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Advancements in Neonatology and Perinatal Health

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Abstract **Review Article**

The present study was conducted to review the literature about the updates of neonatology and perinatal health. To extract the appropriate literature, the researchers reviewed the main research engines including Science direct, Pub med, Google Scholar, and others. The conclusions of this review indicated to the global importance of this topic and challenges such as policies and financial resources.

Keywords: Neonatology, Perinatal Health, Health Policy, Financial Resources, Health Organization.

1. INTRODUCTION TO NEONATOLOGY AND PERINATAL HEALTH

The field of neonatology is one of the most exciting areas in medicine and involves the care of newborn infants and their mothers before, during, and after pregnancy (Health Organization., 2023). Despite substantial gains in neonatal health, over 2.4 million children still die annually before their first month of life, a figure that represents 47% of children under the age of five years (Pullabhotla *et al.*, 2023). Those who die are usually premature, underweight, and have infections or other complications resulting from inadequate care at birth or insufficient care at home (Bassat *et al.*, 2023). Therefore, focused attention to the field of neonatology and perinatal health may be of immense help to those involved in the care of newborns (Toor *et al.*, 2021). Infants are not small adults and not just small people, but can function effectively only when all their body systems work in tandem (Mahtab *et al.*, 2023). Newborn care, particularly that of the preterm, is riddled with challenges, among them respiratory and temperature control problems, risk for infection, and others (Dempsey *et al.*, 2022). With advances in perinatal care leading to improved survival of preterm and low-birth-weight infants, neonatologists, who look after all sick newboms, need to understand comprehensive or, better still, holistic child care in both the short and the long terms to address all aspects, especially intellectual growth and various hormones (Flores *et al.*, 2022). Neonatology is an evolving science and art. The survival of small babies has improved from 21% in the 1970s to 89% in the United States, with most deaths occurring in babies born before 24 weeks (Bauer *et al.*, 2022). North America, the UK, and Europe report an average of babies weighing about 500 g surviving the majority of complications, whereas only masses of over 1000 g babies can survive in developing countries (Masuke *et al.*, 2021). Early and essential newborn care providers in developed and developing countries require adequate knowledge in clinical obstetrics that leads to normal newbom care in addition to clinical pediatrics that involve the short and long-term health of an infant (Heys *et al.*, 2023). Care of the pregnant mother is equally important as it has a bearing on neonatal outcomes (Heys *et al.*, 2023). Reliance on any one discipline, especially neonatologists without additional skills in preventive and community pediatric care, will not address the needs in totality (Masuke *et al.*, 2021). Obstetricians, pediatricians, and neonatologists together can perhaps work for the benefit of the new generation (Health Organization., 2023). A holistic approach is therefore being advocated for the best care of children everywhere (Bassat *et al.*, 2023). Neonatal care still remains a challenge for most countries, as it requires both technical and non-technical skills in terms of perinatal care, nursing care, and an overall care of the neonate (Alkhatib *et al.*, 2023). In developing countries, where resources are limited, the real area of concern is how to deal with larger numbers of low-birth-weight babies that require special technical care, and at the same time deal with a large pool of babies with birth asphyxia that require more non-technical nursing care (Health Organization., 2023). Therefore, there is a desperate need to train community workers to handle neonatal care at various levels in any developing country with an extended family system, as

to date it is mostly women, whether specialists, gynecologists, obstetricians, nurses, or non-doctors, who handle this care (Pullabhotla *et al.,* 2023). This document therefore links up both clinical pediatric approaches and preventive community approaches. A regular update of information on the subject is thus an ongoing process. There has been immense improvement in perinatal care related to the advancement of science and technology. Regardless of this, the neonatal outcome is still dismal in developing countries where 5–10% of neonates in developed countries get nursed in intensive care units in developed countries in contrast to only 1% in developing countries. Socioeconomic, cultural, and environmental factors contribute to significant neonatal care (Bassat *et al.,* 2023).

