatrician to the children's wards at Bellevue Hospital noted:

> The first question that will arise on the part of the family and the physician in the management of a premature baby is whether or not is should be put into an incubator. My experience with most incubators and their methods of management would lead me to give a decided negative to this question. Incubators are expensive; they are complicated. It is inconvenient to change the baby's clothing while it is in an incubator, and most of all, an incubator is difficult to ventilate and to keep free from germ contamination. Moreover, to keep the temperature equable in them and the ventilation proper requires a

nurse who is thoroughly familiar with the use of the particular incubator installed.[138]

A rise in public health awareness and theories of sanitation prompted a resurgence of environmental control and fresh air therapy. Because the pathology of prematurity was not well understood, closed incubators were often dismissed because of a lack of proper ventilation.

Additionally, the small number of hospital nurseries that utilized incubator technology in the early twentieth century often had exceedingly high mortality rates for premature infants. Similar to the *services des débiles* that had been established in Paris, babies often arrived at the hospital too sick to be successfully resuscitated, and the sickest infants were often the ones placed in the few mechanical incubators a hospital could afford. Consequently, the infants in the enclosed incubators showed a much higher mortality rate than those placed in warmed rooms or heated boxes. The American medical community quickly discounted incubators as a useful tool for increasing survival.[139]

Even the incubator baby exhibits may have contributed to the controversy, as negative media reports cast doubt upon the safety of the technology. Because the shows relied on mass media to generate interest and increase admissions, any success or failure was also highly publicized. The diarrhea epidemic that killed half of the infants at the Louisiana Purchase Exposition incubator exhibit in 1904 brought a great deal of negative reaction both in popular press and medical journals. After John Zahorsky, MD took over as medical director, the mortality rate of the premature infants in the exhibit dramatically decreased, but the epidemic further

damaged medical perceptions of the incubator. Zahorsky would go on to publish the most comprehensive account of premature care at an incubator show, but because it was a self-published book, it may not have been recognized as legitimate within the medical community or reached a large enough audience at the time. Martin Couney would also become familiar with bad press. After a fire at Coney Island in 1911, the *New York Times* reported that some of the infants in Couney's exhibit had been killed during the blaze.[140] Despite a story the following day stating that all the infants had been rescued to safety by staff members, physicians appeared to agree that earlier enthusiasm for the incubator had been misplaced.[141]

Julius Hess and the Birth of American Neonatology

In the 1920s, Chicago would once again find itself at the forefront of premature infant care, largely due to the work of Julius Hess, MD. As chief of Michael Reese Hospital, Hess discovered an early interest in prematurity, publishing his first article on newborn care and feeding in 1911 and designing his own type of incubator, the open Hess heated bed, in 1914 (Figures 7-8, Appendix A).[142] Unique in his efforts to champion premature infants compared to many American physicians, Hess asserted that, "as an important factor in national health… the care of premature infants and the conservation of their flickering lives has a prominent place."[143]

Hess accomplished two important things in 1922: he published his first text on the care of premature infants, and established a premature infant station at Sarah Morris Hospital. Hess' book, *Premature and Congenitally Diseased Infants*, was the

first major American text on medical and nursing care in prematurity and would cement Hess as a leader in the care of premature infants. The structure and content of the book would also serve to help change public opinion about prematurity. Lack of the term "weakling" to describe premature infants in the title signified a changing approach to understanding the pathophysiology of prematurity.[144] Additionally, the systematic way in which Hess presented follow-up research with his graduates reinforced the notion that premature infants could demonstrate equivalent physical and intellectual development to their full-term counterparts.[145]

Hess also benefitted from Chicago's unique status as the only American city with a philanthropic society specifically for babies. Hortense Schoen Joseph, a prominent member of the Chicago Jewish community, founded the Infant Aid Society in 1914. The organization dedicated part of its advocacy to premature infants, and assisted in funding Michael Reese Hospital. Joseph's unexpected death in 1922 left Hess with a large endowment to establish a premature infant station at Sarah Morris Hospital, the hospital for children associated with Michael Reese Hospital.[146] Under Hess' direct supervision, the Hortense Schoen Joseph Premature Station opened in 1922 and was intended to care for premature infants born at home who could not be accepted into the clean newborn nursery at Michael Reese Hospital.[147]

Hess appointed Evelyn Lundeen, RN, a graduate of the School of Nursing at Lutheran Hospital, as supervisor of the station. Additional staff included two graduate nurses, three graduate infant nurses, a part-time social worker, and three wet nurses. A weekly outpatient follow-up clinic was also created for the station's

infant graduates.[148] By 1928, the mortality rate at the station had dropped to 24 percent and admission rates had increased from less than 20 infants in its first year to over 100 infants.[149] Hess adamantly promoted skilled nursing care and expected nurses at the station to carry out daily operations fairly autonomously, a characteristic that was unique for hospital-based nursing care at the time. Together, Hess and Lundeen would make the Premature Station at Sarah Morris Hospital the preeminent center for the care of premature infants and the system they established would serve as a model for a number of prominent hospitals around the country.

Conclusions

National context played an important role in understanding the process of technology transfer of the infant incubator in the early twentieth century. Originally emerging from a French pronatalist movement in the late 1800s, the early and more simplistic designs flourished in maternity hospital systems with highly trained nursing staff that encouraged maternal involvement and responsibility for the newborn. Transfer of incubator technology to an American setting proceeded from adoption to rejection, then to reinvention and eventual lasting adoption. Numerous sociocultural forces altered the path of incubator technology diffusion in the United States, and previous analyses have taken a social constructivist perspective to explain the nonlinear progression of incubator acceptance. Rather than evaluating Martin Couney as an active participant in the transfer process, the incubator sideshow phenomenon is given little significance and Julius Hess is viewed as the "bridge" between French origins and American advancement of premature care.[150]

This analysis evaluated the role of individual agency in the work of introducing or transferring a new medical device. Martin Couney's story becomes particularly intriguing when analyzed alongside that of Julius Hess, MD, not simply because the two men are remembered quite differently within the history of premature infant care, but also because they promoted similar technology during an overlapping time period. That technology- essentially a model of premature care that involved utilizing incubators to maintain heat, having trained nursing staff providing all infant care, the exclusive use of breastmilk and wet nursing for nutrition, and the application of specialized feeding techniques- proved to be technically successful for both physicians with reference to their low mortality rates. A unique opportunity existed to reevaluate the history of the infant incubator and advanced premature care in the United States by comparing the success of two system builders working during a similar time frame, employing nearly identical technology, and navigating many of the same challenges presented by a shared sociocultural context. More importantly, constructing and comparing the technology systems of Couney and Hess helped uncover the role of the premature infant nurse in early twentieth century America and provided insight into the fluidity of power relationships within the system as technology became routinized.

[1] Herman Bundeson, "Transcript of Infant Incubator Homecoming, July 25, 1934." Courtesy the Hess, Julius Hays Papers, Crerar Ms 51, [Box 3, Folder 11], Special Collections Research Center, University of Chicago Library.

[2] A photograph taken at the 1933 Century of Progress exposition shows the exterior of the Infant Incubator exhibit, with the front reading "Living Infants in Incubators." The sign for the Streets of Paris exhibit, the Incubator Exhibit's closest neighbor along the Midway section of the World's Fair, can be seen in the background. Courtesy the Silverman Papers, Pediatric History Center at the American Academy of Pediatrics.

[3] The start of the Great Depression is usually attributed to the crash of the stock market on October 29, 1929, also known as Black Tuesday. The longest, deepest, and most widespread economic disaster of the 20th century, the Great Depression lasted through the late 1930s to early 1940s in most countries. In the United States, entrance into World War II brought heavy defense spending and increased factory production, facilitating economic growth and decreasing unemployment.

[4] Jeffrey Baker, *The Machine in the Nursery*. (Baltimore: The Johns Hopkins University Press, 1996): 105.

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

[6] Thomas P. Cone, *History of the Care and Feeding of the Premature Infant*. (Boston: Little, Brown and Company): 3-4.

[7] Elizabeth Reedy, "From Weakling to Fighter: Changing the Image of Premature Infants," *Nursing History Review, 11*(2003):110. See also Cone, *History of the Care*

and Feeding of the Premature Infant; Desmond, *Newborn Medicine and Society*; and William Silverman, *Retrolental Fibroplasia: A Modern Parable* (New York: Grune and Stratton, 1980).

[8] Samuel X. Radbill, "A History of Children's Hospitals," *American Journal of Diseases of Children* 90 (1956): 411.

[9] L. Emmett Holt, "Infant Mortality, Ancient and Modern: An Historical Sketch," *Transactions of the American Association for the Study and Prevention of Infant Mortality* 4 (1913): 24.

[10] Silverman, *Retrolental Fibroplasia*, 14.

[11] Reedy, "From Weakling to Fighter," 112.

[12] John Rodman, "Case of a Child Born Between the Fourth and Fifth Month and Brought Up," *Edinburgh Medical and Surgical Journal,* 11 (1815): 455.

[13] Reedy, "From Weakling to Fighter," 112.

[14] See Cone, *History of the Care and Feeding of the Premature Infant*; and Baker, *The Machine in the Nursery*.

[15] Jean-Louis-Paul Denucé, "Berceau incubateur por les enfants nès avant terme," *Journal de Mèdicine de Bordeauz* (1857): 723-724.

[16] In Baker's *The Machine in the Nursery*, he credits Thomas Cone and F. F. Marx with tracing the origins of the *warmwännen* to von Reuhl in 1837. See F.F. Marx, *Die Enwicklung der Säuglingsinkubatoren: Eine, Medizintechnische Chronik* (Bonn:Verlag Siering, 1968): 26; Thomas Cone, "The First Published Report of an Incubator for Use in the Care of the Premature Infant (1857)," *American Journal of Diseases of Children* 135 (1981): 658-660; and Baker, *The Machine in the Nursery*, 191.

[17] Carl Credé, "Ueber Erwärmungsgeräthe für frühgeborene und schwächliche kleine Kinder," *Archives für Gynäkologie* 24 (1894): 128-147.

[18] Alfred Auvard, "The Incubator for Infants," *Archives de Tocologie* 10 (1883): 577; William Silverman, "Incubator-Baby Side Shows," *Pediatrics* 64 (1979): 128; Baker, *The Machine in the Nursery*, 26.

[19] Auvard, "The Incubator for Infants," 421.

[20] Baker, *The Machine in the Nursery*, 28.

[21] Pierre Budin, *The Nursling: The Feeding and Hygiene of Premature and Full-Term Infants*, translated by William Maloney (London: Caxton Publishing, 1907): 11.

[22] Jeffrey Baker, "The Incubator Controversy: Pediatricians and the Origins of Premature Infant Technology in the United States, 1890-1910," *Pediatrics* 87 (1991): 322.

[23] Baker, *The Machine in the Nursery*, 44.

[24] Stephane Tarnier, "Des Soins à Donner aux Enfants né Savant Terme," *Bulletin of Academic Medicine* 14 (1885): 944.

[25] Silverman, *Retrolental Fibroplasia*; Jeffrey Baker, "The Incubator and the Medical Discovery of the Premature Infant," *The Journal of Perinatology* 5(2000): 322.

[26] Baker, "The Incubator and the Medical Discovery of the Premature Infant," 323.

[27] Pierre Budin, "Les Enfants Débiles," *La Pressed Medical* 97 (1902): 1156.

[28] A. Bellman, "Visits de la Society International: La Clinique Tarnier ET le Dr. Budin," *Revue Philanthropies* 18 (1905-1906): 490.

[29] Baker, *The Machine in the Nursery*, 65.

[30] Budin, "Les Enfents Débiles," 1157; Pierre Budin, "Rapport sur la Mortalité Infantile," in Commission de la Dépopulation, Sous-commission de la Mortalité. *Séances, 1202-1903* (Melun: Imprimerie Administrative, 1903): 44.

[31] Budin, *The Nursling*; Baker, "The Incubator and the Medical Discovery of the Premature Infant," 324.

[32] James Walter Smith, "Baby Incubators," *The Strand Magazine* 12 (1896): 770-776.

[33] Baker, *The Machine in the Nursery*, 87.

[34] Editors, "The Use of Incubators for Infants," *The Lancet* 149 (1897): 1491.

[35] Baker, "The Incubator and the Medical Discovery of the Premature Infant," 324.

[36] Smith, "Baby Incubators," 776.

[37] Robert Rydell, John E. Findling, and Kimberly D. Pelle, *Fair America: World's Fairs in the United States* (Washington, D.C.: Smithsonian Books, 2000): 14-16.

[38] Ibid., 17.

[39] Ibid., 10-36.

[40] Smith, "Baby Incubators," 776.

[41] In a 1939 interview for the New Yorker, Couney claimed to have created the exhibit at the Berlin Exhibition in 1896 with the support of Pierre Budin, in A.J. Liebling, "Patron of the Preemies," *The New Yorker*, June 3, 1939, 20-24. A later article in *Pediatrics* would reveal that Alexandre Lion most likely created the exhibit and that presumably Couney worked with Lion at the show, in The American Academy of Pediatrics Perinatal Section Ad Hoc Committee on Perinatal History, "Martin Couney's Story Revisited," *Pediatrics* 100 (1997): 159-160.

[42] Liebling, "Patron of the Preemies," 20-24; Baker, *The Machine in the Nursery*, 92.

[43] Articles in the Chicago Daily Tribune mentioning Martin Couney and his Baby Incubator exhibit at White City Amusement Park include "Incubators Save Baby's Life," *Chicago Daily Tribune*, June 30, 1905, 9; "Babies' Friends Fill White City," *Chicago Daily Tribune*, August 8, 1906, 3; "White City Astir to Succor Babies," *Chicago Daily Tribune*, July 29, 1907; "Go to White City Today; Aid Babies," *Chicago Daily Tribune*, August 7, 1907, 4; "Prize Incubator Baby of the World," *Chicago Daily Tribune*, September 12, 1909, G2. Reports on the timing of Couney's exhibit at White City range from 1912-1920 and include Lawrence Gartner and Carol Gartner "The Care of Premature Infants: Historical Perspective," in *Neonatal Intensive Care: A History of Excellence*, NIH Publication No. 92-2786, October 1992 and Baker, *The Machine in the Nursery*, 104.

[44] Silverman, "Incubator-Baby Side Shows," 136.

[45] Ibid., 135.

[46] John Zahorsky, "The Baby Incubators on the "Pike: A Study of the Care of Premature Infants in Incubator Hospitals Erected for Show Purposes," *St. Louis Courier of Medicine* 31 (1904): 346.

[47] Editors, "The Danger of Making a Public Show of Incubators for Babies," *The Lancet* 1 (1898): 390-391.

[48] Ibid.

[49] Ibid.

[50] John E. Kasson, *Amusing the Million: Coney Island at the Turn of the Century* (New York: Hill and Wang, 1978): 100-101.

[51] Lenox Lohr, *Fair Management: A Guide for Future Fairs. The Story of a Century of Progress Exposition* (Chicago: Cuneo Press, 1952): 116.

[52] Lois N. Magner, *A History of Medicine* (New York: Informa Healthcare, 2007): 313.

[53] "American versus European Medical Science," *Medical Record* 4 (1869): 133.

[54] Philip A. Kalisch and Beatrice J. Kalisch, *American Nursing: A History* (Philadelphia: Lippincott Williams & Wilkins, 2004): 80-82.

[55] Ibid., 95.

[56] Paul Starr, *The Social Transformation of American Medicine: The Rise of a Sovereign Profession and the Making of a Vast Industry* (New York: Basic Books, 1983): 117-118.

[57] Abraham Flexner, *Medical Education in the United Sates and Canada* (Washington, D.C.: Science and Health Publications, Inc., 1910).

[58] Starr, *The Social Transformation of American Medicine*, 123-130.

[59] Ibid., 5.

[60] "Report of the Committee on the Training of Nurses," *Transaction of the American Medical Association* 20 (1869): 161.

[61] Kalisch and Kalisch, *American Nursing*, 60.

[62] Patricia D'Antonio, *American Nursing: A History of Knowledge, Authority, and the Meaning of Work* (Baltimore: The Johns Hopkins University Press, 2010): 55; Kalisch and Kalisch, *American Nursing*, 62.

[63] Lorraine Freitas, "Historical Roots and Future Perspectives Related to Nursing Ethics," *Journal of Professional Nursing* 6 (1990): 197.

[64] Nancy Cadmus, "Ethics," *American Journal of Nursing* 16 (1916): 411-416.

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[91] United States Children's Bureau, *The Children's Bureau Legacy: Ensuring the Right to Childhood* (Washington, D.C.: Department of Health and Human Services, 2012): 9-11. See also *Zelizer, Pricing the Priceless Child.*

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[104] United States Department of Labor, *The Children's Bureau: Yesterday, Today, and Tomorrow* (Washington, D.C.: United States Government Printing Office, 1937): 1.

[105] Helen Witmer, *A Research Program for the Children's Bureau* (Washington, D.C.: Children's Bureau, 1953): 8.

[106] United States Children's Bureau, *The Children's Bureau Legacy*, 30.

[107] D. Meredith Reese, *Report on Infant Mortality in Large Cities, the Sources of Its Increase, and Means for Its Diminution* (Philadelphia: T.K. and P.G Collins Printers, 1857): 5-6.

[108] For a detailed explanation of the transformation of infant mortality from a demographic condition to an urban social problem, see Meckel, *Save the Babies*, 11-39.

[109] Reese, *Report on Infant Mortality in Large Cities,* 14.

[110] Emma Duke, *Infant Mortality: Results of a Field Study in Johnstown, PA., Based on Births in One Calendar Year* (Washington: Government Printing Office, 1915). The small budget available to Julia Lathrop and the Children's Bureau made a national survey of infant mortality an impossible task. Johnstown was chosen because of its

well-established birth and death registration program and modest population of fewer than 100,000 residents.

[111] Ibid., 27.

[112] Ibid., 5.

[113] United States Children's Bureau, *The Children's Bureau Legacy*.

[114] Sydney A. Halpern, *American Pediatrics: The Social Dynamics of Professionalism, 1880-1970*. (Berkeley: University of California Press, 1988): 10. Halpern cites a seminal 1944 study by George Rosen, in which he argues that French scientific discoveries in the nineteenth century paved the way for medical specialization by changing the prevailing paradigm of disease. Conceptualizing disease as localized rather than unitary stimulated the development of diagnostic and therapeutic devices and further underscored a need for more specialized knowledge about specific organs, systems, or technologies. New medical specialties emerged that each focused on a specific disease or organ system, or on the application of specific technology. See George Rosen, *The Specialization of Medicine with Particular Reference to Opthamology* (New York: Froben, 1944).

[115] Ibid, 48.

[116] United States National Office of Vital Statistics, *Vital Statistics- Special Reports: National Summaries Volume 35, Numbers 1 To 19, 1948*. (Washington: National Office of Vital Statistics, 1951): 349-353.

[117] Joseph Bolivar De Lee, *The Principles and Practice of Obstetrics* (Philadelphia: W.B. Saunders, 1913): Introduction xv.

[118] Flexner, *Medical Education in the United Sates and Canada*, 117.

[119] Dennis Wentz and Charles Ford, "A Brief History of the Internship," *Journal of the American Medical Association* 252(1984): 3390-3394.

[120] White House Conference on Child Health and Protection, *Obstetric Education* (New York: The Century Company, 1932), 38.

[121] For statistics comparing maternal mortality rates of midwives versus the overall national average, see Frances Kobrin, "The American Midwife Controversy: A Crisis of Professionalization," *Bulletin of the History of Medicine* 40 (1966): 350-363; J. Clifton Edgar, "The Education, Licensing, and Supervision of the Midwife," *The American Journal of Obstetrics and Diseases of Women and Children* 73 (1916): 394; and I.S. Falk, Rufus Rorem, and Martha Ring, *The Costs of Medical Care* (Chicago: The University of Chicago Press, 1933), 281.

[122] Abraham Jacobi, "Claims of Pediatric Medicine," *Transactions of the American Medical Association* 31(1880): 713.

[123] L. Emmett Holt, *The Diseases of Infancy and Childhood: For the Use of Students and Practitioners of Medicine* (New York: D. Appleton, 1897): 31.

[124] Joseph Brennemann, "Periods in the Life of the American Pediatric Society: Adolescence," *Transactions of the American Pediatric Society* 50(1938): 63 as cited in Halpern, *American Pediatrics*, 63. For more detail on how early twentieth century pediatricians approached the task of infant feeding, see also Thomas E. Cone, Jr, *History of American Pediatrics* (Boston: Little, Brown, 1979): 131-148 and Meckel, *Save the Babies*, 46-61.

[125] L.E. Holt and E.C. Babbitt, "Institutional Mortality of the Newborn: A Report on Ten Thousand Conseutive Births at the Sloane Hospital for Women, New York,"

Transactions of the American Association for the Study and Prevention of Infant Mortality 5 (1914): 151-152; C.F. Wilinsky, "A Study of Maternal and Infant Mortality in Boston," *Transactions of the American Childrens Hygeine Association* 6 (1929): 133.

[126] In *The Machine in the Nursery* and related journal publications, Baker provides a well-constructed argument for the differences in national context between France and the United States that account for the lag in American awareness of prematurity as an issue. Contributing factors include the absence of thorough birth records prior to the establishment of the Children's Bureau, as well as the lack of a national pronatalist movement like the one that begins in France after massive loss of life in the Franco-Prussian war. Baker, "The Incubator Controversy," 655.

[127] Vanderpoel Adriance, "Premature Infants," *American Journal of the Medical Sciences* 121(1901): 410.

[128] Articles from the *American Journal of Nursing* include Mary Hayes, "Care of a Premature Baby without an Incubator," *American Journal of Nursing* 6 (1906); Jessie Christie, "The Care of an Incubator Baby," *American Journal of Nursing* 8 (1908); Mary Smith, "Incubator Babies," *American Journal of Nursing* 10 (1911); Beatrice Clutch, "Feeding Premature Infants," *American Journal of Nursing* 25 (1925); Ellen Schalin and Margaret Stewart, "The Care of Premature Infants," *American Journal of Nursing* 27 (1927); Lila Napier, "Caring for Premature and Underweight Babies: As Practiced at the Lying-in Hospital, New York," *American Journal of Nursing* 27 (1927); Mary Herwick, "The 'Pride of the General': Its Babies," *American Journal of*

Nursing 30 (1930); Gwendolyn Webster, "Incubators for Premature Infants," *American Journal of Nursing* 31 (1931).

[129] For a detailed account of the early American medical response to the incubator and a discussion of some of the models developed by physicians, see Baker, *The Machine in the Nursery*, 66-85. Physicians held differing views on the superiority of certain incubator designs, but all appeared to agree on the necessity of maintaining constant temperature. Baker also notes that the American response was an attempt to imitate the prenatal environment as much as possible by creating a maternal substitute that required little intervention. This differed substantially with the French model of care, which relied heavily on trained staff and maternal involvement.

[130] Adriance, "Premature Infants," 410. Selected medical articles describing the physical attributes of premature infants also include: Holt, *The Diseases of Infancy and Childhood*, 10-14; W.H Taylor, "Some Points in Relation to Premature Children," *American Journal of Obstetrics and Diseases of Women and Children* 20 (1887): 1022-1028; J.W. Ballantyne, "The Problem of the Premature Infant," *The British Medical Journal* 1 (1902): 1196-1200; John Lovett Morse, "The Care and Feeding of Premature Infants," *American Journal of Obstetrics and Diseases of Women and Children* 40 (1905):589-599.

[131] Ballantyne, "The Problem of the Premature Infant," 1196.

[132] Hayes, "Care of a Premature Baby without an Incubator," 510.

[133] Ibid.

[134] New York Babies' Hospital, *Annual Reports* (1912) as cited in Baker, *The Machine in the Nursery*, 148. Out of 58 infants admitted to Holt's incubator room, only ten were successfully treated. Baker notes that the particularly dismal survival rate was probably due to premature infants arriving too cold to be resuscitated, as most of the infants perished in the first 24 hours after arrival.

[135] Joseph De Lee, "Infant Incubation," *Chicago Medical Recorder* 22(1902): 22-40.

[136] Baker, "The Incubator and the Medical Discovery of the Premature Infant," 325; Reedy, "From Weakling to Fighter," 113.

[137] See Pernick, *The Black Stork*. Pernick's book discusses the career of Harry J. Haiseldon, MD, a Chicago surgeon who admitted to withholding life-saving interventions for multiple infants in the 1910s. At least six of his cases were highly publicized, many by Haiseldon himself, sparking public and professional debate over the morality and legality of allowing debilitated infants to die when medical treatments could likely have kept them alive. An inquest into Haiseldon's actions concluded that no crime had been committed and no charges were filed against the physician. He was expelled from the Chicago Medical Society, but only because he publicized the cases in newspapers and in a movie, not for his refusal to treat the infants. The book's title comes from the eugenic propaganda motion picture loosely based on one of Haiseldon's cases.

[138] L.E. La Fétra, "The Hospital Care of Premature Infants," *Transactions of the American Pediatric Society* 28 (1916): 93.

[139] Baker, "The Incubator Controversy: Pediatricians and the Origins of Premature Infant Technology in the United States, 1890-1910," 658. Many articles published in

medical journals either dismissed all incubators as useful, or promoted either less mechanical devices or the construction of incubator rooms as the best method of maintaining temperature in premature infants. See Roger Durham, "Notes on the Care of Premature Infants," *Archives of Pediatrics* 29 (1912): 438-441; H.M. McClanahan, "Management of Delicate and Premature Infants in the Home," *Journal of the American Medical Association* 63 (1914): 1758-1760; Joseph S. Wall, "The Status of the Child in Obstetric Practice," *Journal of the American Medical Association* 66 (1916): 255-259; and N.O. Pearce, "Review of Recent Literature on the New-Born," *The American Journal of Diseases of Children* 18 (1919): 51-68.

[140] "Flames Sweep Coney Island; Incubator Babies Killed," *New York Times*, May 27, 1911, 1.

[141] Baker, "The Incubator and the Medical Discovery of the Premature Infant," 325.

[142] Julius Hess, "A Study of the Caloric Needs of Premature Infants," The *American Journal of Disease of Children* 2 (1911): 302-314; Peter Dunn, "Julius Hess, MD (1876-1955) and the Premature Infant," *Archives of Disease in Childhood: Fetal & Neonatal* 85 (2001): F141.

[143] Julius Hess, *Premature and Congenitally Diseased Infants*, (Philadelphia: Lea & Febinger, 1922): Preface, vi

[144] Baker, "The Incubator and Discovery of the Premature Infant," 326.

[145] Hess, *Premature and Congenitally Diseased Infants*, 377-388.

[146] Evelyn Lundeen, "History of the Hortense Schoen Joseph Premature Station," *The Voice of the Clinic* 2 *(*1937): 8; Julius Hess, "Experiences Gained in a Thirty Year

Study of Prematurely Born Infants," *Pediatrics* 11 (1953): 421; Baker, "The Incubator and Discovery of the Premature Infant," 326.

[147] Julius Hess, "Chicago Plan for Care of Premature Infants," *Journal of the American Medical Association* 146 (1951): 891.

[148] Vern Bullough & Lilli Sentz, eds., "Evelyn Lundeen," *American Nursing: A Biographical Dictionary, Volume 3* (New York: Springer Publishing Company, Inc., 2000): 184; Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8

[149] Julius Hess, "Chicago Plan for Care of Premature Infants," 891; Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8.

[150] Baker, *The Machine in the Nursery*, 105 and 173.

Chapter 3: Nurses as Performers in the Infant Incubator Company

"Tell me Doctor… when do the little dears give their next performance?"[1] In 1939, a woman visiting the New Work World's Fair posed this question to Martin Couney, MD who was standing outside of his Infant Incubator exhibit. The woman was referring to the live babies on display inside the building. For over forty years, Couney had been directing a financially successful incubator show along the popular Midway section at a number of amusement parks and international World's Fairs. After paying a small admission fee, fairgoers could watch the self-proclaimed "Incubator Doctor" and his staff of trained nurses care for the premature babies who lived on site. While the woman's query frustrated Couney, who tried desperately throughout his career to legitimize his work with premature infants, her question reflected an inescapable carnival undercurrent prevalent in the display's location. Indeed, the juxtaposition of a sterile, hospital-like nursery amidst the freak shows along the Midway cast doubt upon the legitimacy of incubator technology as a useful intervention to improve survival rates in premature infants. It also undermined Couney's personal declaration as a leader in premature infant care.

Despite Couney's central role in one of the most unforgettable chapters in American medicine, scholars continue to debate his influence in shaping the course of neonatal history. Like his incubator shows, Couney struggled with the conflicting nature of his public image as both legitimate physician and consummate showman. Couney was the first physician to offer specialized treatment for premature babies in the United States, but he did so in an unconventional manner that required

parents to put their babies on display in exchange for their care. The success of his exhibits afforded him a very comfortable lifestyle, allowing him to work only during the summer months and enjoy his share of fine wine and gourmet food, for which he remained unapologetic throughout his career.[2] His influence on the advancement of the science of premature care also remains controversial, as Couney never published any results from his extensive career despite claiming to have "handled at least four times as many" preemies as any other American physician during his time.[3] Moreover, Couney consistently reported survival rates of 80 to 85 percent for his premature infants without much empirical data to support the claims.[4] As a result, medical historians continually criticize and discount the accuracy of his statistics.

While Couney remains center stage, nurses are conspicuously absent from the current narrative on the baby incubator sideshow phenomenon. A constant feature in each of Couney's exhibitions, the specialized care provided by nurses was on display as much as the incubators and premature infants. Trained nurses lived on site, tending to the infants around the clock, and were, in all probability, the primary reason for low mortality rates among the incubator babies.[5] When asked about Couney's nursing staff, medical historian Jeffrey Baker, MD commented, "I suspect that it was nursing care that was responsible for Couney's high survival rates, more so than the incubators."[6] Despite being central to the success of the incubator shows, very little scholarship has investigated the role of nursing in early premature care or explored the professional and ethical impact from nurses' involvement in the exhibits.

The complex early history of the infant incubator in the United States demonstrates how an inventor must engage and negotiate with both the physical and social worlds in order to be successful. Creators of new technologies wrestle with nature to solve an observed problem, but they also intentionally connect the technology with a social need or demand.[7] In the case of the incubator, the device provided a means for keeping premature infants warm to aid in their survival, but the sociocultural landscape of early twentieth century America, as discussed in the previous chapter, lacked a strong imperative to save the lives of these babies. To date, research on early premature infant care in the United States has concentrated on these cultural forces as explanation for the delayed acceptance of incubator technology, with the infant-incubator sideshows providing only an "ephemeral" impact on professional attitudes toward premature babies.[8]

This chapter will explore Martin Couney's agency as an inventor who actively persuaded his audiences and convinced Americans that an advanced system of premature care was both necessary and valuable. He did this through a combination of showmanship and presentation. Using the network metaphor from Social Construction of Technology (SCOT) theory, this chapter demonstrates how Couney negotiated with different social groups to connect his new technology with the sociocultural landscape of the time, doing so by marketing the image and actions of nurses. Nursing care at the Infant Incubator exhibits is explored as a primary focus, not only to describe the activities and treatments provided by nursing staff, but also to examine the role of nursing within the overall technology system.

Martin Couney: The "Incubator Doctor"

Born on December 31, 1869, Martin Arthur Couney grew up in Alsace, a northeastern French region bordering Germany and Switzerland.[9] Martin was the youngest of four children, with two older brothers, Alphonse and Marx, and a sister Betty. His family eventually moved to Breslau in Lower Silesia (now known as Wroclaw, the largest city in Western Poland and current capital of the Lower Silesian province), where Martin would begin his schooling. He continued his medical education in Germany, studying in Berlin and Leipzig, and eventually received his medical degree. In the early 1890s, Couney traveled to Paris to train with Pierre Constant Budin, famed obstetrician at Paris' Maternité Hospital. Under Budin's guidance, Couney learned the keys to improving survival rates for premature infants: maintaining their temperature, feeding them properly, and decreasing exposure to disease.[10]

The path that led Couney from Paris and Budin to an exhibition of live premature infants at the 1896 Berlin World's Fair remains unclear. Contemporary accounts of the Berlin Exposition suggest that Alexandre Lion's incubator charities provided both the design inspiration and financial backing for the immensely popular infant-incubator exhibit.[11] Indeed, the incubators chosen for the Berlin display, as well as all of Couney's subsequent exhibits, were modeled after Lion's design and bore no resemblance to the more simplistic wooden incubators favored by Budin at the Clinique Tarnier. A photograph taken inside Lion's incubator charity in Paris (Figure 9, Appendix A) bears a striking resemblance to illustrations from the "Baby Incubator Pavilion" at the 1896 Berlin Exposition (Figure 10, Appendix A),

each showing a row of Lion-type incubators along the wall, nurses and doctors alongside their charges, with a wooden railing acting as a partition separating the infants from the public space for visiting patrons.[12] Over one hundred thousand fairgoers viewed the Berlin infant-incubator display in its first two months, outpacing other popular amusements such as the sky rides and the Tyrolian yodelers.[13] The exhibit also caught the attention of Samuel Schenkein, a British show promoter, who persuaded Couney to partner with him in sponsoring a similar exhibit the following year at the Victorian Era Exhibition at Earl's Court in London.

Couney arrived in London in the spring of 1897, bolstered by two editorials in the prestigious medical journal *Lancet* praising his new mechanical incubator and the upcoming infant incubator display. Drawing attention to the rising number of infant deaths related to premature birth in England, *Lancet* heralded the "life-saving" and "remarkable" incubator as the key to solving this growing social problem.[14] A lengthy description of the incubator design and means of self-regulating temperature were provided, highlighting the use of glass and metal in its construction for easy cleaning and sterilization. The new technology itself featured prominently throughout the article, contrasting it with some of the "old-fashioned" and unreliable methods of warming premature infants in order "to illustrate the progress accomplished in modern days."[15] On more than one occasion, the editorial stressed that the device was portable and required no trained attendant for proper use, a feature intended to increase accessibility to middle class families by reducing the costs associated with skilled nursing care.

Erected just opposite the Welcome Club at Earl's Court, the exhibit building itself was divided into three compartments: living quarters for the nursing staff on one side, a nursery for feeding and bathing infants on the opposite side, and a central room highlighted by incubators along the wall, allowing the public full view of the infants housed inside. Couney and Schenkein, referenced as the "representatives in England of this the 'Altmann Incubator,'" stood by the integrity and legitimacy of their display, willing to "invite the criticism of the medical profession" and "ready to take in their charge any prematurely born child."[16] This confidence most likely arose not only from their trust in the incubator, but also in the support staff they hired to supervise the infants. Despite claims that the incubator could function almost independently, a specially trained nurse and two "wet" nurses lived on site and provided round-the-clock care. Two local physicians observed the infants three to four times daily.

From Earl's Court on, trained nurses featured prominently in each of Couney's incubator shows, and this trend continued throughout his long career. Madame Louise Recht, a French nurse who trained at the Hospital Maternité in Paris under Pierre Budin, acted as Couney's head nurse and chief aide from the 1897 Victorian Era Exhibition at Earl's Court through the closing of his exhibit at Coney Island in 1943. One *Lancet* editorial in 1897 mentioned her specifically, stating that Recht had been "specially trained" to "look after debilitated and prematurely born infants reared in incubators."[17] Recht always lived and traveled with Couney, a constant fixture in all of his incubator shows.

Despite the positive press, Couney encountered his first real challenges during the Earl's Court Exhibition. He had difficulty securing premature infants for the display, as the hospitals in London refused to surrender any of their patients. According to Couney's description of the tale, he rushed back to Paris and asked his mentor Pierre Budin for help.[18] Budin reportedly escorted Couney to a foundling hospital and permitted him to take any of the more than fifty premature patients currently housed at the institution. Transporting his charges in three washbaskets warmed with hot water bottles, Couney returned to Earl's Court and enjoyed yet another popular showing. On its busiest day, the exhibit hosted more than 3,600 visitors.[19]

Early success at Earl's Court and the promise of profit had also drawn the attention of other show promoters looking to cash in on the popularity of infant incubator displays. *Barnum and Bailey's Greatest Show on Earth*, headquartered in Olympia, London from December 1897 through April 1898, began an infant incubator show of their own. Clearly Barnum and Bailey were not the first competitors, as Couney and Schenkein penned a letter to the editors of *Lancet* in September of 1897, cautioning the medical community, nurses, and parents against "unscrupulous imitators… asking for the loan of children to experiment with."[20] The article attempts to distinguish the Earl's Court exhibit as the first and only legitimate institution, proclaiming all others as imposters and showmen who were simply looking to capitalize on the esteemed reputation of the incubator.

