

Original Article

Spectrum and Outcome of Neonatal Emergencies Seen in a Free Health-Care Program in South-Western Nigeria

MT Abiodun, RO Oluwafemi¹

Department of Child Health, University of Benin Teaching Hospital, Benin City, Edo State, ¹Department of Paediatrics, Mother and Child Hospital, Akure, Ondo State, Nigeria

ABSTRACT

Background: Neonatal emergencies contribute significantly to under-five morbidity and mortality in developing countries, partly due to poverty and limited access to quality healthcare in rural communities. **Aims:** The aim is to evaluate the spectrum, outcome, case fatality rates (CFRs), and prognostic factors of neonatal emergencies seen in the two free health-care facilities in Ondo State. **Methods:** This was a cross-sectional descriptive study of neonatal emergencies. Data were collected on eligible consecutive infants using a self-designed questionnaire. Neonatal emergencies were classified based on systemic involvement and underlying causes. Categorized data were expressed as percentages. Outcome and CFRs were presented pictorially. Inferential analysis was performed. The value of $P < 0.05$ was considered statistically significant. **Results:** Altogether, 425 infants with neonatal emergencies were recruited, constituting 21.3% of the under-five medical emergencies managed during September 2014 to February 2015. The most frequent emergencies were neonatal sepsis (45.2%) and neurological emergencies, especially hypoxic ischemic encephalopathy (22.1%) and acute bilirubin encephalopathy (14.6%). Furthermore, 6.1% of the infants presented with disseminated intravascular coagulopathy. The outcome of the emergencies was as follows: 88.6% were discharged, 7.4% died, and 3.7% left against medical advice whereas 0.3% were referred for subspecialty services. The leading causes of death among the 32 mortalities in this survey were sepsis (39.5%), hypoxic ischemic encephalopathy (36.9%), and hypothermia (13.2%). Hypothermia, perinatal asphyxia, and hypoglycemia had the highest CFRs, 22.7%, 12.6%, and 11.8%, respectively. **Conclusion:** Neonatal encephalopathy and sepsis were the most common emergencies seen in the free health-care program. Furthermore, they accounted for a majority of the neonatal deaths. This should be taken into cognizance while designing local interventions for neonatal emergencies.

KEYWORDS: Free health-care program, neonatal emergencies, outcome, spectrum

Acceptance Date: 09-05-2016

INTRODUCTION

Neonatal emergencies contribute significantly to under-five morbidity and mortality in developing countries.^[1] There are 3.82 million neonatal deaths each year globally.^[2] The World Health Organization estimated that over 90% of these neonatal deaths occurred in developing countries.^[2,3] Annually, 276,000 neonates die in Nigeria constituting 8% of the global burden.^[4,5] The leading causes of neonatal deaths include sepsis, perinatal asphyxia, prematurity, and neonatal jaundice.^[4-7] In eastern Nigeria, Anyanwu *et al.* found that sepsis and prematurity accounted for most of the neonatal deaths that occurred in their series.^[8] Furthermore, Guerrier *et al.*

in 2014 reported a similar trend in an emergency health-care program in northern Nigeria.^[9] This scenario can be reversed by improving and synchronizing available services in low-income countries to provide a continuum of care from conception till childhood.

The high burden of neonatal deaths in sub-Saharan Africa is often due to poor health-seeking behavior,

Address for correspondence: Dr. MT Abiodun, Department of Child Health, University of Benin Teaching Hospital, Benin City, Edo State, Nigeria. E-mail: biodunmt@yahoo.com

This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Abiodun MT, Oluwafemi RO. Spectrum and outcome of neonatal emergencies seen in a free health-care program in South-Western Nigeria. *Niger J Clin Pract* 2017;20:283-9.

Access this article online	
Quick Response Code: 	Website: www.njcponline.com
	DOI:10.4103/1119-3077.187324

poverty, late postnatal visits, and limited access to quality healthcare in communities.^[10,11] Therefore, poor outcome of neonatal emergencies can be prevented by identifying at-risk pregnancy during antenatal care, ensuring adequate monitoring during labor and prompt neonatal resuscitation as well as optimal care of ill neonates.^[12-14] Zimba *et al.* reported significant reduction in Malawi's neonatal mortality rate through a community-based Maternal and Newborn Care package.^[15] Hence, easy access to affordable antenatal and neonatal services is a viable tool to improve child health indices of a population.