2. Perinatal Health Assessment

Perinatal is the timeframe that encompasses all the stages of pregnancy until the end of an infant's first month of life (Van *et al.,* 2020). The assessment of perinatal health includes antenatal care, pre-pregnancy, prenatal care, postpartum care, and newborn care (Moyer and Kinser, 2021). Antenatal care traditionally includes a series of visits during which the status of the pregnant person and the development of the fetus are monitored on a routine basis, providing the opportunity for education, screenings, and possible interventions for the prevention or staging of pregnancy-related complications (Hannon *et al.,* 2022; Binks *et al.,* 2023).

The intrapartum period or labor and delivery covers the care rendered to the laboring person at risk of non-life-threatening complications during childbirth in order to improve birth outcomes, minimize adverse events, and enhance well-being (Folliard *et al.,* 2020; Berk, 2022; Graf *et al.,* 2023). There are also women at low risk of harm from childbirth where the focus of nursing care is supportive rather than essential (Health Organization, 2022; Johansson *et al.,* 2023).

Evidence-based practice

Gestational age dating is necessary for evidence-based guidelines addressing perinatal care (Gantt *et al.,* 2023). It is the first and essential step in the complete clinical and/or sonographic, multidisciplinary evaluation of fetal and infant health (Ramírez, 2023). It is primarily healthcare providers such as doctors, optometrists, advanced nurse assistants, pharmacists, occupational therapists, midwives, social workers, and psychologists who collect data for the purpose of a health assessment (Kleinhout *et al.,* 2021). Intrapartum, it is the labor and delivery nurse who collects data, especially for the assessment of the progress of labor (Wilson, 2022). Using evidence-based selected diagnostic tests, monitor fetal well-being (Peahl *et al.,* 2021). Consider all known preexisting chronic conditions and your exam and history (Rodrigues, 2022). Address biomedical and cultural issues to reflect a common understanding of the problem and to set the short- and long-range goals of providing optimal care with health promotion and prevention for the critically ill, chronically mentally ill, and primary medical problems, plus simultaneous community resources and placement program management (Augur *et al.,* 2022; Aziz *et al.,* 2020; Brancazio *et al.,* 2024; Saxena *et al.,* 2024).

Current challenges

In 2014, the recommendation on antenatal care for a positive pregnancy experience was reflected in a focus on a positive pregnancy experience that needs to be tailored to individuals, and which concentrates on a thorough antenatal assessment, giving all pregnant people, including those in the most complex and vulnerable situations, information, support, and care to directly raise the chance of a healthy pregnancy (Morgan *et al.,* 2022). In the first stage, regardless of the absence or presence of pre-existing or new pregnancy-related risk factors, accurate assessment of gestational age is a crucial strategy to identify and intervene with the prevention of an extreme preterm birth (da *et al.,* 2020). Because of differences between countries, there are delays specifying the lower gestational onset for antenatal care initiation, but it is suggested that most pregnant women should have at least eight antenatal care contacts (Pusdekar *et al.,* 2020). In the assessment of perinatal health, antenatal care is used for the first 20-week gestation assessment and starting as early as the preconception visit (Ohuma *et al.,* 2023). The first visit allows time for education, the administration of immunity testing, appropriate vaccinations, and the determination of health risk to prevent or control and monitor conditions during pregnancy (Griggs *et al.,* 2020). Conventional prenatal diagnosis includes measurement and accurate assessment of gestational age and placental location, regular monitoring of the person's general health, physical status, and any complaints she may have as a consequence of her pregnancy, fetal physical development, and any ongoing and new risk factors that compromise pregnancy (Lees *et al.,* 2020; Deng *et al.,* 2021). Antenatal care involves routine screening and treatments to keep the pregnant woman and her developing fetus in good health, such as regular assessment of the well-being of the fetus, potentially involving diagnostic tests, seasonal influenza vaccines, sexually transmitted infections, and any other bloodborne pathogens, along with close contact precautions in the face of endemic or active events, with the potential to affect pregnant women and/or infants (Waitzman *et al.,* 2021; Cao *et al.,* 2022; Piekos *et al.,* 2022).