The first objection to infant incubator displays from the medical community was published shortly after the conclusion of the Earl's Court exhibit. In sharp

contrast to its earlier endorsement, this *Lancet* editorial criticized a number of incubator exhibitions, attacking everything from low admission fees to the shared environment and air supply of an agricultural hall. Even the propriety of surrounding amusements came under question, with the article asking, "is it in keeping with the dignity of science that incubators and living babies should be exhibited amidst the aunt-sallies, the merry-go-rounds, the five-legged mule, the wild animals, the clowns, penny peep-shows, and amidst the glare and noise of a vulgar fair?"[21] Couney's exhibit at Earl's Court escaped any controversy, and was instead lauded for the quality of the incubators, the skilled staff, and its optimal location, providing the infants with plenty of fresh air from the surrounding gardens. Success at Earl's Court was considered a mixed blessing, however, concluding that its popularity had:

> … attracted the attention and cupidity of public showman, and all sorts of persons, who had no knowledge of the intricate scientific problem involved, [who] started to organize baby incubator shows just as they might have exhibited marionettes, fat women, or any sort of catch-penny monstrosity. It is therefore necessary that we should at once protest that human infirmities do not constitute a fit subject for the public showman to exploit.[22]

Although appearing to condemn any display of live infants, the editorial instead attempted to define the only acceptable circumstances for infant incubator shows. The medical community would only support serious exhibitions run by an experienced director, and one that only displayed premature infants who would otherwise perish without intervention. Most importantly, the exhibit had to be

staffed by skilled attendants "who had been specially trained not merely in the care of babies and the management of incubators but more particularly in the nursing of prematurely born or especially debilitated infants."[23] Perhaps in response to rising scrutiny by medical professionals or the increasingly competitive market in Europe, Couney brought his incubator institution to the United States, beginning with the 1898 Trans-Mississippi Exposition in Omaha, Nebraska.

World's Fairs in the United States from 1876-1939

Prior to the United States' entrance into World War II, more than twenty world's fairs and expositions were held across the country, and each event served a number of cultural and political functions. They provided fair promoters with the opportunity to facilitate local and national economic development, present new architectural forms and urban planning styles, showcase industrial and commercial innovation, and debut new mediums of entertainment. For scientists, the fairs also afforded an unparalleled chance to educate the public on a mass scale regarding the latest scientific advancements and research findings. As President McKinley stated in his last public address at the 1901 Buffalo Pan-American Exposition:

> Expositions are the timekeepers of progress. They record the world's advancement. They stimulate the energy, enterprise, and intellect of the people; and quicken human genius. They go into the home. They broaden and brighten the daily life of the people. They open mighty storehouses of information to the student. Every exposition, great or small, has helped to some onward step… The good work will go on - it cannot be stopped. These

> buildings will disappear. This creation of art and beauty and industry will perish from sight. But who can tell the new thoughts that have been awakened, the ambition fired, and the high achievement that will be wrought through this exposition.[24]

President McKinley's remarks reflect the hope, passion, and curiosity for progress that fair organizers aimed to stimulate among patrons long after they had left the grounds. The expositions presented visitors with a unified vision of American culture that emphasized nationalism, capitalism, and technological advancement.[25]

Both medicine and nursing used the atmosphere of the expositions to advance individual and professional ambitions, either as a means for showcasing a new medical device, or as a convenient venue for gathering professional leaders to discuss pressing issues. The 1893 Columbian Exposition in Chicago, named to celebrate the 400th anniversary of the arrival of Columbus in the New World, served both of these purposes. Thomas Rotch, MD, the first professor of pediatrics at Harvard, introduced his version of an enclosed incubator for use with premature infants as part of the university's exhibit at the fair. Rotch displayed his "brooder," the first infant incubator designed by an American physician, in an attempt to entice device manufacturers and hospitals to purchase the new technology.[26] The 1893 Chicago exposition also held a Congress on Hospitals, Dispensaries, and Nursing, a section of the International Congress of Charities, Correction, and Philanthropy, where nursing leaders gathered to discuss the state of the profession. Presenters at the congress, including a paper from Florence Nightingale in absentia, emphasized the importance of pushing toward professionalization as a way to improve social

standing and distinguish the discipline from medicine. At the completion of the session, about eighteen superintendents met to form the American Society of Superintendents of Training Schools in the United States and Canada (later known as the National League for Nursing), which would eventually transform nursing education and practice.[27]

As social welfare emerged as a national concern throughout the Progressive era, sponsored exhibits at world's fairs offered an opportunity to educate the masses on public health history and progress. At the 1933-34 *Century of Progress* Exposition in Chicago, a large nursing exhibit in the Social Science Hall demonstrated "the gifts of nursing to the community and the standards of nursing education."[28] Funded by a number of local nursing agencies, the exhibitors used dioramas, slide presentations, painted signs, and a pictorial timeline to demonstrate the breadth and reach of nursing in preserving and maintaining the nation's health. The exhibit welcomed about 12,000 visitors each week who received "not just a pretty picture of nursing but a sense of the importance of nursing to health and to the whole pattern of social welfare."[29]

By the 1939-40 New York World's Fair, exposition planners had designated an entire building, the Medical and Public Health Building, for the presentation of health science research and education. Exhibit sponsors used "pictorialization and illustration" to explain facts "with scientific accuracy, yet with life, color, and motion," and treated the subjects "with such simplicity that they will be readily understandable to the public."[30] The building was divided into three separate sections: the Hall of Man presented anthropology, ethnology, anatomy, and

physiology; the Hall of Medical Science highlighted medical triumph over diseases; and the Hall of Public Health demonstrated how individual health practices promoted community health. Visitors to the New York World's Fair could even purchase a fifty-cent guidebook to the exhibits housed within Medical and Public Health Building, titled *Man and His Health*, and attendance was estimated to be about one third of the daily paid admissions to the exposition.[31]

Each of the exhibits of nursing, medicine, and health at the world's fairs left no doubt as to their strictly educational nature, both in terms of their content and their location on the fairgrounds. Housed in one of the scientific buildings, the exhibits remained far removed from the amusement areas of the fairs. The 1893 World's Columbian Exposition had first introduced fairgoers to a mile-long Midway Plaisance, a separate section of the fair designated for exhibits focusing on entertainment and pleasure. Despite the reluctance of exposition backers to allow cheap amusements within the boundaries of their utopian "White City," the addition of entertainment exhibits, rides, and food concessions to a fair was a proven revenue generator.[32] To combat any uncertainty and provide an "aura of scientific respectability" to the Midway, the Committee on Ways and Means assigned a large number of living ethnographic displays to the area, including a West African village, the Streets of Cairo exhibit, and a Japanese Bazaar.[33] The Midway Plaisance attractions were the most popular of the world's fair, generating over four million dollars in revenue in 1893. From then on, a "Midway" section became standard at expositions, amusement parks, and circuses around the world. In this environment,

one promising a complimentary blend of education and amusement, infant incubator displays finally found their niche.

Early American Infant Incubator Shows

The first baby incubator display in the United States occurred at the Trans-Mississippi and International Exposition in Omaha, Nebraska between June and November of 1898. Little data exists from this show, but a local newspaper stated the exhibit was "intended for the rearing of the weakly born babies, who, under ordinary circumstances soon pass away" and that the display was "attracting considerable attention" from the medical profession.[34] A photograph from the exterior of the building shows a marquee sign advertising "Infant Incubators with Living Infants" over the fenced and guarded turnstile entryway; the walls of the building proclaim the incubator as "a wonderful invention" and announce that over 200,000 patrons enjoyed the exhibit at the 1897 Diamond Jubilee in London (Figure 11, Appendix A).[35] The incubator exhibit was located along the East Midway of the fair near the Japanese Tea Garden, German Village, and Mammoth Whale ride, but exposition planners again attempted to maintain an atmosphere of civility in the amusement section, forbidding concessionaires to "present any feature which could be criticized for a lack of moral tone."[36] Over the course of the exposition's three month run, Martin Couney's nurse Madame Recht had cared for a total of fourteen infants with only two fatalities, and the exhibit itself hosted more than 100,000 visitors.[37]

After spending the next few years in Europe, Couney brought his incubator institution back to the United States in 1901 for the Pan-American Exposition in Buffalo, New York where a substantially larger exhibit was planned. The official guidebook for the fair describes the sizeable brick building containing a complete premature nursery, capable of caring for up to eleven infants in incubators, and showcasing "many new and original devices" (Figure 12, Appendix A).[38] In addition to the staff of trained nurses and wet nurses, Couney placed barkers outside the exhibit to entice fairgoers inside, and also hired lecturers to accompany patrons along their tour of the incubator room and nursery, describing the premature infants inside and explaining any nursing care being provided. Popular press articles focused on the appearance and potential of the premature infants, mentioned the specialized feeding techniques used when infants were unable or unwilling to breastfeed, and praised the attention given by the "watchful nurse."[39] All articles listed the survival rate of the incubator institution at exactly 85 percent.[40]

The Infant Incubator display at the Pan-American Exposition had also finally caught the attention of the American medical community, and articles appeared in the scientific journals *Pediatrics* and *Buffalo Medical Journal* praising the "eminently instructive and interesting nature" of "the only scientific attraction on the Midway."[41] Both articles focus on the design and technological features of the incubator and independently commend the cleanliness and attractiveness of the entire operation. Care of the premature infants merits a single sentence in each publication, noting only that the babies are removed from the incubators to be

changed and fed every two hours, never attributing the work to the nurses who actually performed these duties. The oversight reflected contemporary sentiment among the medical community regarding both the incubator and the nursing profession; American physicians viewed the incubator as a mechanical substitute for the maternal environment that could independently preserve the life of premature babies, and nursing care was understood as simply an extension of a prescribed treatment plan, unworthy of distinction or commendation.[42]

Nursing at the Infant Incubator Company

Popular media and medical journal accounts of nursing care in the exhibit underscored the complexity of the treatments provided by nurses to the premature infants and the dedication required to work within the environment of a Midway attraction. The infant incubator exhibit employed one to two head nurses and up to ten assistant nurses, working in three eight-hour shifts each day, depending on the size and capacity of the building.[43] Each nurse claimed responsibility for no more than three babies at a time, providing all care and any feedings around the clock. Upon admission to the exhibit, a nurse supplied each premature infant with a "bath in water and mustard, then two drops of brandy… which acts as a stimulant."[44] The infant was then weighed, carefully swaddled, given an identifying necklace with their initials stamped on one side, and then placed in a heated incubator. Nurses stationed in the incubator room stood at attention and monitored the infants for signs of distress or readiness for a feeding, at which point the infant was removed from the incubator and taken to the nursery for treatment.[45] In order to preserve

warmth, infants were carefully wrapped from head to toe with blankets any time they were transported by nurses around the exhibit.[46]

Once they had arrived in the nursery room, nurses changed, weighed, and rewrapped their charges. Baths were given at least once daily, followed by a quick oil massage. Feedings were provided every one and a half to three hours, depending on the age, size, and average daily weight gain of the infant being treated.[47] Infants strong enough to breastfeed were then escorted to the building's living quarters to be nourished in private by one of the hired wet nurses. Those infants too small or too weak to suckle at the breast were fed by nurses using any number of specialized techniques, including bottle feeding by a dropper, gavage feeding, or nasal spoon feeding.[48] When the nurse completed the feeding, the infant was weighed again to determine whether enough milk had been consumed, and if not the baby was "persuaded in various ways to absorb more nourishment."[49] Nurses kept a complete record of infant weight gain, as well as daily temperatures, feeding schedules, and growth. A graph of the infants' measurements was placed atop their individual incubators to display progress to visitors.[50] In addition to specialized treatments, the nurses also provided the infants with necessary physical comfort. They rocked infants before and after feedings, holding them close and providing skin-to-skin contact.[51] Once the infants had grown stronger, graduating from the incubator room to the bassinets in the nursery, nurses brought them to an outdoor patio each day for fresh air and a "sun-bath."[52]

Working at the Infant Incubator Company, which existed within the environment of the Midway or amusement park, required a serious commitment by

nursing staff. For the scheduled duration of the show, nurses lived and worked in the same building, often for three to six months at a time, and shared personal living space with the wet nurses and their own nursing infants. Early twentieth century nurses were certainly familiar with the demands of balancing a shared living space while providing care, as private duty nurses often moved into a patient's home to allow twenty-four hour availability during a patient's illness. The infant incubator exhibit, however, also demanded that nurses be willing to have their entire professional persona on constant display to the general public. A nurse's physical appearance, as well as the performance of every nursing activity involved in caring for premature infants, became part of the image presented to audiences who visited the incubator shows. In order to garner the "commendation of visitors," everything about the exhibit, including the nurses who worked inside, had to be "kept neat, clean, and attractive."[53] Only the small living quarters afforded nurses any measure of privacy, and even this space had to be shared with the wet nurses.

The Power Hierarchy of the Incubator Exhibit

Martin Couney exercised complete control over most aspects of the incubator sideshows, particularly with respect to hired staff members. Lecturers were given a "sober, factual speech" written by Couney to follow as they described the premature infants on display.[54] Directing the crowd across the incubator room, lecturers would remark:

> You may talk, ladies and gentlemen, you may cough. They will not hear you. They do not even know you are here. And now, suppose you all follow me.

> Just come this way, if you will, and we will meet the first of our temporary visitors… Now this little baby came in nine days ago. It weighed only one pound eleven ounces and we were afraid we might be too late. It was even bluer than that little fellow over there in the other incubator…[55]

Couney commented that most of his lecturers were "former actors [that] can't seem to help ad-libbing," and that he often had to scold them "for failing to do their work solemnly."[56] This occurred once over a spontaneous inappropriate joke made by a lecturer in response to an inquiry from a visitor. A woman had asked how long it took a trained nurse to become a wet nurse, to which the lecturer replied, "That depends on how careful she is."[57] Couney fired the lecturer, supposedly his favorite, on the spot.

The Infant Incubator Company also employed up to five wet nurses at each exhibit to provide the premature babies with breastmilk for nourishment. Like his mentor Pierre Budin, Couney believed there was no substitute for mother's milk, but also shared Budin's assertion that a number of factors, both maternal and environmental, could negatively impact the quality of breastmilk. In his seminal text on premature care, Budin stated, "In certain cases a mother's milk may be injurious to her infant. This may happen when she has experienced some violent emotion; when she is in bad health; and when her milk has an abnormal composition."[58] Budin cited "evidence" from his clinic proving that anything from anxiety and anger, illness and fatigue, regular menstruation, or poor diet and alcohol consumption in a mother had deleterious effects on the nursing infant. Couney responded by heavily screening wet nurses and only employing those who had "successfully passed the

Wassermann test and whose family records are free from taints of insanity and alcoholism."[59] He also strictly controlled the environment and diet of his wet nurses, "doing his best to protect them from any experiences which might make them nervous and thus affect their supply of milk."[60] Nursing mothers were encouraged to eat frequently throughout the day, but only the "good, milk-producing food" prepared by Couney's wife or a private chef in the exhibit's kitchen.[61] Any nurse caught eating at a local restaurant or "having a hot dog or an orange drink outside" was immediately fired.[62] Couney invited friendly competition among the wet nurses, offering weekly prizes of stockings to those whose premature charges had gained the most weight.

Couney's association with the trained nurses in his exhibits often blurred the boundaries between his professional and personal life. His wife, Annabelle "May" (Segner) Couney, began their relationship as a hired nurse for one of his early world's fair displays. Educated at Purdue University in Indiana, May Segner received her nursing training at Chicago's Women's and Infant's Hospital (later known as Mary Thompson Hospital). The pair met at the 1901 Pan-American Exposition in Buffalo, after Ms. Segner had been recommended as a nurse with experience handling infants, and she worked with Madame Recht for the duration of the show.[63] Martin and May were married soon after the exhibit concluded, and May continued working with her husband and managing many of the financial aspects of the incubator shows until her death in 1936.[64]

In the winter of 1907, the Couneys' daughter Hildegarde was born six weeks premature, weighing less than three pounds. Tales of her birth claim that Couney

kept his daughter alive while others brought an incubator out of storage in Coney Island. Hildegarde lived in the incubator for nearly three months.[65] She traveled with the Couneys as they toured the country for their incubator exhibits, and participated in some of the events at the fairs as a young child.[66] As she grew, Couney became fond of remarking on her "robust" size and healthy weight to fairgoers, proclaiming, "Look at her! You wouldn't believe that back in 1907 I had her in an incubator!"[67] Once she reached adulthood, she acted as a nurse in Couney's shows, and would later manage the exhibit in Atlantic City in conjunction with a local physician.[68] Articles published around the time of Chicago's 1933-34 *Century of Progress* exposition cite her "recent graduation" from a nurse training school, but at this time her attendance at an established school remains unconfirmed.[69]

Establishing a Successful System and Promoting the Technology

Making the leap from Midway concession to permanent amusement park exhibit proved easy for the infant incubator display. After witnessing the popularity of the exhibit at both the Trans-Mississippi and Pan-American Expositions, American showmen Frederic Thompson and Elmer Dundy convinced Martin Couney to bring his enterprise to their new amusement venture Luna Park on Coney Island in New York. The promise of an annual concession pushed Couney to fully immigrate to the United States and establish a permanent Baby Incubator show at Luna Park from 1903 to 1943, the longest running exhibit in the history of Coney Island. From their home base at Luna Park, Couney and his Infant Incubator

Company continued presenting at world's fairs and amusement parks throughout the United States and around the world. His early experiences and immediate success shaped how the system of premature care displayed at the infant incubator exhibits was designed and promoted, often in very different ways. Martin Couney and the mechanical incubator emerged as the central focus, with trained nurses quietly ensuring the survival of the infants without praise or recognition.

By 1903, Couney had stumbled upon a successful technology, more specifically a system of advanced premature care, which he would continue to replicate at every exhibit he sponsored until the closing of his Coney Island show in 1943. The system went beyond the use of a specific incubator design, and included a staffing mix of trained nurses, wet nurses, lecturers, barkers, and local physician consultants, as well as a building layout that enabled his staff to remain on site but also maximized the viewing potential of paid visitors. Developing a technology that works in no way guarantees continued success, however, because inventors must also negotiate with interested groups to connect their technology with a pressing social need. Martin Couney employed a number of convincing techniques, mixing live demonstration, scientific theory, and showmanship, to persuade different audiences to invest in his exhibit.[70] The audiences, or relevant social groups, included the patrons of his exhibit, premature patients and their families, the medical community, fair promoters, and the general public. In negotiating with each of these social groups, Couney expertly managed and promoted the appearance of the trained nurses in his exhibits without ever publicly recognizing the importance of their care in saving the lives of the premature infants on display. A diagram of the

sociotechnical network of the Infant Incubator Company (Diagram 1, Appendix B) illustrates the connections between the identified social groups, as well as the methods of communication between them.[71] The following section provides more detailed explanation of the reciprocal communication and negotiations occurring with the three groups most closely connected to the Infant Incubator Company- patrons of the exhibit, premature patients and their families, and the medical community. Fair promoters and the general public are included in the diagram for the sake of completeness, but will not be discussed in this analysis.

Patrons of the Exhibit

The financial solvency of the infant incubator exhibits relied on the admission fee paid by patrons at the fair. As one newspaper described, "No charge is to be made for the care of infants and the only tax involved is the slight admission fee for spectators, which, while it bars the disinterested and undesirable, is essential to the proper conduct and maintenance of the exhibit itself."[72] Aside from high start up costs involved in constructing the exhibition building and purchasing the necessary equipment, daily operating costs, which included staff salaries, electricity and oxygen use, laundry services, and maintenance, turned out to be "hideously expensive."[73] As early as 1904, John Zahorsky, MD, the pediatrician in charge of an infant incubator exhibit at the Louisiana Purchase Exhibition, estimated operating costs at around fifteen dollars per infant per day; by 1939, Couney claimed a daily overhead of 140 dollars, demanding an attendance of at least 700 customers each

day.[74] The sheer cost of premature care prevented any incubator station from operating for strictly altruistic purposes.

As paying customers were the intended audience, the design and location of the exhibit space, as well as the specific incubator used to display the premature infants, were all chosen to enhance the visitor experience. Architectural plans of the Infant Incubator building at the 1933-34 *Century of Progress* Exposition show a semicircular shaped "baby room" with fifteen infant incubators placed in a row along the inner edge, separated from spectators by a glass wall (Figure 13, Appendix A).[75] This layout offered the visiting public clear visualization of all infants and nursing activities from every possible angle. Work stations in the nursery, where nurses changed, weighed, and fed infants, were at counter height and sectioned off by white curtains, resembling a small theater stage.[76] The incubator Couney preferred, a modified Lion device, had glass front doors and offered an unobstructed view of the infant placed inside. Special metal stands were produced to raise the height of the incubator off the floor and place the premature babies at approximately eye level. Despite being the most expensive design, and not necessarily the most reliable or easy to operate, this incubator best showcased the infants to paying customers.

The inclusion of trained nurses at each of the incubator shows lent an air of scientific legitimacy and medical endorsement to the entire enterprise. In addition to their physical presence, the nurses' bodily appearance and attractiveness reflected the clean, sterile, and sober environment of the ethical institution Couney hoped to present. Photographs of nurses from the Infant Incubator Company show

them impeccably dressed in a style reflective of nursing attire in the respective time period. Early photos capture Madame Recht clad in traditional Victorian dress, while pictures from the 1939-40 New York World's Fair exhibit present nurses wearing a white cap and uniform dress (Figures 14-15, Appendix A). Couney also enjoyed drawing attention to his daughter Hildegarde's physical stature, describing her as a "radiant and robust miss… who tips the scales at 135 pounds."[77] Having been born six weeks early herself, Hildegarde became the physical embodiment of the success of his advanced care techniques and the potential of all premature infants to become healthy, productive members of society.

In return for their paid visit to the infant incubator exhibits, patrons gained knowledge and were provided with entertainment as they witnessed the live displays inside the building. A distinct gender bias emerged in written accounts regarding the way the exhibits were presented to men and women. As an article in the popular magazine *Cosmopolitan* explained, "Men go to the expositions to see and to think," whereas women need to be admonished and educated: "there is a lesson for mothers in every incubator baby, and it shall be told."[78] For men, the exhibit afforded a glimpse into the wonders of technological application in medicine, with articles published in scientific and engineering journals highlighting the technical aspects of the incubator itself. The message was powerful; the incubator became an opportunity for man, science, and machine to succeed where mothers had failed. As one article remarked:

> …the robot mother is here at last…Unbelievable as it may sound, Dr. Couney's incubator machine actually serves as a substitute for mother in the crucial

> stages of a baby's life… So indispensible are these mechanical mothers to prematurely born babies that life would vanish instantly from their bodies without them. Nothing else in the world of science or nature could save them."[79]

The infant incubator displays reinforced contemporary notions of "progress" as synonymous with science and technology. Incubator technology presented an opportunity for men, more specifically physicians and scientists, to enter the historically female controlled arena of birth and childcare and emerge as heroes to premature infants whose lives could not be saved by mothers alone.

The visions of education and amusement presented to female patrons of the incubator exhibits were intended to elicit different responses than those for men. Incubator technology offered a solution to the inadequacies of mothers who had somehow caused their infants to be born prematurely. As one article declared, "Most babies who arrive ahead of schedule do not do so because there is anything the matter with them. Rather the trouble is with the mothers."[80] Women could also be educated on the proper way to care for infants, either through watching the nurses feeding infants, or in the small museum area containing a display of historical infant feeding bottles and infant care pamphlets.[81] The sentiment reflected contemporary medical theories about the causes of prematurity, as well as attempts by pediatricians to transform motherhood into a scientific endeavor that must be learned. On the entertainment side, Couney recognized that female "repeaters," women who returned to the exhibit at regular intervals to watch the progress of particular infants, formed the foundation of his enterprise.[82] Lecturers

became adept at highlighting individual features of the infants on display, noting a baby's long, slender fingers or bright blue eyes, personalizing them to fairgoers.[83] Visitors knew the babies by first name, would learn their birth date and hear how much they had grown since their arrival from the lecturers, but the absence of parents alongside their infants gave the impression that the babies could belong to anyone. In their anonymity, the premature infants offered women the opportunity to experience "a kind of vicarious motherhood," as they returned throughout the season to witness the infants growing and thriving.[84]

While undoubtedly intriguing for the novelty of witnessing tiny premature infants, the incubator shows may have also subtly communicated new possibilities to patrons. The opportunity to observe live premature infants within the environment of a specialized hospital, and watch the skilled care provided by nursing staff, gave audiences a new perspective on prematurity, one that ran counter to contemporary cultural and scientific theories of premature infants as unfortunate but acceptable losses in the fight against infant mortality. The appearance of premature infants of diverse economic, racial, and ethnic backgrounds also implied to visitors that prematurity was a universal health concern. Watching nurses care for every baby with equal fervor and dignity suggested that all infants were worthy of medical attention, and witnessing their progress and survival perhaps helped dispel eugenic arguments against the utility of saving premature babies.

Premature Patients and their Families

The nurses at the incubator shows received patients either from local hospitals or from individual families who could bring their premature or sick children to the institution for free care in exchange for being part of the exhibit.[85] As George Johnson, one of the infants on display at Couney's show in 1937, recalled, "My father didn't have any money, and this doctor says you can use our incubator for free, but you have to put them on display."[86] The science and practice of premature care in the United States in the early twentieth century had done little to improve mortality rates among these infants. In contrast, the methods practiced at the Infant Incubator Company boasted an 85 percent survival rate for infants under their care. Parents of premature babies had to determine whether or not being part of a sideshow exhibit was an acceptable compromise for the chance to save the life of their child. For many families there was no choice and they quickly consented to the agreement, but others proved more reluctant. As Beth Allen, a former graduate of the infant incubator exhibit at Coney Island recalled:

> My mother was adamant, she absolutely refused. She didn't want me to go be on exhibit, I wasn't a freak, she didn't want to send me. Dr. Couney himself came to the hospital and spoke to her about the wonderful care that would be given to me and she finally relented and let me go."[87]

Allen's story appears anomalous, however, as exhibit staff rarely worried for lack of patients and more frequently turned them away for lack of space, leading Martin Couney to proudly claim, "We never have difficulty in getting all the babies that we can care for."[88]

The financial structure of the incubator institutions, in which paying customers funded the entire exhibit, provided premature infants with access to specialized care that had generally been restricted to wealthy, elite, white families who could afford the expense of private treatment. Any infant, regardless of ability to pay or the racial and ethnic background of the family, was accepted into the exhibit. As one newspaper described, "The parentage of babies cuts no figure in their treatment. They may be orphans or foundlings, they may be of high or low degree… The same thing applies to babies born in every other station in life, high or low, rich or poor, black or white. The doctors make no distinction."[89] A story from the 1901 Pan-American Exposition illustrated this philosophy, claiming that the exhibit had received babies from both a prominent Buffalo society family, as well as an American Indian woman performing at the "Indian Village" exhibit across the midway, on the very same day.[90]

The ethnic diversity of the premature infants in the exhibit emerges in written descriptions of the babies, who are frequently differentiated by their cultural identities.[91] One *Cosmopolitan* article attributed personality characteristics to the infants based on their ethnic affiliation, many of which were consistent with contemporary cultural stereotypes. Describing the "little human dynamos," the author notes that the infant of "pure Irish stock" would "challenge any baby of his weight… [and] the nurses declare he tries to fight them," and that the baby of German descent "is distinctly philosophical."[92] Families of premature infants also performed a wide range of cultural and spiritual practices before handing them over to the incubator shows: a Swedish grandmother pulled the child through a leg of its

father's trousers to instill the father's strength; Orthodox Jewish babies wore a red string tied around their right wrist, the *nachora bendel*, as protection from the evil eye; similarly, Italian infants wore amulets to ward off the *malocchio*; and an Armenian preemie wore a garlic necklace to make it vigorous.[93] The unifying thread among the practices was familial desire to guard and protect the vulnerable infant.

Constant supervision and the specialized treatment provided by nurses trained in the care of premature infants became a major selling point for parents. While some families could afford to rent an incubator and hire a private nurse in the event of a premature birth, the Infant Incubator Company boasted an experienced staff of nurses who focused solely on the care of this unique population. Newspapers frequently praised the extensive training Madame Recht had received in Paris in the proper care of premature babies, and highlighted her many years of experience, unparalleled by any other nurse in the country.[94] In addition to being highly skilled, the nurses in the exhibit displayed genuine dedication toward their charges. When a fire at Dreamland threatened the infant incubator building, Madame Recht and another nurse rescued the premature infants from danger. An article praised their heroism, stating:

> The nurses coolly directed the work, forbidding the removal of a single child until it had been swathed in many layers of wrapping, the innermost of which had been warmed to precisely the right temperature… Thanks to the foresight of the nurses, not one of their charges showed signs of developing pneumonia or of suffering otherwise from his or her early morning jaunt.[95]

Even under the most extreme circumstances, the nurses put the lives of the infants before their own and were able to adapt to the situation to ensure the least amount of harm.

The Medical Community

Despite the longevity of the infant incubator show phenomenon, the American medical community displayed a measure of ambivalence toward the subject. After the initial enthusiasm noted in medical journals at the turn of the twentieth century, the incubator exhibits receive almost no attention from physicians, mirroring the disappearance of interest in prematurity that occurred between 1910 and 1920. In fact, some analyses of early premature infant care suggest that the baby-incubator exhibits had only a fleeting impact on professional medical opinion, and their inclusion in historical accounts occurs because "they remain of interest for the way in which they illuminate attitudes toward premature infants *outside* of the medical profession" [emphasis added].[96] Even without an overt declaration of support from the medical community, the lack of outright condemnation or attempts to stop the Infant Incubator Company from continuing to operate implies that some form of negotiation was undoubtedly occurring between the two groups.

The 1898 *Lancet* editorial questioning the scientific integrity of certain infant incubator shows, published after an increase in imitators following the success at Earl's Court, qualified its critique by highlighting the elements necessary for directing an ethical display. Primary among the requirements was the continuous

supervision of the premature infants by skilled nurses specially trained to properly care for this unique population. The authors also urged that, "An incubator show, if such there must be, should correspond in every respect to a hospital ward."[97] Couney's display had been singled out as a "serious exhibition" of "extraordinary success," so he replicated all the required elements in planning exhibits in the United States.[98]

World's fairs and expositions were portrayed as the ideal environment for displaying the incubator institutions, as the Midway guaranteed a sizeable audience and the use of live infants not only drew crowds, but also showcased the incubator in action. In describing their philosophy, Couney's business partner Samuel Schenkein proclaimed:

> Our idea in making these exhibits has been to introduce our system by showing it in actual operation at places where a large number of people are brought together… Any doctor, nurse or experienced mother who investigates will be perfectly assured of the soundness of the theory of the incubator system for saving the lives of prematurely born children and the intelligent care the babies in our care receive.[99]

The infant Incubator Company welcomed scrutiny and invited medical professionals to experience the exhibit. Buildings were designed to mimic the interior of a hospital, and care was taken to adhere to prevailing theories of sanitation and environmental healing. An article in *Pediatrics* described the interior of the exhibit as "a pleasant and well-lighted and sunshiny room" full of glass and metal incubators that could be "washed and disinfected with the greatest celerity," noting

that "scrupulous cleanliness is observed in every minute detail of the establishment."[100]

By experiencing the incubator exhibit, physicians received new scientific knowledge and visual proof regarding the effectiveness of incubator technology. Local hospitals also benefitted from the exhibits, as Couney frequently sold or donated incubators and other equipment at the end of the exhibition season, providing some hospital nurseries with access to the advanced technology without having to incur a large expense. The high cost of an incubator, listed as 160 dollars in 1915, was prohibitive for many institutions, particularly for an item not unanimously endorsed by physicians and intended for a population some believed unworthy of treatment.[101] Following the close of the 1901 Pan-American Exposition, Couney sold some of his incubators to the Buffalo Children's Hospital. Over the next four years, the hospital's pediatrician DeWitt Sherman, MD directed a small incubator station, which treated 29 infants and enjoyed a survival rate of nearly 66 percent.[102] In addition to the incubators, Sherman instituted some of the practices he had witnessed at the Pan-American Exposition, including the exclusive use of breastmilk and nasal spoon feedings for smaller premature babies.

In return for his work with premature infants, Couney had hoped to receive acclaim and professional recognition, but for the majority of his career the medical community reacted with something akin to tolerance, offering neither support nor rebuke. After his experience running the infant incubator exhibit at the 1904 Louisiana Purchase Exposition, John Zahorsky, MD proclaimed:

> The feeling of the medical profession is against the show incubators, of this there can be no doubt. On the one hand there is a prejudice that showmen can not have the proper sentiment toward these little ones and may sacrifice proper requirements of care for show purposes; on the other hand, we feel it degrading to human sentiment to make an exhibition of human misfortunes, especially in the shape of tiny infants.[103]

A large part of the issue undoubtedly related to the lack of published accounts of mortality statistics or other research endeavors from the Infant Incubator Company. Continued reports of survivability between 75 and 90 percent without recorded statistics drew critique from other physicians and allegations that premature infants in the exhibit could not possibly have been less than seven and a half months' gestation.[104] Couney's prolific use of newspapers as a means for publicizing the shows may have also negatively influenced medical opinion, particularly when seen alongside the professional response to eugenic physician Harry Haiseldon, MD. Haiseldon rose to national fame after publicly discussing his role in allowing a handful of "defective" babies to perish, utilizing newspapers to generate support for his cause, and eventually producing a full-length motion picture, *The Black Stork*, loosely based on his experience.[105] Haiseldon's prolific use of mass media ignited far more backlash from the medical community than his role in the infants' deaths, and the only punishment Haiseldon received came in 1916 when the Chicago Medical Society expelled him "not on the fact that the physician did not operate on the baby, but because he permitted [the case] to be published… in a daily newspaper [and to be] exploited in moving picture shows."[106] Professional misgivings about

physician self-promotion reflected contemporary attempts by the medical elite to distance themselves from the historical blemish of quackery and charlatans.

Medical professionals never publicly rebuked the infant incubator exhibits, or made any concerted effort to outlaw the proceedings. To date, the only known attempt to block the incubator displays came from the New York Society for the Prevention of Cruelty to Children (SPCC), which inquired into Couney's medical license and unsuccessfully proposed an amendment to the New York Penal Code "prohibiting the exhibition of infants undergoing the process of artificial incubators" in 1906.[107] In response to the fire at Dreamland in 1911, SPCC President John D. Lindsay issued a public statement condemning the "mercenary" exhibit, hoping that "unfortunate infants [would] not again be permitted to be exhibited under similar grewsome [sic] conditions."[108] Despite the accusations, Couney continued exhibiting at Coney Island and other amusement parks around the county, only achieving the respect he had craved from the medical profession following his collaborative exhibit with Julius Hess, MD at the 1933-34 *Century of Progress* Exposition in Chicago.

"Propaganda for the Preemies": Live Demonstrations as Tools of Persuasion

In a 1939 interview, Martin Couney claimed that throughout his career hosting infant incubator displays, he had been "making propaganda for the proper care of preemies."[109] Supporting his claim was the frequent use of live demonstrations at the infant incubator exhibits as a powerful tool for demonstrating the success of their system of care. Employing elements of performance to highlight

the connection between the technology on display and the intended message to the audience, these demonstrations offered visual proof that the incubator was both successful and socially valuable. The following sections will explore two such demonstrations: the Homecoming celebration at the 1933-34 *Century of Progress* Exposition in Chicago, and the display of nursing activities at the 1939-40 New York World's Fair.

Chicago's 1933-34 *Century of Progress* Exposition

In December of 1927, Chicago civic leaders gathered at city hall to discuss the merits of holding a second world's fair. At the time, the city's national reputation had deteriorated significantly as a result of economic, political, and social crises. Chicago's race riots of 1919, the worst conflict in a series of racially motivated uprisings during the nation's Red Summer, highlighted the city's escalating ethnic tensions as large numbers of diverse racial groups settled near one another and competed for jobs and housing.[110] Economic success during the roaring twenties resulted from widespread political corruption across the state of Illinois, which had facilitated the rise of Chicago's organized crime syndicate and massive gang violence during Prohibition. To restore Chicago's image, city leaders needed a new fair "as wonderful and exhaustive and as representative of the progress of the world in 1933 as was the Columbian Exposition in 1893."[111] Following the events of Black Tuesday, as the country found itself in the midst of economic disaster, the success of the exposition became paramount not just for the city, but for the nation as a whole.[112]

Referencing the celebration of Chicago's centennial anniversary, the chosen theme of a "Century of Progress" was intended to assert the city as a world leader in technological and industrial advancement. For the 1933 World's Fair, "progress" would also take on an additional meaning, as the exposition would not only showcase innovations in science and industry, but also provide hope for a better future amid the suffering of the Great Depression. Along with the customary large educational exhibits, the fair offered visitors numerous amusements along the Midway section. The ability to escape the challenges of daily life would be of particular importance at the height of the Depression. One of the most popular attractions along the Midway, the Streets of Paris concession, was the site where Sally Rand performed her scandalous fan and bubble dances. Next door, in a pink and blue striped building, spectators could pay twenty-five cents to watch nurses care for "living babies in incubators" (Figure 16, Appendix A).[113]

The *Century of Progress* Infant Incubator Exhibit

Nurses from the Premature Infant Station at Chicago's Sarah Morris Hospital would support the Infant Incubator exhibit at the 1933 Chicago World's Fair, a joint venture between the city's Infant Aid Society and Martin Couney's Infant Incubator Company. Per their financial agreement, once each party's initial investment was repaid, all profits would go to the Infant Aid Society, and the reimbursement received would directly benefit the premature station directed by Julius H. Hess, MD at Sarah Morris Hospital.[114] That is not to say the nurses were unsupportive of this arrangement. As Evelyn Lundeen, RN, head nurse of the Premature Station at Sarah

Morris recalled, since most of the infants cared for were "charity cases," the money was "greatly appreciated because the depression had made the necessary funds more difficult to raise."[115] During the months of the *Century of Progress* exposition, the premature station at Sarah Morris was closed, the babies transferred to the Infant Incubator building on the fairgrounds, and the nursing staff loaned to Couney for the duration of the show.[116] The fair was the most successful incubator show to date, with nearly 1,250,000 total visitors over the two seasons.

