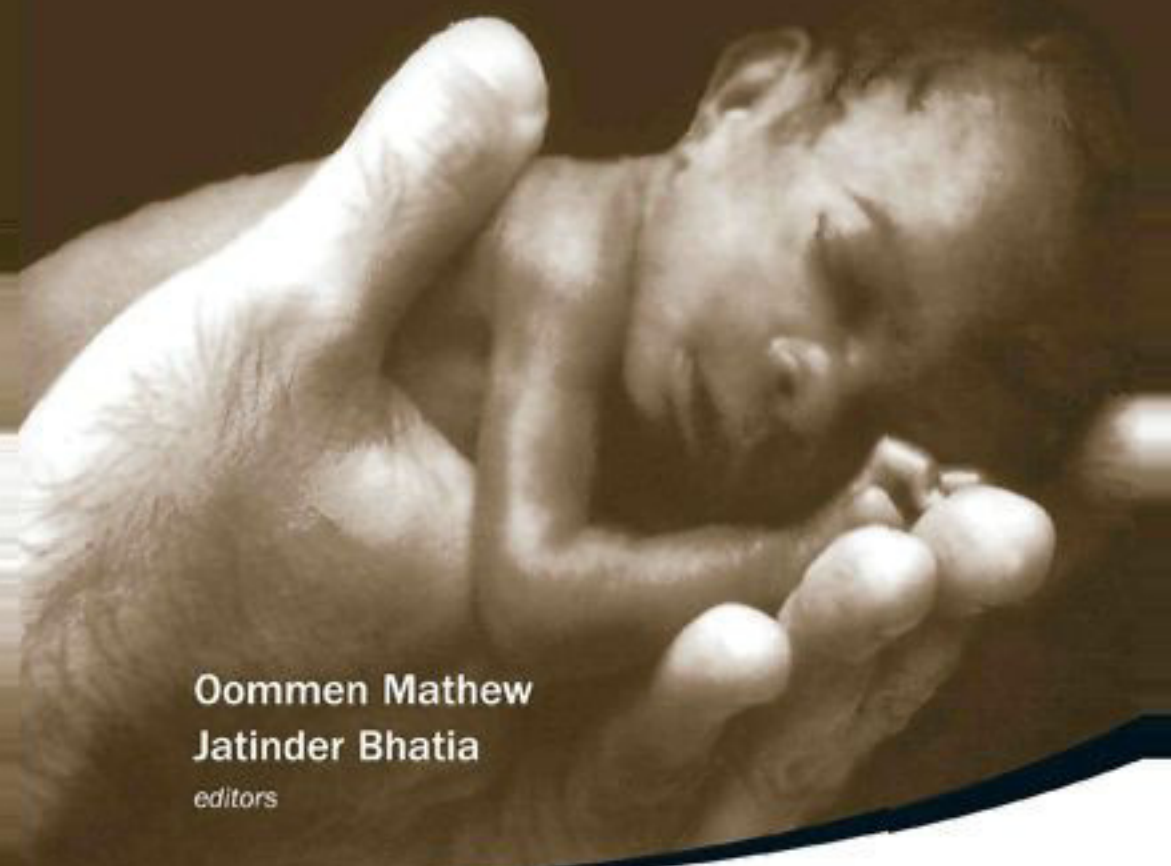


Innovations in Neonatal-Perinatal Medicine

Innovative Technologies and Therapies that have
Fundamentally Changed the Way We Deliver Care
for the Fetus and the Neonate

A close-up photograph of a newborn baby being held in a person's hands. The baby is lying on its back, with its head resting on the person's hand. The person's fingers are visible, gently supporting the baby's head and neck. The background is dark and out of focus.

Oommen Mathew
Jatinder Bhatia

editors

 World Scientific

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INNOVATIONS IN NEONATAL-PERINATAL MEDICINE

**Innovative Technologies and Therapies that have Fundamentally Changed the Way
We Deliver Care for the Fetus and the Neonate**

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Preface

The last few decades have brought major innovations in medicine. Life expectancy in the US improved by 25 years during the last century, infant mortality rate decreased by 90%, and maternal mortality decreased by 99%. The focus of this book is to highlight, not to catalog, the impact of innovations in the field of neonatal-perinatal medicine. There are numerous important mile stones in neonatology. However, the principles of life support for the premature infants can be summarized by few seminal observations which set the stage for the evolution of neonatology. These include Silverman's observation on the effect of hypothermia on neonatal mortality, Usher's "radical" use of intravenous fluids in preterm infants, Gregory's report on the effect of continuous positive airway pressure (CPAP) in respiratory distress syndrome (RDS) and successful surfactant replacement therapy for RDS by Fujiwara.

Louise Joy Brown, the poster child of *in vitro* fertilization (IVF), is the world's first successful "test tube" baby and her birth heralded a new era in perinatal medicine. Unlike all other previous experimental pregnancies, the fertilized egg was implanted in the uterine wall and the pregnancy evolved without apparent complications. In 1999, Natalie, her sister, became the first test tube baby to have a baby of her own. Over 100,000 IVF babies have been born by 2004 in the US alone. As Caplan, a renowned bioethicist, once said "You can't buy a baby in the US but you can buy the sperm, buy the egg and you can rent a uterus."