2.1. Antenatal Care

Antenatal care, also known as prenatal appointments, consists of regular support and monitoring for a singleton pregnant woman during her pregnancy (Hlongwane *et al.,* 2021; McCauley *et al.,* 2022). Consultants in Obstetrics and Gynecology, Family Medicine, Midwifery, and paramedics form a multidisciplinary team aiming to provide a wide, comprehensive, and holistic view of the health of the

mother and the developing fetus (Uwambaye *et al.*,2020; Hu *et al.*, 2021). The objectives of antenatal care include recognizing healthy behavior, prompt and timely detection of physical and mental disorders, and their comprehensive care when they occur, as well as the early detection and management of evolving pregnancy-related pathologies, with pre-eclampsia and gestational diabetes being two of these pathologies (McCauley *et al.*, 2022; Adewuyi *et al.*, 2024). There are a number of routine examinations and simple blood and urine tests performed over the course of pregnancy, and their purpose is to assess baseline health and identify women who start as low risk but then become high risk (Barrera *et al.*, 2021). They aim to predict and identify women who will develop pre-eclampsia and gestational diabetes, enabling timely investigation and care (Saarikko *et al.*, 2021; Krukowski *et al.*, 2022).

A number of complementary, non-routine ultrasound examinations are performed in addition to the routine laboratory tests (Geltore and Anore, 2021). Women are cared for on an individual basis with a care plan suited to address their prevalent identified significant risk factors (Shiferaw *et al.*, 2021). These factors relate to risks identified before women become pregnant, during pregnancy, and also in labor (Hofmeyr *et al.*, 2023). A woman, her partner, or other family members would have received nutritional advice before and during pregnancy, although further guidance is required throughout the pregnancy (Atkinson *et al.*, 2023). Guidance also revolves around enhancing mental health and promoting a smoke-free life (McCauley *et al.*, 2022). Education of the pregnant woman and her spouse will empower her to learn about fetal movements (Deo, 2023). Fetal movement and kick counting enable her to bond better with her baby and empower her with information that may be vital in seeking help promptly if there is a change in the pattern of fetal movements (Dessu and Dawit, 2020). Directing her to additional resources encourages her to seek additional guidance (Aksünger *et al.*, 2022). A pregnancy where some complication may have occurred involves maternal-fetal specialists, including obstetric medicine physicians and endocrinologists, who continue to provide direct guidance to the women (Nxiweni *et al.*, 2022). Improvement in technology and the use of telemedicine during the pandemic have enabled better access to antenatal services for all pregnant women (Hofmeyr *et al.*, 2023). Clear evidence exists to confirm that regular antenatal care can prevent or alleviate maternal and newborn morbidity and mortality, as well as improve the overall maternal, neonatal, child, and reproductive health of women (Nxiweni *et al.*, 2022). The trend towards greater morbidity during pregnancy may be related to later motherhood, higher BMIs, and the number of women who were heavier during the index pregnancy (Dessu and Dawit, 2020). Local and national variations, including racial differences, may contribute. The possible reasons for high maternal morbidity are directly related to obstetric conditions, pre-existing complications that worsen during pregnancy, iatrogenic complications, and indirect conditions related to the health status of the woman (Nxiweni *et al.*, 2022).

2.2. Intrapartum Care

The intrapartum care section includes components of care provided during labor, birth, and the immediate postnatal period, including the onset of care around the time of birth, immediate newborn care, resuscitation when necessary, and care in the early postnatal phase (Symon and Shinwell, 2020; Buerengen *et al.*, 2022). The one-to-one care of the laboring mother in a supported environment is associated with several improved maternal and infant outcomes and should be encouraged (Turner *et al.*, 2021; Cummins *et al.*, 2022; Swift *et al.*, 2021). There are a few core components of intrapartum care, including emergency obstetric care and pain management in labor (Kapoor *et al.*, 2021; Wright *et al.*, 2021). While strategies for ensuring a supported birthing environment are provided, it is suggested that each hospital or clinical site also have practices that allow a supportive environment for the birthing woman according to her wishes, culture, and testimony (Choudhary *et al.*, 2020; Olza *et al.*, 2020; Lundborg *et al.*, 2024).