Consequently, the Integrated Maternal, Newborn and Child Health (IMNCH) initiative was launched in Ondo State, Nigeria, in 2009 as a free health-care program to improve the availability of high-quality antenatal and neonatal services in the setting.^[16] Postimplementation evaluation found that the proportion of live births attended by skilled health personnel increased from 51% in 2008 to 67% in 2013 with favorable impacts on obstetric emergencies.^[16,17] The effects of this novel initiative on the burden of neonatal emergencies had not been previously determined in our setting. This article reports a study that evaluated types, case fatality rates (CFRs), and prognostic factors of neonatal emergencies seen in the two cost-free IMNCH facilities in the state.

METHODS

Study setting and participants

The study was carried out at the Mother and Child Hospitals (M and CHs) in Akure and Ondo towns. These are busy, 100-bed, ultra-modern public facilities with level II Neonatal Intensive Care Units (NICU) providing specialized free health-care services to people in the state capital, allied communities and neighboring states in the South-Western Nigeria. They were established to implement IMNCH interventions in the state.

Akure is the state capital of Ondo State, located in the South-West geopolitical zone of Nigeria with land area of 15,000 km². The state has a population of 4.1 million (estimated 47.1% are children) and a total fertility rate of 5.^[17,18]

This cross-sectional descriptive study was carried out from September 2014 to February 2015. Ethical clearance was obtained from the Research and Ethical Committee of the M and CH Akure. The participants were all consecutive inborn neonatal infants with emergencies and those referred from lower health facilities, admitted to the NICUs during the study. Neonatal emergency was defined as the presence of a potentially life-threatening systemic disorder or anomaly in the first 28 days after birth.^[19] Prematurity alone was not considered an emergency in

this study if the infant was stable.^[19] A minimum sample size of 385 was calculated by assuming the prevalence of emergencies as 50% among neonatal infants seen in the free health-care program, a 95% confidence interval (CI) and a sample error of 5%. A total of 425 neonates were recruited for this study.

Data collection

Data were collected on every neonatal emergency using a structured 28-item questionnaire comprising of three sections: Demographic/antenatal history, types of emergency, and short-term outcome. Neonatal emergencies were categorized based on systemic involvement and underlying causes, using the mnemonic "THE MISFITS:"^[19] Trauma, heart disease/hypoxia/hypovolemia, endocrine, metabolic, inborn errors of metabolism, sepsis, formula mishaps, intestinal catastrophes, toxins/poisons, and seizures. The diagnosis of hypoxic ischemic encephalopathy was based on Sarnat and Sarnat's criteria;^[20] whereas acute bilirubin encephalopathy was based on the presence of hyperbilirubinemia and neurologic dysfunctions.^[21] Probable (clinical) sepsis was defined as the presence of risk factors and abnormal complete blood count in a symptomatic infant;^[22,23] severe sepsis comprises disseminated intravascular coagulopathy (DIC) and septic shock.^[24] meningitis was diagnosed based on cerebrospinal fluid (CSF) microscopy, elevated CSF protein (≥ 180 mg/dl), and reduced CSF glucose.^[25] Hypoglycemia was defined as blood glucose < 50 mg/dl.^[26] Ultrasound scanning and radiologic imaging were done when indicated. Socioeconomic classification of the infants was based on parents' occupation/educational level.^[27] Clinical records and laboratory reports of the participants were reviewed to document their definitive diagnoses. Follow-up phone calls were made to caregivers by trained research assistants verifying the outcome of referred cases after 48 h of leaving the MCHs.

Data analysis

Data were entered into an Excel sheet and later analyzed using SPSS version 20.0 statistical software for Windows (IBM, Armonk, NY, USA). Gender, socioeconomic class, and place of delivery were presented as percentages. Outcome and CFR's were presented pictorially. Using multiple logistic regression, odds ratio (OR) and 95% CI were calculated for some variables as possible predictors of mortality among the neonatal emergencies. The value of $P < 0.05$ was considered statistically significant.