One of the most highly anticipated events of the 1934 *Century of Progress* Exposition was the homecoming reunion held for the 1933 World's Fair incubator graduates. The ceremony was conducted in a respectful manner, evidenced by a note to the announcer in the transcript offering freedom to improvise, but also stressing "that the ethical standing of the medical men present… preclude its being conducted as a farce."[117] The Chicago ceremony was by far the most impressive Homecoming to date, widely publicized in local newspapers leading up to the event and aired live on nationwide radio broadcast WMAQ from the National Broadcasting Company.[118] Event speakers represented the interests of all the relevant social groups within the sociotechnical network, and included Martin Couney, Mrs. Mollie Greenfield, the mother of a 1933 graduate, Herman Bundesen, MD, Chicago's Health Commissioner, Julius Hess, MD, director of Chicago's Premature Infant Station, and Miss Mae Winter, a graduate of Couney's incubator station at the Pan-American Exposition in 1901 (Figure 17, Appendix A).

Overall, the event cast a positive light on both the Infant Incubator station itself, and the image of premature infants as viable members of society. At the very

start of the ceremony, Couney asserted to the crowd that his reasoning behind the celebration was "to demonstrate visibly that the children are fine and healthy, and, I'm sure, happy."[119] Every speaker made a concerted effort to emphasize the social value of providing life-saving treatment to prematurely born children, describing them as "useful members of society," who "develop mentally and physically equal to any normal baby," and are "actually worth saving."[120] To reinforce the sense of major accomplishment for their survival, graduates were honored with a commemorative certificate, a sweater with the *Century of Progress* insignia from the Infant's Aid Society, and a silver cup engraved with their name.

Individual presenters addressed concerns relative to their specific social group. Speaking on behalf of mothers, Mrs. Greenfield expressed sincere gratitude toward the exhibit staff, asserting that, "It was their skill, their tender care, their devotion to our dear little ones that saved the lives of our precious children."[121] Representing the infant graduates, Miss Winter praised medical progress for its role in her survival claiming, "It gives one a feeling of confidence in the future to know that science is making such strides in the saving of human life."[122] Remarks from the Chicago physicians focused on the plight of the premature infant, the serious life-saving aspect of the incubator exhibit, and the promotion of incubator technology.[123] At this Homecoming celebration, Bundeson and Hess heralded the results from a unified effort across all of Chicago that aimed to improve the process and outcomes associated with premature birth. Bundeson implored other cities across the nation, whose "hospital facilities for the care of such infants are frequently lacking," to initiate a similar plan.[124]

Almost universally, the speakers at the ceremony thanked the trained nursing staff for their dedicated work and their part in saving the lives of the incubator babies. Hess spent the majority of his speech praising the activities of nursing staff at the fairgrounds, as well as the visiting nurse who prepared families to receive their infants upon graduation, and who followed up with the babies once they had returned home. He made a point to celebrate the continuity of care provided by the six nurses who lived at the exhibit for the duration of the summer. The one notable exception was Martin Couney himself, who never once made mention of the nurses involved with the exhibit. He made a point to thank the mothers and babies in attendance, as well as Bundeson, Hess, the other "professional gentlemen" present at the ceremony, and even physicians who could not be present but who had provided support over the years. Couney even found time to thank the Infant's Aid Society and his other financial partners, but completely neglected to thank his nursing staff for their part in his success.

Nursing Care on Display: The 1939-40 New York World's Fair

By 1935, city leaders in New York began looking for ways to boost economic growth and improve community morale during the Great Depression. Noting the financial and political success of Chicago's *Century of Progress*, the decision was made to host a world's fair in the summer of 1939, commemorating the 150th anniversary of George Washington's first presidential inauguration, an event that had also occurred in New York City. After much debate, board members chose a future-oriented theme over a more traditional celebration of modern progress, and

the fair's motto became "Building the World of Tomorrow."[125] Architectural design reflected a modern art deco influence, with structures accentuating geometric lines and integrating domes, pylons, towers, and pyramids. Corporate sponsors were required to incorporate the chosen theme and add futuristic features when planning their exhibits. Fairgoers would come away from the New York exposition with an understanding of science not as an independent academic venture, but as a necessary component to all sectors in a modern society, including government, transportation, communication, art, and amusement. The baby incubator exhibit was perhaps an ideal embodiment of the fair's theme, demonstrating how scientific and technological progress could facilitate a better future from the very beginning of life for even the most vulnerable individuals (Figure 18, Appendix A).

The most detailed account of the duties of nurses inside the Infant Incubator Company comes from a motion picture clip filmed at the baby incubator exhibit during the 1939 New York World's Fair by renowned child psychologist Arnold Gesell, MD. In describing his experience documenting the nursing care of premature infants, Gesell remarked, "…the small patients received superlative care."[126] Since Couney's first exhibit at the 1897 Berlin exhibition, every nursing activity performed while on duty at the incubator show was on full display to patrons of the exhibit. In addition to maintaining an immaculate physical appearance, nurses were required to demonstrate specialized techniques for the changing, bathing, and feeding of premature infants under their care. `

As active participants in the displays, nurses were also asked to incorporate elements of showmanship in the provision of their daily care to increase

entertainment value. Evelyn Lundeen, RN, head nurse of the Premature Infant Station in Chicago, recalled with some contempt the entertainment aspects of her duties while working in the exhibit at the *Century of Progress* Exposition. Lundeen admitted that nurses were, "instructed to add more clothes as the babies grew larger to heighten the illusion of smallness of each of the infants on display."[127] To demonstrate the tiny size of the hands of premature infants, Madame Recht periodically slipped her oversized diamond ring around the wrist of her charges (Figure 19, Appendix A).[128] Couney and other nurses co-opted the performance, as one incubator graduate recalled her parents describing how the doctor "took his pinky ring off and put it on my wrist and I had a bracelet!"[129] Images from the *Century of Progress* exhibit also depict Hildegarde Couney measuring the size of a premature infant against a quart bottle of milk (Figure 20, Appendix A).

For fairgoers, experiencing the exhibit involved much more than simply looking at tiny infants or marveling at the technological achievement of the mechanical incubator. After a leisurely walk through the incubator room, patrons of the exhibit were escorted into an adjoining room, which allowed an unobstructed view into the nursery, complete with bassinets, infant pram, a washbasin, baby scales, and rows of short cabinets with shelves full of clean linens. Through a wall of glass windows, audiences viewed the nursing staff as they tended to infants at individual stations, sectioned off by adjustable white curtains and resembling a small theater stage. The curtains could be opened and closed at will to allow privacy for the infant during a diaper change or other treatment if deemed necessary. Feedings were the most popular live displays, and nurses frequently demonstrated

different techniques for providing nutrition to infants unable or unwilling to feed directly from the breast.

Nurses often demonstrated the process of gavage feeding, a technique championed by Pierre Budin for premature infants too weak to suck, which utilizes a rubber tube attached to a graduated cylinder of milk. Before beginning, the nurse primed the rubber tube with milk to rid it of any air, and checked the temperature of the milk, often by placing the cylinder of milk against her cheek. Once the infant was situated supine across her lap, the nurse inserted the end of the tube into the infant's stomach via the esophagus, allowing for the provision of necessary nutrition without the infant expending effort or energy. Once the tube is placed inside the mouth of the infant, the nurse then controls the flow of milk by pinching the end of the tubing and/or raising the height of the graduated cylinder. Both hands are required for the process, one to hold the graduated cylinder and the other to control the flow of milk and placement of the tube in the infant's stomach. The nurse continually assessed the infant's response and tolerance of the feeding and adjusted the flow of milk accordingly. As the infant begins swallowing, the level of milk in the cylinder goes down, being refilled as needed until the desired amount is consumed.

For the smallest infants at the exhibit, or those with difficulty tolerating gavage feeding, nurses exhibited the nasal spoon feeding method. While observing this type of feeding, Gesell noted that the infant being fed, identified as "Ann," was a seventeen days old infant, supposedly twenty-eight weeks gestation at birth, whose current weight was 945 grams (two pounds, one ounce).[130] Watching nasal spoon feeding offered patrons a rare glimpse of these smaller premature infants, who were

initially placed in a Hess Heated Bed in a private corner of the nursery until they were deemed stable enough to be transferred into the Lion-style incubators displayed to the public in the baby room.[131] The feeding process itself was straightforward:

> Nurse holds child… rests head in palm of left hand. The sagittal axis of the head makes an angle of about 30 with the table top. An assistant nurse takes the rubber cap from a small bottle containing 3 cc of warm and diluted mother's milk. Pours portion in the spoon, filling about three-quarters of the bowl. Nurse gently places the point of the spoon beaker at the left nostril, slightly tilting when necessary. The milk is not actually poured but held in a position where the imperceptible aspirations of the infant's breathing apparently by gently suction withdraw the fluid. The rate of withdrawal is variable, although the infant in this case remained relatively quiescent throughout the whole period of feeding, which may require some 10 minutes, introducing several spoonfuls [sic] totaling 3 cc.[132]

What Gesell's written account could not describe was the constant assessment being performed by the nurse feeding the infant. The process of feeding an infant via the nasal spoon carried a high risk for aspiration of milk into the trachea, which could eventually lead to pneumonia or even death. To the unskilled observer, the process appeared tranquil, as if the infant were sleeping through the whole feeding. All the while the nurse continually evaluated feeding tolerance, respiratory status, and skin color, both during and after the feeding, to determine whether this method of supplying nutrition proved both safe and effective for her patient.

Premature Infant Outcomes as an Indicator of Success

The survival rate of premature infants cared for by the Infant Incubator Company remained high throughout the numerous exhibits over the years. Clearly nursing care was key to decreasing mortality, despite a lack of recognition for its impact. Reports found in newspapers from some of the early American incubator displays, those that occurred between 1898 and 1904, claim survival rates ranging from 84 to 92 percent, with nursing staff caring for between 35 and 76 infants over the course of a summer season.[133] During the two summers of the *Century of Progress* Exhibition, nurses cared for a total of 71 premature infants, 58 of which survived, for a survival rate of nearly 82 percent.[134] At least three of the surviving infants from the summer of 1933, who had been admitted to the station weighing less than two pounds, were present at their Homecoming celebration the following year (Figure 21, Appendix A).[135]

The most thorough record of mortality statistics from the Infant Incubator Company comes from the 1939-40 New York World's Fair. Before the exhibition closed in October of 1940, a detailed outcomes report was submitted to the fair's Medical Director J. Peter Hoguet, MD regarding the infants cared for at the incubator exhibit.[136] In an accompanying letter to Hoguet, Couney stated:

> This report covers the work only until September 26th and still leaves in my care, 15 babies, of which I can safely say, will be discharged in perfect condition the day after the closing. Including these last mentioned 15 babies, the Incubator Institution took care of 108 babies, 10 of which died. However, of the ten which died, they were received in such condition, most of them not

surviving beyond 24-48 hours. Taking the foregoing into consideration, less than 10% were lost.[137]

Some outcome figures and statistics have been organized and are presented in tabular form (Table 1, Appendix B).[138] Premature infants were classified according to their birth weight; information regarding average length of stay, average weight gain and weight at discharge, and overall mortality are also included.

The Infant Incubator Company cared for more than twice the number of girls (sixty-six) than boys (thirty) during the two years of the New York World's Fair, and the infants weighed between 800 grams (one pound, twelve ounces) and 2,100 grams (four pounds, ten ounces) at birth. The incubator babies also enjoyed an average daily weight gain of between twenty and thirty grams, an above average result when compared to Hess' standard recommendation of between 10 and 20 grams, and were discharged home once they achieved a weight between five and six pounds.[139] The average length of stay ranged from twenty-nine days for the largest infants (birthweight between 1,751 and 2,100 grams) up to ninety-one days for the smallest infants (birthweight between 800 and 1,000 grams).

A list of maternal estimates of gestational age in total numbers was also provided by Couney, with the majority of infants born between six and a half and eight months gestation, but these numbers are not correlated with birthweight and therefore provide little insight into their accuracy, particularly considering the difficulty determining gestational age during that time. A modern day growth chart for preterm infants, which categorizes infants by weight and gestational age, is presented for comparison (Table 2, Appendix B). Using an average estimate for

infants in the exhibit and following the contemporary growth curve along the fiftieth percentile, an infant weighing between 800 and 1,000 grams corresponds with approximately twenty-five to twenty-seven weeks gestation, and this group of premature infants achieved a 73 percent survival rate during the New York World's Fair.

Conclusions

From the time of his first American exhibit in 1898 to his final showing at Coney Island in 1943, the plight of the premature baby had gained considerable attention from both the general public and the medical profession, and hospital units dedicated to treating these infants began proliferating in large cities across the nation. The role of the baby incubator displays in altering the path of premature care has largely been relegated to the sideline in historical analyses, and the role of nurses in the exhibits had previously been overlooked. Data from this study support the conclusion that the complex, individualized nursing care provided to premature infants at the exhibits was a major factor in the high rates of survival enjoyed by the incubator babies.

The Infant Incubator Company expertly managed the image and appearance of nurses to promote their system of care, and nurse participation in live displays helped persuade various social groups to "invest" in the technology. Both their physical appearance and general presence provided scientific legitimacy to the infant incubator displays, and the live demonstrations of nursing care presented an educational opportunity for patrons. Staffing the exhibit with nurses specially

trained in premature infant care made the Infant Incubator Company more acceptable to the medical community. While general attitudes among American physicians toward the incubator displays may have been of disapproval in the method of presentation and disbelief in reported results, the utilization of specialized nurses would eventually become central to the design of hospital-based units for premature care, but only after prominent pediatrician Julius Hess, MD began promoting such a system.

[1] Meyer Bergert, "At the Fair," *New York Times*, June 5, 1940, 31.

[2] Memorial statue cited in William A. Silverman, "Incubator-Baby Side Shows," *Pediatrics* 64 (1979): 140. In 1970, a bronze tablet was placed on the wall near the entrance of the Holiday Inn on the Atlantic City Boardwalk at the site of Couney's incubator exhibits, and states, "Dr. Couney was the first person in the United States of offer specialized care for premature infants"; References to Couney's lifestyle made in A.J. Liebling, "A Patron of the Preemies," *The New Yorker*, June 3, 1939: 20-24.

[3] Liebling, "A Patron of the Preemies," 20-24.

[4] To date, no patient or personal records from Couney's shows have been recovered, including any identifying information, progress notes, or nursing records for the infants involved in the exhibits. It is unclear whether Couney kept any records, or whether they have simply been lost over time. Some record of the infants' names, dates of birth, and parents were probably kept, particularly when considering the invitation of infant incubator graduates to Homecoming ceremonies. A 1913 newspaper article, describing the Dreamland fire in Coney Island in 1911, stated, "All of the babies were saved, but the records were destroyed." See "Incubator Graduates in Reunion," *The Cairo Bulletin*, August 31, 1913: 1. Outcome information on infant mortality were located for the final two World's Fairs in which the Infant Incubator Company participated, the 1933-34 Chicago World's Fair, which were kept by Julius Hess, MD, and the 1939-40 New York World's Fair, in a report presented to the fair's Medical Director J. Peter Hoguet by Couney himself, see Martin Couney, "Results of the Premature Care at the Infant Incubators Years 1939

& 1940," letter to J. Peter Hoguet, October 20th, 1940. Courtesy the New York World's Fair 1939-1940 records, Manuscripts and Archives Division, The New York Public Library, Series I, Box 547, Folder 2.

[5] See Silverman, "Incubator-Baby Sideshows" and Jeffrey P. Baker, *The Machine in the Nursery* (Baltimore: The Johns Hopkins University Press, 1996).

[6] Personal communication from Jeffrey P. Baker, July 7, 2013.

[7] W. Bernard Carlson, "Invention, History, and Culture," in *Science, Technology, and Society: An Encyclopedia*, ed. Sal Restivo (New York: Oxford University Press, 2005): 230-236.

[8] Baker, *The Machine in the Nursery*, 92.

[9] Much of the information gathered on Martin Couney's early life and education comes from an interview Couney gave for a *The New Yorker* profile by Liebling, "A Patron of the Preemies" leading up to the 1939 New York World's Fair. Some of this information was corroborated in Silverman, "Incubator-Baby Side Shows," through interviews with Couney's nephew Dr. Alfred J. Ephraim and others who worked with Couney over the years. However, historians have thus far been unable to corroborate all of Couney's claims, and have also found evidence that directly disputes some of his other statements, such as when he claimed to have been solely responsible for the incubator exhibit at the 1896 Berlin Exhibition, see Baker, *The Machine in the Nursery*, 90-91 and Letter to the Editor, "Martin Couney's Story Revisited," *Pediatrics* 100 (1997): 159-160. The validity of this information therefore remains in question.

[10] Pierre Budin, *The Nursling: The Feeding and Hygiene of Premature and Full-Term Infants*, translated by William Maloney (London: Caxton Publishing, 1907).

[11] James Walter Smith, "Baby Incubators," *The Strand Magazine* 12 (1896): 770-776.

[12] Images found in Smith, "Baby Incubators," 714 and "Baby Incubators in the Berlin Exhibition," *The Graphic* 54 (1896): 461.

[13] Smith, "Baby Incubators," 776 and Liebling, "A Patron of the Preemies."

[14] "The Use of Incubators for Infants," *Lancet* 2 (1897): 1490-1491.

[15] "The Victorian Era Exhibition at Earl's Court," *Lancet* 2 (1897): 161.

[16] "Ibid. The "Altmann Incubator" was manufactured by Paul Altmann of Berlin and modeled after Alexandre Lion's design. Altmann designed and produced medical instruments for Robert Koch, the German physician and microbiologist responsible for discovering the causative bacteria for tuberculosis, cholera, and anthrax. Through a licensing agreement, the Kny-Scheerer Company of New York would later manufacture the Altmann incubator in the United States.

[17] "The Victorian Era Exhibition at Earl's Court," 161. Recht's association with Couney, particularly the timing of their initial connection at Earl's Court, has been used as evidence to substantiate Couney's alleged link to Pierre Budin, see Baker, "The Machine in the Nursery," 91.

[18] Liebling, "Patron of the Preemies." In similarity with early details of Martin Couney's life, the only contemporary account of the Earl's Court story comes from this interview.

[19] "The Danger of Making a Public Show of Incubators for Babies," *Lancet* (1898): 390-391.

[20] Samuel Schenkein and Martin Coney(sic), "Infant Incubators," *Lancet* 2 (1897): 744.

[21] "The Danger of Making a Public Show of Incubators for Babies," *Lancet* (1898): 390-391.

[22] Ibid.

[23] Ibid.

[24] Len Spencer, "Address by the late President McKinley at the Pan-American Exposition, Buffalo, New York, September 5, 1901," transcribed from Columbia Graphophone Record A28, Library of Congress.

[25] For more detail on the hegemonic function of early American exhibitions to promote the political, financial, and cultural interests of the country's elite, see Robert W. Rydell, *All the World's A Fair: Visions of Empire at American International Expositions, 1876-1916* (Chicago: The University of Chicago Press, 1984). Rydell explores how each American world's fair between 1876 and 1916 endorsed a cohesive vision of progress as economic growth and imperial expansion, particularly through culturally "diverse" amusements that reinforced white supremacy.

[26] Thomas M. Rotch, "Description of a New Incubator," *Archives of Pediatrics* 10 (1893): 661-665.

[27] Bertha Potter Palmer, "Address delivered on the occasion of the opening of the Woman's Building, May 1st, 1893," in *The Congress of Women*, ed. Mary Kavanaugh Oldham Eagle (Chicago: Monarch Book Company, 1894): 25-29; Louise C. Selanders and Patrick Crane, "Florence Nightingale in Absentia: Nursing and the 1893 Columbian Exposition," *Journal of Holistic Nursing* 28 (2010): 306; Janet Wilson

James, "Isabel Hampton and the Professionalization of Nursing in the 1890s," *The Therapeutic Revolution* (1979): 231.

[28] Madeline Kneberg, "Nursing is Depicted at the World's Fair," *American Journal of Nursing 33* (1933): 858.

[29] Ibid.

[30] Editoral, "An American Museum of Health," *American Journal of Public Health* 28 (1938): 771-773.

[31] Mazyck P. Ravenel, "Book Review: Man and His Health," *American Journal of Public Health* 29 (1939): 1166-1167.

[32] For more on the development and historical significance of the Midway Plaisance, See Rydell, *All the World's a Fair*, 40-71.

[33] Ibid, 62. Rydell asserts that the function of the ethnographic displays along the midway, none of which were the national displays of the countries or regions they purportedly represented, was to provide a scientific basis for racial discrimination. Nonwhite cultures were shown as primitive and barbaric, suggesting white supremacy in building a racial foundation for utopian society.

[34] "Saves the Weakly Born Babies: Infant Incubators and its Place in the Economy of Life," *Omaha Daily Bee*, August 12, 1898:5.

[35] "1898 Trans-Mississippi and International Exposition Infant Incubator Building," photograph courtesy the Pediatric History Center at the American Academy of Pediatrics, Infant Incubator Collection.

[36] James B. Hayes, *History of the Trans-Mississippi and International Exposition of 1898* (St. Louis: Woodward and Tiernan Printing Co., 1910): 51.

[37] "A Live Exhibit: Revival of Last Year's Most Attractive Show," *Omaha Daily Bee*, August 30, 1899: 5.

[38] *Official Catalogue and Guide Book to the Pan-American Exposition* (Buffalo, NY: Charles Arhart: 1901): 50.

[39] Quotation from Arthur Brisbane, "The Incubator Baby and Niagara Falls," *Cosmopolitan* 31 (September 1901): 509-516. Other articles describing nursing care include "Twelve at the Exposition: Tiny Mites of Humanity Receive Most Assiduous Care from Nurses and Physicians," *Buffalo Express*, June 12, 1901; "Baby Incubators at Buffalo," *The Sun*, June 23, 1901: 4; and "Some Medical Aspects of the Pan American Exposition: Infant Incubators," *Buffalo Medical Journal* 57 (1901): 55-56.

[40] An 85 percent survival rate is consistently quoted throughout Couney's career, and has been a source of criticism without any surviving patient records or published research from the Infant Incubator Company supporting the claim. Articles at the time of the Pan-American Exhibition citing an 85 percent survival rate include "Exhibit of Infant Incubators at the Pan-American Exhibition," *Pediatrics* 12 (1901): 414-419; "Some Medical Aspects of the Pan American Exposition: Infant Incubators," *Buffalo Medical Journal* 57 (1901): 55-56; "Baby Incubators at Buffalo," *The Sun*, June 23, 1901: 4; and "Twelve at the Exposition: Tiny Mites of Humanity Receive Most Assiduous Care from Nurses and Physicians," *Buffalo Express*, June 12, 1901.

[41] First quotation from "Exhibit of Infant Incubators at the Pan-American Exhibition," 414; second quotation from "Some Medical Aspects of the Pan American Exposition: Infant Incubators," 55.

[42] For detailed analysis of the history of nursing being defined in relation to that of the medical profession, see Barbara Melosh, "*The Physician's Hand": Work Culture and Conflict in American Nursing* (Philadelphia: Temple University Press, 1982) and Margarete Sandelowski, *Devices and Desires: Gender, Technology and American Nursing* (Chapel Hill: The University of North Carolina Press, 2000): 44-66.

[43] "Proposal Analysis for Infant Incubator Project," report submitted February 15, 1938. Courtesy the New York World's Fair 1939-1940 records, Manuscripts and Archives Division, The New York Public Library, Series I, Box 547, Folder 3.

[44] "Twelve at the Pan-American Exposition," *Buffalo Express*, June 12, 1901.

[45] "Saving Babies," *World's Fair Weekly*, June 4, 1933: 31. Personal and promotional images taken from inside the various incubator stations depict uniformed nursing staff standing alongside the incubators when not actively caring for an infant in the nursery.

[46] "'Mechanical Mother' Saves Lives of Infants," *Modern Mechanics and Inventions*, March 1931: 100-103. The process of removing an infant from an incubator is clearly demonstrated by a nurse in a film clip from a motion picture taken inside the infant incubator exhibit at the 1939-40 New York World's Fair. Motion picture viewing courtesy the Pediatric History Center of the American Academy of Pediatrics, William Silverman Collection.

[47] Infant feeding schedules are mentioned in numerous scientific and popular press articles, with a cited range from every one and a half hours to every three hours. See, for example, "The Victorian Era Exhibition at Earl's Court," 161-162; Exhibit of Infant Incubators at the Pan-American Exhibition, 414-419; "Some Aspects of the

Pan American Exhibition: Infant Incubators," 55-56; Brisbane, "The Incubator Baby and Niagara Falls," 509-516; "'Mechanical Mother' Saves Lives of Infants," 100-103; "Twelve at the Pan-American Exposition"; and "Saving Babies," *World's Fair Weekly*, June 4, 1933: 31.

[48] A motion picture clip taken from inside the 1939-40 New York World's Fair depicts nurses feeding premature infants using many different types of techniques. The film comes from a larger motion picture commissioned by Arnold Gesell, famed child psychologist and physician, who studied the behavior and interaction of young children in an attempt to understand normal growth and development throughout childhood. He preferred the use of motion pictures to record controlled studies of thousands of children at various ages, and created a theory of mental growth in children based upon his recordings. Gesell concluded that progress through childhood was achieved through sequential developmental stages in the areas of motor skills, language development, adaptive behavior, and social skills. In the 1930s, Gesell became interested in understanding the human mind from its earliest embryonic stages, and hypothesized that recordings of premature infants might provide insight into fetal growth and development. Upon learning of Couney's exhibit at the New York World's Fair, Gesell arranged to take multiple video recordings of the premature infants on display in both 1939 and 1940. A copy of the short length of Gesell's motion picture recording at the New York World's Fair was originally obtained by William Silverman, M.D. (see Silverman, "Incubator-Baby Side Shows") and donated to the Pediatric History Center of the American Academy of Pediatrics. During a visit to the Pediatric History Center in July 2013, the author

was allowed to view the film and purchase a copy with the approval of head archivist Ms. Veronica Booth. The film clip has no accompanying audio, so any language used by those on camera, or any accompanying narration is not available for analysis. All detailed descriptions of the process involved in the nursing activities come from textual analysis performed on this video clip.

[49] Quotation from Brisbane, "The Incubator Baby and Niagara Falls," 511. See also "Twelve at the Pan-American Exposition," *Buffalo Express*, June 12, 1901; Elizabeth Walker, "Saving the Babies Who Arrive Too Soon," *The Ogden Standard Examiner*, September 10, 1933.

[50] A detailed photograph of a chart used to monitor temperature, growth, and weight gain can be found in Smith, "Baby Incubators," 770-776. Similar graphs are seen on the front of individual incubators from photographs taken inside Couney's incubator exhibits, although the exact details from each record cannot be seen. These records are referenced in medical journal articles "The Victorian Era Exhibition at Earl's Court," 161-162; Exhibit of Infant Incubators at the Pan-American Exhibition," 414-419; and "Some Medical Aspects of the Pan American Exposition: Infant Incubators," 55-56.

[51] Images of nurses cradling infants and motion picture evidence from the Gesell footage show Madame Recht hugging an infant cheek to cheek. Images and video courtesy the Pediatric History Center at the American Academy of Pediatrics, William Silverman Collection.

[52] Walker, "Saving the Babies Who Arrive Too Soon," *The Ogden Standard Examiner* (Ogden, UT), September 10, 1933.

[53] "Some Medical Aspects of the Pan American Exposition: Infant Incubators," 56.

[54] Liebling, "A Patron of the Preemies," 21.

[55] Edo McCullagh, *Good Old Coney Island: A Sentimental Journey Into the Past* (New York: Fordham University Press, 1957): 276 and 279.

[56] [56] Liebling, "A Patron of the Preemies," 21.

[57] Oliver Pilat and Jo Ranson, *Sodom by the Sea: An Affectionate History of Coney Island* (Garden City: Doubleday, Doran, & Company, 1941): 198.

[58] Pierre Budin, *The Nursling: The Feeding and Hygiene of Premature and Full-Term Infants*, translated by William Maloney (London: Caxton Publishing, 1907): 89-101. Budin cited specific mother-infant dyads, providing evidence through graphs of infant weight gain or loss in response to maternal factors, to support his claim that poor quality breastmilk could negatively impact a nursing infant.

[59] Elizabeth Walker, "Saving the Babies Who Arrive Too Soon," *The Ogden Standard Examiner*, September 10, 1933, 26. The Wassermann antibody test was developed in 1906 as a screening tool for syphilis.

[60] Liebling, "A Patron of the Preemies," 23.

[61] Ibid.

[62] Ibid.

[63] "Mrs. M.A. Couney, Baby Incubator Expert, is Dead," *The Brooklyn Daily Eagle*, February 23, 1936.

[64] "Obituary, Mrs. Martin A Couney," *The New York Times*, February 24, 1936.

[65] Gary Brown, "The Coney Island Baby Laboratory," *Invention and Technology Magazine* 10 (1994): 3.

[66] Hildegarde's photo is found in the article "Prize Incubator Baby of the World," *Chicago Daily Tribune*, September 12, 1909, G2, which recounts a reunion event for graduates of Martin Couney's incubator exhibit at White City; she is also mentioned as an officiant in a "planting" ceremony at Toyland on October 13, 1914 for the Panama-Pacific Exposition in San Francisco in 1915, in Frank Todd, *The Story of the Exposition, Volume 2* (New York: G.P. Putnam's Sons, 1921): 153.

[67] Liebling, "A Patron of the Preemies," 23, also see Walker, "Saving the Babies Who Arrive Too Soon," 26.

[68] Ibid.

[69] Ibid.

[70] W. Bernard Carlson, "Nikola Tesla and the Tools of Persuasion: Rethinking the Role of Agency in the History of Technology," lecture presented at a meeting of the Society for the History of Technology, November 3-6, 2005: 1-22. Using the network metaphor from Social Construction of Technology Theory, Carlson demonstrates how Nikola Tesla used different methods of persuasion to negotiate with his audiences and link his invention to society. Through live demonstrations, Tesla deliberately connected scientific theory with showmanship to successfully integrate his technology with prevailing cultural structures.

[71] In their original essay on Social Construction of Technology, Trevor Pinch and Weibe Bijker visually represented the developmental process of a technology through the use of model that mapped connections between the artifact and relevant social groups, and their relationship with perceived problems and eventual solutions. W. Bernard Carlson built upon the framework used by Pinch and Bijker to

describe how Tesla negotiated with and persuaded different audiences to buy in to his technology. Focusing on the bidirectional communication between the system builder and the identified social groups, Carlson demonstrates how successful inventors utilize multiple methods of persuasion as they communicate with and receive input from each group. The diagram created for this study developed from the framework outlined in Carlson's lecture. See Carlson, "Nikola Tesla and the Tools of Persuasion," 1-22; and Trevor J. Pinch and Weibe E. Bijker, "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, eds. Weibe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge: The MIT Press, 2012): 11-44.

[72] "The Incubator Babies at Wonderland Park," *The Minneapolis Journal*, May 20, 1905: 10.

[73] Liebling, "A Patron of the Preemies," 23.

[74] See John Zahorsky, "Baby Incubators on the 'Pike': A Study of the Care of Premature Infants in Incubator Hospitals Erected for Show Purposes," *St. Louis Courier of Medicine*, 31(1904): 349 and Liebling, "A Patron of the Preemies," 23. A breakdown of estimated operating costs for the 1939 New York World's Fair exhibit comes from "Proposal Analysis for Infant Incubator Project," report submitted February 15, 1938. Courtesy the New York World's Fair 1939-1940 records, Manuscripts and Archives Division, The New York Public Library, Series I, Box 547, Folder 3.

[75] "Babies, Babies, and Babies at World's Fair," *Chicago Daily Tribune*, June 5, 1932, 20.

[76] The Gesell motion shows the curtained work stations lined up along the interior of the nursery, with nurses providing care to infants at each station, separated by glass windows from the public space for patrons. Video courtesy the Pediatric History Center at the American Academy of Pediatrics, William Silverman Collection.

[77] Walker, "Saving the Babies Who Arrive Too Soon," 26. Hildegarde was pictured in an article during her childhood, see "Prize Incubator Baby of the World," *Chicago Daily Tribune*, Septemer 12, 1909: 12. Couney again commented on her weight as an adult in Liebling, "A Patron of the Preemies," 23.

[78] Brisbane, "The Incubator Baby and Niagara Falls," 509-516.

[79] "Mechanical Mother," 100.

[80] Walker, "Saving the Babies Who Arrive Too Soon," 26

[81] "Babies, Babies, Babies at World's Fair," 20. The incubator building at the 1933-34 Chicago World's Fair also contained a small theater room projecting motion pictures of proper newborn care.

[82] Liebling, "A Patron of the Preemies," 23.

[83] Interview of Beth Allen by Elinoar Astrinsky, June 28, 2007. Beth (Bernstein) Allen was a graduate of the infant incubator exhibit at Luna Park in Coney Island. Born May 23, 1941 at seven months gestation and weighing one pound, ten ounces, Allen spent months on display at Coney Island. Discussing the role of lecturers in the exhibit, she commented that the lecturers would point out little things about each of the babies, and her slender fingers were often remarked upon. One lecturer

signed a photograph taken of her inside the incubator, "To our glamour girl Beth." Interview courtesy the Coney Island History Project, Oral History Archives.

[84] Ibid.

[85] Thomas B. Givan, MD, letter to Lawrence M. Gartner, MD, January 18, 1971. In the letter, Givan, a pediatrician with New York's Child Health Committee who acted as a consultant for Couney's incubator show during the 1939-40 New York World's Fair stated, "I asked him how did he obtain the infants. He told me from satisfied patients who had friends and from M.D.'s." Courtesy the Pediatric History Center of the American Academy of Pediatrics, Incubator Collection.

[86] Michael Brick, "Coney Island's Lifesaving Freak Show: Reviled Doctor's Reputation Revived," *Chicago Tribune*, June 12, 2005, 14.

[87] Interview of Beth Allen by Elinoar Astrinsky, June 28, 2007. Martin Couney most likely pursued Beth Allen for the opportunity to care for an infant of her small size and gestational age. By the time of Allen's birth in 1941, crowds had become desensitized to the uniqueness premature infants and Couney needed to showcase smaller and smaller infants to maintain attendance. Interview courtesy the Coney Island History Project, Oral History Archives.

[88] "Wonderland Park is Well Opened: Great Crowds Throng New Amusement Resort," *The Minneapolis Journal*, May 29, 1905: 7.

[89] "The Incubator Babies at Wonderland Park," *The Minneapolis Journal*, May 20, 1905: 10.

[90] "Some Medical Aspects of the Pan American Exposition: Infant Incubators," 55.

[91] Many articles identify infants by ethnicity alone, for example, the Romanian mites, the Irish boy, the Jewish triplets, son of a Negro woman. See "Three Tiny Girls in the Incubators," *Buffalo Evening News*, July 17, 1901; Brisbane, "The Incubator Baby and Niagara Falls," 509-516; "Century of Progress Notes," *Chicago Daily Tribune*, September 26, 1934: 7; Liebling, "A Patron of the Preemies," 23.

[92] Brisbane, "The Incubator Baby and Niagara Falls," 513.

[93] Liebling, "A Patron of the Preemies," 23.

[94] "Incubator Tots Meet: A Reunion at Coney," *New York Daily Tribune*, July 30, 1906. This article claimed Recht had "handled more than eight thousand waifs." See also Jane Dixon, "5 World War Veterans Among 'Incubator Babies' to Attend Reunion." *The Evening Telegram New York*, June 5, 1928: 7.

[95] "Incubator Babies Saved From Fire," New York Tribune, August 20, 1917: 12. See also "Incubator Babies Saved at Coney," *The Evening World*, May 27, 1911: 2.

[96] Baker, *The Machine in the Nursery*, 92.

[97] "The Danger of Making a Public Show of Incubators for Babies," 390.

[98] Ibid.

[99] "Wonderland Park is Well Opened," *The Minneapolis Journal*, May 29, 1905: 7.

[100] "Exhibit of Infant Incubators at the Pan-American Exposition," 417.

[101] A 1915 trade catalogue for the Kny-Scheerer Company listed the price range for their "Incubators for Prematurely Born Children" between US$160 and $180, depending on a gas, petroleum, or electric heat source. This model was the preferred design used by the Infant Incubator Company. See The Kny-Scheerer

Company, *Illustrations of Surgical Instruments of Superior Quality* (New York: Kny-Scheerer Co., 1915): 5063.

