

Okolo AA  
Okonkwo IR  
Ideh RC

## Challenges and opportunities for neonatal respiratory support in Nigeria: a case for regionalisation of care

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Okolo AA (✉)  
Okonkwo IR, Ideh RC  
Department of Child Health,  
University Benin Teaching Hospital  
Benin-City, Nigeria.  
Email: [angelneneo@yahoo.com](mailto:angelneneo@yahoo.com)

**Abstract:** *Background:* Neonatal health appears not to have received the deserved attention in the context of the Child Survival Strategies and this must have contributed to the non-attainment of the MDG-4 in Nigeria. Neonatal mortality contributes 40% or more to the current rate of child deaths globally, with birth asphyxia, prematurity and its complications and severe infections as the leading causes. This emphasises the need to re-focus on neonatal health.

Given the state of the economy in the low- and middle-income countries, Nigeria, like most of the other countries lack the resources required for efficient neonatal health care with minimal attention on the strategies needed to address the major causes of newborn death.

*Objectives:* To assess the contemporary situation of neonatal care in Benin City, Nigeria and examine diverse approaches to be adopted to provide high level neonatal care services aimed at improving neonatal survival rates.

*Methods:* The trends of neonatal morbidities and mortality over the period between 1974 and 2014 were studied by reviewing the hospital records covering admissions and weekly mortality records. The pattern of categories of babies and the causes of death were recorded. The information gathered identified the gaps in the management strategies for newborns over the years. Electronic databases such as the Medline and Pubmed were searched for relevant literatures published between 1960 and 2015 which might provide ideas required to fill the gaps.

*Results:* In the 1974-1976 era, the major cause of neonatal mortality at the University of Benin Teaching Hospital (UBTH), Benin City, Nigeria, was birth asphyxia with an attendant perinatal mortality of 80.9/1000 births. The decline in the perinatal mortality to 33.4/1000 births between 1976 and 1980 was linked to the introduction of delivery room resuscitation with a reciprocal decline in the incidence of birth asphyxia. Thereafter, neonatal mortality rate has continued to increase. This increase could be attributed to a three-fold rise in the proportion of very preterm admissions from 6.5% in 1985 to 19.3% in 2013. This population of babies is predisposed to Respiratory Distress Syndrome and respiratory failure.

Neonatal intensive care did not include respiratory supports until very recently (2013) when the facilities were provided but at high cost to the patient and the health system.

*Conclusion:* The strategies required to address reduction in neonatal mortality rates should necessarily include neonatal resuscitation and mechanical ventilation, all within the context of Neonatal Intensive Care. In order to provide the full range of neonatal intensive care services in a resource-constrained setting such as Benin City, Nigeria, regionalisation of care in a stepwise manner is recommended, both for improved medical outcomes and economic realities.

**Key words:** Challenges, Neonatal ventilatory support, Regionalisation of care

## Introduction

Several studies have highlighted the high rates of infant and young child mortalities in sub-Saharan Africa<sup>1-4</sup>. Indeed this is clearly reflected by the fact that majority of these countries did not meet the MDG 4.<sup>5,6</sup> In an attempt to meet the MDGs, resources were directed into improving maternal and child health in the last decade. This action contributed to a significant decline in maternal and child mortality rates but the decline was less for newborn deaths which also declined but at a very slow pace as maternal health and child survival programs received greater attention<sup>4-6</sup>. Neonatal mortality contributes 40% or more to the current rate of child deaths globally<sup>5,6</sup>. This emphasises the need to re-focus on neonatal health.

Given the state of the economy in the low- and middle-income countries, Nigeria, like most of other countries, lack the resources (material, manpower and financial) require for optimal newborn care services. Therefore, the newborn care physicians in Nigeria need to be innovative, learn to apply the basic principles of child health and adopt a holistic approach in their practices. This group of practitioners cannot rely too much on the availability of equipment and other facilities, as it obtains in the high-income parts of the world, to impact on newborn care in their setting.