RESULTS

Altogether, 425 infants with neonatal emergencies were recruited, constituting 21.3% of the 1996 under-five

medical emergencies and 46.6% of the 913 neonatal admissions during the study. The mean birth weight of the infants was 2.8 ± 1.1 kg while their mean estimated gestational age (EGA) was 39.0 ± 4.0 weeks. Furthermore, 337 (88.5%) of them were term (≥ 37 weeks), 24 (6.3%) were preterm (32-36 weeks) and 20 (5.2%) were very preterm (< 32 weeks); 224 (60.5%) were normal birth weights (≥ 2.5 kg), 124 (30.6%) were low birth weight (1.5-2.5 kg) and 36 (8.9%) were very low birth weight (< 1.5 kg). Their mean age at presentation was 5.8 ± 9.4 days (median = 2.0, interquartile range = 5). Also, 350 (82.4%) of them were inborn while 75 (17.6%) were outborn babies. A majority (77.2%) of the infants were in the low socioeconomic class [Table 1]. Maternal systemic illnesses (hypertension, diabetes mellitus, and viral hepatitis) were present in 27 (6.4%) of the infants.

Spectrum of neonatal emergencies

Neonatal sepsis (45.2%), hypoxic ischemic encephalopathy (22.1%), acute bilirubin encephalopathy (14.6%) and DIC (6.1%) were commonest emergencies found in the infants. Sepsis comprised meningitis, neonatal tetanus, urinary tract infections, and pneumonia. Seizures occurred as a manifestation of underlying neurological disorders in 4% of participants. Necrotizing enterocolitis was diagnosed in

2% of them. Also, 22 (5.2%) infants had hypothermia and 15 of them were preterm infants, comprising 9 (60.0%) outborn and 6 (40.0%) inborn. Again, hypoglycemia occurred in 17 (4.0%) of the infants, commoner in the preterm than term babies, 11 (64.7%) versus 6 (35.3%). Other rare neonatal emergencies in this case series include major congenital malformations, endocrine disorders, and accidental injuries [Table 2].

Outcome of neonatal emergencies

The outcome of the emergencies was as follows: 88.6% were discharged, 7.4% died, 3.7% left against medical advice while 0.3% were referred to tertiary institutions for surgical and other subspecialty services [Figure 1] a. Available feedbacks on the outcome of neonates who were referred from our facility during the study showed that 7% died within 24 h of arrival at the receiving facility while 5% survived beyond 24 h [Figure 1b].

Causes of neonatal death and their case fatality rates

The leading conditions associated with the 32 mortalities in this survey were sepsis (39.5%), hypoxic ischemic encephalopathy (36.9%), and comorbid hypothermia (13.2%). Hypoglycemia accounted for 5.2%, whereas neonatal jaundice and severe sepsis (DIC and septic shock) constituted 2.6% of the deaths, respectively.

Figure 2 shows the CFR's of the neonatal emergencies seen in the two hospitals. Hypothermia, hypoxic ischemic encephalopathy, and hypoglycemia had the highest CFR's, 22.7%, 12.6%, and 11.8%, respectively. These were distantly followed by sepsis (5.4%), severe sepsis (3.9%), and neonatal jaundice (1.6%) in the hospitals.

Table 1: Baseline characteristics of the participants

Characteristics	Frequency, n	Percentage
Age (days)		
Mean±SD	5.8±9.4	
Sex		
Male	233	54.8
Female	192	45.2
Birth weight (kg)		
Mean±SD	2.8±1.1	
≥2.5	224	60.5
1.5-2.5	124	30.6
<1.5	36	8.9
EGA (weeks)		
Mean±SD	39.0±4.0	
≥37	337	88.5
32-36	24	6.3
<32	20	5.2
Socioeconomic class		
Low	328	77.2
Middle	82	19.3
Upper	15	3.5
Place of delivery		
M&CH	350	82.4
TBA	1	0.2
Home	8	1.9
Others [†]	66	15.5

[†]Mission houses, inside the car, farmland, peripheral primary health centers, etc. SD=Standard deviation; EGA=Estimated gestational age; TBA=Traditional birth attendants