The organization of health services for the provision of quality care should pay attention to team care and the importance of communication between the various healthcare providers (Daoud *et al.*, 2022). Intrapartum care is the time when the obstetric care provider, whether an obstetrician or a midwife, or both, must be watchful for and act promptly to deal with any complications and obstetric emergencies that may arise (Haltia-Nurmi, 2024). Being prepared for complications or obstetric emergencies and having a team trained to deal with them can be lifesaving for the woman or newbom (Schaaf *et al.*, 2023). Pain management strategies should be set in accordance with the wishes and needs of the mother (Balogh, 2024). A pain-free beneficial environment might need adequate education regarding pain management strategies in prenatal care (Huang, 2022). Providing information on what strategies are available to support women who are in labor can also be achieved by using a leaflet with information on all opportunities available (Adonteng-Kissi, 2023). Giving birth and being born is a significant and extremely emotional process not only for the woman but also for the newborn baby, and the support of the family and the attending personnel during the time in the maternity hospital, as well as delivering them to the next stage, is of utmost importance (Health Organization, 2022). Care must be given according to the wishes and the physical or material conditions of the person entering motherhood (Kim, 2021). Given that many women give birth in countries other than where they were born, understanding their background, culture, and support can be part of the care provision (Roy and Raj, 2022). Effective anti-discrimination health services in labor and the maternity ward can directly affect the health and

welfare of a child (Health Organization, 2022). Postnatal care and the next chapter, follow-up arrangements, represent a shift from immediate care provision to the next phase (Health Organization, 2022).

3. Common Neonatal Conditions

Neonatal conditions that require treatment by skilled healthcare professionals during the first days, weeks, or months of an infant's life include a wide variety of physiological, infectious, and endocrine processes (Möllers *et al.,* 2022). Keep in mind that this list is not all-inclusive and that many other conditions could be added (Street *et al.,* 2024). Respiratory distress syndrome is a condition that occurs when the lungs are not capable of providing enough oxygen to the body (Morton and Teasdale, 2022). Causes can vary but are most commonly due to immaturity of infant lungs, a lack of surfactant, a prolonged or traumatic childbirth, or a conditional emergent cesarean section (Radke, 2022). The main treatment approaches will depend upon the underlying cause, but all neonatal babies will be monitored closely for signs of distress and apnea (Gonçalves *et al.,* 2020). Patients affected by RDS are most commonly preterm and have had ventilator-assisted deliveries (Demay *et al.,* 2024). The good news is that with early recognition of the signs and symptoms and surfactant therapy, damage to the infants is being avoided (Hunter *et al.,* 2023).

Not all nursing assessments may be predictable, but conditions such as sepsis have seen both short- and long-term outcomes enhanced because of the hard work and research of NICU professionals and workers in neonatal research institutions (Fleischmann *et al.,* 2021). Sepsis is a condition of the body caused by overwhelming infection in the blood (Belachew and Tewabe, 2020). It is difficult to combat sepsis in a neonate because their immune system is not fully active yet, so the infection can wreak havoc (Markwart *et al.,* 2020). Included in the list of complications related to neonatal sepsis are pneumonia, heart, lung, brain, and kidney damage that can affect the individual in later life (Milton *et al.,* 2022). Both gram-positive and gram-negative bacteria are the usual causes of sepsis (Manandhar *et al.,* 2021). The clinical manifestations might be subtle, but the treatment is not (Glaser *et al.,* 2021). Earlier recognition of signs and symptoms and treatment with IV antibiotics are the focus for healthcare officials regarding infantile sepsis (Stoll *et al.,* 2020). Healthcare professionals often work with experts in infectious control when developing policies. Today, less than 1% of all neonates will develop sepsis while in the hospital receiving treatment for their accelerated condition (Blázquez-Gamero *et al.,* 2020). Infants who do survive have a heightened risk for developing neurodevelopmental problems later in life (Blázquez-Gamero *et al.,* 2020). The critical importance of these areas of care is stressed, along with the emotional anguish and struggle against despair that the parents go through when their infants have been issued a terrible diagnosis (Milton *et al.,* 2022). Specialized techniques and caring healthcare providers are just part of the process (Milton *et al.,* 2022). We can now see why, with the development of universal surfactant therapy and ongoing research projects, infants can vastly reduce mortality, morbidity, and pain early in their lives (Milton *et al.,* 2022). Healthcare staff all over are working to develop systems that help to recognize and treat such catastrophic events with speed, without wasting valuable time in the effort to best preserve life (Demay *et al.,* 2024).