[102] DeWitt H. Sherman, "The Premature Infant," *New York Medical Journal* 82 (1905): 272-76.

[103] Ibid., 389-349.

[104] Zahorsky, "The Baby Incubators on the Pike," 348.

[105] Martin S. Pernick, *The Black Stork: Eugenics and the Death of "Defective" Babies in American Medicine and Motion Pictures Since 1915* (New York: Oxford University Press, 1996).

[106] As quoted in Pernick, *The Black Stork*, 117. Pernick briefly discusses Martin Couney in relation to Haiseldon as further indication that the use of mass media was perceived as more egregious than his lack of treatment of impaired newborns. While Couney and Haiseldon practiced opposing philosophies with regard to caring for sick infants, but they were both mostly attacked over their utilization of newspaper and other media to promote their endeavors. For a more detailed analysis of medical opposition to the use of mass media for publicity, see Pernick, *The Black Stork*, 117-128.

[107] As quoted in Baker, *The Machine in the Nursery*, 97. See also McCullough, *Good Old Coney Island*, 277.

[108] Statement cited in "Fire Arouses the S.P.C.C.: Its President Complains of Incubator Baby Shows Anyway," *The Sun*, May 28, 1911: 2; and "Babies in Incubator Endangered by Fire," *New York Herald*, May 28, 1911.

[109] Liebling, "A Patron for the Preemies," 20.

[110] Robert G. Spinney, *City of Big Shoulders: A History of Chicago* (Chicago: Northern Illinois University Press, 2000).

[111] Conference regarding World's Fair, Stenographic Report, December 17, 1927, folder 1-12017, A Century of Progress Collection, The University of Illinois at Chicago (UIC).

[112] October 29, 1929, also known as Black Tuesday, was the single most catastrophic stock market collapse in the United States. In a single day, the market lost over $14 billion, and signaled the start of the Great Depression.

[113] A photograph taken at the 1933 *Century of Progress* exposition shows the exterior of the Infant Incubator exhibit, with the front reading "Living Infants in Incubators." The sign for the Streets of Paris exhibit can be seen in the background. Photo courtesy the Pediatric History Center at the American Academy of Pediatrics, Incubator Collection.

[114] "Babies, Babies, Babies at World's Fair," 20.

[115] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 10.

[116] Ibid.; see also Reedy, "From Weakling to Fighter," 118.

[117] "Transcript of Infant Incubator Homecoming, July 25, 1934," 1. Courtesy the Hess, Julius Hays. Papers, Crerar Ms 51, [Box 3, Folder 11], Special Collections Research Center, University of Chicago Library.

[118] Ibid.; See also Donald Dye and Karen Tarpey, "Maternity and Infant Care Services in Chicago Retrospectus: Our Legacy, Our Challenge," in *Historical Review and Recent Advances in Neonatal and Perinatal Medicine*, eds George F. Smith and Dharmapuri Vidyasayar (Glenview: Mead Johnson Nutritional Division, 1980). The earliest

record of a Couney reunion ceremony was in the article "Incubator Graduates Hold a Reunion," *New York Times*, August 1, 1904. Newspaper articles providing accounts of homecoming reunions include "Incubator Tots Meet," *New York Daily Tribune*, July 30, 1906, 8; "Prize Incubator Baby of the World," *Chicago Daily Tribune*, September 12, 1909, G2; "5 World War Veterans Among 'Incubator Babies' to Attend Reunion," *The Evening Telegram New York*, June 3, 1928, 7.

[119] "Transcript of Infant Incubator Homecoming, July 25, 1934," 3.

[120] Ibid., 5 and 15.

[121] Ibid., 5.

[122] Ibid., 14.

[123] Ibid., 7-12.

[124] Ibid., 8.

[125] Rydell, *Fair America*.

[126] Arnold Gesell, *The Embryology of Behavior: The Beginnings of the Human Mind* (New York: Harper & Bros., 1945): 250.

[127] Silverman, "Incubator Baby Sideshows," 137. Silverman interviewed Lundeen regarding her experience assisting at Couney's exhibit during the 1933-34 *Century of Progress* exposition.

[128] Ibid.; This dramatic act was employed frequently by Couney and other nurses at the exhibit. The Gesell motion picture shows Hildegarde performing this exact deed with a small infant.

[129] Rita Wechsler, letter to Dr. Field, August 17, 1978. Courtesy the Pediatric History Center at the American Academy of Pediatrics, Incubator Collection, Box 1, Folder 2.

[130] As quoted in Silverman, "Incubator-Baby Side Shows," 140. Gesell's notes accompany a section of the motion picture clip received from the American Academy of Pediatrics.

[131] "Boy Triplets Put in Oxygen Tent at Fair," *Chicago Daily Tribune*, June 25, 1933: 2; and "2 1/4 Pound Baby Coming on Train to World's Fair," *Chicago Daily Tribune*, September 12, 1934: 8. The newspaper articles refer to the Hess Heated bed as an "oxygen tent" or "oxygen cubicle."

[132] As quoted in Silverman, "Incubator-Baby Side Shows," 140.

[133] See "Incubator Graduates Hold a Reunion," *The New York Times*, August 1, 1904 and "Where Babies are Made Strong By Artificial Means," *The Washington Times*, October 2, 1904.

[134] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 10.

[135] "Transcript of Infant Incubator Homecoming, July 25, 1934," 10.

[136] Martin A. Couney, letter to J. Peter Hoguet, October 20th, 1940. Courtesy the New York World's Fair 1939-1940 records, Manuscripts and Archives Division, The New York Public Library, Series I, Box 547, Folder 2. Couney had presented these statistics at a gathering of New York pediatricians in mid-October of 1940, and a brief summary of the vital statistics were reprinted in the Journal of the American Medical Association a week after the fair concluded, see "Medical News: New York City," *Journal of the American Medical Association* 115 (1940): 1648.

[137] Ibid.

[138] Ibid.

[139] Julius H. Hess, *Premature and Congenitally Diseased Infants* (Philadelphia: Lea & Febinger, 1922): 183.

Chapter 4: Nurses as Experts at the Premature Infant Station

By 1941, the Premature Infant Station at Chicago's Sarah Morris Hospital for Children had emerged as the preeminent center for the care of preterm babies. In direct contrast to the carnival-like atmosphere surrounding the infant incubator sideshow exhibits, "the Station" established premature care as a hospital-based specialty that placed trained and experienced nursing staff at the center of its treatment model. Focus shifted away from the technologic wonders of the mechanical incubator, and instead highlighted the necessity of skilled nurses for improving premature infant survival. To reflect this change, Julius Hess, M.D. published an updated guide on the care of premature infants, and completely restructured content to situate specialized nursing care in a prominent role when describing proper care of premature infants. Coauthored by Evelyn Lundeen, R.N., Superintendent of the Station, the book presents a clear message that the responsibility for increasing premature infant survival rests largely with nursing staff. The authors set the tone from the very beginning of the text, declaring, "Since it is our conviction that untiring, unremitting care has no substitute in the care of the premature infant, we have deemed it essential to give equal prominence to the role of the nurse."[1]

In the nearly twenty years since the opening of the Station, Julius Hess and Evelyn Lundeen had worked together to develop and refine a model of premature infant care that dramatically improved survival rates among their patients. Published results of patient outcomes from the Premature Infant Station started a

national conversation about the importance of comprehensive programs for dealing with premature birth, and renewed professional medical interest in the role of the mechanical incubator and other technology in newborn care. The standards and nursing procedures practiced at the Station would form the foundation for the development of neonatal nurseries in cities around the nation.

Interestingly, the key features in the model of care practiced at the Station, which included maintaining infant temperature, providing adequate nutrition, and reducing exposure to infection, had been promoted by Pierre Budin of France as early as 1900 and had also formed the basis for the treatment practices executed at the infant-incubator sideshows popular in the early twentieth century.[2] Previous research on the early history of premature care in the United States has proclaimed Hess as the solitary link between Budin's system in France at the turn of the century and the proliferation of neonatal units across the United States beginning in the 1930s. Despite being credited as the first permanent hospital-based premature nursery, research has yet to explore the underlying reasons behind the success of the Premature Infant Station in promoting their system of care. This chapter will utilize Social Construction of Technology theory to examine the different methods of communication utilized by Hess and Lundeen as they actively negotiated with local and national audiences to shift attention to the impact of nursing care, rather than incubator technology, on improving premature infant survival.

Julius Hess: The "Father of Neonatology"

Julius Hays Hess was born on January 2, 1876 in Ottawa, Illinois. He graduated from medical school at Northwestern University in Chicago in 1899, and spent his intern year at Alexian Brothers' Hospital in the pathology department.[3] The following year, Hess completed post-graduate training at Johns Hopkins University Hospital, capped off by a trip to Europe to study hospitals and clinics in Germany and Austria. He returned to his hometown, and on April 15, 1902 married his childhood sweetheart, Clara Merrifield. The couple settled in Chicago and raised two daughters, Jean Merrifield Hess and Carole Lucille Hess.[4]

In 1902, Hess began a private practice in Chicago, one he maintained for ten years. Visiting his patients around the city using a horse-drawn carriage, Hess quickly gained an excellent reputation among his clients, later admitting to a student that he was "especially proud that within a few years he was so successful that he had two horses pulling his buggy."[5] Also in 1902, Hess began a long career teaching at Chicago medical schools, starting at Rush Medical College (1902-1908), moving on to his alma mater Northwestern University Medical School (1908-1913), and finally joining the faculty at the University of Illinois (1913-1944), becoming Professor of Pediatrics and chief of staff at Cook County Hospital, positions he retained until his retirement.[6] A former student described Hess as, "a commanding presence and, when you were with him, you felt the aura of importance which emanated from him. He was kind and gentle to patients, although he could be very firm when the need arose. As a teacher and critic, he was never abrasive and he was a superb instructor who shared his knowledge generously."[7] Despite his success in

private practice and obvious love of teaching, Hess would truly find his calling only once he focused on pediatrics, and more specifically the newborn period. This process began in 1907, when Hess was appointed to the position of attending pediatrician at Michael Reese Hospital in the Department of Children's Diseases.

Michael Reese Hospital

Founded in the spirit of a Jewish tradition of charity, Michael Reese Hospital received its first patients on October 23, 1881. The hospital was funded through a sizeable endowment from the surviving family of real estate speculator Michael Reese, whose last will and testament designated that a majority of his fortune be given to a number of Jewish charitable organizations across the nation, including Mount Sinai Hospital in New York, the Cleveland Orphan Asylum, and the San Francisco Foundling and Lying-in Hospital. Reese's family offered the money on two conditions: first, that the hospital be named for Michael Reese, and second, that the institution treat patients of all racial, ethnic, and religious backgrounds.[8] Built near the south side of Chicago, the hospital primarily ministered to poor European immigrants, and relied heavily on both financial donations and non-monetary contributions of time, labor, linens, bandages, and even flowers for patients by its philanthropic Jewish community members.

It quickly became clear that the need for medical services administered by Michael Reese Hospital was larger than its sixty beds could accommodate, and in 1907 a newer and substantially larger building was opened. Still guided by a charitable philosophy, the hospital could now provide advanced medical treatment

for up to 300 patients in a state of the art facility. As a Chicago-based German Jewish newspaper described on the opening day of the new Michael Reese Hospital:

> All kinds of patients will be admitted, without religious discrimination or regard to financial considerations. Patients without means will be welcome as well as those of high class who pay for their care. The intent of the hospital is to continue to help certain patients- those who leave the hospital penniless- with a gift of money to ease their recovery.[9]

In the new facility, an entire floor was devoted to serving the unique needs of women and children, with a dedicated pediatric ward on the north wing of the third floor and a women's unit on the south wing. This area also housed a full obstetric clinic, as well as a clean newborn nursery equipped with a small number of incubators.[10]

The Department of Children's Diseases at Michael Reese quickly flourished and experienced ever-increasing hospital admissions for children. To accommodate this growing patient population, Sarah Morris Hospital for Children was built in 1913, located across the street from the main Michael Reese Hospital building. After conducting extensive research in Europe visiting children's hospital wards, Children's Department Director Isaac Abt, MD worked with architects and planned Sarah Morris Hospital with children in mind. The design included brightly colored walls, smaller, age-appropriate furniture, a playroom, and an outdoor porch to allow for fresh air and sunlight therapy.[11] Pediatricians at Michael Reese had recently recognized a relationship between diarrheal disease and infant diet, so the new

hospital facility emphasized the importance of proper milk preparation and storage. As Abt recalled:

> After working in hospitals which made little distinction between the food for infants and adults, I was particularly pleased with the plans for the Sarah Morris diet kitchen and milk station. Here we were to have our own pasteurizing equipment, sterilizers, and other devices for making milk preparations. There was to be ample refrigeration, and we thought we had overlooked no detail that would contribute to the cleanliness of the place or the aseptic precautions.[12]

Sarah Morris Hospital also distinguished itself with regard to its nursing staff, as Abt believed that pediatric patients deserved treatment from experienced providers. Students from the Michael Reese Training School for Nurses were not allowed to receive assignments in the pediatric wards until they reached their second or third year of training, an attitude that differed from most other hospitals with an associated nursing school. Pupil nurses were often viewed as an inexpensive and interchangeable workforce, and the provision of quality nursing care was believed to simply involve discipline and strict adherence to prescribed orders.

The Michael Reese Training School for Nurses

The Michael Reese Training School for Nurses was established in 1890 "to improve furthermore the comforts of the suffering and at the same time to open a new avenue of industry to intelligent and conscientious young ladies."[13] Association with a nurse training school provided the hospital with a constant supply of cheap

labor, whose costs were almost completely recovered by the substantial supplemental income gained through students' private duty nursing services. Early nursing leader Isabel Hampton Robb remarked, "is it not poor economy and mistaken judgment… to sacrifice the health of one class of people [nurses] in trying to restore that of others [patients]?"[14] Robb severely opposed private duty requirements for students, believing they furthered their economic exploitation, interfered with academic studies, and endangered their health. Despite the critique, hospital administration considered the provision of an education and training opportunities, room and board, and a small weekly stipend to be fair compensation for the nursing services provided by students, requiring second-year pupil nurses to serve on "private cases among the rich or poor" in addition to their assigned ward rotations.[15]

Admission requirements for the School reflected the rigorous demands of student nursing in most training schools of the time, as applicants had to be young, healthy, without physical deformity, unmarried, and without young children.[16] The sole duty was to the hospital, and a family would have required an unacceptable level of commitment outside hospital life. Also requisite were the names and addresses of two references, usually one from a clergyman testifying to moral character, and one from a physician confirming good health. Upon acceptance, a probationer moved into the hospital and surrendered herself to the hard work ahead during her one-month trial with the school. Attrition commonly occurred, either through dismissal or voluntary departure; of the thirty-six probationary nurses chosen in the first year of the Michael Reese Training School's operation,

only fifteen became pupil nurses.[17] If the Superintendent found the student to be satisfactory at the end of the probationary period, the now pupil-nurse would be required to sign a two-year contract, promising to "obey implicitly the commands of [her] superior in charge."[18]

Life as a pupil nurse at the Michael Reese Training School challenged a young woman's physical, emotional, and intellectual limits. Standard training schedules had student nurses working 12 to 14 hours a day, 7 days a week, 50 weeks a year.[19] An hour each day was allotted for "study, exercise, and rest," and nurses were given only one afternoon off each week.[20] Instruction on how to make and apply bandages, line splints, cook and serve proper food for the sick, and the best methods of controlling the environment of the sickroom occurred entirely through practical experience on the wards. Student nurses quickly learned their role was that of watchful handmaid for the physician in the care of the sick. Formal instruction was lacking, if not missing entirely, and pupil nurses had difficulty staying awake during these presentations, which were often held in the evening after a long day on the wards.[21] A "trained" nurse resulted from hard experience under meager supervision by head nurses, who were often only second-year students themselves.

Success on the busy wards required swift, efficient work and strict adherence to a prescribed set of regulations. Designed not only to promote the technical skills and moral character thought necessary for nurses, these rules also protected patients from inexperienced students whose responsibilities often exceeded their technical skill. Superintendents in the early training schools took it upon themselves to mold their students into an idealized version of the "proper" nurse,

often through the use of militaristic discipline. Traits of self-sacrifice, dedication to duty, and complete obedience to superiors were stressed over individuality and independence, with overall behavior considered the measure of a student's moral character.[22] In describing the militaristic organization of nurse training schools, Lavinia Dock wrote, "It is not and cannot be democratic… to this end complete subordination of the individual to the work as a whole is as necessary for her as for the soldier."[23] The overwhelming work load on the wards necessitated stringent regulation, and as many of the new students, who had come from middle- to upper-class families, had few disciplined work habits, head nurses and superintendents believed demanding complete obedience to be the only possible way to get everything done. For the most part, Michael Reese Hospital operated under the same assumptions for the management and training of its pupil nurses, with the exception of requiring some practical experience before allowing nurses to care for children. This plan proved successful for most types of patients, until the establishment of a premature ward at Sarah Morris Hospital highlighted the need for a specially trained and more permanent staff of graduate nurses to care for this unique population.

Early Premature Care at Sarah Morris Hospital

The specifics regarding when and why Julius Hess turned his attention toward prematurity remains unclear, although he declared that his interest "in this phase of the practice of medicine [went] back to 1906."[24] A reconnection with renowned pediatrician Isaac Abt, MD at Michael Reese Hospital may have

contributed, as both physicians endorsed the increasing role of pediatrics within the hospital obstetric nursery and believed in developing specialized units and equipment designed with children in mind. The pair had met back in 1892, when Abt completed his intern year at Michael Reese Hospital under the tutelage of Hess' father, Amson Hess.[25] Another potential source of motivation behind Hess' focus on prematurity may have come from his religious beliefs and ties to the Chicago Jewish community. Medical historian Jeffrey Baker was the first to suggest that the experience of cultural or religious persecution during the peak of the eugenics movement may have encouraged Hess to gravitate toward a similarly vulnerable medical population.[26] Regardless of the underlying motivation, Hess found a supportive environment at Michael Reese Hospital, one that proved necessary to design and refine a system of care for premature infants that would revolutionize treatment practices across the nation.

Hess' first professional contribution to premature care came in 1911 when he published his first article on the subject, discussing the caloric requirements for premature infants based on the feeding history and overall outcome of seventeen patients he had overseen at Michael Reese. The hospital had been utilizing incubators in the obstetric nursery since the newer building opened in 1907, and Hess had embraced many of the suggestions of Pierre Budin of France for treating newborns. In particular, Hess used human milk exclusively for premature babies, and advocated gavage or dropper feedings for any infant unable to feed directly from the breast.[27] His work with premature infants inspired the design of his own incubator, the Hess Heated Bed, which he began using on the obstetric wards at

Michael Reese Hospital in 1914 (Figures 7-8, Appendix A).[28] In the summer of 1915, Hess would witness many of Budin's techniques in action while he assisted Martin Couney with the Infant Incubator Company's exhibit at the Panama Pacific International Exposition in San Francisco.[29] Noticing the "absence of any definite collection of material on the care of prematurely born human infants," Hess would eventually publish his first textbook in 1922, which would elevate him to the level of American authority on prematurity.[30] Combining research from other respected physicians with his own patient records and clinical observations, *Premature and Congenitally Diseased Infants* offered providers a comprehensive resource for understanding and treating prematurity using the best scientific evidence available at the time.

The majority of the text addressed medical management of premature infants, encompassing the etiology and the physiology of prematurity, commonly encountered diseases and pathology, and even short-term prognoses, but Hess also devoted an entire section to describing the nursing and feeding care of these babies. Skilled nursing was listed as an essential component of a successful model of care, but only after adequate preparation of the home or hospital room and immediate medical intervention at birth had first been addressed.[31] The prevention of heat loss, the exclusive provision of human milk, and limiting the infant's exposure to potential infection were also deemed vital aspects of a successful treatment regimen.

Nursing care described in the text provided guidance for the performance of duties when following a specified daily routine for premature infants, either in a

hospital-based nursery unit or a private home. A quick overview of the care and treatment for all body systems, as well as general recommendations for nursing assessment of body temperature, pulse, respiration, and infant weight, were offered.[32] Baseline normal values, as well as common abnormalities and variations seen in premature infants, were also included. The text stressed that nurses not only needed to be experienced in the careful and proper handling of premature babies, but also must be "intensely interested in their work," exhibiting characteristics of diligence, sound judgment, adaptability, attention to detail, and discretion.[33] Hess recognized that the inherent challenge for any hospital unit for premature infants would be the rapid turnover of trained staff, as pupil nurses often rotated to another unit as soon as they had gained adequate experience. He said:

> In our hospital wards we have found the constant changing of nurses, as is so frequently the case in meeting the curriculum for nurses' training in general hospitals, to be of the greatest disadvantage. Far better results are obtained when the nurse in charge has under her care assistants… preferably young women who are especially preparing themselves for the care of young infants, and who can be relied upon to stay in the station for long periods of time.[34]

Fortunately, strong philanthropic ties to Michael Reese hospital among prominent Jewish families would prove invaluable, as the Infant's Aid Society turned an unexpected tragedy into a blessing for premature infants throughout the city of Chicago.

The Infants' Aid Society of Chicago

Many hospitals believed that providing treatment to premature infants was both costly and meaningless. While administrators often authorized the expense of specialized equipment, most hospitals refused to permit the hiring of permanent graduate nurses to administer care, particularly when pupil nurses were readily available. Luckily, a partnership between Sarah Morris Hospital and a local charity would eventually provide an annual donation precisely for nursing salaries. In 1914, Hortense Schoen Joseph, the wife of a wealthy businessman and an active member of Chicago's Jewish community, founded the Infants' Aid Society of Chicago. The nonprofit, nonsectarian, philanthropic association quickly distinguished itself by becoming the first charitable association in the United States dedicated solely to the welfare of premature babies. Infants' Aid hoped to ensure that all prematurely born infants in the city of Chicago, regardless of race, religion, or economic status, were given every opportunity for survival. As the first president of the Society, Joseph worked with Hess and other physicians at Michael Reese Hospital to improve care for prematurely born babies, and by 1915 had facilitated the placement of three incubators in the obstetric wards of Michael Reese.[35]

Unfortunately Joseph died suddenly in August of 1922, and as a memorial, the Infants' Aid Society pledged an endowment fund of at least sixty-five thousand dollars to establish a Premature Infant Station at Sarah Morris Hospital for children, to be paid in full by June of 1939. During this period, the charity also guaranteed a five thousand dollar annual maintenance fee. All maintenance funds were to be used "only for the employment of nurses in the station or the procurement of breast

milk in necessary instances."[36] By 1924, the Infants' Aid Society had assumed almost complete financial responsibility for the Station, which was renamed the Hortense Schoen Joseph Premature Infant Station to honor the founder and first president of the organization.[37]

The Early Years of the Premature Infant Station

The Premature Infant Station at Sarah Morris Hospital opened for admissions in May of 1922. According to Hess, the primary purpose of the station was to:

> …fulfill the needs for special care of prematurely born and immature infants encountered among the population in a large city. The need for an institution which would receive infants prematurely born in the homes as well as in other hospitals was best evidenced by the rapidly increasing demand for admission of infants.[38]

The Station became the only stand-alone unit in the city of Chicago capable of receiving any premature and/or full-term infant requiring special care, regardless of its place of birth. While general hospitals in most large cities were equipped in some way to deal with sick or preterm infants born in their own obstetric wards, nearly all refused to admit an infant born outside of their hospital for fear of introducing infection to the newborn nurseries.

In its first two years of operation, the Station performed poorly, with low admission rates and high levels of mortality. During the eight months the Station operated in 1922, nursing staff cared for a total of 19 infants, most between 1,000 and 2,500 grams, and only 11 survived.[39] The following year, admission rates were

still stagnant and outcomes were even worse. Out of the 28 premature infants cared for in 1923, only 12 graduated from the station, for an overall mortality rate of almost 43 percent.[40] Hess recognized that changes needed to be made across the board, so he remodeled the layout of the nursery, hired more graduate nursing staff, secured wet nurses to supply breast milk, and purchased new equipment, including a portable Hess ambulance bed to accompany nurses when they picked up babies born at home. The Station also sponsored a weekly outpatient clinic to follow up with premature graduates in their first years of life.[41] Finding a head nurse to direct daily activities at the station was the final necessary improvement, and in 1924 Hess recruited Evelyn Lundeen.

Evelyn Lundeen Joins the Station

Born on February 15, 1900 in Rockford, Illinois, Evelyn Lundeen grew up in a strict and deeply religious Scandinavian home. Her parents governed the family through order, cleanliness, and discipline, characteristics that would symbolize Lundeen's approach to nursing practice. Following the death of her mother, Lundeen and her sister spent a few years in California with grandparents before returning to Rock Island, Illinois once her father had remarried. Despite strong religious convictions, Lundeen decided against missionary work and attended the School of Nursing at Lutheran Hospital in her hometown. After her graduation in 1922, Lundeen continued working at Lutheran hospital where her superior nursing skill captured the attention of her supervisor, Emilia Dahigran, a friend of Julius

Hess. Lundeen quickly became Hess' first choice for nursing supervisor of the Premature Infant Station.

Hess' offer to become director and head nurse of the Station initially evoked little interest from Lundeen, who enjoyed working with her adult medical-surgical patients in the small hospital of her hometown. "I don't particularly care for pediatrics," she remembered responding when first asked about the position.[42] Hess persisted, however, and appealed to Lundeen's conviction that graduate nurses should be providing their expert skill to patients with the greatest need and strongest possibility for recovery. Indeed, in her first scholarly publication, Lundeen argued that since nursing had "reached the stage where the entire profession is of inestimable value to humanity," an individual nurse's "capabilities for giving service" should never exceed her opportunities for usefulness.[43] Lundeen believed that because graduate nurses were in such high demand, they had a duty to the general public to serve in positions that adequately utilized their skills. She remarked that it was "absurd for a woman with that amount of training to spend her time, day in and day out, doing that work which does not require such thorough training as she, a graduate nurse, has received."[44] Hess convinced Lundeen that caring for premature infants was both a valuable and necessary endeavor, and the pair began their work together at the Station in the fall of 1924.

Placing Lundeen in charge of the Premature Infant Station did not immediately improve results. On the positive side, annual admission rates continued to steadily increase, thanks largely to efforts by Lundeen to market the services of the Station to local midwives and other agencies that provided birth

assistance across Chicago. Highlighting the ability of the Station to safely transport infants to the unit, which involved the use of a portable electric incubator that plugged into the cigarette lighter of a taxi, Lundeen also emphasized that services were available to all needy infants, regardless of background or ability to pay. As Lundeen stated, "There was absolutely no restriction as to color, race, or religion of the prematures. All were most welcome."[45] The promotional strategy worked well, and over the course of its first five years of operation, admission rates at the station had increased sevenfold, from 19 patients in 1922 to 138 patients in 1927.[46]

Unfortunately, despite the changes in unit design, updated equipment, more personnel, and a broadening of services to include pre-hospital as well as post-discharge care, premature infants cared for at the Station continued experiencing poor outcomes. Survival rates remained lower than desired, bottoming out at just 34 percent in 1924, followed by a modest improvement over the next three years to 65, 53, and 54 percent, respectively.[47] In addition to the unacceptably low overall survival rates, Lundeen also noted that alarming numbers of their premature patients were developing infections during their hospital stay. Realizing their current system was still "far from satisfactory," Lundeen admitted, "We had to face the following facts: 1. That equipment alone was far from all that was necessary. 2. That our nursing technique was not up to the standard required to prevent mortality and infections. 3. That at least 20 percent of our mortality was not necessary."[48] In response, Lundeen made radical changes in nursing technique on the unit, namely an overhaul of aseptic practices that were integrated throughout nursing procedures, and altered their infant feeding routines. The modifications

worked and the overall survival rate jumped to 74 percent in 1928, remaining above 72 percent thereafter.[49]

Nursing at the Premature Infant Station

From the very beginning, the Premature Infant Station situated quality nursing care at the forefront of treatment practices. As Hess later recalled, a main objective for the Station was to "demonstrate that a general hospital could provide good care for premature infants with a minimum of equipment if the nurses were skilled and conscientious in carrying out the regulations established for the protection of the infants."[50] Recognizing that the acquisition of expensive equipment for premature infants presented a substantial financial barrier to most hospitals, the Station set out to prove that positive outcomes and a reduction in mortality could be achieved in any unit with properly instructed nursing staff, a resource already available at every institution. In addition to training, the Station also stressed the need for adequate staffing, both in total numbers and individual experience. After the unit was remodeled in 1928, the Station included two patient rooms equipped with twelve Hess Heated beds, and in-house nursing staff consisted of a nursing supervisor, three graduate nurses, and three assistant infant nurses working in three 8-hour shifts each day.[51] One nurse cared for no more than two to three infants at a time, and extra staff was always available due to the unexpected nature of premature infant care. Lundeen explained that this model of staffing ensured that "when emergencies arise, when there is an unusual number of new

admissions or when unscheduled procedures are required, nurses will be available to carry out the established routine."[52]

When the Station was alerted to a new admission, a graduate nurse was sent either to assist in the immediate care of the premature infant at delivery on the maternity ward, or to pick up the infant born at home and transport them to the unit. In both situations, nursing responsibilities remained similar, with infant stabilization and prompt return the Station as the primary goal. Upon arrival, the nurse warmed and dried the newborn using as minimal handling as possible. Mucus or other secretions were gently suctioned from mouth and nose, and if apnea or cyanosis were noted, nurses would attempt either tracheal catheterization for mouth to lung insufflation or provide chest compressions.[53] Inhaled stimulants, usually five to six drops of spirits of ammonia on cotton, would also be administered according to physician orders.[54] The infant's temperature was taken within the first thirty minutes of life, and environmental conditions were adjusted accordingly, either by providing more warm blankets or access to a heated bed. Once the infant's condition had stabilized, the nurse placed the infant into a portable incubator and swiftly traveled back to the premature unit. If sent to a private home to retrieve an infant, the nurse called for taxi service, paid for by the Infant's Aid Society, and the portable Hess bed was plugged into the car battery to keep the infant warm on the return trip to the Station.[55]

Admission procedures on the unit included weighing, measuring, and bathing the infant, assuming the baby's condition permitted such activities. Nursing assessment and clinical observations were performed simultaneously with required

admission procedures so as not to increase unnecessary exposure for the infant, either to cold or potential infection. Infants were dressed and swaddled in lightweight wool flannel clothing, and a cloth identification band, complete with a unique numerical identifier, was sewn on the right wrist of each infant with the number recorded in the chart.[56] Nurses remained vigilant at the infant's bedside, monitoring for any change in color, appearance, or respiratory status, until the patient's condition had sufficiently stabilized and any new physician orders had been received.

All infant care activities, as well as the cleaning and maintenance of equipment and linens for the entire unit, fell to the nursing staff. In describing nursing duties at the Station, Lundeen stated, "The technic [sic] used, the emergency treatments, the maintenance of a normal body temperature, the methods of feeding, and the close observance of clinical symptoms and the early recognition of any pathological manifestations are all responsibilities of the nurse."[57] A daily routine for was developed and strictly followed, with every minute of active duty accounted for during each of the three shifts (see example schedule in Figure 22, Appendix A). Feeding schedules for the infants, who were fed either every three or every four hours, governed most of the daily routine. Nurses fed infants using a variety of methods, including gavage, nasal spoon, and medicine dropper feedings. The Premature Infant Station preferred the medicine dropper, and all infants, regardless of size, were initially fed using this technique. Despite being the most time intensive approach for nurses, Lundeen believed it best because "the rubber tip prevents irritation to the mucous membrane of the mouth and helps in teaching the baby to

suck."[58] Over the course of the infant's stay, developing a feeding plan became a highly individualized process, with the assessment and clinical judgment of each baby's feeding tolerance by nursing staff often valued over the orders prescribed by physicians.[59]

Analysis of the major contributors to infant mortality in the first few years of the Station led Lundeen to conclude that prevention of infection and complete maintenance of asepsis needed to be included in all aspects of nursing care. The mantra of the Station became "morbidity is always potential mortality."[60] Frequent hand washing became the hallmark of aseptic practices in the nursery, with staff members washing hands between 60 and 90 times during an 8-hour shift.[61] Nursing procedures were divided into manageable steps, with emphasis placed on activities commonly leading to a break in aseptic technique. Restructuring nursing duties in such a way emphasized that nursing personnel alone held "the responsibility of infections occurring in the nursery."[62]

While effective at minimizing infection, stringent aseptic practices left few opportunities for nurses to provide physical comfort by cradling or snuggling with premature patients. Nearly every nursing procedure, including changing, feeding, provision of medication, and vital sign assessments, was completed while the infant stayed inside the Hess bed. If an activity required the infant to be removed from the incubator, nurses were encouraged to hold the infant in their hands and forearms and away from the body, preventing contact between the baby and the nurse's uniform (Figure 23, Appendix A).[63] When burping an infant after a feeding, nurses were instructed to place a cloth over their shoulder and turn their head away from

the infant to eliminate the possibility of any skin-to-skin contact along their face and neck.[64] Aseptic protocol also restricted access to the premature unit to only those staff deemed necessary for daily care activities, which did not include the parents and family members of the infants. Parents were allowed to visit the Station, but could only watch their infant being cared for by nursing staff through glass windows while standing outside the nursery. Mothers were encouraged to pump and store breast milk to bring to the Station to nourish their own infants, but were not permitted inside the unit for fear of introducing potential infectious agents and endangering the lives of all the premature babies currently admitted.

This is not to say that nurses at the Station lacked dedication or caring for their patients. On the contrary, Hess and Lundeen sought nurses who demonstrated enthusiasm, conscientiousness, and vigilance in their practice.[65] William Oh, MD, a pediatrician who trained at the Premature Infant Station, recalled the level of commitment he noted while watching Lundeen care for the premature infants, saying:

> She used to have patients with RDS [respiratory distress syndrome]. They have this pectus excavatum, the chest sunk in. She figured that if she put a safety pin on the chest wall and hung it up in the hole of the incubator, it would help the baby expand the chest wall… She did that for several babies. They all died. It didn't help, but that was a reflection of her devotion. Then the other thing she did was to go down to the building and grounds department and ask them to build a seesaw to put a baby in… It was to stimulate an iron lung- not the iron lung, but allowing the diaphragm to move

> up and down. It didn't help, but that's how it was… There was no evidence-based in those days. You just did it by intuition. And she was so devoted to those babies that she would do anything to save them.[66]

Ensuring infant survival became the driving force behind nursing actions, and without a complete understanding of the pathophysiology of prematurity or the importance of early physical contact, the Station continued to isolate infants from anything potentially infectious, including human touch.

Power Hierarchy

While Julius Hess directed activities in the Premature Infant Station, graduate nursing staff clearly practiced with a high level of autonomy, and their opinions were given high regard. For nurses, Hess believed that "since clinical observations are of more diagnostic value than the signs detected on physical examinations, conscientious observations are of the greatest importance, and her attention should be directed to every change in the infant's condition."[67] Nurses took a great deal of responsibility for infant outcomes, especially in the area of infection control, and were rewarded with the freedom to function fairly independently. Physicians and interns examined infants and wrote orders once daily, but graduate nursing staff performed all treatments and were encouraged to report their own observations and clinical judgments. William Oh, MD recalled the self-sufficiency of Evelyn Lundeen, saying:

> When you are a resident rotating through premature nursery with Ms. Lundeen, you only get called three times. When the baby gets admitted, she

> needs a physical. When the baby dies, she needs someone to write a death certificate. And when the baby does not poo, because she needs a barium enema order. Everything else she does.[68]

The expectation was that nursing staff would perform duties to the fullest extent of their scope of practice, and partner with physicians whenever necessary.

As Superintendent and Head Nurse, Lundeen felt responsible not only for providing excellent care to each of the infants, but also for ensuring that all other personnel on the unit did the same. She believed the head nurse "must actually 'police' the nursery to make sure that doctors, residents, interns, ward helpers, engineers, plumbers and cleaning personnel use good technic [sic]. It will be her responsibility if an infectious epidemic occurs."[69] All practical teaching of new staff members fell to the unit supervisor, who first demonstrated proper technique and then witnessed student nurses perform each duty at least twice before allowing independent practice. One pediatric resident, Alwin Rambar, MD remembered Lundeen as, "totally in charge of the station. She managed the feeding and care of those delicate babies and she trained nurses who came there from all over the world to learn from her… She was also an autocrat who knew more about the care of the premature than the doctors did, and woe unto them who dared to write orders."[70] Lundeen took her responsibility as Superintendent of the Station very seriously, and devoted her life to her work and her patients. She clearly held power in managing daily operations on the unit, and believed her duty toward the premature infants, to provide them with the best care possible, gave her the authority to question anyone

or anything that deviated from the established treatment protocols, regardless of their position.