Table 2: Pattern of neonatal emergencies seen in the free healthcare program

Neonatal emergencies*	Frequency	Percentage
Sepsis (meningitis, pneumonia, urinary tract infection)	192	45.2
Severe sepsis (DIC and septic shock)	26	6.1
Hypoxic ischemic encephalopathy	94	22.1
Bilirubin induced neurological dysfunction	62	14.6
Hypothermia [†]	22	5.2
Necrotizing enterocolitis	7	1.6
Intestinal obstruction	3	0.7
Trauma (nonaccidental and accidental)	1	0.2
Endocrine (congenital adrenal hyperplasia, thyrotoxicosis)	3	0.7
Others (respiratory distress syndrome, etc.)	15	3.6

*Only primary diagnoses of the infants at admission were included to avoid multiple entries; hypoglycemia was a common comorbid emergency. Seizures occurred in 4.0% of the infants, [†]Some cases of hypothermia were later managed as neonatal sepsis. DIC=Disseminated intravascular coagulopathy

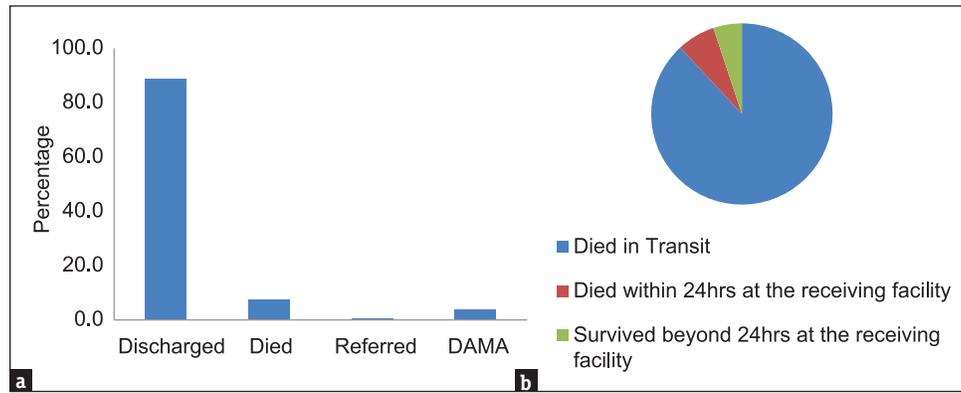


Figure 1: (a) General outcome of the neonatal emergencies, (b) referral outcome of the neonatal emergencies

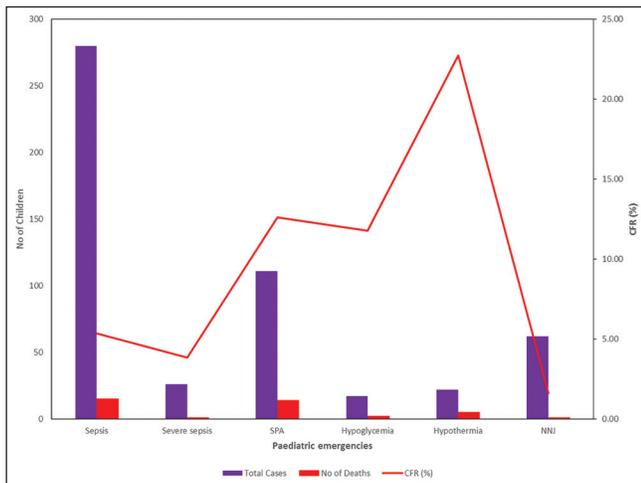


Figure 2: Case fatality rates of neonatal emergencies seen in the free health-care program (SPA: Severe perinatal asphyxia; NNJ: Neonatal jaundice)

Multivariate analysis

Using a multiple logistic regression, the prognostic value of some relevant variables was determined. EGA <32 weeks did not predict mortality in this cohort, OR = 0.38; CI: 0.09–1.67. Likewise, a 5th min APGAR score <6 did not increase the likelihood of death among the infants, OR = 0.44; CI: 0.15–1.30 [Table 3].

In addition, maternal systemic illness, socioeconomic class, booking status, and place of delivery had no significant influence on the outcome of the neonatal emergencies ($P > 0.05$).