The first chapter discusses the impact of healthcare innovations on neonatal and infant mortality from a global perspective. The impact of IVF, a major innovation in the field of perinatal medicine, and other assisted reproductive technologies is discussed in Chapter 2. Advances in fetal diagnosis including preimplantation genetics, chorionic villous sampling and amniocentesis are summarized in Chapter 3. These innovations help us diagnose chromosomal abnormalities and biochemical disorders at an early gestation *in utero* and cope with the consequences.

Today, fetal and neonatal imaging has become a routine, but vital, part of obstetric and neonatal care. Fetal ultrasound gives us a window into the health and well being of the fetus. Role of imaging in fetal congenital heart disease and neonatal brain development and its complications is addressed in Chapters 4 and 5. Survival of extremely premature infant is commonplace today. Their increased survival can be attributed to several factors. These include noninvasive monitoring techniques (Chapter 6), better regulation of the environment (Chapter 7), better nutrition (Chapter 8), and ventilatory support (Chapter 9). One has to keep in mind that the greatest impact may come from innovations that are perceived as mundane. For example, keeping the preterm infant warm and providing optimal nutrition fall in this category but continue to be a challenge for the critically ill and extremely premature infants.

Drugs designed to treat unique conditions in the neonate also had immense impact on the survival of neonates. Development of surfactant to treat respiratory syndrome in preterm infants (Chapter 10) and inhaled nitric oxide to treat hypoxic respiratory failure in term and near-term infants (Chapter 11) are excellent examples of drugs in this category. Several hundred thousands of infants have been saved by these miracle drugs. Treatment of women during labor with common and inexpensive antibiotics such as penicillin has substantially reduced infections in the immediate neonatal period in developed countries. Still, over a million neonates die from infection worldwide, mostly in developing countries. As in other areas of medicine, surgical innovations have benefited neonates as well. These innovations extend from laser surgery for retinopathy of prematurity which saves thousands of preterm infants from blindness to staged repair of hypoplastic left heart syndrome, an otherwise

fatal disease (Chapter 12). The ethical and moral issues raised by IVF and other advanced life sustaining measures of extremely premature and critically ill newborns is discussed throughout the book.

We hope that the readers will find this unique collection of reviews by authors who are experts in their respective fields interesting and worthwhile.

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Chapter 1

Medical Innovations in the 20th Century and Their Impact on Neonatal-Perinatal Medicine: A Global Perspective

Dharmapuri Vidyasagar*

1.1 Introduction

The twentieth century has seen the greatest progress in healthcare than any other time in history. Several reviewers in the field have recounted the progress made in different fields of medicine at the end of the 20th century. For example, the Center for Disease Control (CDC) declared that the 20th century made major progress in the ten most important areas of health during 1900 and 1999.¹ Of these gains, improved maternal and child health was noted to be the most impressive gain. During this period, the life expectancy improved by 25 years, infant mortality rate (IMR) decreased by 90%, and maternal mortality decreased by 99% in USA. It further stated that these gains “resulted from better hygiene and nutrition, availability of antibiotics, greater access to healthcare and technologic advances in maternal and neonatal medicine.”

Whereas the statement reflected the progress made in USA, the same can be said of the gains made in Western industrialized countries during

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this same period. Although the progress has been slow in the developing countries, it is unquestionable that the benefits of these technological advances have been percolating slowly but surely during the later half of the 20th century. In spite of these observations, the history of neonatal medical technologies and their impact on *global* neonatal and infant mortality has not received much of scholarly attention. Subsequent chapters of this book detail the history of medical innovations that changed the way we deliver care to the fetus and the newborn during the last century. In this chapter I will attempt to summarize the evolution of numerous healthcare technologies and their overall impact on *global* neonatal mortality rate (NMR) and IMR. The subject is daunting however, because of the difficulty in collecting information on the vast number of innovations that have developed during the last century.

1.2 Innovations that Influenced Population Health

Technological innovations of the 20th century that influenced the health outcome of people include those that improved agricultural products, as well as water purification and sanitation. These innovations are known to have had the greatest impact on population health, especially child health. They were the most responsible for the decrease in overall mortality and child mortality and an increase in life expectancy. Development of newer medical technologies on the other hand has made a direct impact on neonatal and perinatal outcome. These include biomedical technologies such as vaccines, pharmacologic technologies such as antibiotics, and instrumentation such as ventilators. Of the ten most important advances declared by CDC, vaccination, or control of infectious diseases, has made the most impact on IMR/NMR. Innovation of medical technologies in isolation would have no benefit unless they are made accessible to the public and are utilized in countries around the world. To understand the mechanisms of the impact of technology on global health, we need to understand the methods of transferring technology from “bench to bedside” in a country of innovation and then “diffusion” of medical technology from a country of innovation to countries with limited resources.

The model in Fig. 1.1A shows the pathways of development of medical technology in a developed country and its diffusion. There is usually