Establishing a Successful System and Promoting the Technology

By 1931, the Premature Infant Station had refined their model of premature care to a point that mortality rates hit an all-time low of just 19.3 percent even as admission rates peaked and the unit began caring for smaller babies.[71] Most of the basic components of the treatment model resembled the one utilized by Martin Couney and the Infant Incubator Company, and included incubators to preserve warmth, trained nursing staff to provide all infant care, wet nurses to supply patients exclusively with breast milk, and the use of specialized feeding techniques to ensure adequate nourishment. Despite the similar technology, the message presented by the Infant Incubator Company and the Premature Infant Station differed dramatically. Two important contextual factors, namely an increased national interest in prematurity as well as the unprecedented financial support of the Infant's Aid Society, undoubtedly altered the structure of the system and changed some of the groups the Premature Infant Station regularly negotiated with while promoting their model of care. These relevant social groups included the Infant's Aid Society, premature patients and their families, the medical community, the nursing profession, the Chicago Board of Health, the general public, device manufacturers, and patent examiners. A diagram of the sociotechnical network of the Premature Infant Station illustrates the connections between relevant social groups and the Station (Figure 4, Appendix B.). The following sections explain the

bi-directional negotiations between the Station and five of these groups- the Infant's Aid Society, premature patients and their families, the medical community, and the nursing profession. Manufacturers and patent examiners, while important to Hess as an inventor, are included in the diagram only for completeness but will not be discussed in this study. The Premature Infant Station interacted with some of the same audiences as the Infant Incubator Company, but the content of these negotiations and the methods used to communicate the message were decidedly different.

The Infants' Aid Society

The financial support provided by the Infants' Aid Society not only enabled the initial establishment of the Premature Infant Station, but the commitment of an annual endowment pledge solely for nursing salaries and breast milk acquisition undoubtedly ensured the continued success of the Station's model of care. Hospital administration typically relied on pupil nurses to provide care for all patient populations, and the expense of hiring trained graduate nurses would almost certainly have been met with resistance. As Hess remarked, "In many hospitals the executive officers do not hesitate to spend large sums of money for the finest of equipment but refuse to employ a sufficient number of nurses to permit aseptic technic [sic]. A shortage in the nursing personnel accounts for inadequate care."[72] Even the system in place at Sarah Morris Hospital, which required student nurses to have at least one or two years' experience before caring for pediatric patients, proved unsatisfactory with reference to the skill level necessary to expertly care for

premature infants. The rapid turnover of pupil nurses meant that an inordinate amount of time was spent training students who would inevitably spend only a short time working independently before rotating to another unit. An annual endowment from the Infants' Aid Society enabled the Station to hire permanent graduate nurses, as well as a handful of "nursery maids," young women who had spent one year training in the care of newborn and young infants and were expected to assist graduate nurses in routine tasks such as cleaning equipment and the folding of linen.[73]

The Infants' Aid Society continued its financial and volunteer support for the Premature Infant Station and other hospitals in the Chicago area for decades, and by 1955 had given more than 250,000 dollars to its cause.[74] Membership grew to more than one thousand women, and volunteers would meet twice a month to hand sew all garments worn by the premature babies in the Station, and pack hundreds of complete layettes that were distributed to needy families throughout the city. In addition to the inpatient unit for premature care, Infants' Aid also financed the Babette and Emanuel Mandel Clinic that provided follow-up care for Station graduates, where many society volunteers acted as assistants to the staff and dedicated visiting nurse. Describing the Infants' Aid Society in 1958, current president Natalie Solway wrote:

> The story of the Infants' Aid Society is a human, sacrificial and urgent one. It is the business of providing equipment, medication, nursing and follow-up care leading to a normal childhood for premature infants. The Infants' Aid tools are incubators, oxygen, medicines, nursing and a staff of skilled workers

> dedicated to saving the lives of prematurely born babies. The Infants' Aid objective is, through research, to study the cause and the cure of accompanying diseases in the premature baby.[75]

Hess had promoted research efforts aimed at better understanding prematurity since the initial founding of the Station. After his death in 1955, the Infants' Aid Society worked to continue Hess' research legacy, and established a memorial to fund a medical fellowship dedicated to research endeavors for premature infants at Michael Reese Hospital. Through all of the assistance given to the Station, the Infant's Aid Society had fulfilled its original mission of providing support to all prematurely born infants in Chicago, ministering to the families in greatest need, and ensuring improved outcomes for a vulnerable population.

Premature Infants and Their Families

Nursing staff at the Premature Infant Station cared for any baby, regardless of race, religion, financial status, or even place of birth. The Station's open policy for receiving sick or premature infants from any source proved truly unique, as no other institution in the city, and possibly the nation, risked admitting an infant born outside the hospital into the clean obstetrical nursery. While estimates of the percentage of hospital births at the time range from 30 to 50 percent for large cities, a significant number of infants born in Chicago were still delivered at home and would therefore benefit from a dedicated hospital ward willing to accept all premature babies in need of care.[76] Families could also rest assured that the high cost of specialized care for premature infants, often regarded as a barrier to

treatment, was either adjusted based on ability to pay or forgiven altogether. As one family remembered, "We had so little, no car, no bank account… no way to pay for 18 dollars a day care. The hospital people never asked us for a cent."[77] In its first twelve years of operation, approximately 80 percent of all infants admitted to the Station had received care free of charge.[78]

The overall survival rate for patients at the Station from 1928 onward, which remained above 72 percent despite increasing numbers of admissions for progressively smaller infants, attests to the high quality of care delivered by nursing staff. Looking back on the success of the Station, Lundeen remarked, "Many premature infants owe their lives to the devotion and the care given to them by the many nurses who worked so diligently and so long in their behalf."[79] The dedicated care by nursing staff began before the infant even arrived at the Station, and continued well after it had been discharged. Safe pre-hospital transportation became a focus for the Station, as early experience led Hess and Lundeen to conclude that premature infants unnecessarily exposed to cold prior to their arrival to the unit fared worse than those whose temperature had been properly maintained. Hess had developed an electrically heated portable incubator in 1923, which was basically a large leather and steel bag that could be powered using outlets from ordinary home lighting, overhead train lighting, or the lamp socket on the instrument panel of an automobile.[80] The city of Chicago developed a systematic alert method, whereby delivery attendants were required to notify the Health Department by telephone within an hour of a premature birth and in writing within the first 24 hours. Upon hearing that an infant needed transportation, an intern and

trained nurse were sent to the home or outside hospital, initially via taxi and eventually by Health Department ambulance, to stabilize the infant and transfer them to the premature unit.

Lundeen recognized that the transportation process was crucial not only in improving survival of the infants, but also in the development of a partnership with the parents. After detailing the nursing actions necessary for safe travel, she made a point to highlight the significance of the encounter, saying:

> It is important that in this first visit the nurse establish friendly relations with the family. The attitude of the nurse, her interest in the baby, her careful handling of the baby, her kindly answers to the many questions will do much to establish a feeling of confidence and trust on the part of the family. While taking babies to the hospital may be routine to the nurse, it in an unusual and sometimes fearful event in the mother's life, and the nurse must do everything possible to evoke the mother's and the family's co-operation.[81]

The nurse provided parents with the hospital address and phone number, as well as written instructions for the mother on hand expression and the importance of breast milk for the survival of premature infants. Transportation procedures also demonstrated a level of cultural sensitivity, as part of the process involved inquiring about parental beliefs regarding baptism- whether it had already been performed or whether parents would desire the ceremony take place should the infant's condition worsen.[82]

Follow-up care for premature infants after graduating from the Station also became a vital aspect of the treatment process. Growing awareness of the premature unit in the late 1920s brought increasing numbers of admissions, and bed availability soon became an issue; rather than turn away newborn infants, the Station began discharging current patients once they reached a weight of four and a half pounds. This policy unfortunately resulted in high rates of readmission for infant graduates. As Lundeen recalled, "We would discharge our babies in good condition, and within a week or two we had to re-admit many of them. Since many of these babies came from the poorest homes and from the poorest districts in Chicago, naturally the home environment was not an inducement to the welfare of the premature infant."[83] To solve the issue, the Station hired Roberta Stannard, RN in 1931 to function as its private visiting nurse for infant graduates. Stannard's duties involved helping mothers prepare for their infant's discharge home, providing detailed written instructions and demonstrations on bathing, handling, and milk preparation, as well as following up with families on a regular basis to facilitate clinic visits or provide treatment in the home if necessary.[84] Having Stannard focus exclusively on premature graduates not only decreased the likelihood of readmission to the hospital, but also ensured the infants regularly received pediatric consultation and developmental assessments until they reached an age of two years, at which point they were referred to the pediatric clinic at Sarah Morris Hospital.[85] Regular follow up clinic attendance benefitted the Station as well, because it allowed clinic pediatricians to conduct thorough research studies examining the long-term outcomes of premature infants.

The Medical Community

With the publication of *Premature and Congenitally Diseased Infants* in 1922, Julius Hess reinvigorated medical attention to the cause of prematurity. In the wake of an expansive national campaign against infant mortality and improved birth records, Hess prefaced his text by contextualizing the impact of premature birth alone on the infant mortality rate. By strategically removing the terms "congenital debility" or "weakling," Hess distinguished premature infants as wholly different from feeble full-term babies and newborns suffering from a specific disease. Combining treatment recommendations and research from French, German, and American physicians with his own clinical records, the textbook propelled Hess to the level of national authority on prematurity. The continued success of the premature unit at Sarah Morris, combined with Hess' commitment to research and teaching, would solidify his reputation among the American medical community. An active member of numerous medical societies, including the American Medical Association, the American Pediatric Society, the American College of Physicians, and the Illinois Medical Society, Hess also served as a member of the Jewish Children's Bureau and on the Pediatric Advisory Board of the U.S. Children's Bureau.

The establishment of the Premature Infant Station afforded Hess an unprecedented level of practical experience that focused solely on the treatment of prematurity. He took full advantage of the opportunity to research premature infants, whom he believed to be "the most helpless of the human race," refining his model of treatment in response to the physiologic outcomes of his patients.[86] A prolific writer, Hess published numerous textbooks and articles, both in medical

journals as well as popular press and mass media outlets. His published work demonstrates a methodical approach to research, particularly on the subject of prematurity, as he grounded the majority of his outcome studies in statistics. Hess frequently relied on the objectivity of numbers and percentages to convey the message that a significant proportion of infants suffering from simple prematurity could and would develop into healthy children when given adequate care.[87] While Hess' Jewish heritage has previously been suggested as a potential motivation for his work with premature infants, it is also worth considering how this may have influenced his approach to research. With increasing anti-Semitic sentiment throughout the United States in the early twentieth century, particularly after World War I, it is possible Hess felt compelled to ensure his research findings remained beyond reproach. By maintaining a meticulous, methodical, and scientifically sound approach in both the design and presentation of his outcomes, his overall conclusions emerged from objective data rather than personal or moral sentiment.

Partnering with Evelyn Lundeen proved pivotal in shaping Hess' understanding of successful management of premature infants. While Hess had learned from Budin that skilled nursing was valuable in the care of premature infants, it was not until Lundeen completely restructured graduate nurse training and all nursing procedures at the Station that nursing care would emerge as the single most important factor for increasing survival. The message Hess continually presented to the medical community emphasized the absolute necessity of a well trained, experienced, and stable staff of graduate nurses, sufficient in number, to adequately provide for the unique needs of preterm infants.[88] This was the first

time within medical literature that credit for improved survival rates for premature babies shifted from a focus on incubator technology onto the diligent care provided by nurses, and Hess supported his claims with objective measures of success, citing thorough patient records and impressive outcome statistics. Indeed, the model of care promoted at the Premature Infant Station involved a significant paradigm shift for the medical community at the time, one that involved placing complete control of daily activities on the unit directly in the hands of nursing staff.

The Nursing Profession

The nursing profession also became an important audience for the dissemination of research findings. With a number of individual publications, Lundeen showcased her own ability to promote the methods of premature infant care practiced by graduate nurses at the Station. A series of Lundeen's articles published in the late 1930s detail the proper methods for nursing care of premature babies, both at home and in the hospital, and stress the importance of maintaining proper technique to promote growth and reduce infection.[89] Highlighting the responsibility of nurses in managing the environment of care, Lundeen preached strict adherence to aseptic practices in all nursing duties, constant vigilance to the potential for change in the infant's status, and the necessity of minimal handling to protect against exposure.[90] She continued publishing throughout her career, and the message presented mirrored the one presented to physicians, that the presence of well-trained nursing staff afforded the best opportunity for reducing neonatal mortality.

Promoting the Station: Partnerships and Specialization as Tools of Persuasion

At the Homecoming celebration at Chicago's Century of Progress Exposition on July 25, 1934, physician speakers Julius Hess and Herman Bundesen presented a dual message to audiences: first, that prematurity as a public health concern was a growing issue that few institutions were prepared to handle, and second, that the model of care presented at the Infant Incubator exhibit not only reduced needless deaths from prematurity, but also allowed formerly premature infants to grow and thrive and become productive members of society. The celebration proved to be as much of a turning point for the Premature Infant Station as it had been for Martin Couney and the Infant Incubator Company, except the goals for the Station broadened tremendously as Hess and Lundeen looked beyond the continued development of their own unit and more toward a comprehensive local and national campaign for premature birth. Both the medical community and the public at large had come to recognize the success and value of advanced care for premature infants, but translating the individual achievement of the Premature Infant Station on a much larger scale would require a concerted effort to promote specialized nursing as a key component in any premature program and develop partnerships with public health agencies. Through the establishment of a graduate nurse training program and the development of the Chicago citywide plan for the care of premature infants, the Station would eventually achieve this new goal.

A Specialty Course in Premature Care

After the overhaul of nursing practices at the Premature Infant Station in 1928 resulted in better outcomes for patients and a reduction in overall mortality, Hess and Lundeen recognized that their system of care could serve as a model for correctly training nurses to handle this delicate population. Together, they developed a course for graduate nurses designed to impart both the knowledge and practical skill necessary to properly care for premature infants. Offered for the first time in 1931, the instructional seminar lasted anywhere from two to six weeks for post graduate pediatric nurses, and could be extended into a three month course for nurses interested in specializing with premature infants.[91] Instruction combined at least three hours of classroom teaching on the state of the science of premature care, followed by hands on training at the Premature Infant Station. Practical experience on the unit involved learning the different methods of feeding small or weak premature infants, as well as the therapeutic treatments for common pathology in prematurity, including how to safely administer oxygen, blood, and fluids.[92] Lundeen personally oversaw graduate nurse teaching on the unit, first demonstrating the proper technique for nursing duties and then supervising student performance in each activity for at least the first two to three attempts. At the end of the course, graduate nurses would be skilled in all aspects of premature infant management, including bathing, medicine dropper, bottle, and gavage feeding, proper handling and maintenance of strict asepsis, and the care and cleaning of incubators and other equipment. When nurses stayed for the longer course, they also received instruction on the calculation of individual feedings by

calorie requirement, how to regulate feedings and ensure vitamin intake, and experienced the system of follow-up care at the Station by watching home care provided by the visiting nurse and spending time at the outpatient clinic for premature graduates.[93]

By 1940, as more children's hospitals around the country began to recognize the value of specialized units for premature care, physicians and administrators looked to the Station for guidance as they developed their own plan for handling preterm birth. Lundeen became an ambassador for the Premature Infant Station, visiting hospitals and training nursing staff in the care of incubator babies. For example, in November of 1940, Lundeen spent a week at Children's Hospital in Pittsburg after the institution established a premature baby room. Hailed as a "professional life-saver," Children's Hospital appointed Lundeen to demonstrate the methods of premature care employed by the Premature Infant Station, including pre-hospital management, the use of a portable incubator, the correct method for bathing, dressing, and handling the infants, and proper feeding techniques.[94] The United States Children's Bureau even selected Lundeen to administer a six-week premature course to the department's regional supervisors.[95] Through these courses, the message presented remained clear, that the role of the skilled nurse was of utmost importance in the successful care of premature infants.

Partnering With The Chicago Board of Health

By 1932, the need for quality premature infant care in the city of Chicago had outpaced current availability. Despite greater capacity, the Premature Infant

Station, which now admitted up to 35 infants, and a separate, slightly larger premature station at Cook County Hospital could no longer provide care to all newborn infants in need of treatment. The city had recently reelected Herman Bundesen, MD as Health Commissioner of Chicago, whose record of service pointed toward strong campaigns aimed at reducing maternal and child mortality. After reviewing neonatal mortality statistics across the city of Chicago, which indicated the number of infant deaths occurring within the first month of life, Bundesen recognized that prematurity alone accounted for a significant percentage of these preventable deaths. Bundesen decided to focus the efforts of the Department of Health on reducing the impact of prematurity on neonatal deaths across the city, a cause of "tremendous importance… especially for small premature infants, whose tragic and untimely deaths were in vain."[96] In 1934, the Board of Health partnered with the Premature Infant Station at Sarah Morris Hospital and the premature unit at Cook County Hospital to launch a citywide plan for the care of premature babies.

The comprehensive Chicago plan outlined key principles deemed necessary for the successful operation of a hospital nursery for both full-term and premature infants, based largely on the system of care in place at the Station. These standards were distributed to all hospitals delivering maternity services across the city, followed by three surveys by Health Department staff at each nursery between February 1935 and July of 1936 to determine if the unit was meeting expectation.[97] Premature stations needed to have some type of heated bed or incubator available, as well as equipment to provide oxygen therapy and emergency management when needed. Only trained personnel, both physicians and nurses, could supervise and

undertake the care of premature infants, and for every shift, the staffing ratio would follow a recommendation of one graduate nurse for every two to four infants.[98] The plan also endorsed breast milk feeding exclusively for preterm infants, and promoted the development of follow-up care clinics associated with the Health Department to monitor infant graduates and conduct research on the outcomes of the plan.

To support these goals, the Health Department invested a significant amount of money and labor in the citywide plan. Municipal funds were used to purchase extra equipment, such as portable incubators and small oxygen tanks, which could be loaned to hospitals and homes for short periods of time. The Board of Health also established a breast milk station to provide premature units or individual families with mother's milk free of charge. Providers across the city were required to notify the department by telephone of every premature delivery within the first hour after birth, regardless of where the birth took place, and had to notify the department in writing within the first 24 hours. If the delivering physician or midwife requested immediate medical assistance for the baby, an alarm system at the Board of Health, similar to those used by fire departments, would signal the need for transportation to the graduate nurse on duty, who had been trained by Lundeen at the Premature Infant Station.[99] A newly acquired Health Department ambulance, equipped with a portable incubator and oxygen tanks, would then be dispatched to bring the sick infant to one of the premature stations with an open bed.

In its first fifteen years, the new standards set by Chicago's citywide plan proved successful at reducing child deaths within the first month and year of life.

The neonatal mortality rate decreased from 27.5 deaths per 1,000 live births in 1935 to 19.4 deaths per 1,000 in 1950, a reduction of nearly 30 percent. Infant mortality dropped from 40.1 deaths per 1,000 live births in 1935 to a rate of 25.7 deaths per 1,000 in 1950, a decrease of nearly 36 percent.[100] Bundeson, Hess, and other physicians associated with the Chicago Health Department published research outcomes from the plan in medical journals, promoting the adoption of a similar system in other cities across the nation. In addition, Bundeson utilized many forms of mass media to publicize his message to the general public, authoring a syndicated health column for newspapers and popular magazines and frequently appearing on radio broadcasts.[101] The increased publicity worked, and a number of health departments across the country, starting with Boston and New York City, began to establish similar models for premature infant care as early as 1937.

National Change as an Indicator of Success

In 1951, Leona Baumgartner, MD, a pediatrician who had served as Director of Public Health Training, Director of the Bureau of Child Health, and was currently serving as Assistant Commissioner of Maternal and Child Health Services in Washington D.C., called for a national plan aimed at reducing premature infant mortality. Commending the work of the Children's Bureau in combatting and reducing infant mortality rates, which decreased from 100 deaths per 1,000 live births in 1915 to just 31 deaths per 1,000 in 1949, Baumgartner now stressed that "the problem of prematurity presents the same sort of challenge that infant mortality did 35 years ago."[102] Indeed, while the overall national infant mortality

rate had been drastically reduced as a result of improvements in sanitary conditions, milk pasteurization, and better medical practice, national neonatal mortality rates had not decreased as dramatically during the same time frame. By 1949, the 21 neonatal deaths per 1,000 live births accounted for roughly two-thirds of all infant deaths, suggesting prematurity as a significant factor in the contemporary infant mortality rate.[103]

Medical and public interest in prematurity had finally reached a critical level, and a number of states began to invest in developing coordinated systems of care for handling premature birth, largely modeled after the city and state-wide plan that developed first in Chicago and then spread throughout Illinois. In the late 1930s and 1940s, children's hospitals in Colorado, Hawaii, Louisiana, Maryland, Massachusetts, New York, North Carolina, Pennsylvania, Tennessee, and West Virginia developed "centers" dedicated to treating this population, using the four tenets promoted at the Premature Infant Station: provide skilled nursing care with the least amount of handling; maintain the infant's body temperature; safeguard against infection; and provide adequate feeding.[104] More comprehensive programs were established in Colorado, Massachusetts, and New York, modeled almost entirely on the Chicago plan, and included statewide coordination of birth registration and notification of premature delivery within one hour of life, pre-hospital care and transportation, as well as a commitment to researching the causes and outcomes of premature birth.

Federal agencies also began to recognize that treating premature infants, while important for improving national health, was expensive and often beyond the

financial ability of individual families or even local governments. Early premature centers estimated total cost of care for premature infants to range from 199 dollars to over 827 dollars per infant, with smaller infants incurring larger costs; data from a Colorado hospital also demonstrated that only one family out of the first 175 premature patients under their care had possessed the financial resources to cover their hospital bill.[105] Local and federal funding sources would be key to the long-term success of any comprehensive program for premature care. Under Title V of the 1935 Social Security Act, which outlined provisions for maternity, infant, and child health, state and local health departments could receive grants-in-aid funding for a number of activities to improve access to and the quality of premature infant care. A range of prematurity-related activities qualified for these funds, and included the specialty training of nurses and physicians, money needed for the loan of incubators, and hospital consultation by premature nursing advisers to develop and improve standards of care for premature babies.[106] With the increased availability of funding, state health departments in thirty-three states and the District of Columbia had reported to the Children's Bureau in 1941 that they had developed or expanded plans for the care of premature infants.[107]

Conclusions

In studies of the history of neonatology, Julius Hess is credited with reviving medical concern for prematurity at a time when public and professional interest had waned in the wake of a rising national eugenic movement and the questionable success of the mechanical incubator. The system of care he established at the

Premature Infant Station, in which trained nurses provided all daily care for patients, was remarkably similar to the one employed by the Infant Incubator Company. However, the message that Hess promoted situated nursing care in a central role, asserting, "The place occupied by the nurse in the care of the premature infant is of major importance."[108] For the first time, a respected physician directing a premature unit had not only recognized trained nurses as a necessary component for reducing mortality, but had given nursing care itself the position of prime importance.

Prior publications within medical journals had focused solely on the design and technical merits of the mechanical incubator, a message that was reinforced to the public and physicians alike at the popular infant-incubator sideshow displays. These representations of premature care left the impression that providing a preterm infant with a warm, sterile environment, which could be easily maintained through the new mechanical incubator, would independently save the lives of these fragile newborns. Unfortunately, as physicians around the country began instituting the "incubator only" model of care and consequently experienced high mortality rates and poor outcomes, professional medical opinion of the incubator turned decidedly negative. Claims of high survival rates for infants in the incubator shows were dismissed without scientific research to support them. Julius Hess recognized that his research would have to conclusively prove not only that the incubator worked in his own premature unit, but also that other physicians could successfully reproduce his model of care. The skilled work by Evelyn Lundeen in reducing the mortality rate at the Station would convince Hess that nursing care alone was the

single most important component of a successful unit for premature infants, and this was the message he preached.

The flexible power structure within the Station proved anomalous given contemporary medical opinion about the role of nursing in patient care. Physicians who trained in the Station recognized that this was most likely a reflection of the unique collaborative relationship between Hess and Lundeen, who may not have found as much success independently. As William Oh, MD remarked, "[Hess] wouldn't have been successful without Evelyn Lundeen. It's a mutual thing. I don't think Evelyn Lundeen would have been successful without Hess on her side. The two made a good team."[109] Together they would revolutionize medical understanding of the premature infant nursery, and their conservative system of care, which advocated strict asepsis and minimal handling, would become the model upon which the first modern neonatal units were based.

[1] Julius H. Hess and Evelyn C. Lundeen, *The Premature Infant: Its Medical and*

[2] Pierre Budin, *The Nursling: The Feeding and Hygiene of Premature and Full-Term Infants*, translated by William Maloney (London: Caxton Publishing, 1907): 4.

[3] Peter M. Dunn, "Julius Hess, MD, (1876-1955) and the Premature Infant," *Archives of Diseases in Childhood, Fetal and Neonatal Edition, 85*(2001): F141-F144; "The Spirit of '76: The Story of a Pioneer, Julius H. Hess," Northwestern Medical School Newsletter, January 23, 1952. Courtesy Hess, Julius Hays. Papers, Crerar Ms 51, [Box 1, Folder 10], Special Collections Research Center, University of Chicago Library.

[4] Alwin C. Rambar, "Julius Hess, M.D." in *Historical Review and Recent Advances in Neonatal and Perinatal Medicine*, eds George F. Smith and Dharmapuri Vidyasayar (Glenview: Mead Johnson Nutritional Division, 1980): 373-376.

[5] Ibid., 374.

[6]Dunn, "Julius Hess, MD, (1876-1955) and the Premature Infant," F141; "The Spirit of '76: The Story of a Pioneer, Julius H. Hess," Northwestern Medical School Newsletter, January 23, 1952. Courtesy Hess, Julius Hays. Papers, Crerar Ms 51, [Box 1, Folder 10], Special Collections Research Center, University of Chicago Library.

[7] Rambar, "Julius Hess, M.D.," 373.

[8] *All Our Lives: A Centennial History of Michael Reese Hospital 1881-1981* (Chicago: Michael Reese Hospital and Medical Center, 1981), ed. Sarah Gordon: 3.

[9] "The New Michael Reese Hospital," *Westen und Daheim*, June 16, 1907, as cited in Gordon, *All Our Lives*, 75.

[10] Gordon, 74.

[11] Isaac Arthur Abt, *Baby Doctor* (New York: Whittlesey House, McGraw-Hill Book Company, 1944): 141. See also Gordon, *All Our Lives*, 87.

[12] Abt, *Baby Doctor*, 141-142.

[13] As quoted in Gordon, *All Our Lives*, 40.

[14] Isabel A. Hampton, "Educational Standards for Nurses" in *Nursing of the Sick 1893* (New York: McGraw-Hill, 1949), 10.

[15] As cited in Gordon, *All Our Lives*, 41.

[16] Ibid., 43. The page displays an application form from the Michael Reese Training School, asking about height and weight, marital status, church affiliation, and children or other domestic responsibilities. See also The 8th Annual Report of the Illinois Training School for Nurses, 1888-1889," 24, courtesy The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions; Philip A. Kalisch and Beatrice J. Kalisch, *American Nursing: A History* (Philadelphia: Lippincott Williams & Wilkins, 2004): 71.

[17] Ibid., 40.

[18] Ibid., 43.

[19] Kalisch and Kalisch, *American* Nursing, 117; Cynthia A. Connolly, "Hampton, Nutting, and Rival Gospels at The Johns Hopkins Hospital and Training School for Nurses, 1889-1906*," Image: Journal of Nursing Scholarship* 30 (1998): 24.

[20] Isabel Hampton, "Aims of the Johns Hopkins Training School for Nurses," *The Johns Hopkins Hospital Bulletin* 1 *(*1889): 6.

[21] Gordon, *All Our Lives*, 40-41.

[22] For more detail on the daily life of pupil nurses and the connection between moral character, discipline, and strict obedience utilized by superintendents of early training schools for nurses in the 1800s, see Susan M. Reverby, *Ordered to Care: The Dilemma of American Nursing, 1850-1945* (New York: Cambridge University Press, 1987): 39-59; and Patricia D'Antonio, *American Nursing: A History of Knowledge, Authority, and the Meaning of Work* (Baltimore: The Johns Hopkins University Press, 2010): 28-53.

[23] Lavinia Dock, "The Relation of Training Schools to Hospitals," in *Nursing of the Sick 1893* (New York: McGraw-Hill, 1949): 16.

[24] Julius H. Hess, "Chicago Plan for Care of Premature Infants," *Journal of the American Medical Association* 146 (1951): 891. There are conflicting stories about the origin of Hess' interest in premature infants and its relation to Martin Couney. In a Chicago Medical Society obituary for Julius Hess, Morris Fishbein, M.D. asserted that the curiosity began when Hess was appointed by the Chicago Medical Society to help supervise Martin Couney's infant incubator exhibit at Chicago's White City Amusement Park, see L. Joseph Butterfield, "The Incubator Doctor In Denver: A Medical Missing Link," in *The 1970 Denver Westerners Board Book*, ed Jackson C. Thode (Denver: The Westerners, 1971): 358. This and most other stories, while conflicting over details, corroborate the timing of their meeting to be around 1914, see William Silverman, "Incubator-Baby Side Shows," *Pediatrics* 64 (1979): 136; Lawrence Gartner and Carol Gartner "The Care of Premature Infants: Historical Perspective," in *Neonatal Intensive Care: A History of Excellence*, NIH Publication No. 92-2786, October 1992 and Jeffrey P. Baker, *The Machine in the Nursery* (Baltimore:

The Johns Hopkins University Press, 1996): 104. Research for this study has uncovered evidence from a local Chicago newspaper suggesting that Couney's run in White City most likely occurred between 1905 and 1912, see "Incubators Save Baby's Life," *Chicago Daily Tribune*, June 30, 1905, 9; "Babies' Friends Fill White City," *Chicago Daily Tribune*, August 8, 1906, 3; "White City Astir to Succor Babies," *Chicago Daily Tribune*, July 29, 1907; "Go to White City Today; Aid Babies," *Chicago Daily Tribune*, August 7, 1907, 4; "Prize Incubator Baby of the World," *Chicago Daily Tribune*, September 12, 1909, G2. These dates are more consistent with Hess' publication history, see Julius H. Hess, "A Study of the Caloric Needs of Premature Infants," *American Journal of the Diseases of Children* 2 (1911): 302-314.

[25] "Transcript of Testimonial Dinner to Honor Julius H. Hess, January 23, 1952," 21. Courtesy Hess, Julius Hays. Papers, Crerar Ms 51, [Box 1, Folder 10], Special Collections Research Center, University of Chicago Library.

[26] Baker, *The Machine in the Nursery*, 169. Baker connects Hess and Joseph DeLee, two early leaders in premature infant care, through their shared Jewish faith, arguing that experiences of religious discrimination during the socially volatile early twentieth century may have motivated both physicians to independently turn toward a patient population outside mainstream medical attention.

[27] Julius Hess, "A Study of the Caloric Needs of Premature Infants," *American Journal of Diseases of Children* 2 (1911): 302-314.

[28] Julius Hess, "An Electric-Heated Water-Jacketed Infant Incubator and Bed," *Journal of the American Medical Association* 64 (1915): 1068-1069; See also U.S.

Patent Number 1176555 A, "Water-Jacketed Bed," filed May 3, 1915 by Julius H. Hess.

[29] "Diploma of Honorable Mention for Dr. Julius Hess at the Panama Pacific International Exposition," courtesy Hess, Julius Hays. Papers, Crerar Ms 51, [Box 16, Folder 1], Special Collections Research Center, University of Chicago Library. The certificate states, "The United States of America Panama-Pacific International Exhibition, San Francisco, MCMXV Celebrating the Opening of the Panama Canal the International Jury of Awards has Conferred a Diploma of Honorable Mention Upon Dr. Julius Hess, Chicago, Illinois, as Collaborator in the Exhibit of the Infant Incubator Company."

[30] Julius Hess, *Premature and Congenitally Diseased Infants* (Philadelphia: Lea & Febinger, 1922): v.

[31] Ibid., 131.

[32] Ibid., 146-159.

[33] Ibid., 146 and 168.

[34] Ibid., 146.

[35] Hess, "An Electric-Heated Water-Jacketed Infant Incubator and Bed," 1068-1069.

[36] Julius H. Hess, "Chicago Plan for Care of Premature Infants," *Journal of the American Medical Association, 146*(1951): 891.

[37] Few details are known about the history of the Infant's Aid Society or the connection between Hortense Schoen Joseph, Julius Hess and their dedication to premature infants, although Jeffrey Baker hints at a possible friendship between the Joseph and Hess families as explanation. Exact numbers for the initial pledged

endowment to the Premature Infant Station are quoted as either sixty-five thousand or eighty-five thousand dollars in multiple primary sources. See Natalie P. Solway, "The Story of the Infant's Aid Society," in *Care of the Premature Infant*, ed. Evelyn C. Lundeen and Ralph H. Kundstadter. (Philadelphia: J.B. Lippincott, 1958): 306-309; Evelyn C. Lundeen, "History of the Hortense Schoen Joseph Premature Station," *The Voice of the Clinic* 2 (1937): 8-11; Julius H. Hess, George J. Mohr, and Phyllis Bartelme, *The Physical and Mental Growth of Prematurely Born Children* (Chicago: University of Chicago Press, 1934): ix.

[38] Hess, Mohr, and Bartelme, *The Physical and Mental Growth of Prematurely Born Children*, ix.

[39] Ibid., 4.

[40] Ibid.

[41] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8.

[42] Nancy J. MacMullin and Mary C. Bruckner, "Evelyn Lundeen: Perinatal Pioneer," *Neonatal Network, 4*(1986): 20.

[43] Evelyn C. Lundeen, "Private Duty and the Incurable Case," *The American Journal of Nursing, 24*(1924): 804.

[44] Ibid.

[45] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8.

[46] Hess, Mohr, and Bartelme, *The Physical and Mental Growth of Prematurely Born Children*, 4.

[47] Ibid.

[48] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8.

[49] Hess, Mohr, and Bartelme, *The Physical and Mental Growth of Prematurely Born Children*, 4; Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8.

[50] Julius Hess, "Prevention and Control of Infections," *American Journal of Diseases of Children, 73*(1947): 696-705.

[51] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8.

[52] Hess and Lundeen, *The Premature Infant*, 58.

[53] Ibid., 79-82 and 170-171.

[54] Ibid., 81. Lundeen recommended having written physician orders in hand for treatment of cyanosis and apnea whenever possible.

[55] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 8.

[56] Hess and Lundeen, *The Premature Infant*, 69 and 82.

[57] Evelyn Lundeen, "Safe Hospital Care for the Premature Baby," *Hospitals* 14 (1936): 111.

[58] Evelyn Lundeen, "Feeding the Premature Baby," *The American Journal of Nursing, 39*(1939): 600.

[59] Ibid., 596-604.

[60] This exact sentence is cited numerous times in publications by both Hess and Lundeen when describing aseptic practices at the Premature Infant Station. See Lundeen, "Safe Hospital Care for the Premature Baby," 112; Hess and Lundeen, *The Premature Infant*, 50; Hess, "Prevention and Control of Infections," 702; and Evelyn Lundeen, "Prematures Present Special Problems: Basic Factors in Nursing Care," *Modern Hospital* 82 (1954): 61.

[61] Hess and Lundeen, *The Premature Infant*, 52.

[62] Lundeen, "Safe Hospital Care of the Premature Baby," 112.

[63] Hess and Lundeen, *The Premature Infant*, 53; and Lundeen, "Prematures Present Special Problems," 61.

[64] Ibid., 77 and 114.

[65] Ibid., 48; and Hess, "Prevention and Control of Infections," 699.

[66] "William Oh, M.D. interview by Lawrence M. Gartner, M.D.," October 8, 2008, 8-9. Courtesy the Pediatric History Center of the American Academy of Pediatrics, Oral History Project. Dr. Oh credited Lundeen with inspiring him to become a neonatologist and devote his career to researching extremely low birth weight premature infants.

[67] Hess, "Prevention and Control of Infections," 699.

[68] "William Oh, M.D. interview by Lawrence M. Gartner, M.D.," October 8, 2008, 9.

[69] Lundeen, "Prematures Present Special Problems," 61.

[70] Rambar, "Julius Hess, M.D.," 375.

[71] Hess, Mohr, and Bartelme, *The Physical and Mental Growth of Prematurely Born Children*, 4.

[72] Hess, "Prevention and Control of Infections," 700.

[73] Hess and Lundeen, *The Premature Infant*, 50; Hess, "Prevention and Control of Infections," 700.

[74] Solway, "The Story of the Infant's Aid Society," 308.

[75] Ibid., 308-309.

[76] For trends in United States childbirth practices, see Judith Walzer Leavitt, *Brought to Bed: Childbearing in America, 1750-1950* (New York: Oxford University Press, 1986).

[77] Jean Komaiko, "Her baby was a premature," *Chicago Tribune*, September 5, 1954: 4. The article quotes Mrs. Clarence Flight, mother of JoAnn Flight, a premature infant cared for at the Premature Infant Station.

[78] Hess, Mohr, and Bartelme, *The Physical and Mental Growth of Prematurely Born Children*, 5.