3.1. Respiratory Distress Syndrome

RDS is a common respiratory disease of preterm newborns in which the lungs are not able to expand to bring in air (Demay *et al.,* 2024). It is a life-threatening condition that causes breathing difficulty, affects oxygen intake, and must be treated right away (De Luca, 2021). RDS is caused by surfactant deficiency and structural and biochemical immaturity of the lung (De *et al.,* 2021). Surfactant is a substance secreted by type II alveolar cells that reduces lung surface tension during expiration and prevents the lung alveoli and capillaries from sticking when they inflate and deflate (Chen and Chen, 2022). Lack of lung surfactant causes collapse of the alveoli and causes RDS (Bhandari *et al.,* 2023). Factors leading to the development of RDS include age, drug exposure, and antenatal infection (Hallman *et al.,* 2022). The severity of RDS is determined by the pulmonary surface-to-volume ratio at birth (Foligno and De Luca, 2020). Direct risk factors for RDS include the baby being born by cesarean section, maternal colonization with group B streptococci, chorioamnionitis, vaginal bleeding, preeclampsia, and fetal distress (Wright *et al.,* 2022). RDS onset occurs within minutes to several hours and is marked by a number of typical clinical features. The most important aspect of treatment is immediate respiratory support to maintain pulmonary expansion and gas exchange (Sammour and Karnati, 2020). Since the 1970s, the number of premature babies with serious RDS needing aggressive respiratory care due to the lack of surfactant has been reduced following advances in neonatology (Schulzke and Stoecklin, 2022). However, babies born at low-resource centers can have primary RDS associated with a high mortality rate due to mechanical ventilation support (Schulzke and Stoecklin, 2022). Prophylactic surfactant replacement therapy and treatment with capsulated surfactant or surfactant inhaled using the new devices, high-flow nasal cannula and nasal continuous positive airway pressure, which are less invasive than intubation, reduce the need for continuous mechanical ventilation and decrease RDS mortality rates (Sammour and Karnati, 2020). More clinical studies will aid in the development of a more effective method for prenatal and postnatal RDS prevention (Sammour and Karnati, 2020). Caregiving is very similar to the previous subtitle (Bhandari *et al.,* 2023).

3.2. Neonatal Sepsis

Neonatal sepsis is, superficially, an infection of the blood affecting newborns (Celik *et al.,* 2022). In actuality, sepsis affects all major systems and metabolic processes, making it a life-threatening condition for affected neonates (Raba *et al.,* 2020). Sepsis tends to develop during the first month of life, with infections being the leading cause of death in this vulnerable population (Hammitt *et al.,* 2022; O'Reilly *et al.,* 2022). The two primary forms of neonatal sepsis—early-onset sepsis (EOS; developed within 72 hours of birth) and late-onset sepsis (LOS; arising after 72 hours of life)—manifest differently and are associated with differing risk factors (Ross and Kimberlin, 2021; Zhou *et al.,* 2023). Early-onset sepsis is generally vertically transmitted through the mother, with amniotic infections being a likely source (Gabriel *et al.,*2020; Malcangi *et al.,* 2022). GBS, PROM, pyrexia, and prolonged or premature rupture of membranes increase the infant's risk profile (Shaikh *et al.,* 2020; More *et al.,* 2022).

Neonatal sepsis presents with a variety of non-specific symptoms and signs. Some early warning signs include fatigue, poor sucking ability, grunting when breathing, and slow thinking (Conti *et al.,* 2020). Untreated, early-onset sepsis can lead to a severe, systemic infection in neonates, with severe cases leading to changes in vital signs and organ dysfunction (Peshimam and Nadel, 2021). In the LOS presentation of neonatal sepsis, more non-specific symptoms need to meet diagnostic criteria (O'Dea *et al.,* 2020). If diagnosis hinges on these non-specific symptoms, sepsis may be mistaken (both over- and under-diagnosed) (Cai *et al.,* 2020). The potential for rapid progression to severe illness in instances of neonatal sepsis means blood cultures can be important in diagnosis (Khosrojerdi *et al.,* 2021). This can also be used to adapt treatments (Borankulova and Sazonov, 2024). Typically, the first-line defense in treating sepsis is broad-spectrum antibiotics (assuming clinical evidence of sepsis) (Oumer *et al.,* 2022). Time to the initial treatment of sepsis and the length of therapy can affect outcomes at discharge and post-discharge (Beudeker *et al.,* 2022). Children who have had GBS and late-onset sepsis need hyper-vigilant monitoring for long-term effects (Beudeker *et al.,* 2022). There is a recommendation to highly adopt the sepsis prevention bundles with evolved evidence basis and establish training programs to encourage evidence-based practice (Beudeker *et al.,* 2022). There is also a consensus on the need to train staff in recognizing sepsis (Beudeker *et al.,* 2022).