DISCUSSION

This study found a wide range of neonatal emergencies. A majority of them were potentially preventable morbidities, similar to the trend noted among postneonatal medical emergencies in the state capital by Oluwafemi and Abiodun.^[28] Neonatal infections accounted for nearly half of the emergencies, consistent with prior reports of high prevalence of neonatal sepsis in the country by Ekwochi

Table 3: Multivariate logistic regression analysis for mortality by selected clinical-demographic characteristics

Variables	Frequency (%)	OR	95% CI	P
Gestational age (weeks)				
<32	8 (8.6)	0.38	0.09-1.67	0.201
>32	85 (91.4)	1.00		
Apgar score 5 min				
<6	16 (34.0)	0.44	0.15-1.30	0.136
6+	31 (66.0)	1.00		
Social class				
Low	65 (75.6)	2.91	0.13-67.61	0.506
Middle	19 (22.1)	1.29	0.05-32.33	0.876
Upper	2 (2.3)	1.00		
Booking status				
Booked	54 (59.3)	0.72	0.28-1.85	0.499
Unbooked	37 (40.7)	1.00		
Place of delivery				
M&CH	80 (86.0)	1.24	0.25-6.14	0.790
TBA/others	13 (14.0)	1.00		
Maternal systemic illness				
Present	7 (7.5)	1.60	0.29-8.88	0.591
Absent	86 (92.5)	1.00		

TBA=Traditional birth attendants; OR=Odds ratio; CI=Confidence interval; M&CH=Mother and Child Hospitals

et al.^[29] in Enugu, Omoigberale *et al.*^[30] in Benin and Okechukwu and Achonwa^[31] in Abuja. This underscores the need to focus on interventions to prevent infections in all ongoing neonatal programs in the country.^[4,32] Likewise, over one-fifth of the infants suffered hypoxic ischemic encephalopathy while others had acute bilirubin encephalopathy. Hence, there is a need to present a

complete health education package to the populace on prevention of these disorders. Avoidance of icterogenic agents and prompt phototherapy will prevent complicated neonatal jaundice.^[29-31] Good-quality intrapartum care and essential newborn care are components of essential interventions needed to attain the intermediate Goal 2020 to reduce preventable neonatal mortality in the subregion.^[33] It is notable that the common neonatal emergencies in developing settings are potentially preventable disorders within the limit of available resources.^[7] This is unlike in developed countries where complications of prematurity and birth defects are the leading neonatal morbidities.^[12,34] Neonatal surgical emergencies were relatively rare in this series perhaps due to the absence of a pediatric surgery unit in the free health-care program.

The overall outcome of neonatal emergencies in this cost-free healthcare program compares favorably with findings in fee-paying facilities elsewhere.^[30,31] Consistently, eight out of every ten neonatal emergencies were successfully managed and discharged home in this survey. The death rate of 7.4% was lower than the overall mortality rates of 20.3% reported by Omoigberale *et al.*^[30] in the Special Care Baby Unit (SCBU) of University of Benin Teaching Hospital and 13.3% by Okechukwu and Achonwa^[31] in the SCBU of University of Abuja Teaching Hospital, Nigeria. However, this may be due to the higher proportions of preterm neonates in their series. Also, we did not monitor long-term outcome of the survivors in our study. Moreover, most of the infants referred from our center to tertiary institutions died in transit, perhaps due to suboptimal intra-transport stabilization. Furthermore, prior researchers found that undue delays in making or implementing referral decisions often lead to poor outcome of referred cases.^[35] This can partly be due to reluctance of indigent caregivers to promptly transfer infants to fee-paying centers after referral. Hence, there is a need to subsidize pediatric services including neonatal care in tertiary institutions nationwide.^[36] Also, routine use of a neonatal severity of illness scoring comparable to the Paediatric Early Warning System score would enhance referral decision making by frontline clinical staff in lower health facilities.^[35]

Furthermore, over three-quarters of the deaths are due to perinatal asphyxia and sepsis. This shows the need to ensure that births are conducted by only trained health personnel in peripheral facilities adequately equipped for neonatal resuscitation. Also, hygienic newborn care including the use of proven interventions like chlorhexidine ointment should be promoted in the hospitals.^[14] Despite the availability of free antenatal and delivery services in our setting, some patients present

late in labor with prolonged rupture of membrane, chorioamnionitis and other risk factors for newborn compromise, as observed in our monthly Hospital Morbidity and Mortality Review Meetings. This highlights the need to continue to educate the society on the importance of good health-seeking behavior. Again, hypoglycemia and hypothermia had the highest CFRs in this survey, especially among outborn preterm infants from distant suburban communities. These can be reduced by providing prompt transfer services for neonatal emergencies with appropriate low-cost technology like Kangaroo Mother Care, comparable to the on-going free tricycle services for obstetric emergencies in the state.^[16] Alternatively, peripheral primary health centers and comprehensive health centers should be revitalized by the provision of appropriately trained manpower and physical resources for improved healthcare delivery in the ally communities. This can be attained through the relevant arms of the National Primary Health Care Development Agency in the state.