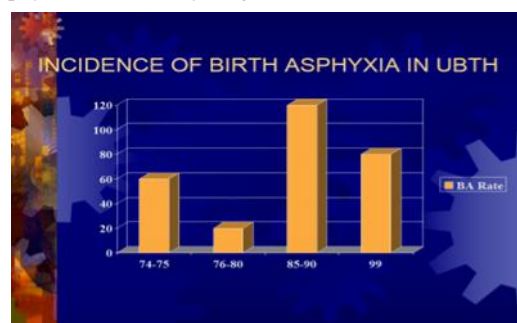
In the efforts to improve the quality of routine newborn care, the standard of care provided for sick newborn infants and improve neonatal survival rates, several new approaches need to be adopted and adapted to boost the basic principles of paediatrics and child health. The high rates of mortality and morbidity among infants and under-five children accrue from the very high neonatal mortality rate (NMR)<sup>2,5</sup>. The major causes of neonatal morbidities and mortality in Nigeria have not changed over time. Birth asphyxia (27%), prematurity and its complications (25%), severe infections (23%) including diarrhoeal diseases (4%), Tetanus (8%) and Jaundice (8%) are largely responsible for early neonatal deaths in Nigeria<sup>6</sup>. Efforts to address some of these underlying causes of mortality among infants and young children through the Child Survival Strategies (CSS) gave less attention to neonatal health<sup>4</sup>. Other contributory factors like the poor health-seeking behaviour of women<sup>7</sup>, low hospital delivery rate with a low skilled attendance at birth (ranging from 35% to 40%), were not directly addressed by the CSS.<sup>6,7</sup>

In the past, in Nigeria, only major teaching hospitals provided neonatal care services including routine care of well newborn infants. Although sick babies were cared for in the neonatal ward, sophisticated and highly-specialized neonatal care facilities were not available. In addition, delivery room resuscitation of the newborn was not routinely done. Therefore, birth asphyxia, prematurity, sepsis, respiratory disorders and jaundice were the major killers of newborn babies.<sup>8</sup>

## The Benin-City Case study

Birth asphyxia has been the leading cause of perinatal mortality since 1974<sup>8-10</sup>. Between 1976 and 1980, neonatal mortality trends significantly declined with a reciprocal drop in perinatal mortality rate (PMR) and a decline in cause-specific mortality in birth asphyxia. This observed decline in PMR rates could be attributed to the introduction of basic perinatal health measures in late 1975. In the 1980s and the 1990s, neonatal mortality declined due to a decrease in the loss of bigger babies. Specialized teams were available for care in the delivery room<sup>8-10</sup>. Early use of assisted ventilation was available in the mid-1980s but it was not sustained over time. However, a few babies weighing less than 1000gm were salvaged. The mortality rate for the crop of babies weighing less than 1000gm was greater than 90% while the mortality rates for babies less than 1500gm was greater than 60%. Therefore, these group of babies contributed the bulk of neonatal mortalities<sup>9</sup>.

**Fig 1:** Bar chart showing the trends of the incidence of birth asphyxia in Benin City, Nigeria



By 1990, it was realized that further reductions in neonatal mortality could not be achieved unless attention was shifted to the care of the Extremely Low Birth Weight (ELBW) infants using intensive care facilities, particularly, respiratory support<sup>10,11</sup>. This management strategy was instituted in 2013 and small babies are now ventilated in the context of neonatal intensive care unit.

## Mechanical Ventilation

This form of newborn care often requires other advanced modalities of care in the context of neonatal intensive care, which makes it quite expensive<sup>11</sup>. This form of care is capital intensive both to the health system and to the individual patients. The neonatal intensive care requires ancillary supportive care and efficient team work. Such care, rudimentary as it may be, should be provided in the context of a minimum standard of care at a Level-II facility. At this level of neonatal care, not only increasing technology is required but also meticulous nursing services, new professional techniques and team approach<sup>12</sup>. Ideally, oxygen saturation and other multiple parameters should be monitored when humidified oxygen is administered to babies, even when arterial blood gas (ABG) measurement is impossible. The neonatal intensive care unit team must have the skills to intubate babies rapidly and provide

endotracheal toileting and other supportive care as required. More importantly, skills for the safe and effective use of infant ventilators without causing lung injury and oxygen toxicity are essential<sup>13</sup>.

*What is Neonatal Intensive care Unit (NICU) and what types of Neonatal Units are available?*

The NICU is an intensive care unit specialized in the care of ill newborns within the first 28 days of life. The first official Intensive Care Unit (ICU) for neonates was established by Professor Mildred Stahlman at the Vanderbilt University in 1961<sup>14</sup>. At the same time in the US, the first NICU was established and was so recognised while Stahlman was the first to use a ventilator to assist a baby with breathing difficulties<sup>14</sup>.

In addition to trained neonatologists, other cadres of specialist doctors and nurses also work in the NICU as necessary. In the least, this group of health workers must be able to provide neonatal resuscitation. Following the introduction of intensive care into newborn care in the US, neonatal mortality has fallen more than four-fold from 18.73 per 1000 live births to 4.04 per 1000 live births in 2012<sup>15,16</sup>. Much of this decline can be attributed to the highly specialised care provided for preterm and sick newborn babies by the neonatologists and the multidisciplinary teams in the NICU<sup>17,18</sup>.