[79] Evelyn C. Lundeen and Ralph H. Kunstadter, *Care of the Premature Infant* (Philadelphia: J.B. Lippincott Company, 1958): x.

[80] Julius Hess, "Heated Bed for Transportation of Premature Infants," *Journal of the American Medical Association* 80 (1923): 1313. For operating instructions of the Hess Baby Ambulance, see Hess and Lundeen, *The Premature Infant*, 273-274.

[81] Hess and Lundeen, *The Premature Infant*, 86.

[82] Ibid., 85.

[83] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 9.

[84] Ibid., 9. See also Hess, Mohr, and Bartelme, *The Physical and Mental Growth of Prematurely Born Children*, x. The authors thank Ms. Stannard for her role in assisting regular attendance of infant graduates to the follow up premature clinic.

[85] Hess and Lundeen, *The Premature Infant*, 97-98.

[86] Hess, *Premature and Congenitally Diseased Infants*, iii.

[87] See Hess, Mohr, and Bartelme, *The Physical and Mental Growth of Prematurely Born Children*. The text presents extensive longitudinal research into the physical

growth and mental development of formerly preterm graduates of the Premature Infant Station. Researchers used results from both standardized groups and sibling cohorts to examine differences between "normal" children and those born prematurely.

[88] Publications by Hess discussing premature infant care after 1928 all listed the role of the supervising nurse and her staff as the most important factor in increasing survival rates. See Hess and Lundeen, *The Premature Infant*; Hess, "Prevention and Control of Infections," 700; and Julius Hess, "Chicago Plan for Care of Premature Infants," *Journal of the American Medical Association, 146*(1951): 891-893.

[89] Lundeen, "Safe Hospital Care of the Premature Baby," 110-115; Evelyn C. Lundeen, "The Premature Infant at Home," *The American Journal of Nursing* 37 (1937): 466-470; and Evelyn C. Lundeen, "Feeding the Premature Baby," *The American Journal of Nursing* 39 (1939): 596-604.

[90] Ibid.; See also Evelyn Lundeen, "Prematures Present Special Problems: Basic Factors in Nursing Care," *Modern Hospital* 82 (1954): 60-65; and Evelyn C. Lundeen, "Newer Trends in the Care of Premature Infants," *Nursing World* 133 (1959): 9-11.

[91] Lundeen, "History of the Hortense Schoen Joseph Premature Station," 10.

[92] "Suggested Teaching Outline for Class on Nursing of Premature Infants," 1-2. Courtesy Hess, Julius Hays. Papers, Crerar Ms 51, [Box 6, Folder 8], Special Collections Research Center, University of Chicago Library.

[93] Ibid.

[94] "Professional Life Saver Visits Children's Hospital: Chicago Expert Demonstrates Care Which has Helped to Save Lives of Numerous Premature Infants," *The Pittsburg Press*, November 10, 1940: 35.

[95] "Obituary: Miss Lundeen, Infant Nurse Expert Dies," *Chicago Tribune*, January 30, 1963.

[96] Herman N. Bundesen, Edith L. Potter, William I. Fishbein, Frank C. Bauer, and Gertrude V. Plotzke, *Progress in the Prevention of Needless Neonatal Deaths* (Chicago: Report of the Chicago Health Department, 1951): 1.

[97] Ibid. See also Gerald Oppenheimer, "Prematurity as a Public Health Problem: U.S. Policy from the 1920s to the 1960s," *American Journal of Public Health* 86 (1996): 873.

[98] Julius Hess, "Chicago Plan for Care of Premature Infants," *Journal of the American Medical Association* 146 (1951): 892; and Bundesen, Potter, Fishbein, Bauer, and Plotzke, *Progress in the Prevention of Needless Neonatal Deaths*, 134 and 153-154.

[99] Alarm system referenced in Joan Beck, "Medical Science and Speed Save Premature Babies' Lives," *Chicago Tribune*, September 10, 1951:3. Details about the citywide notification system and Board of Health transportation ambulance in Hess, "Chicago Plan for Care of Premature Infants,"891-892; Lundeen, "History of the Hortense Schoen Joseph Premature Station," 9; L. Joseph Butterfield, "Historical Perspectives of Neonatal Transport," *Pediatric Clinics of North America* 40 (1993): 232-233; and Oppenheimer, "Prematurity as a Public Health Problem," 873.

[100] Bundesen, Potter, Fishbein, Bauer, and Plotzke, *Progress in the Prevention of Needless Neonatal Deaths*, 231.

[101] Popular press articles by or about Bundesen include Herman Bundesen, "What to Do in Case the Baby is Prematurely Born," *Ladies' Home Journal, 57*(November, 1940): 94; "The Nation," *Newsweek*, April 25, 1936: 11; and Paul De Kruif, "Chicago's Rough and Tumble Death Fighter," *Reader's Digest, 52* (1948): 73. The frequency of Bundesen's radio appearances, which are estimated to have reached 425 talks in 1933 alone, are referenced in Oppenheimer, "Prematurity as a Public Health Problem," 873.

[102] Leona Baumgartner, "Nation-Wide Plan for Reduction of Premature Mortality," *Journal of the American Medical Association, 146* (1951): 893.

[103] Infant and neonatal mortality statistics from the National Center for Health Statistics, *Vital Statistics of the United States, 1985, Vol. 2, Mortality* (Washington, D.C.: Government Printing Office, 1988): part A, section 2, p.1. Infant mortality rate is the number of deaths within the first year per 1,000 live births; neonatal morality rate is the number of deaths within the first 28 days of life per 1,000 live births. In Baumgartner's 1951 *JAMA* article, she claims that premature birth is the leading cause of infant death, and that the numbers are "sufficiently large" to make prematurity the eighth leading cause of death in the country. See Baumgartner, "Nation-Wide Plan for Reduction of Premature Mortality," 893.

[104] Hess and Lundeen, *The Premature Infant*; Lundeen, "Safe Hospital Care for the Premature Baby," 111-114. See also Baumgartner, "Nation-Wide Plan for Reduction of Premature Mortality," 895; Florence McKay, "Massachusetts State Program for the Care of Prematures," *American Journal of Public Health* 31 (1941): 72-78; and

H.R. O'Brien and Marion I. Murphy, "A County Program for the Care of Prematures," *American Journal of Public Health* 31 (1941): 46.

[105] Baumgartner, "Nation-Wide Plan for Reduction of Premature Mortality," 895.

[106] Ibid., 894.

[107] *Maternal and Child-Health Services under the Social Security Act, Development of Program, Title V, Part 1, 1936-1939, publication number 259* (Washington, D.C.: Children's Bureau, 1941): 44-45. See also Baumgartner, "Nation-Wide Plan for Reduction of Premature Mortality," 895; and Gerald Oppenheimer, "Prematurity as a Public Health Problem: U.S. Policy from the 1920s to the 1960s," *American Journal of Public Health* 86 (1996): 873.

[108] Hess and Lundeen, *The Premature Infant*, 48 and Hess, "Prevention and Control of Infections," 699.

[109] "William Oh, M.D. interview by Lawrence M. Gartner, M.D.," 54-55.

Chapter 5: Conclusions

To date, the narrative of the early history of premature infant care in the United States has focused mainly on the mechanical incubator, with previous research using a predominantly sociocultural framework to explain the nonlinear trajectory of medical acceptance of the new technology. These accounts largely feature the efforts and actions of physicians as they react to specific and often conflicting contextual forces, using cultural phenomena like the rising social value of children, the eugenics movement, and increasing specialization within the medical profession to account for the complex process of technology diffusion for a device that has become so central to our understanding of neonatal care.[1] Despite the recognition that nurses also participated in early neonatal history, nursing roles and responsibilities, as well an assessment of the impact of their involvement, have thus far been overlooked.

Previous histories on the subject would have us believe that Martin Couney and the infant incubator sideshow phenomenon, while entertaining, had no lasting impact on professional medical opinion, that Julius Hess was the anomalous pediatric voice in favor of advanced care for premature infants who succeeded only when the national context had evolved to match his own enthusiasm, and that nurses were simply along for the ride. The problem with this narrative is that it approaches a level of cultural determinism, and allows no room for an exploration of individual agency in the process of promoting a new technology. By applying a Social Construction of Technology framework to reevaluate the early history of

premature care in the United States, this research uncovered the deliberate actions of early leaders in neonatology as they actively persuaded different audiences to invest in their technology, and in the process revealed the important role nurses played in providing and promoting advanced treatment for preterm babies.

Comparing the Infant Incubator Company and the Premature Infant Station

For both the Infant Incubator Company and the Premature Infant Station, the quality care administered by nursing staff was a key factor for the high survival rates experienced by premature babies in their care. For comparison, Table 3 (Appendix B) lists survival rates for premature infants broken down by birth weight as reported by the Infant Incubator Company and the Premature Infant Station, as well as the predicted survivability rates for a more modern-day NICU based on a retrospective research study.[2] While the Infant Incubator Company experienced lower overall mortality compared to the Premature Infant Station, particularly with infants of smaller birth weight and presumably earlier gestational ages, both institutions saw high survivability, particularly for infants 1,500 grams (3 pounds, 5 ounces) and over. Rates for the infant incubator exhibits could be higher for a number of reasons, including the small sample size available and the potential for the sideshows to have benefitted from a convenience sample of stronger or heartier infants. Since the incubator exhibits received infants hours to days after birth, the time period during which the highest percentage of preterm infants perished, the recorded mortality rates could be skewed lower than those experienced by the Premature Infant Station, which received infants directly after birth or shortly

thereafter. Even though survivability rates for both the Infant Incubator Company and the Premature Infant Station are lower than those for a more modern NICU environment, especially for smaller preterm infants, it is nonetheless remarkable what the nurses were able to provide to infants considering how little was understood about the pathophysiology of prematurity and that treatments were largely supportive or preventive during that time.

Direct comparison of the diagrams of the sociotechnical networks of the Infant Incubator Company (Diagram 1, Appendix B) and the Premature Infant Station (Diagram 2, Appendix B) reveals some important differences. At first glance, the diagram of the Premature Infant Station appears more complex, with a greater number of relevant social groups in the network. While this information is helpful for understanding the range of stakeholders involved in the process of promoting a model of advanced care for premature infants, the total number of groups involved does not solely explain why one network succeeded over another.[3] To better understand the process of persuasion, this analysis focused on the links between the groups, which represent the different methods of communication and the content of the message presented. In both networks, nurses became a powerful tool of persuasion. However, the success of the Premature Infant Station relative to that of the Infant Incubator Company was undoubtedly related to the role of nurses within the network and the way nursing care itself was presented to each of the relevant social groups.

Nurses within the Premature Infant Station held greater professional autonomy, and the system demonstrated a flexible power structure. The

collaborative relationship between Julius Hess and Evelyn Lundeen enabled successful negotiations with different stakeholders to promote their advanced model of premature care. With certain groups, Hess assumed control of communications, whereas Lundeen took the lead with others. Methods of communication also varied depending on the audience, and in this way Hess and Lundeen utilized methods that were perhaps more "professionally appropriate" than those preferred by Martin Couney. They persuaded medical and nursing colleagues through research publications and lectures, by developing a premature care course and using Lundeen as a professional ambassador, and partnering with the Chicago Board of Health to increase local and national awareness. Whatever the method, the predominant message remained consistent: that the key to successful premature care rests with trained and experienced graduate nurses directing an integrated system of complementary treatments.

In contrast, nurses in the Infant Incubator Company held no power and had little agency. Existing simply as an extension of the technology on display, nurses were viewed only as performers or props in the show rather than a vital component of the model of premature care practiced at the exhibit. The overall take home message presented at the infant incubator displays revolved around technology and progress. Popular media and medical journal accounts consistently portrayed the incubator alone as the most important aspect of premature infant care and the only instrument needed to ensure survival. Homecoming celebrations helped generate publicity for the Infant Incubator Company, and became an avenue through which to demonstrate the scientific success of the treatment provided to the premature

infants at the institution. Nursing received little to no recognition for its role in the process, and its impact becomes almost universally ignored, even by patrons witnessing the complex care nurses provided to the infants on display. A profile on Martin Couney in *The New Yorker* at the time of the New York World's Fair made mention of the process of gavage feeding, stating, "it is almost like threading a needle and requires dexterity on the part of the operator."[4] While the article remarks on the skill required to perform the task, ownership of the duty is never attributed to the trained nurses who actually executed the gavage feeds.

The most complex nursing duties, like the specialized techniques used to feed premature infants, became categorized as manual skill rather than a knowledge base unique to nursing science. As nursing scholar Margarete Sandalowski explained, "even when nurses possessed greater knowledge than physicians, this knowledge was either not recognized or minimized, even by nurses themselves."[5] Nurses working in the exhibits made their "performances" appear so effortless that they had unconsciously reinforced the notion that nursing care was simply practical knowledge rather than an intelligent interplay of science and technical proficiency.

As previously discussed, initial enthusiasm for the enclosed mechanical incubator dissolved in the second decade of the twentieth century in the wake of high rates of home births, rising eugenic sentiment, increasing medical specialization, and the poor outcomes experienced in hospitals after using the technology for premature care. Medical historian Jeffrey Baker sees the initial failure in acceptance of the incubator in the United States primarily as a function of the division between obstetricians and pediatricians; more specifically, the different

environments in which they practiced and the timing of the incubator's use by the different specialties.[6] For Baker, the incubator began as a successful obstetric technology because these physicians had immediate access to infants after birth and prevented premature babies from environmental exposure and heat loss. It failed to translate to pediatricians because of their exclusion from newborn nurseries, which meant that the premature infants they encountered in children's hospitals arrived hours to days after birth in unrecoverable conditions. In this interpretation, the context of time and place, rather than the message being presented about premature care, held more influence over the incubator's success.

These contextual forces certainly shaped pediatric perception of the value of incubator technology, since an invention must actually work to be perceived as useful. However, this study argues that part of the failure existed before pediatricians attempted to use the incubator, and occurred as a result of both the method used to promote the technology as well as the content of the message presented. Early publications in American medical journals demonstrate an overwhelming enthusiasm for the promise held by incubator technology. Articles are even supportive of Martin Couney's enterprise, complementing the new mechanical incubator and sterile hospital-like environment where he treated premature infants. However, in both promotions of the incubator, the importance of also including trained nursing staff to care for the premature infants somehow gets lost in translation. Whether by choice or by chance, as written accounts increasingly focused on the device alone as the key to premature infant survival, and with the infant incubator shows continually reinforcing this message, doctors and

hospitals neglected to include the supportive care of specialized, experienced nurses in the application of incubator technology. Results were disastrous, leading to professional disdain for the device and a retreat from premature care in general. It was not until Julius Hess and Evelyn Lundeen began promoting their model of treatment at the Premature Infant Station, which prominently featured skilled nursing within a unified system of care, that hospitals and pediatricians began to rethink their approach to premature birth.

Finally, the economic element of both networks deserves consideration for the ways in which financial concerns directed the actions of both the Infant Incubator Company and the Premature Infant Station. Caring for preterm infants was exceedingly expensive, and the solvency of both systems depended upon the ability to secure enough funding to maintain operations. This economic need changed the structure of each network, and demonstrates how system builders must adjust to work within existing cultural constraints. Infant incubator displays originally began because Alexandré Lion needed a consistent funding source to pay for the premature care available in his incubator charities. Incubator sideshows continued for years in the United States, not only so that Martin Couney could finance his enterprise, but also because of growing appreciation for mass entertainment and the lack of laws or standards preventing such displays. The philanthropic support of the Infant's Aid Society for the Premature Infant Station provided an unprecedented level of financial freedom, and facilitated the acquisition of a stable, experienced staff of graduate nurses. By stipulating that their funds could only be used for nursing salaries, the Infant's Aid Society ensured that nurses

would always remain part of the model of care practiced by the Station. Economic forces proved immensely powerful in shaping both networks.

Ethical Analysis of Care at the Incubator Sideshow Exhibits

Nursing literature regarding premature infants in the early 20th century was scarce in general, and as such only one article discussed the issue of infant incubator exhibits. The article begins by reviewing the medical profession's disapproval of incubator shows, but also examines some of the potential advantages they might bring.[7] Aware of the current status of premature infant care, the author highlights the ability of the shows to provide sick infants with a level of care that would otherwise be unavailable, as well as improve the social reputation of premature babies and promote dissemination of improved nursing methods for this population. It is worth noting that the author was the superintendent of the Baby Incubator display at the 1907 Jamestown Exposition, so her assessment may not be altogether objective. However, the discussion of ethical issues surrounding the incubator shows is consistent with the moral reasoning that would come to be desired in the ANA's 1926 suggested Code of Ethics. While the article was published years before the suggested code appeared, it was a concrete example of how individual nurses of the time began moving beyond simple deference to the medical profession and into higher levels of ethical reasoning.

Multiple accounts exist from individuals who either worked at or visited the incubator-baby sideshows expressing a vague sense of ethical disquiet in response to the exhibit. A physician recalled meeting with Couney at the *Century of Progress*

Exposition in 1934 as a young resident from the University of Chicago clinics, and coming away feeling both impressed and uneasy, believing "there was something unethical about the whole show."[8] Evelyn Lundeen, known for being an independent thinker and strong advocate for nurses, commended the care provided by Madame Recht and her nurses at the fair, but remarked that she was "most happy to return to Michael Reese Hospital" where she could practice in a "more normal manner."[9] Thomas Givan, MD, who acted as a consultant to Couney during the 1939 World's Fair in New York recalled that both he and Julius Hess had "concluded that he [Couney] carried on a legitimate undertaking," despite a number of unconfirmed rumors to the contrary.[10]

Even considering these accounts, evidence exists to support the claim that the nursing staff at the Infant Incubator exhibits provided both ethically appropriate and excellent infant care in spite of the somewhat auspicious surroundings. While an official code of ethics for nurses had not yet been established, discussions of ethical nursing practice in training schools and nursing literature had occurred since the beginning of the 20th century. A necessary part of maintaining ethical standards was providing the patient with the best possible care; at the incubator shows, premature infants were often receiving care superior to what they may have had access to elsewhere. Nurses within the exhibit paid strict attention to cleanliness and aseptic technique, and much of their efforts went into the intricate feeding process for the babies.[11] Since many premature infants did not have the energy or ability to successfully breastfeed, the nurses were skilled in a number of techniques, including gavage and nasal feeding, that ensured the babies received the

nutrition they needed for survival.[12] Even photographs of Martin Couney holding infants in his many incubator shows contrast sharply with the pictures showing his nurses holding babies. In each picture of Couney with a baby, he holds the infant away from his body in a position that best displays them to others, supporting his role as showman (Figures 26-27, Appendix A). His nurses, however, often cradle them in their arms, conveying a much more protective appearance, reinforcing their role as guardian (Figures 24-25, Appendix A).[13]

That all the nurses working the incubator shows were white deserves mentioning, as the visual imagery of white nurses caring for nonwhite premature infants may have had unanticipated cultural implications. Anthropological exhibits along the Midway of American world's fairs, many of which were sponsored by leading scientists at the Smithsonian Institution, gave cultural legitimacy to the racist and imperialist worldview endorsed by wealthy white sponsors of the expositions.[14] These exhibits frequently presented a view of white cultural sophistication in relation to the savage or primitive nature of nonwhite civilizations. Continually situated within this environment on the Midway, the infant incubator exhibits may have also reinforced ideas of a racial hierarchy, watching an all-white staff of nurses and physicians "saving" nonwhite infants through scientific and technological means.

Nurse historian Julia Hallam has also argued that the development of visual technologies, such as printing and photography, created a venue for projecting the social and moral respectability of white femininity and reinforcing racial and class hierarchies.[15] The image of the post-Nightingale nurse, a white woman freed from

the responsibilities of social class, curing the uncivilized, nonwhite patient through the diffusion of values such as cleanliness and discipline, represented the ability of good nursing care to alleviate both physical and moral deficiency. Reminiscent of other child-focused philanthropic endeavors of upper class women during Progressive Era, the image of the attractive white nurse in the infant incubator display saving the lives of nonwhite infants symbolized the potential for moral elevation of these babies through the transmission of middle-class norms and values by way of proper nursing care.

The issue of potential exploitation must also be addressed, as the motivation behind the establishment and continuation of infant incubator shows appears contradictory at times with respect to Martin Couney's explanations versus his actions. Throughout his career, Couney repeatedly asserted that his goal was to provide and promote advanced care for premature infants, and that once more medical centers began opening premature units, he would have "made enough propaganda for preemies."[16] Admission fees from patrons covered the cost of care, but also enabled Couney to live in "substantial if not glittering style" while only working a few months out of the year.[17] Had his motives been purely altruistic, perhaps Couney would have made his services available to premature infants year-round, or demonstrated greater concern for babies before their arrival to his institutions or after their return home to family members. Instead, the Infant Incubator Company may have benefitted from a relative selection bias with respect to the prematures in his institutions, since the infants on display often came to the exhibit hours or days after birth, the time frame during which most premature

infants perish.[18] Additionally, Couney showed no interest for his infant graduates beyond their ability to participate in future Homecoming celebrations, and in fact, complained about the difficulties he sometimes experienced with reluctant parents who delayed their infant's discharge from the exhibit. Boasting that he had "never been stuck with one," Couney described how he would simply drop an infant graduate back home and leave it, "since a normal size baby [was] useless for exhibition purposes."[19] Finally, Couney eventually closed his exhibit at Coney Island in 1943, several years after New York instituted a widespread increase in hospital-based premature infant units. The closure occurred when the enterprise no longer turned a profit, and not necessarily when access to advanced premature services had drastically improved.

To counter the exploitation argument, the babies on display at the incubator exhibits not only received a superior level of care at no cost, but the sideshows also provided a platform through which to educate audiences on the social value of decreasing premature infant mortality. A small body of literature has suggested that through participation in displays at world's fairs and expositions, groups with relatively little authority or social power had an opportunity to challenge their associated cultural stereotypes.[20] In this respect, the live displays of premature infants growing and thriving inside the exhibit and the annual Homecoming celebrations featuring normal and healthy formerly premature graduates challenged eugenic notions of the futility of providing care to "weaklings." Participation in the incubator sideshows gave a vulnerable, powerless, and voiceless population the chance to transform public opinion.

Ethics and Technology in Modern Neonatal Intensive Care

As the use of technology within premature infant care has improved and become more pervasive, the ethical issues faced by care providers have subsequently become more complex. Every dramatic improvement in survivability within the history of neonatal care has resulted from breakthrough technological advances, and neonatal intensive care units (NICUs) currently enjoy remarkably low mortality rates for infants born at earlier gestational ages.[21] The current sociocultural context in American healthcare supports the application of more expensive and complex technologies to improve infant mortality. As pediatrician and medical ethicist John D. Lantos, M.D. remarked, "The political and economic arrangements in which we live have as much effect, if not more, on the health of children (and adults) as do the particular clinical interventions we undertake."[22]

The economic structure of our healthcare system values intensive care over preventive care because of the individualized return on investment. NICUs have become essential to the economic sustainability of many children's hospitals and academic medical centers, as the length of stay for an average premature patient has dramatically increased while inpatient stays for older children have steadily decreased.[23] The earlier a premature infant is born with respect to gestational age, the higher the likelihood of both a prolonged NICU stay and increased utilization of expensive treatments and services to ensure survival. This structure incentivizes the development and application of newer technology aimed at saving preterm infants at earlier gestational ages. Until scientists discover the root cause of premature birth and take steps to prevent it, neonatal intensive care is the only

logical and currently available means through which we can lower our infant mortality.

Focusing energy and funding toward neonatal technology also validates our society's ethical commitment to the smallest and most vulnerable citizens of our nation. Earnest efforts at reducing neonatal mortality provide a sense of moral superiority regarding the progress made in national attitudes toward premature care since the beginning of the twentieth century. In one respect, applying increasing technology to premature infants has challenged the traditional dehumanizing paradigm in medicine, since innovations in diagnosis and treatment have facilitated survival and made these babies somehow more "human." With each new breakthrough, however, notions about the limits of human viability have changed, and along with it, our understanding of the moral and legal implications related to personhood.

Current discussions on the social value of the infant in the United States now focus on the distinct but related concepts of *personhood*, a social construct, and *viability*, a biological construct. Personhood can be understood as the cultural and legal recognition of the equal and unalienable rights of human beings. Each society determines the social processes involved in turning fetuses and infants into social beings that are recognized and granted a place within the community.[24] Viability is defined as the stage of fetal maturity that ensures a reasonable chance of extrauterine survival and is dependent not only on the biologic capacity of the fetus, but also on the availability of biomedical technology and the quality of local neonatal intensive care providers.[25] To resolve the inherently ambiguous and dynamic

process of determining personhood while maintaining American ideals about individualism, Western biomedicine has linked the timing and conferral of personhood with the determination of viability so that one does not occur without the other.

Gestational age is currently the most widely used marker for determining viability, with 22 to 25 weeks gestation cited as the acceptable range. The designation appears almost arbitrary, and as one obstetrician remarked, "everything changes at 24 weeks at midnight… like *Cinderella*."[26] The fetus now exists in the contested "margins of humanity," straddling a continuously shifting border between human and nonhuman.[27] Attempts at creating objective limits for viability have resulted in the development of legal statutes, as well as the establishment of medical standards and liability. In practice, physicians are actually afforded an extensive amount of individual authority over whether or not to initiate life-saving treatment on a case-by-case basis within the acceptable gestational age range of 22 to 25 weeks, and their motivation to begin resuscitation may have little to do with objective guidelines. Often providers initiate NICU care out of fears of litigation, or in response to a heightened "rescue mentality" from parents, many more of whom are utilizing advanced reproductive technology and have experienced both physical and financial burdens to conceive a baby.[28] This results in increased numbers of infants treated in NICUs with the potential for long-term disability or simply a delayed death, creating more challenging ethical situations for care team members and parents.

While the creation and application of innovative technology has improved overall premature infant survival, a number of these breakthroughs have resulted in unintended and unfortunate consequences for a number of infants throughout the history of neonatology. Early unrestrained administration of oxygen to all premature infants beginning in the 1930s led to an epidemic of retrolental fibroplasia (now referred to as retinopathy of prematurity or ROP) in the 1950s, which caused blindness in approximately 10,000 children.[29] Prophylactic antibiotic trials in the 1950s led to a number of potentially preventable infant deaths due to unknown medication side effects specific to the neonatal population.[30] More recently, improved methods of ventilation, corticosteroids, and surfactant have increased survival for extremely premature infants (gestational age less than 28 weeks), but this same population experiences increased risk for major morbidities, including chronic lung disease, ROP, neurodevelopmental delays, psychiatric issues, and academic problems.[31] Because of these past errors and current issues, discussions of technology use in neonatal medicine are now laden with ethical implications for patients and families. Research has also demonstrated that the challenging ethical situations commonly and repeatedly occurring in the NICU can have profound consequences for providers, nurses in particular.

The increasing complexity of modern NICUs frequently exposes nursing staff to emotionally and morally challenging patient care situations, leaving them to struggle with balancing harm and benefit in a way that provides the best care possible to each individual patient. Often, conflicts arise when different members of the health care team or a patient's family disagree about the best clinical course of

action. The perception of nursing as a moral endeavor, the intimacy of the nurse-patient relationship, and the assumption of an advocate role leave nurses particularly vulnerable to the effects of moral conflict. Moral distress occurs when a nurse feels unable to provide care in a way that is perceived to be morally correct. Although the concept is not new to nursing literature, moral distress has become a pressing concern in healthcare in recent years, as its effects are better understood.

Consequences of nurse moral distress have implications not only for nurses, but also for patients, health care institutions, and society as a whole. On an individual level, a nurse who experiences moral distress not only experiences physical, emotional, and psychosocial pain, but also may suffer a loss of individual moral integrity, the effects of which may irrevocably alter the perception of self.[32] In addition, the individual may continue to experience distress even after the resolution of the morally challenging situation, which is called moral residue. The relationship between moral distress and moral residue with repeated exposure to morally distressing situations has been theorized as the crescendo effect, and highlights a vicious cycle of increasing baseline moral residue over time.[33] Repeated exposures to morally distressing situations leads to a gradual increase in moral residue over time, called the moral residue crescendo. It is theorized that a breaking point occurs somewhere along the crescendo effect trajectory which causes an individual to leave the job or the profession completely.

Patients may end up bearing the burden of nurse coping mechanisms for dealing with moral distress, as nurses may turn to avoidance or maintain emotional distance, lose of the capacity for caring, or become cynical, all of which negatively

affect patient care and may possibly negatively impact patient outcome.[34] On an institutional level, moral distress can increase the cost and decrease the overall quality of nursing care, and may also lead to a decrease in job satisfaction, negatively affecting the work environment.[35] While aspects of the moral distress experience are contextually based, the experience of personal suffering as a result of the inability to provide morally appropriate care is a potentially universal phenomenon for most healthcare workers, adding legitimacy to the claim that the impact of moral distress may be far more profound and widespread than previously believed.

While no research to date has designed or implemented interventions aimed at preventing or reducing moral distress in the NICU, studies have demonstrated that the perceived ethical work environment in which nurses practice, as well as the presence of collaborative physician-nurse relationships, can lessen the incidence or experience of moral distress in providers. The ethical work environment, or ethical climate, of a unit or institution reflects the internalization of core organizational values and provides guidelines for the delivery of patient care. This not only affects the types of barriers to moral action nurses face, but also influences notions of individual empowerment and the perceived value of a nursing perspective in the development of plans of care. Researchers have found an inverse correlation between moral distress and perceptions of ethical climate, meaning the more positive the perception of ethical climate, the lower the level of reported moral distress.[36] A similar relationship has been noted between reported levels of moral distress and other variables, including nurse satisfaction with care quality and

nurse-physician collaboration.[37] These findings highlight the importance of practice environment on the ability of nurses to provide ethically appropriate care to their patients.

Just as nurses need to feel supported and involved in ethical discussions in the NICU environment, so too should the nursing perspective be included in the process of developing and integrating new technologies in a clinical setting. Nurses work in a privileged and unique position within the healthcare environment, situated at the point of negotiation between medical technology and the patient. This position, and the specialized knowledge and skills required to navigate the nursing role, affords an important and powerful perspective. Nurses can most readily communicate intended messages to patients, evaluate outcomes, and receive feedback. How nurses respond to technology can influence the integration process for medical devices, and emphasizes the importance of the user context for interpreting and refining the final product. Historical accounts like this study, which demonstrate the powerful role nurses play in the trajectory of medical technology, provide concrete examples to support the inclusion of a nursing viewpoint in all stages of technology development.

[1] Secondary literature accounts of early neonatal history include Jeffrey P. Baker, *The Machine in the Nursery*. (Baltimore: Johns Hopkins University Press, 1996); Jeffrey P. Baker, "The Incubator and the Medical Discovery of the Premature Infant," *The Journal of Perinatology 5* (2001): 321-328; Thomas P. 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); Elizabeth A. Reedy, "From Weakling to Fighter: Changing the Image of Premature Infants," *Nursing History Review* 11 (2003): 109-127; and William Silverman, "Incubator-Baby Side Shows," *Pediatrics 64* (1979): 127-141.

[2] Survivability data from "Report of outcome data for 1939-1940 New York World's Fair," Martin A. Couney letter to J. Peter Hoguet, October 20th, 1940. Courtesy the New York World's Fair 1939-1940 records, Manuscripts and Archives Division, The New York Public Library, Series I, Box 547, Folder 2; Julius Hess and Evelyn Lundeen, *The Premature Infant* (Philadelphia: J.B. Lippincott Company, 1941): 263; and Elizabeth S. Draper, Bradley Manktelow, David J. Field, and David James, "Prediction of Survival for Preterm Births by Weight and Gestational Age: Retrospective Population Based Study," *British Medical Journal* 319 (1999): 1093-1097.

[3] See W. Bernard Carlson and Michael E. Gorman, "Socio-Technical Graphs and Cognitive Maps: A Response to Latour, Manguin, and Tell," *Social Studies of Science, 22* (1992): 81-91. In this article, Carlson and Gorman argue that the success of a

network rests more on the interactions between the inventor and interested groups, rather than on the total quantity of elements in the system.

[4] A. J. Liebling, "A Patron of the Preemies," *The New Yorker*, June 3, 1939: 22.

[5] Margarete Sandelowski, *Devices and Desires* (Chapel Hill: The University of North Carolina Press, 2000): 64.

[6] See Baker, *The Machine in the Nurser*y and Jeffrey P. Baker, "Technology in the Nursery: Incubators, Ventilators, and the Rescue of Premature Infants," in *Formative Years: Children's Health in the United States 1880-2000*, eds. Alexandra Minna Stern and Howard Markel (Ann Arbor: The University of Michigan Press, 2002): 66-88.

[7] James Walter Smith, "Baby Incubators," *The Strand Magazine 12* (1896): 770-776.

[8] George Waddell, MD letter to William Silverman, MD, November 15, 1979, the Silverman Papers, courtesy the Pediatric History Center at the American Academy of Pediatrics.

[9] Evelyn Lundeen, "History of the Hortense Schoen Joseph Premature Station," *The Voice of the Clinic* 2 (1937): 10; Silverman, "Incubator-Baby Side Shows," 137; Baker, *The Machine in the Nursery*, 173.

[10] Thomas Givan, MD, letter to Lawrence Gartner, MD, January 18, 1971, the Silverman Papers, courtesy the Pediatric History Center at the American Academy of Pediatrics.

[11] Liebling, "A Patron of the Preemies," 23.

[12] Silverman, "Incubator-Baby Side Shows," 139-140.

[13] Photographs of Martin Couney and the nursing staff at many of Couney's incubator shows courtesy the Pediatric History Center at the American Academy of Pediatrics.

[14] See Robert W. Rydell, *All the World's A Fair: Visions of Empire at American International Expositions, 1876-1916* (Chicago: The University of Chicago Press, 1984).

[15] Julia Hallam, *Nursing the Image: Media, Culture and Professional Identity* (London: Routledge, 2000): 11-17.

[16] Liebling, "A Patron of the Preemies," 22-23.

[17] Ibid., 21.

[18] See Silverman, "Incubator-Baby Sideshows," and Baker, *The Machine in the Nursery*. Both authors criticize Couney's high survival rate claims, generally based on the assumption that his exhibits most likely included only the more hearty survivors.

[19] Liebling, "A Patron of the Preemies," 23.

[20] See Lester G. Moses, *Wild West Shows and the Images of American Indians, 1883-1933* (Albuquerque: University of New Mexico Press, 1996) and Mary Frances Cordato, "Representing the Expansion of Woman's Sphere" (PhD diss., New York University, 1989). Both Moses and Cordato argue that through performances and displays at world's fairs, American Indians and women, respectively, were able to push beyond the dominant stereotypes affixed to their social group and educate the public through more accurate representations of their culture and abilities.

[21] Carol Huston, "The Impact of Emerging Technology on Nursing Care: Warp Speed Ahead." *OJIN: The Online Journal of Issues in Nursing 18* (2013), **doi:**10.3912/OJIN.Vol18No02Man01; and Jacqueline M. McGrath, "Developmentally supportive caregiving and technology in the NICU: Isolation or merger of intervention strategies?" *The Journal of Perinatal and Neonatal Nursing* 14, no. 3 (2000): 78-91.

[22] John D. Lantos, "Hooked on Neonatology," *Health Affairs 20* (2001): 238.

[23] Ibid., 235.

[24] Beth A. Conklin and Lynn M. Morgan, "Babies, Bodies and the Production of Personhood in North American and Native Amazonian Society," *Ethos 24* (1996): 657-694.

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[37] Ann B. Hamric and Leslie J. Blackhall, "Nurse-Physician Perspectives on the Care of Dying Patients in Intensive Care Units: Collaboration, Moral Distress, and Ethical Climate," *Critical Care Medicine 35* (2007): 422-429.

Appendix A: Figures and Photographs

Figure 1. Warming tub with double walls, first used in 1857 by Denucé.
Source: Julius Hess, *Premature and Congenitally Diseased Infants*, (Philadelphia: Lea & Febinger, 1922), 206.