Poor prognostic factors documented in the literature for various neonatal emergencies include gestational age, birth weight, and maternal systemic illnesses.^[4,15] However, none of these significantly predicts neonatal outcome in this survey. This is possibly due to the fact that a majority of our participants were term and late-preterm infants, consistent with the prior report of fluctuations in the quarterly incidence of prematurity in the setting.^[37] Also, maternal illnesses such as hypertension, diabetes, and viral hepatitis did not influence the short-term outcome of our participants. This does not preclude the possibility of future complications among them. Again, the place of delivery did not predict mortality in this cohort, with a vast majority being delivered in health facilities. This may be due to the relatively improving maternal and child health services in the state in recent years, with 75% of deliveries being attended by trained attendants in 2010, much higher than the 25% in 2005.^[17] Also, untrained traditional birth attendants (TBAs) have been directed to stop conducting labor in the setting. Delivery in such places could be concealed by parents to protect the TBAs from sanctions imposed by the government for noncompliance. Nonetheless, future researches focusing on specific neonatal emergencies may be able to evaluate other possible prognostic factors in the setting.

The strengths of this study include its multi-site nature involving the two functional IMNCH facilities in the state, and its novel cost-free background for neonatal services. Also, the confirmation of the outcome of referred cases using follow-up phone calls is desirable, considering the paucity of feedbacks from receiving facilities in practice.

CONCLUSION

Neonatal encephalopathy and sepsis were the most common emergencies in this survey. Also, they accounted for most of the neonatal deaths while comorbid hypothermia and hypoglycemia increased CFRs of these emergencies. This should be taken into cognizance while designing local interventions for neonatal emergencies. Strategies should include upgrading resources within the existing template of the Primary Health Care system.