4. Ethical Considerations in Neonatology

Ethical considerations in neonatology cover a range of moral dilemmas in healthcare provision to vulnerable newborns and their families (Hill *et al.,* 2020; Murray and Swanson, 2020). Beneficence, the duty of care, doing 'good', non-maleficence, avoiding harm, autonomy, the ability to make choices based on information provided, and justice, professional fairness, are often viewed as the major guiding ethical principles in healthcare provision (Mills and Cortezzo, 2020; Reich, 2020). Informed consent is necessary for medical professionals to provide a recommended treatment or intervention, and parents have the right to refuse any medical intervention offered (Eekelaar, 2020; Page *et al.,* 2020; Alderson, 2023). For interventions with neonates, parents are usually considered the substitute decision-makers for their child, as the law recognizes infants as legally incompetent (Lundberg *et al.,* 2021; Vill *et al.,* 2021; Ruiz and Bell, 2022).

It is an ethical breach to proceed with treatment without discussing the proposed intervention with the parents, to inform them of all discernible risks, benefits, and alternatives, and to solicit their consent (Zarkowski and Aksu, 2021). However, in critical care situations, it is often difficult to clearly separate the decision-making process as there is often very little evidence or certainty around the effectiveness of a particular therapy for a critically unwell neonate (Vanwymelbeke *et al.,* 2023). As an infant may deteriorate very quickly, requiring action before all uncertainties can be resolved, information will be provided on an ongoing basis to the legally responsible decision maker, even while treatment has begun (Benedetti and Marron, 2021). Making a decision in the best interests of officially incompetent patients, and respecting parents' views when these are known, are usually guiding ethical principles in pediatric critical care (Cao *et al.,* 2023). Members of the healthcare team must maintain a supportive and non-judgmental approach to the parents, with the primary goal of providing excellent medical therapy for the neonate and supporting the parents through this difficult period of their time with their child (Maragakis *et al.,* 2021). Resource allocation in healthcare is an area of ongoing debate and reflects issues of social justice (Kelly *et al.,* 2024). The financial burden and the technical proficiency of offering specific neonatal services to different patient populations is a matter of discussion in resource-rich countries (Joseph *et al.,* 2022). The ethical aspects of resource allocation in a cost-effective way form part of such a discussion (Bateman-House *et al.,* 2023). In less developed countries, such issues are those of distributive justice, as in some areas there is not a sufficiency of service to distribute, in terms of availability and resource allocation between less well-off rural populations and the more affluent urban populations (Longo *et al.,* 2021).

The moral and ethical dilemmas in the provision of neonatal care have been increased by advancing technology (Mills and Cortezzo, 2020). As scientific and technological breakthroughs have led to increased survival of infants and neonates, many premature, with a range of problems, the dilemmas have increased (De *et al.,* 2023). While such high technology is saving the lives of ever more premature babies, to an extent never before dreamed of, such technology is often associated with prolonged periods of hospitalization and

considerable suffering; not only for the infants, but also for families who are often literally watching their infant's life hang in the balance (Di Stefano *et al.,* 2020). In the increasingly technical setting of newborn medicine, with its inevitable choices and boundaries, it is increasingly necessary to have an ethical framework to guide practice and training (Batey *et al.,* 2024). This ethical framework can be seen as a scaffolding which provides a basis on which to extend with case details and experiential knowledge and expertise with a specific family and infant (Sullivan and Cummings, 2020). The unique details of the case narrow the probable options down and often one may be faced with a situation where eventually only one option is sensible and ethical. Below are two case descriptions outlining some of the dilemmas in managing neonates (Jia *et al.,* 2021; Shen *et al.,* 2021; İlter *et al.,* 2024).

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