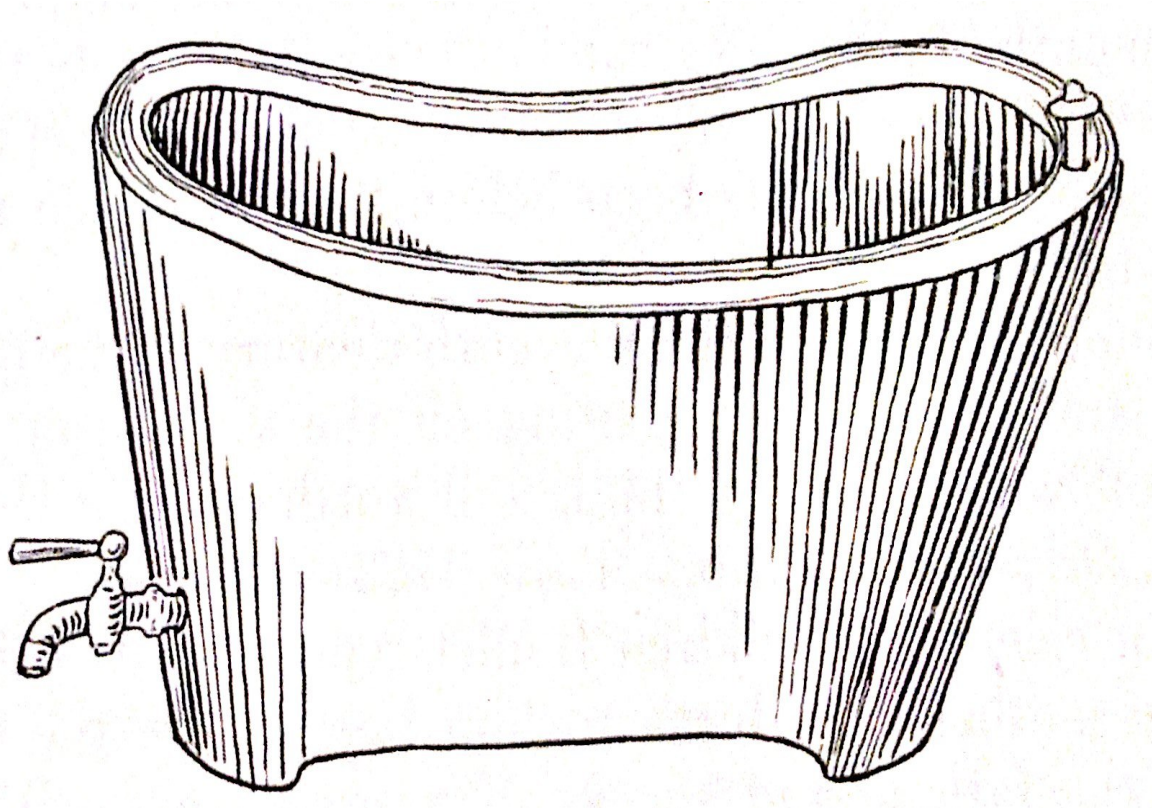


Figure 2. Credé's *Wärmwanne*.
Source: Thomas P. Cone, *History of the Care and Feeding of the Premature Infant*. (Boston: Little, Brown and Company, 1985), 24.

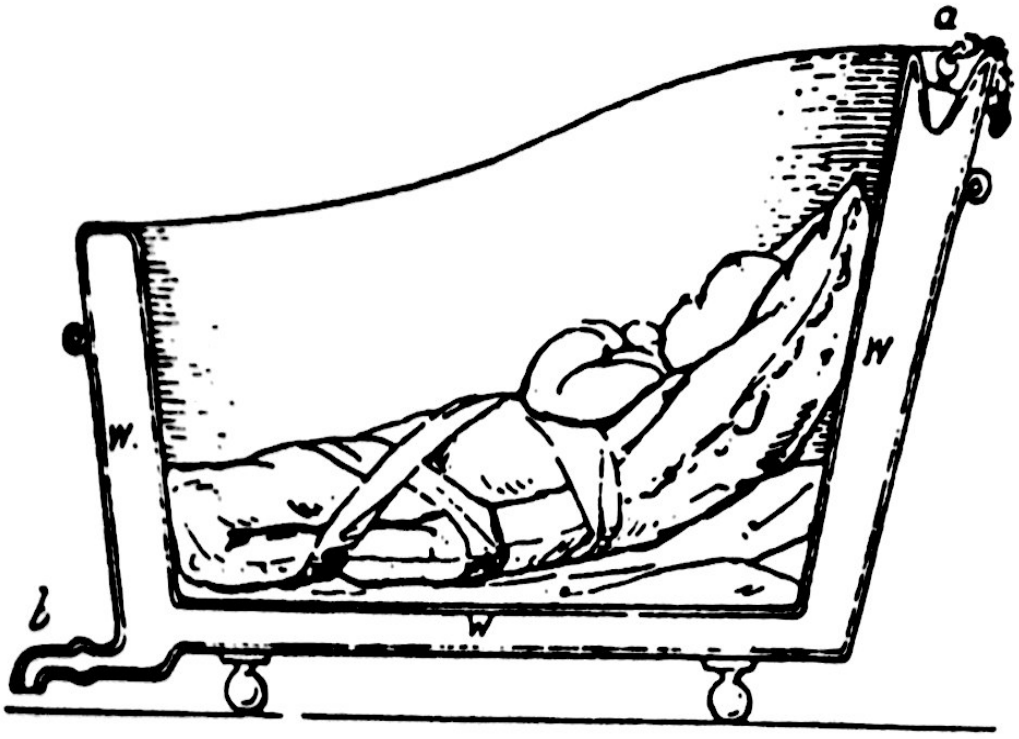


Figure 3. Tarnier's enclosed incubator, 1880.
Source: Alfred Auvard, "The Incubator for Infants," *Archives de Tocologie*, 10, 1883:577.

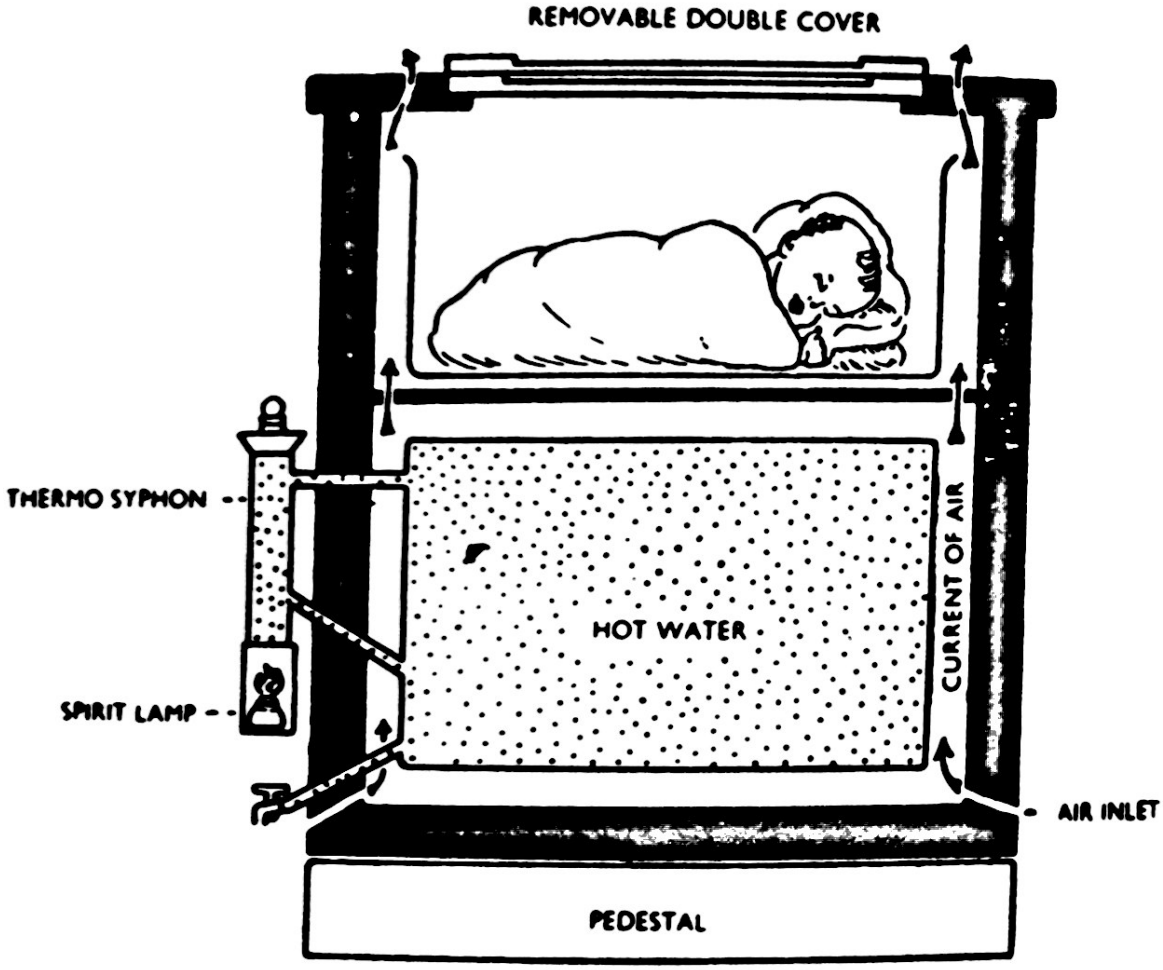


Figure 4. Tarnier-Auvard Incubator, cross section, 1883.
Source: Pierre Budin, *The Nursling: The Feeding and Hygiene of Premature and Full-Term Infants*, trans. William J. Maloney (London: Caxton Publishing, 1907), 11.

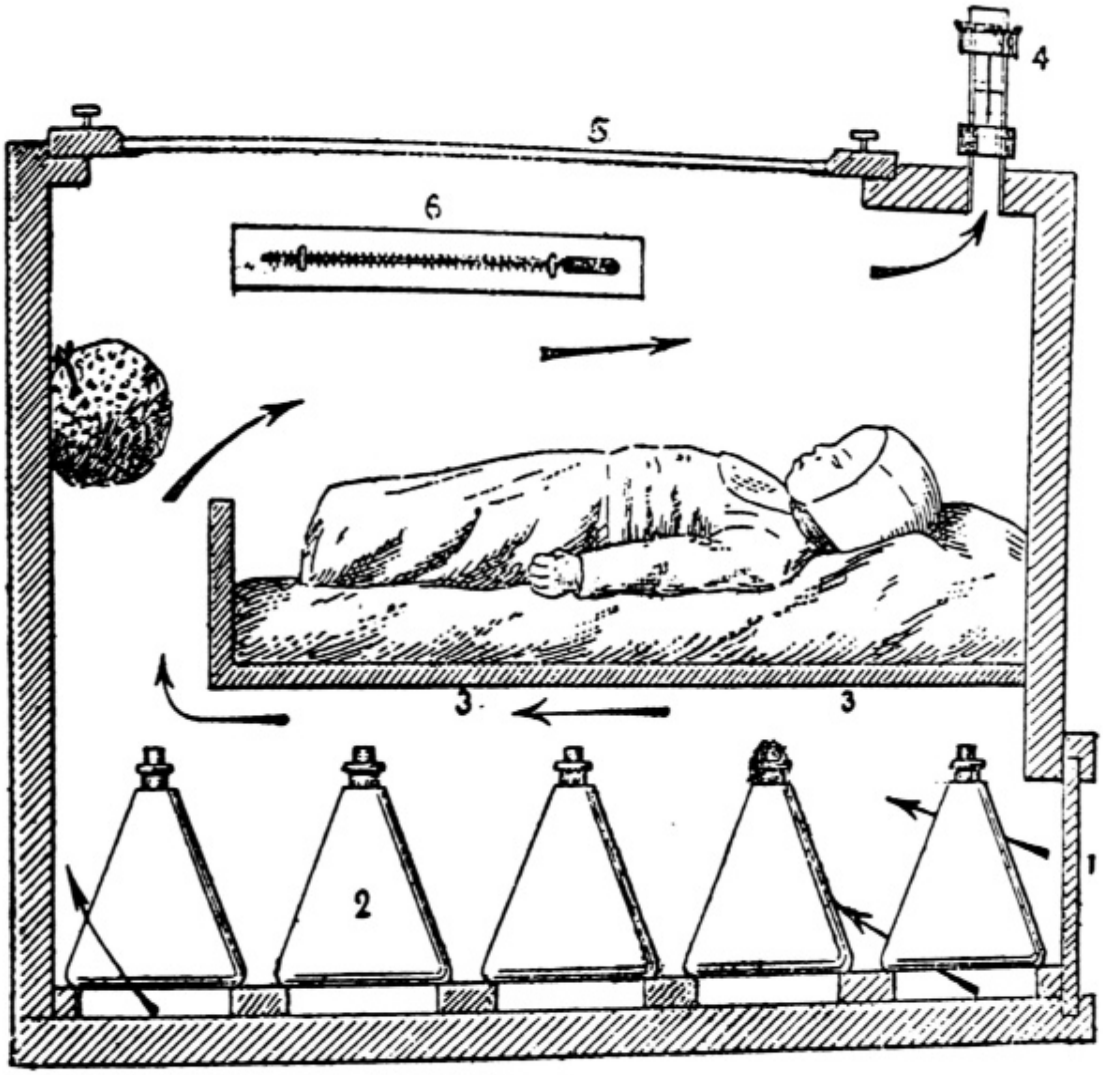


Figure 5. Nurses using the Tarnier-Auvard incubator at the Paris Maternité, 1884.
Source: *Illustrated London News*, 8 March 1884, 228.

Figure 6. Lion incubator, 1891.
Source: Thomas P. Cone, *History of the Care and Feeding of the Premature Infant*. (Boston: Little, Brown and Company, 1985), 30.

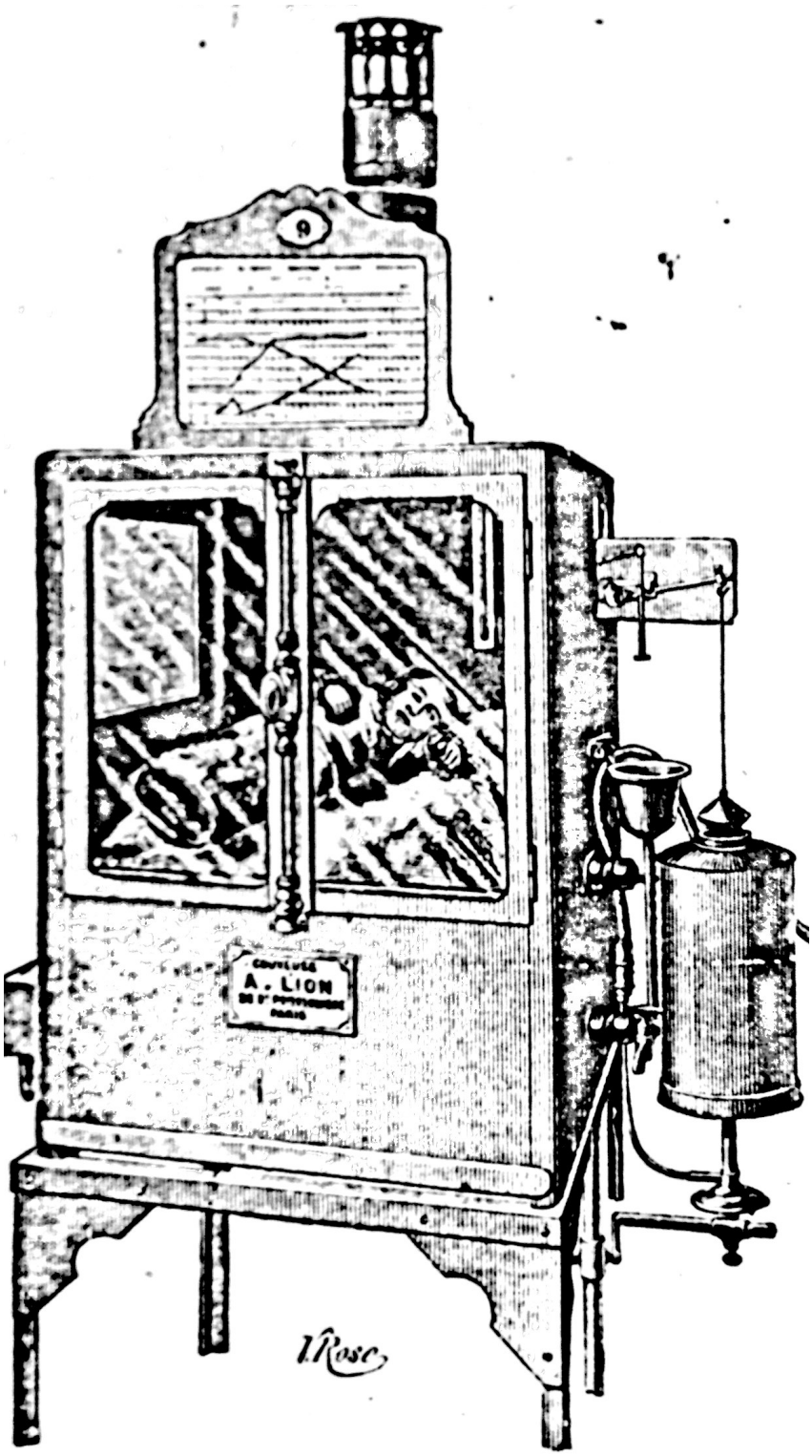


Figure 7. Hess Heated Bed, cross section, 1914.
Source: Julius Hess, *Premature and Congenitally Diseased Infants*, (Philadelphia: Lea & Febinger, 1922), 215.

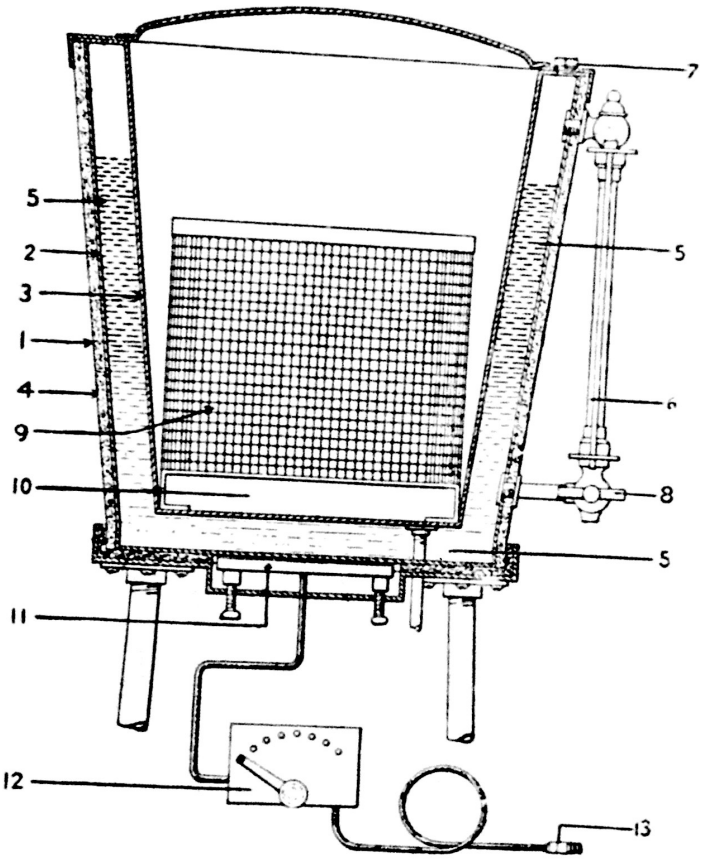


FIG. 140.—Cross-section of Hess heated bed. 1, Cooper wall covering asbestos layer; 2, asbestos layer insulating water-jacket; 3, 4, copper walls covering water-jacket; 5, water surrounding side and floor of bed; 6, water glass; 7, funnel for filling jacket; 8, cock for emptying jacket; 9, removable crib; 10, air space underneath crib; 11, electric heating plate; 12, rheostat; 13, electric plug.

Figure 8. Hess Heated Bed.
Source: Julius Hess, *Premature and Congenitally Diseased Infants*, (Philadelphia: Lea & Febinger, 1922), 214.

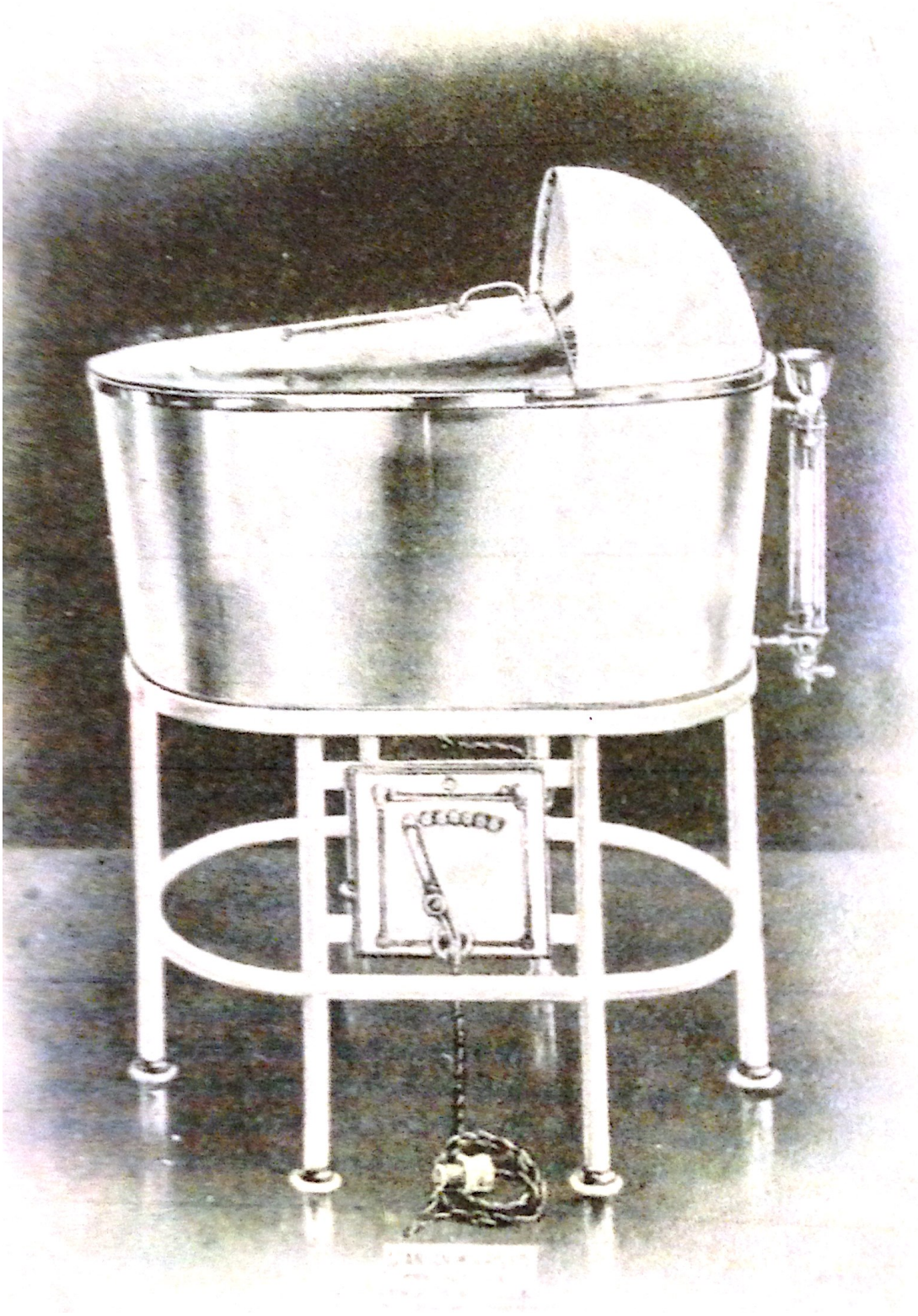


Figure 9. Interior of Alexandre Lion's *Oeuvres Maternelles des Couveuses d'enfants* in Paris, 1896.
Source: James Walter Smith, "Baby Incubators," The Strand Magazine 12(1896): 714.

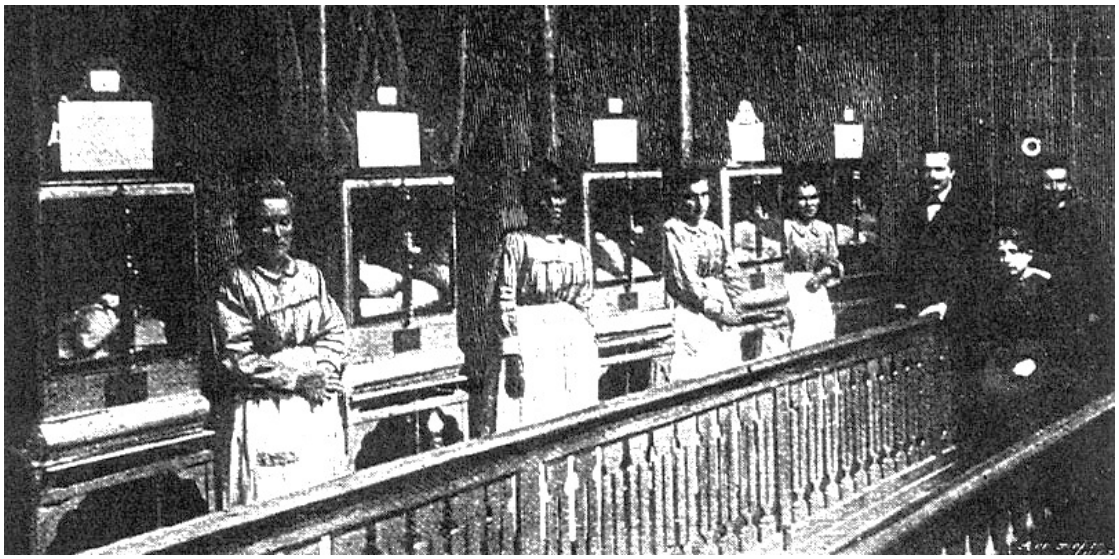


Figure 10. "An Artificial Foster-Mother," 1896.
Source: "Baby Incubators in the Berlin Exhibition," *The Graphic, 54*(1896): 461.

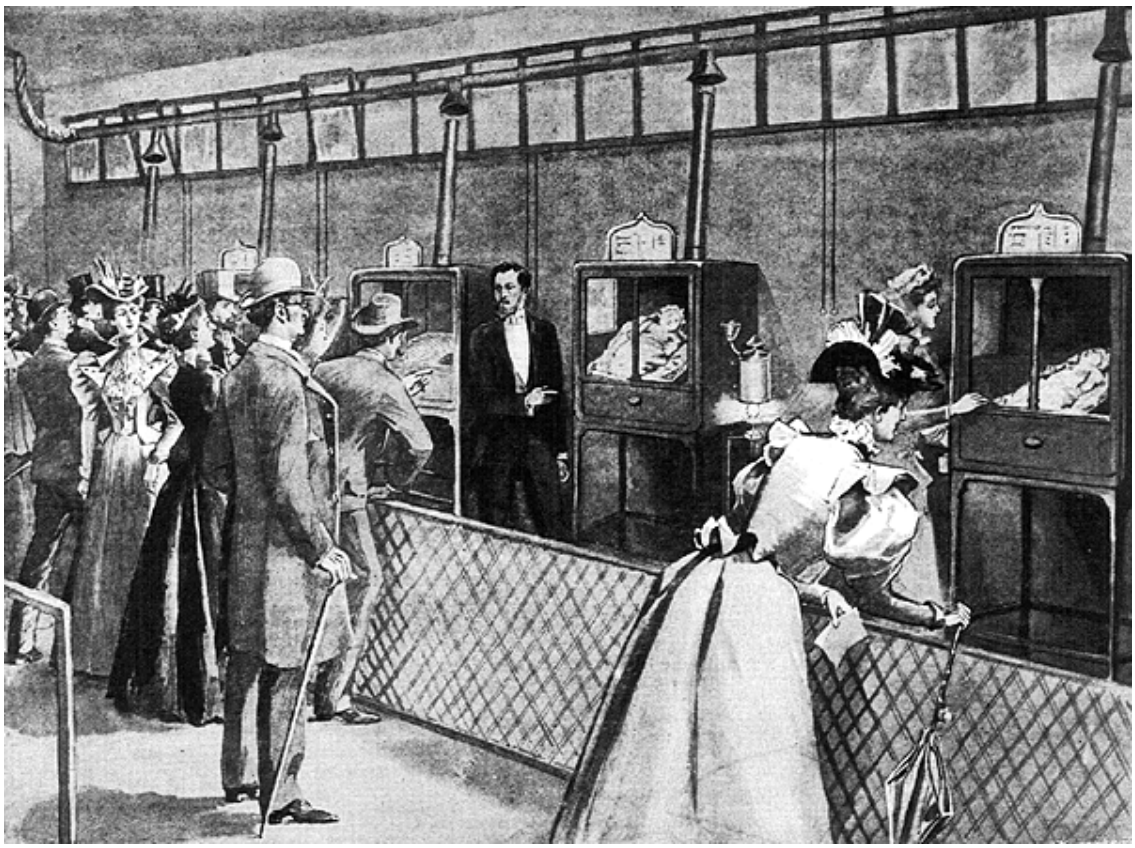


Figure 11. 1898 Trans-Mississippi Exposition, Omaha, Nebraska.
Source: Incubator Collection, courtesy the Pediatric History Center of the American Academy of Pediatrics

Figure 12. Buffalo 1901
Source: Incubator Collection, courtesy the Pediatric History Center of the American Academy of Pediatrics

Figure 13. Architectural Plans for Infant Incubator Building, 1933-34 Chicago Century of Progress Exposition.
Source: "Babies, Babies, and Babies at World's Fair," *Chicago Daily Tribune*, June 5, 1932: 20.

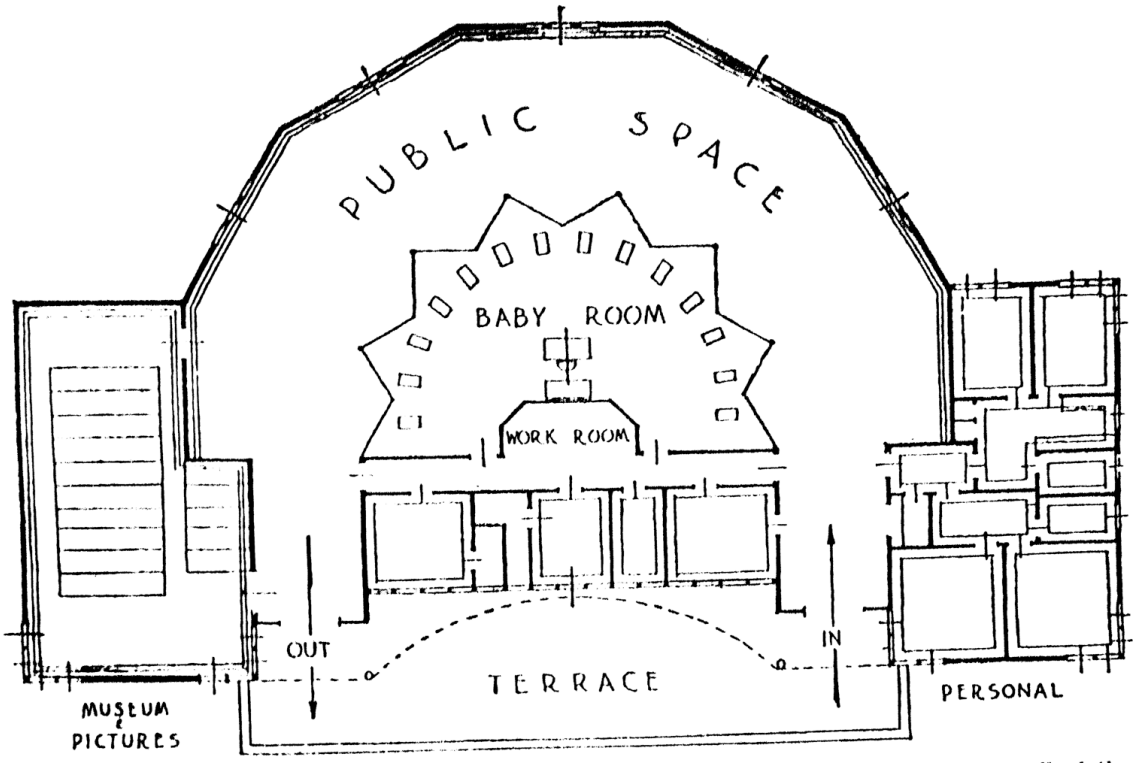


Figure 14. Nurse Madame Louise Recht an infant at the Pan-American Exhibition in Buffalo, New York, 1901.
Source: "Exhibit of Infant Incubators at the Pan-American Exhibition," *Pediatrics, 12*(1901): 414-419.

Figure 15. Hildegarde Couney and Other Nurse Holding Twins, Infant Incubator Exhibit, New York World's Fair, 1939-40.
Source: Manuscripts and Archives Division, The New York Public Library. "Infant Incubator - Hildegarde Couney with other nurses holding three sets of twins" New York Public Library Digital Collections.

Figure 16. 1933-34 Chicago Century of Progress Exposition.
Source: The Incubator Collection, courtesy the Pediatric History Center of the American Academy of Pediatrics.

Figure 17. 1934 Infant Incubator Homecoming Celebration. Martin and May Couney pose with former graduate Mae Winter and a current premature patient.
Source: Acme Newspictures, Inc.

Figure 18. Exterior of Infant Incubator Exhibit, 1939-40 New York World's Fair.
Source: The William Silverman Collection at the Pediatric History Center of the American Academy of Pediatrics.

Figure 19. Premature Infant with Madame Recht's Ring.
Source: The William Silverman Collection at the Pediatric History Center of the American Academy of Pediatrics.

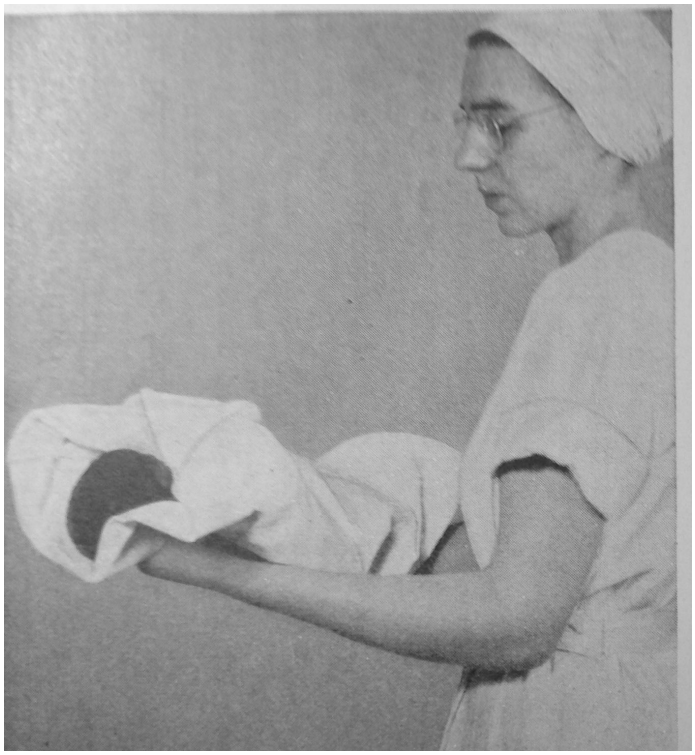
Figure 20. Hildegarde Couney with Infant, 1933-34 Century of Progress.
Source: The William Silverman Collection at the Pediatric History Center of the American Academy of Pediatrics.

Figure 21. Infant Graduates and Mothers, 1934 Infant Incubator Homecoming Celebration.
Source: ; Julius H. Hess, George J. Mohr, and Phyllis Bartelme, *The Physical and Mental Growth of Prematurely Born Children* (Chicago: University of Chicago Press, 1934).

Figure 22. Routine for Day Duty at the Premature Infant Station
Source: Julius H. Hess and Evelyn C. Lundeen, *The Premature Infant: Its Medical and Nursing Care* (Philadelphia: J.B. Lippincott Company, 1941): 58-59.

7:00 A.M.	Hear report of night nurses.
7:10 A.M.	Bathe babies.
	Check incubators and oxygen tanks.
8:30 A.M.	Clean nursery.
	Scrub bath basins and send equipment to be autoclaved.
	Pour feedings for all babies.
	Heat feedings.
	Place in ice box until needed feedings for babies on 4-hour schedule.
8:50 A.M.	Feed babies on 3-hour schedules.
9:20 A.M.	Heat feedings for babies on 4-hour schedule.
9:30 A.M.	Feed babies on 4-hour schedule.
	Check all babies for vomiting and cyanosis.
9:45 A.M.	Pour cod-liver oil, orange juice, or tea for all babies.
10:00 A.M.	Feed orange juice and cod-liver oil or tea to babies on 3-hour schedule.
10:30 A.M.	Wash shirts.
	Make bath packs.
	Fold and put away linen.
11:00 A.M.	Pour feedings for babies on 3-hour schedule.
	Diaper babies on 3-hour schedule.
11:20 A.M.	Heat feedings.
11:30 A.M.	Feed babies on 3-hour schedule.
12:00 P.M.	Give cod-liver oil and orange juice to babies on 4-hour schedule.
12:30 P.M.	Pour tea for babies on 3-hour schedule.
1:00 P.M.	Give tea to babies on 3-hour schedule.
1:15 P.M.	Diaper babies on 4-hour schedule.
1:20 P.M.	Heat feedings.
1:30 P.M.	Feed babies on 4-hour schedule.
	Check all babies for vomiting and cyanosis.
	Fold linen.
2:00 P.M.	Pour feedings for babies on 3-hour schedule.
2:10 P.M.	Diaper babies on 3-hour schedule.
2:20 P.M.	Heat feedings.
2:30 P.M.	Feed babies on 3-hour schedule.
3:00 P.M.	Chart all required records.
	Clean nursery.