NICUs are categorised according to the scope of care available in such units. For example, Level-I facility provides and supports basic care needs of newborn babies<sup>12</sup>. While Level-II facility provides special care needs, Levels III and IV are more demanding as more material and human resources are required to function<sup>12</sup>. These levels provide comprehensive on-site access to subspecialty consultants, performance and interpretation of advanced imaging tests such as computed tomography, magnetic resonance imaging and echocardiography on urgent basis. Other procedures in NICUs include extracorporeal membrane oxygenation, haemofiltration and haemodialysis, or surgical repair of major congenital cardiac malformations which require cardiopulmonary by-pass<sup>12</sup>.

In high-income countries, most NICUs now concentrate on the care of critically-ill neonates and the very small infants<sup>14</sup>. Premature labour, and its prevention, remain a major challenge for doctors<sup>19</sup>. Even though medical advances have made the survival of low birth weight babies more possible, it is better to delay such premature births<sup>19</sup>. No doubt, the use of NICUs have greatly increased the survival of very low birth weight and extremely premature infants<sup>20</sup>. In the era preceding the use of NICUs, infants with birth weight less than 1400 grams rarely survived. Today, infants weighing 500 grams at 24 weeks are known to have a fair chance of survival in the more technologically-advanced countries. Indeed, the NICU environment provides challenges as well as benefits<sup>21, 22</sup>.

*The scope of neonatal care services in Nigeria: How do we meet our needs?*

In most centres, the care for babies referred from other health facilities (out-born) is provided largely by different nurses in a unit that is entirely different from what is provided for in-born babies. These units are manned by nurses with less experience in the care of the newborn babies thus, high mortality rates in such units may not be surprising.

The rudiments of efficient neonatal care were not available in major centres until about the mid-1960s. In 1974 precisely, in UBTH, Benin City, the training of paediatric resident doctors in neonatal resuscitation and mandatory attendance at high risk deliveries was instituted. This development made significant impact on the Newborn Mortality Rate (NMR) in the hospital. Newborn care was centralised in the same area of the hospital, though in different wards. This development was also extended to include the training of nurses to provide specialized neonatal care. Today, paediatric residents perform delivery room resuscitation of high risk neonates as the standard of care and this has been shown to have contributed to the decline in the morbidities associated with birth asphyxia at some point. These efforts need to be improved upon to achieve further reduction in the incidence rates of birth asphyxia<sup>8-10</sup>.

*What do we have in the other parts of Nigeria?*

A present day challenge is coping with the increasing number of preterm admissions with the decline in the number of bigger babies requiring admission<sup>8,23</sup>. The various reasons advanced for the increase in preterm admissions include increasing use of assisted conception and in-vitro fertilisation with high rates of multiple gestation, general increase in birth rates, urbanisation, increase health care-seeking awareness and better utilization of health services for high risk situations<sup>24-27</sup>. Majority of these babies, as high as 85 to 90%, present with varying degrees of respiratory distress culminating in respiratory failure and death in more than 50% of such cases.

*How have we met the needs for respiratory support?*

How many of the neonatal units in Nigeria provide basic respiratory support using the least device for bubble continuous positive airway pressure (bCPAP)? There are currently very few of our care units equipped to provide basic respiratory support for the newborn. Indeed, the use of the bubble Continuous Positive Airway Pressure (bCPAP) as the least respiratory support device is highly limited. There are currently very few neonatal units in Nigeria which use exogenous surfactant for respiratory distress syndrome among very immature babies despite the global acceptance of this therapy. The characteristics of babies in newborn units keep changing; currently, it is usual to have a mixed population of large sick babies as well as ELBW babies whose morbidities are variable<sup>28</sup>.

### *The constraints to the provision of Respiratory Support*

A major constrain in the provision of neonatal respiratory supports is the low level of resources required to sustain and support such care<sup>17,11</sup>.

Material resources may be insufficient or not available. The material resources and equipment required, aside the ventilators and CPAP machines, include infant incubators, infusion pumps syringe drivers, multi-parameter monitors and ABG monitors. These equipment are very expensive<sup>17</sup>. Ventilators, depending on the make, cost on the average between five and nine million Naira while the CPAP machine costs between two and four million Naira<sup>29</sup>. Where the ventilators are available, use may be hindered by incomplete accessories and lack of concrete arrangements for after-sales supports and maintenance. The equipment may be unsuitable for the environmental peculiarities in Nigeria, hence they may be damaged by power outages. On the other hand, the model of equipment may be obsolete and thus, may not be serviceable when the need arises.