Figure 23. Technique for carrying baby, as practiced at the Premature Infant Station.
Source: Julius H. Hess and Evelyn C. Lundeen, *The Premature Infant: Its Medical and Nursing Care* (Philadelphia: J.B. Lippincott Company, 1941): 53.



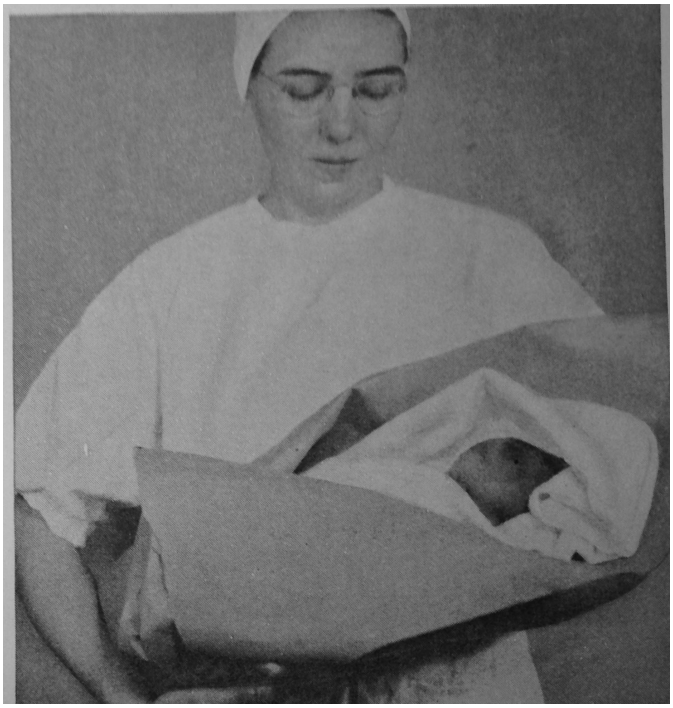


Figure 24. Hildegarde Couney holding baby, 1939-40 New York World's Fair.
Source: Manuscripts and Archives Division, The New York Public Library. "Infant Incubator - Hildegarde Couney holding baby" New York Public Library Digital Collections.

Figure 25. Nurse holding infants, Infant Incubator Exhibit, Coney Island 1926.
Source: Acme Newspictures, Inc.

Figure 26. Young Martin Couney with infant, ca. 1901.
Source: The Incubator Collection, courtesy the Pediatric History Center of the American Academy of Pediatrics

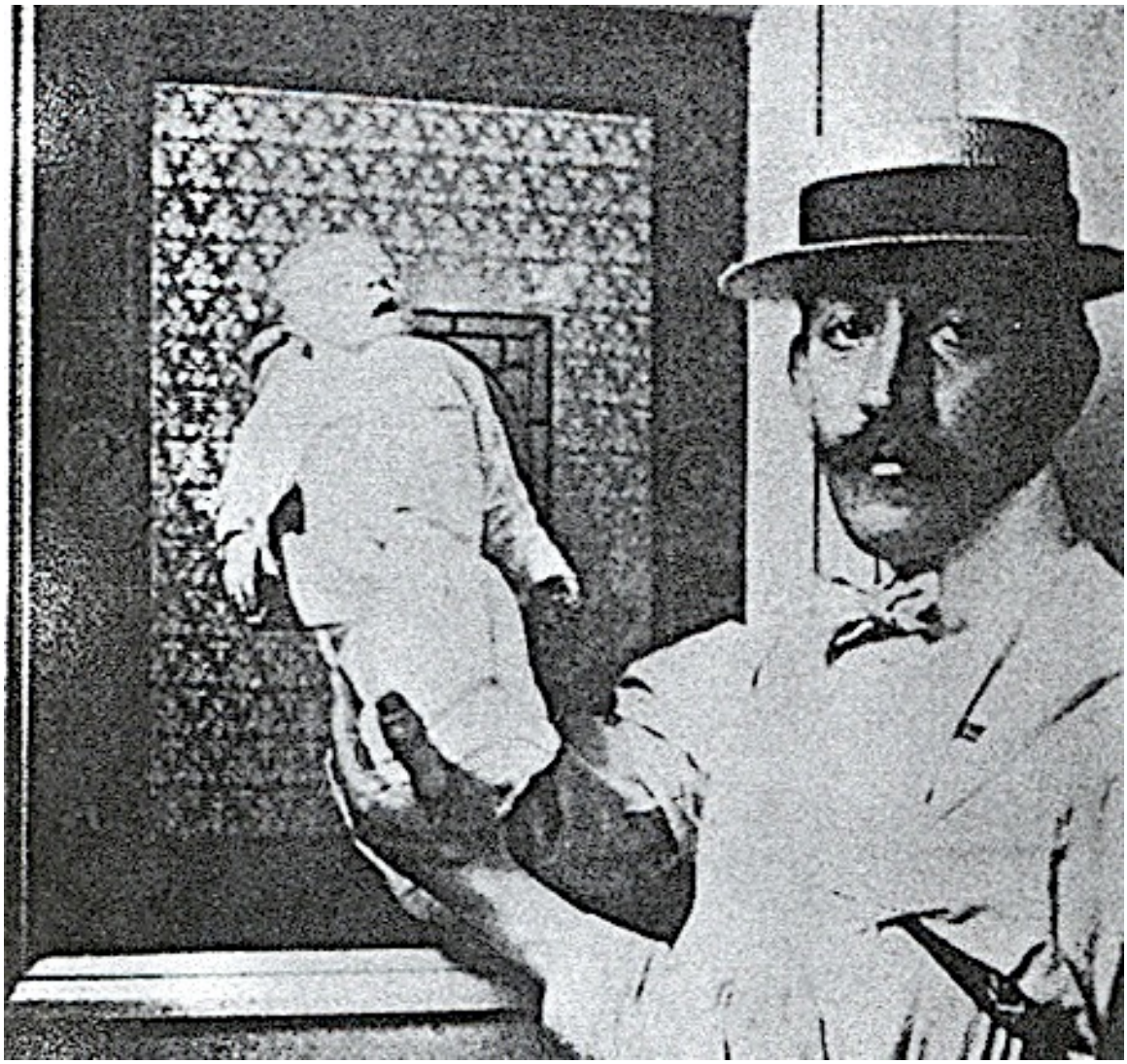


Figure 27. Martin Couney holding two babies, 1939-40 New York World's Fair.
Source: Manuscripts and Archives Division, The New York Public Library. "Infant Incubator - Martin Couney holding two babies" New York Public Library Digital Collections.

Table 1. "Results of Premature Care at the Infant Incubators Years 1939-40"
Source: Martin A. Couney, letter to J. Peter Hoguet, October 20th, 1940. Courtesy the New York World's Fair 1939-1940 records, Manuscripts and Archives Division, The New York Public Library, Series I, Box 547, Folder 2.

Infant Birth Weight (Grams)	Total Number of Infants	Average Length of Stay (Days)	Number of Infants Treated with Oxygen	Average Daily Weight Gain (Grams)	Average Weight at Discharge (Grams)	Mortality Statistics		
						Living	Dead	Percent Died
800-1000	11	91.3	11	21	2863	8	3	27.3%
1001-1250	25	70	23	20.7	2615	21	5	19.2%
1251-1500	24	53	9	24.5	2692	23	1	4.2%
1501-1750	27	40.5	6	27	2707	26	1	3.7%
1751-2100	8	29	0	30.5	2816	8	0	0%

Table 2. Preterm Infant Growth Curve (United States, 2003)
Source: T.R. Fenton (2003), licensee BioMed Central Ltd. This is an Open Access article, retrieved from https://www.meadjohnson.com/pediatrics/us-en/sites/hcp-usa/files/LB2139NEW-01-05_0.pdf

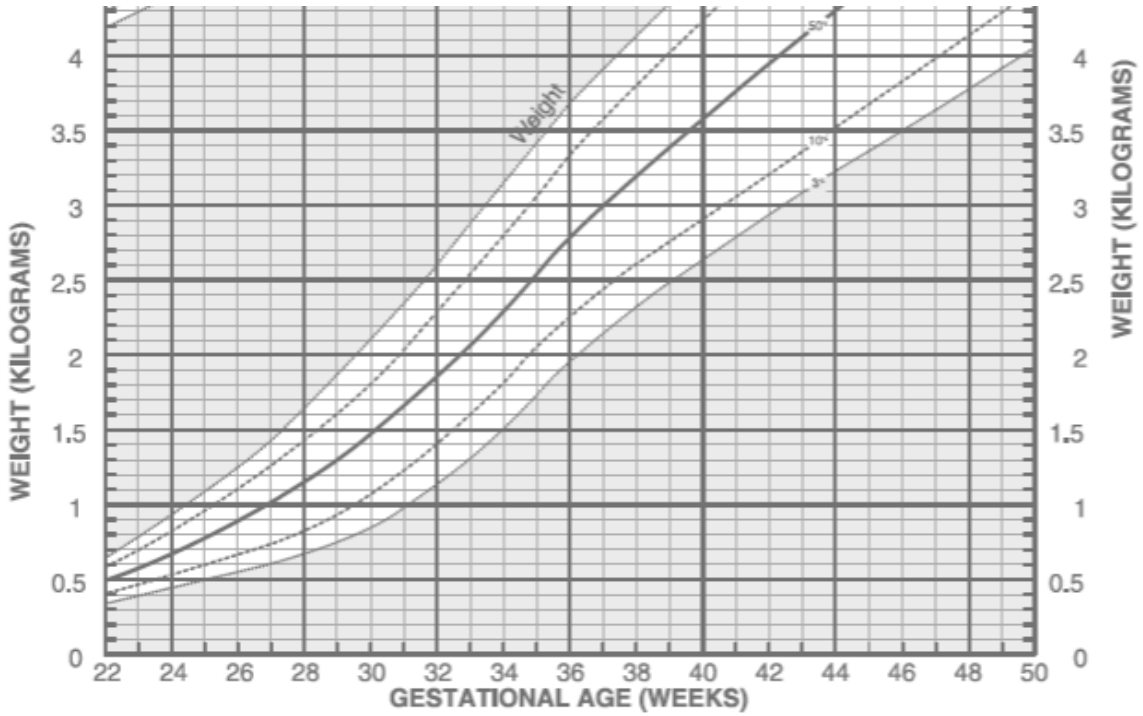


Diagram 1. Sociotechnical Network of Infant Incubator Company

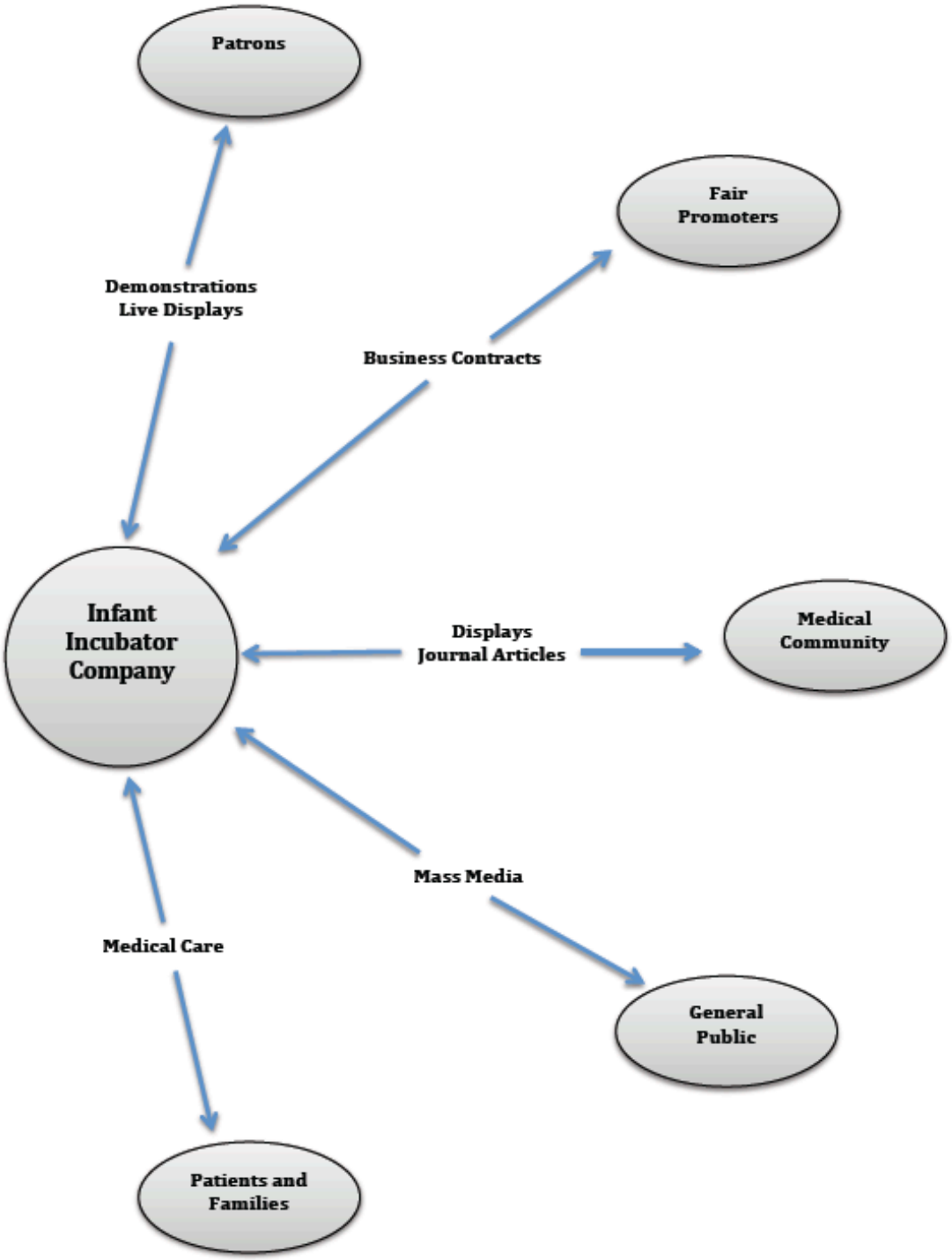


Diagram 2. Sociotechnical Network of the Premature Infant Station

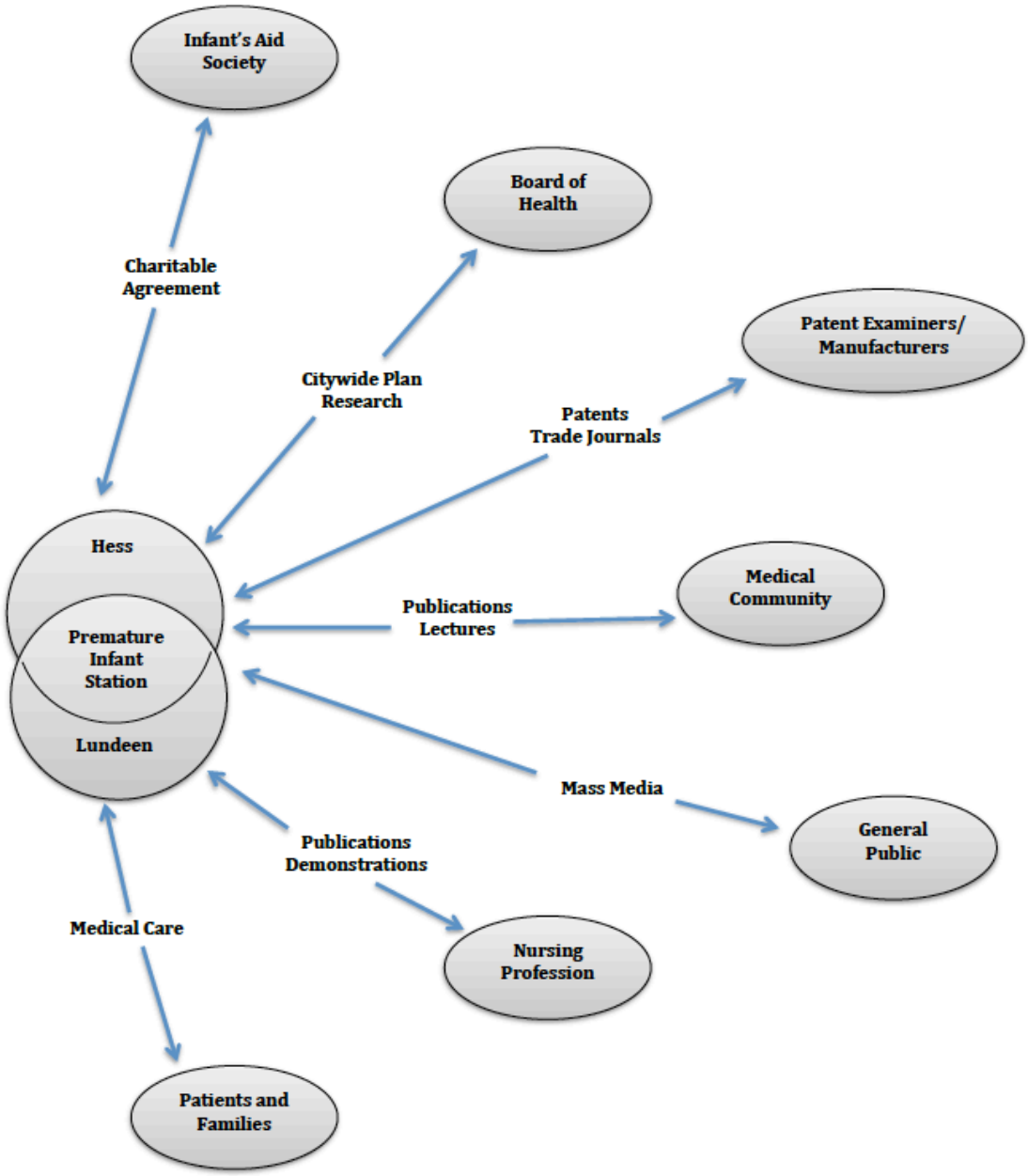


Table 3. Comparison of Survival Rates by Premature Infant Birth Weight

Premature Unit (Years of Data Collection)	Sample Size (total)	Birth weight ≤1000 grams (%)	Birth weight 1001-1250 grams (%)	Birth weight 1251-1500 grams (%)	Birth weight 1501-2000 grams (%)	Birth weight 2001-2500 grams (%)
Infant Incubator Company[1] (1939-1940)	95	72.7	80.8	95.8	96.3	100
Premature Infant Station[2] (1922-1940)	3883	13	38.5	57.2	78.4	88.9
Modern NICU[3] (1991-1997)	3760	58	87	95	98	98

1. Report of outcome data for 1939-1940 New York World's Fair from Martin A. Couney, letter to J. Peter Hoguet, October 20th, 1940. Courtesy the New York World's Fair 1939-1940 records, Manuscripts and Archives Division, The New York Public Library, Series I, Box 547, Folder 2.
2. Statistics from Julius Hess and Evelyn Lundeen, *The Premature Infant* (Philadelphia: J.B. Lippincott Company, 1941): 263.
3. Data from Elizabeth S. Draper, Bradley Manktelow, David J. Field, and David James, "Prediction of Survival for Preterm Births by Weight and Gestational Age: Retrospective Population Based Study," *British Medical Journal* 319 (1999): 1093-1097.

Appendix C: Institutional Review Board Protocol Application

Institutional Review Board for Social & Behavioral Sciences
University of Virginia

A. Investigator Agreement

BY SIGNING THIS DOCUMENT, THE INVESTIGATOR AGREES:

1. That **no participants will be recruited** or data accessed under the protocol **until** the Investigator has received the **final approval or exemption letter** signed by the Chair of the Institutional Review Board for the Social and Behavioral Sciences (IRB-SBS) or designee.
2. That **no participants will be recruited** or entered under the protocol **until** all researchers for the project including the Faculty Advisor have completed their **human investigation research ethics educational requirement** (CITI training is required every 4 years for UVA researchers).
3. That any **modifications of the protocol or consent form** will not be implemented without prior **written approval** from the IRB-SBS Chair or designee except when necessary to eliminate immediate hazards to the participants.
4. That any **deviation from the protocol and/or consent form** that is serious, unexpected and related to the study or a **death** occurring during the study **will be reported promptly to the SBS Review Board** in writing.
5. That all protocol forms for **continuations of this protocol** will be **completed** and returned **within the time limit stated** on the renewal notification letter.
6. That **all participants will be recruited and consented as stated in the protocol approved or exempted** by the IRB-SBS board. If written consent is required, all participants will be consented by signing a copy of the consent form that has a non-expired IRB approval stamp.
7. That the IRB-SBS office will be notified within **30 days of a change in the Principal Investigator** for the study.
8. That the IRB-SBS office will be notified when **the active study is complete**.

Michelle Hehman	10/27/2015
Principal Investigator (print)	**Date**
"Once Seen, Never Forgotten": Nursing, Ethics, and Technology in Early Premature Infant Care in the United States, 1898-1943	
Protocol Title	**Protocol Number (SBS office only)**

Michelle Hehman

Principal Investigator's Signature

FOR STUDENT AND STAFF PROPOSALS ONLY

BY SIGNING THIS DOCUMENT, THE FACULTY ADVISOR HAS READ THE PROPOSAL FOR RESEARCH AND AGREES:

1. To **assume overall responsibility** for the conduct of this research and investigator.
2. To **work with the investigator**, and with the SBS Review Board, as needed, in **maintaining compliance with this agreement**.
3. That the **Principal Investigator is qualified to perform this study**.

Arlene Keeling, PhD, RN, FAAN	10/27/2015
Faculty Advisor (print)	**Date**
Arlene W Keeling	10/29/2015

Faculty Advisor's Signature

The SBS Review Board reserves the right to terminate this study at any time if, in its opinion, (1) the risks of further research are prohibitive, or (2) the above agreement is breached.

Revision Date: 11/01/11 1

Protocol Form

B. Protocol Information

IRB-SBS Protocol Number (assigned by SBS office, leave blank):	
IRB-SBS Grant Approval number: (If you received a Grant Approval prior to submitting a protocol, please include the number issued by our office. If you did not submit a Grant Approval Form, please leave this line blank.)	
Submission Type (delete all those that don't apply):	**New Protocol**
Protocol Title:	**"Once Seen, Never Forgotten": Nursing, Ethics, and Technology in Early Premature Infant Care in the United States, 1898-1943**
Principal Investigator:	Michelle Hehman
Professional Title:	MSN, RN, PhD(c)
School (Curry, Medical, Arts & Sciences, etc.):	Arts & Sciences
Department (CISE, Family Medicine, Psychology, etc.):	Nursing
Campus Box Number:	
Mailing Address (only if campus box number is not available):	7014 Lake Haven Ct Sugar Land, TX 77479
Telephone:	(615) 715-7979
UVA e mail address (no aliases, please): *Your computing ID is used for tracking your IRB CITI training.*	mch2at@virginia.edu
Preferred e-mail address for correspondence (if applicable):	mch2at@virginia.edu
You are (delete all those that	**Graduate Student**

don't apply):	
This research is for (delete all those that don't apply):	**Doctoral Dissertation**
Primary contact for the protocol (if other than the principal investigator):	
Contact's Email:	
Contact's Phone:	
Faculty Advisor:	Arlene Keeling, PhD, RN, FAAN
School (Curry, Medical, Arts & Sciences, etc.):	Arts & Sciences
Department (CISE, Family Medicine, Psychology, etc.):	Nursing
Campus Box Number:	
Telephone:	(434) 924-5906
UVA e mail address (no aliases, please): *Your computing ID is used for tracking on-line human subjects training.*	awk2z@virginia.edu

Other Researchers*:

Please list all other researchers in this study that are associated with UVA.* Please provide the following information for each researcher: Name, UVA email address (no aliases, please.)	
Please list all other researchers not associated with UVA.* Please provide the following information for each researcher: Name, Institution, Phone Number, Mailing Address, Email Address.	

Funding Source: If research is funded, please provide the following:

grant name (or name of the funding source): _____

funding period (month/year): _____

grant number: _____

Anticipated start and completion dates for collecting and analyzing data: (start date is after anticipated IRB approval) **December 2015-December 2016**

*** Please only list researchers that are working directly with human subjects and/or their data. All researchers listed on the protocol must complete the IRB-SBS CITI Training or provide proof of completing IRB training at their institution. If you have any questions about whether a researcher should be listed on the protocol or if a researcher has completed training, please contact our office (irbsbshelp@virginia.edu). Proof of training can be submitted to our office via fax (434-924-1992), by mail (PO Box 800392 Charlottesville, VA 22908-0392) or by email (irbsbs@virginia.edu).**

C. Description of the Research Study

1. **Study Overview:** Give a brief overview of your project. If your study has more than one phase, please clearly map out the different phases. Consider the following when framing your response:
    - What is your purpose in conducting this research? How does the project contribute to the advancement of knowledge and why is it worth doing?
    - Provide the Board with an overview of the data you will use. What does the data consist of? Are you using data sets, video tapes, audio tapes, journal entries, transcripts, etc.?
    - What is the estimated number of participants in the data? If you are using data sets, include a list of the data fields you will use either in this section or as an addendum to this form.

Response 1: (enter response below this header)

The purpose of the proposed study is to examine nurses' involvement in the process of technology transfer for the incubator and other advanced care techniques for premature infants in the United States from 1898 to 1943. This study specifically aims to (1) identify, describe and analyze the role of the nurse in the introduction, promotion, and standardization of new premature care technology in the early twentieth century; (2) analyze how the differing technological systems of the incubator-baby sideshow exhibits and Chicago's Premature Infant Station may have affected the integration of the incubator; (3) explore how the social, cultural, economic, and political realities of the time influenced the acceptance of advanced technologies for premature care; and (4) describe the ethical issues nurses faced in providing care to premature infants in the early twentieth century and explore the implications for current moral evaluation of the nurse-technology relationship in the NICU.

Historiography was the chosen methodology for the proposed study based on the available archival material as it relates to the identified purpose and specific aims. Study data comes from both primary and secondary source material; primary sources have a direct connection to their user or originator during the time period in which they were created, whereas secondary sources are items generated from the interpretation and analysis of primary sources. Secondary sources related to the history of American premature infant care were discovered through online searches of published manuscripts, as well as texts from nursing, medicine, sociology, anthropology, and history. A thorough review of the secondary literature related to the history of the incubator and early twentieth century premature infant care identified the following archival collections for the acquisition of primary source data relevant to the research study. All data contained in these libraries and archives are publicly available sources that historians use when writing books and articles:

The Julius Hayes Hess Collection at the University of Chicago's Regenstein Library. This collection contains 53 boxes (58.75 linear feet) of the personal and professional documents of Julius Hess, MD, spanning the years 1899 through 1958. Data from this archive include personal letters and family photographs, professional and political correspondence, research articles and publications, newspaper clippings related to his professional career and milestones, and extensive drawings and papers on the design and production of his inventions, including an infant incubator.

The William Silverman Collection at the American Academy of Pediatrics. This collection houses

twelve boxes of personal and professional notes and correspondence from William Silverman, MD's career as a neonatologist and researcher. The collection includes final drafts of numerous conference presentations given on the history of neonatology and every publication from his extensive bibliography, many of which discuss issues of technology and morality in the NICU.

The Incubator Collection at the American Academy of Pediatrics. Collection materials include background information about the origin of the incubator, newspaper clippings and popular press articles from the early 1900s, and personal letters and accounts from individuals who either visited or were part of an incubator-baby sideshow.

A Century of Progress Records at the University of Illinois at Chicago's Richard J. Daley Library and Special Collections. This collection, 249 linear feet of documents and items dating from 1927 to 1952, consists of the extant operating records of *A Century Progress* World's Fair. Important contextual information can be gathered from this collection through copies of official publications, press releases, souvenir albums, maps, brochures, photographs, and newspaper articles from the fair. Additionally, this collection houses correspondence between the Infant Incubator Company and exposition developers, transcripts from press releases about the exhibit, and financial records.

The New York World's Fair 1939-1940 Incorporated Records at the New York Public Library. The records of the New York World's Fair 1939-1940 Incorporated, which total 2508 boxes (1203.48 linear feet), present a comprehensive view of all aspects of the fair. In addition to official correspondence and memoranda, the collection consists of reports, minutes, financial and legal records, architectural plans, design drawings, sound recordings, brochures, leaflets, press releases and other promotional materials, and includes over 12,000 photographs of the fair, its exhibits, and visitors. The Digital Collection includes 22 high-resolution promotional photographs from inside the baby-incubator exhibit, showing many of the nurses who worked in the show, and some of the infants on display.

The Coney Island History Project. The collection includes oral histories from incubator show graduates and family members who recall visiting the exhibit, as well as numerous amateur and professional photographs from the shows. The site expressly states that its resources are available for students, teachers, researchers and the general public for educational purposes.

No personal interviews will be conducted. No data sets are available that contain personal identifying information. Medical records from the time are restricted, meaning they are not available for researchers or public access.

2. **Data:** In this section, please describe the how the data will be obtained and handled confidentially. **The IRB-SBS asks that if it is possible for you to de-identify your data (i.e. strip the data of participants' identifiable information), please construct your study in this manner. Data collection in which the subject is not identifiable (i.e. anonymous) offers more protection to participants and can be exempted in most cases.**

Answer the questions below by marking the correct box with an "x" and providing additional responses where appropriate.

a. The data in this study consist of:

[X] **Publicly-available data** [ ] **Private data** [ ] **Both private and public data**

b. Describe below how you will gain access to data. If you will use ANY private data, also include proof of permission to access the data:

Response 2b: (enter response below this header)

All data is publicly available from the libraries and archives identified in the previous section. This data is classified as Not Sensitive per University of Virginia Institutional Data Protection Standards. Once IRB approval is obtained, the PI will travel to the various archives and libraries to collect the data. Some data is in digital form and available to anyone with access to the Internet, such as the data on the Coney Island History Project website and the New York Public Library Digital Collections website.

c. Describe below how you will store data. If you are storing electronic files, make sure that your data storage plan complies with UVa IT policies.

Response 2c: (enter response below this header)

The textual documents from the libraries and archives are Not Sensitive and will be handled in accordance with the policies of the individual archives and libraries. In most cases, documents are allowed to be photographed or scanned directly onto a flash drive. These documents will remain on the flash drive at the PI's home. No personal identifiers are included in the data. In the event that digital reproduction is not allowed, the PI will comply with the institutional policies for each individual library or archive. For example, if the library only allows notes to be taken, then hand-written notes using paper and pencil will be used to collect the needed information. These notes will then be stored in a locked file cabinet in the PI's home.

d. Do any of the archival materials or data contain identifying information?

[ ] **Yes** [X] **No**

If YES, explain what identifying information will be kept and why identifying information is necessary for the study. If it is not necessary for the study, then explain when and how the data set will be de-identified.

Response 2d: (enter response below this header)

Most of the textual documents from the archives and libraries include the personal and professional correspondence of the physicians in charge of the incubator exhibits or Premature Infant Station, as well as general information and operating records from the World's Fairs. The names of individuals who wrote the memos and reports are included on those documents. No other personal identifiers, such as date of birth, social security number, or medical record number are associated with the names. These documents are publicly available, and many of the names of the individuals in positions of power have been identified in the secondary literature.

Any medical records that contain specific identifying and/or medical information, such as the names or diagnoses of the premature and sick infants who were under medical care, is restricted by the archives holding this information because of confidentiality issues related to the Privacy Rule within the Health Insurance Portability and Accountability Act (HIPAA). HIPAA retroactively protects

all individually identifiable health information in existing records, no matter how old or whether the subjects are living or dead. As such, this specific information from any hospital or nursing records is not available to the researcher, and not needed for the dissertation.

e. Can the names of the participants be deduced from the de-identified data set(s)? Can the participants be re-identified (i.e. their identities could be reconnected to their data)?

[X] **Yes** [ ] **No** [ ] **NA/ All data are identifiable**

If YES, please describe how identities might be deduced and/or the participant's might be reconnected to their data. What will you do to prevent this from happening?
Response 2e (enter response below this header)

The textual documents include reports, personal and professional correspondence, and individual accounts written by staff at the incubator sideshows and Premature Infant Station. The names of those individuals writing the reports, involved in meetings, or carbon-copied on those reports, are included on the documents. It is important to know some information about these individuals, such as race and gender, in order to support the central dissertation argument that nurses were able to provide ethically appropriate care to all infants, regardless of the environment in which they worked and other economic or social constraints for women in the Progressive Era.

As stated in the previous section, any specific identifying and/or medical information is restricted by the archives holding this information because of HIPAA Privacy Rule protection. The PI has no access to these restricted records, and the information is not needed to complete the dissertation.

f. Will you merge multiple data sets?

[X] **Yes** [ ] **No** [ ] **NA/ All data are identifiable**

If YES, how will this affect the confidentiality/ anonymity of the data (if at all)?
Response 2f: (enter response below this header)

The purpose of a historical dissertation using archival data is to merge the various documents to support the researcher's argument. In this dissertation, the PI will argue that nurses in both the incubator-baby sideshows and the first in-hospital premature station provided ethically appropriate care to premature and sick infants at a time when advanced care was not otherwise available to this population. Documents recording events associated with the incubator sideshows and the Premature Infant Station will be used to describe the setting and support the PI's argument. Medical records belonging to specific individuals are not available to researchers, and therefore will not be used in this dissertation. For example, although the number of babies who died each month at the incubator side show at Chicago's 1933-34 World's Fair is part of the archival data, the names and identities of these babies is not available.

3. **Risks**: Accessing other people's data carries with it the potential to cause them social, psychological, physical, or legal harm. However, accessing data (particularly de-identified data) will often not put a participant at risk beyond what is considered minimal. **Please describe to the Board the potential risks and the probability of harm in using the**

proposed data. In this section, consider the following when framing your response:

- **Describe the risks to the participants in your study.** Does your study include "risk-sensitive" participants (as identified in the Participants section)? What is the probability that harm could occur?
- **Describe what you will do to minimize those risks.** Describe what you will do if a harmful situation occurs.
- **Would a loss of confidentiality of any of your materials put participants at risk?** If so, how will you prevent this from happening?

Response 3: (enter response below this header)

The PI will have no interaction with anyone who was part of an incubator sideshow or a patient in the Premature Infant Station in any way. The PI will make no attempts to contact any individuals who were involved with either the sideshows or the Premature Infant Station. In addition, the majority of individuals directly associated with either of these events are now deceased. The transcripts of any interviews for oral histories have been conducted, recorded, and transcribed by the primary researchers involved in those studies, and made available for other researchers to use. For the oral histories available on the Coney Island History Project website, interviewees have agreed to share their name and tell their story so others may learn from their experiences

The possibility of a harmful situation could arise as data are interpreted by the PI. Data could be taken out of context to support the PI's argument. The PI's advisor and dissertation committee are in place to assist the PI with analysis of the data. In this way, any risk of portraying the individuals from the incubator sideshows or the Premature Infant Station in an illogical or detrimental fashion is minimized.

4. **Benefits**: Benefits help to outweigh the risks to the participants, though not every study will have direct benefits to the participants. In this section, consider the following when framing your response:
    - Will the data analysis provide any benefits to the participants? If so, what are they?
    - What is the general importance of the knowledge you expect to gain?

Response 4: (enter response below this header)

The majority of individuals directly associated with the incubator-baby sideshows and the Premature Infant Station are now deceased. It is not expected that these individuals will personally gain any benefits from the research. However, some transcripts reveal the pleasure that the interviewees express in being able to tell their stories. It can be inferred that these individuals will be pleased that their stories are being read and shared with a larger audience.

It is hoped that the larger contribution to nursing and women's historical literature will be a result of this dissertation. Most of the literature related to early twentieth century premature infant care celebrate the achievements of the medical profession, and little is known about the life-saving care provided by the trained nurses in both sideshow and hospital-based care settings. The argument that will be presented acknowledges the contributions of physicians and technology in revolutionizing premature care, but introduces the nursing perspective as a similarly powerful force behind the success of these medical endeavors. This study will hopefully make a positive contribution to the scientific body of knowledge, highlighting the connectedness between past and present issues in nursing education and practice.

IRB Approval of Protocol

IRB-SBS arival data submission

4 messages

Blackwood, Bronwyn L. (blb2u) <blb2u@eservices.virginia.edu> Wed, Nov 4, 2015 at 11:44 AM
To: "Hehman, Michelle Chambers (mch2at)" <mch2at@virginia.edu>
Cc: "Keeling, Arlene Wynbeek (awk2z)" <awk2z@virginia.edu>

Good afternoon, Michelle,

The IRB-SBS has received and reviewed your protocol submission titled "Once Seen, Never Forgotten: Nursing, Ethics, and Technology in Early Premature Infant Care in the United States, 1898-1943." We have determined that your research does not meet the federal definition of human subject research and therefore does not require an IRB submission. Our understanding is that all data included in your research project is public data. Data from public archival sources is not considered to be private, even if the individuals are identifiable. Additionally, most of the people represented in the archival data are most likely no longer living.

Please feel free to start your research project. If you have questions, please contact me directly.

Best of luck with your research project.

Sincerely,

Bronwyn

Ms. Bronwyn Blackwood

Director, Institutional Review Board for the Social and Behavioral Sciences

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