### *Infrastructural arrangements are inadequate*

Most newborn units are not purpose-built and may not be in close proximity to the delivery suites in the maternity units. The neonatal units may be space constrained and thus, may not have the capacity for mechanical ventilation. Infection control measures may also be difficult to implement. There may also be lack of piped oxygen or air or other sources of oxygen supply to the neonatal unit. The ambiance may be non-conducive and the unit may have poor air conditioning/ cooling system which is unsuitable for the temperature- and humidity-sensitive machines and equipment. Some of the equipment are not conditioned for harsh tropical climatic conditions and may deteriorate with hot and humid weather conditions. The incessant power outages affect the electrical components of machines and indicate the need for back-up power sources.

### *Un-met human resource needs*

Manpower resources are in short supply as there are insufficient numbers of doctors adequately trained in highly specialised neonatal care to provide the needed services.

Similarly, there is the dearth of nurses trained in neonatal intensive care services. This implies inability to meet the recommended nurse-to-patient ratio for efficient nursing care at the Levels II and III settings<sup>12</sup>.

In addition, there is a dearth of biomedical engineers in most institutions hence, maintenance services for the equipment in the NICU may be difficult to come by.

When these equipment breakdown, NICU activities maybe disrupted. This renders support services for ventilator care precarious, not prompt, or unavailable. Even breathing circuits became available in Nigeria, only recently, as most centres have been highly dependent on the importation of such materials. Indeed, the available ancillary services are rudimentary. Capacity should be developed for all level of personnel particularly where

Level-III facilities are available; such NICU should provide mechanical ventilation beyond CPAP by nasal prongs<sup>12</sup>.

### *Unfavourable Policy environment*

Policy and management issues are a challenge as relevant policies are almost non-existence. Neonatal care is capital intensive. Both the overhead cost and maintenance cost are quite high and the returns to service are not commensurate with the level of investment made. The cost of care is high both to the system and to the individual patient's family who often have to pay out-of-pocket.

### *Financial Resources are lacking<sup>11</sup>*

Financial resources are lacking but resources can be committed, in all its ramifications, to provide the needful for ventilator support and care in the context of the NICU in Nigeria.

Resources are needed for the development of infrastructure, procurement and maintenance of equipment, capacity building and the strengthening of human resources management. Policy and management challenges should be addressed and social support services should be provided for the users.

### *Proposed Solutions include*

The centralisation of care and investment in a concerted effort and approach is desired. This will enable the implementation of a phase approach to the introduction of change in practices. Regionalisation of such essential care<sup>12,18</sup> which may not be made available at all the centres may be a way of reducing costs at the Federal level. The States may wish to develop Private-Public Partnerships to grant the immediate catchment population access to such care. In addition, the state governments may provide Level-II neonatal care.

The foreseen benefits of the provision of highly specialized neonatal care in Nigeria are numerous. In the economically advanced countries, investments are made in the development of care and research. Significant mortality from respiratory disorders impaired the attainment of the Fourth MDG for most countries of Sub-Saharan Africa, including Nigeria<sup>1</sup>.

If neonatal mortality must decline considerably, health planners and administrators must invest in the provision of ventilator care in the critical care of high-risk newborn babies<sup>17</sup>. The loss of vulnerable newborns translates to huge economic losses as the nation, by extension, is deprived of potential manpower for workforce and economic development<sup>1,2</sup>.

At the family level, such losses also translate to the impoverishment of the family and a health risk for the mothers who would desire another pregnancy to replace the lost babies.

These issues imply increased utilisation of the health resources and depletion of economy, which in turn translates to high mortality indicators for the country

and shifts the country lower down in the global ranking of healthy nations.<sup>1</sup>In the Nigerian setting, now is the time to focus on how the need for ventilator support as a crucial part of neonatal care services, could be met and be made appropriate for the identified level of care

## Conclusion

The number of preterm babies admitted to neonatal care units is on the rise coupled with a decline in the number of larger babies requiring hospitalisation. Therefore,

there is a cogent need to address the quality of the management of respiratory morbidities to reduce the mortality arising from them. This can be achieved by providing efficient respiratory support care. The regionalisation of such highly specialized care at specific tertiary regional centres may reduce costs whilst secondary level centres could offer basic respiratory support with the bCPAP. In the same vein, it is attractive to propose the regionalisation of full intensive care support for the Nigerian newborn babies.

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