Acknowledgment

Author AMT is thankful to Dr. Akinwumi BC who facilitated data collection at M & CH, Ondo State, Nigeria.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- de Silva S. Enhancing child survival by bridging the gaps in emergency paediatrics. *Sri Lanka J Child Health* 2013;42:115-28.
- Lawn JE, Lee AC, Kinney M, Sibley L, Carlo WA, Paul VK, *et al.* Two million intrapartum-related stillbirths and neonatal deaths: Where, why, and what can be done?. *Int J Gynaecol Obstet* 2009;107 (Suppl 1):S5-19.
- World Health Organization Neonatal and Perinatal Mortality: Country, Regional, and Global estimates. Geneva, Switzerland: World Health Organization; 2004. Available from: <http://www.who.int/publications/2007/9789241596145.pdf> [Searched on 2015 Nov 26]
- Saving Newborn Lives in Nigeria: Newborn Health in the Context of the Integrated Maternal, Newborn and Child Health Strategy. Abuja: Federal Ministry of Health, Save the Children, ACCESS; 2009. Available from: http://www.who.int/pmnch/topics/newborn/sn1_nigeria_execsum.pdf [Last accessed on 2015 Nov 26]
- Lawn JE, Blencowe H, Oza S, You D, Lee AC, Waiswa P, *et al.* Every Newborn: Progress, priorities, and potential beyond survival. *Lancet* 2014;384:189-205.
- Wall SN, Lee AC, Carlo W, Goldenberg R, Niermeyer S, Darmstadt GL, *et al.* Reducing intrapartum-related neonatal deaths in low- and middle-income countries-what works?. *Semin Perinatol* 2010;34:395-407.
- Lawn JE, Manandhar A, Haws RA, Darmstadt GL. Reducing one million child deaths from birth asphyxia – A survey of health systems gaps and priorities. *Health Res Policy Syst* 2007;5:4.
- Anyanwu OU, Ezeanosike OB, Ezeonu CT. Pattern and outcome of admissions at the children emergency room at the Federal Teaching Hospital Abakaliki. *Afr J Med Health Sci* 2014;13:6-10.
- Guerrier G, Oluyide B, Keramarou M, Grais R. High maternal and neonatal mortality rates in northern Nigeria: An 8-month observational study. *Int J Womens Health* 2013;5:495-9.
- Lawn JE, Zupan J, Begkoyian G, Knippenberg R. Newborn survival editors. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, *et al.* editors. *Disease Control Priorities in Developing Countries*. 2nd ed. Washington (DC): World Bank; 2006. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK11775/bookshelf>. [Last accessed on 2016 Jan 12]
- Peterson S, Nsungwa-Sabiiti J, Were W, Nsabagasani X, Magumba G, Namboozee J, *et al.* Coping with paediatric referral-Ugandan parents' experience. *Lancet* 2004;363:1955-6.
- CDC: Infant Mortality. Available from: <http://www.cdc.gov/reproductivehealth/MaternalInfantHealth/InfantMortality.htm>. [Last accessed on 2015 Jul 20]
- Conde-Agudelo A, Belizan J, Diaz-Rossello J. Kangaroo mother care to reduce morbidity and mortality in low birth weight infants. *Cochrane Libr* 2011;3:2-23.
- Segrè S, Coffey P, Metzler M, Villadiego S, Brandes N, Hodgins S, *et al.* Chlorhexidine for umbilical cord care. A case study prepared for the UN Commission on life-saving commodities for women and children. February, 2012. Available from: http://www.pdf.usaid.gov/pdf_docs/pnady705.pdf [Last accessed 2016 Jan 12]
- Zimba E, Kinney MV, Kachale F, Waltensperger KZ, Blencowe H, Colbourn T, *et al.* Newborn survival in Malawi: A decade of change and future implications. *Health Policy Plan* 2012;27: Suppl 3iii88-103.
- Ogundipe OL. Experiences of women participating in a safe motherhood (Abiye) project in Ondo State of Nigeria. *Int J Cur Microbiol App Sci* 2013;2:148-61.
- FMOH and Saving Newborn Lives Program Nigeria State Data Profiles: An Accountability Tool for Maternal, Newborn and Child Health in Nigeria. Available from: <http://www.healthynewbornnetwork.org/resource/nigeria-state-data-profiles>. [Last accessed on 2015 Nov 26]
- National Population Commission: 2006 Provisional Census Results. Federal Republic of Nigeria official Gazette 2007;94:24.
- Neonatal Emergencies Medscape Emergency Medicine. Available from: <http://www.medscape.org/viewarticle/557824>. [Last accessed 2014 August 08]
- Sarnat HB, Sarnat MS. Neonatal encephalopathy following fetal distress. A clinical and electroencephalographic study. *Arch Neurol* 1976;33:696-705.
- Volpe JJ. *Neurology of the Newborn*. 4th ed. Philadelphia: WB, Saunders; 2001
- Tripathi S, Malik GK. Neonatal Sepsis: Past, present and future; a review article. *Internet J Med Update* 2010;5:45-54.
- Saini SS, Dutta S, Ray P, Narang A. Short course versus 7-day course of intravenous antibiotics for probable neonatal septicemia: A pilot, open-label, randomized controlled trial. *Indian Pediatr* 2011;48:19-24.
- Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, *et al.* Surviving sepsis campaign: International guidelines for management of severe sepsis and septic shock: 2012. *Crit Care Med* 2013;41:580-637.
- Srinivasan L, Shah SS, Padula MA, Abbasi S, McGowan KL, Harris MC. Cerebrospinal fluid reference ranges in term and preterm infants in the neonatal intensive care unit. *J Pediatr* 2012;161:729-34.
- Committee on Fetus and Newborn, Adamkin DH. Postnatal glucose homeostasis in late-preterm and term infants. *Pediatrics* 2011;127:575-9.
- Olusanya O, Okpere E, Ezimokhai M. The importance of social class in voluntary fertility in developing countries. *West Afr J Med* 1985;4:205-12.
- Oluwafemi RO, Abiodun MT. Morbidity and mortality pattern in emergency paediatric unit of mother and Child Hospital Akure, Nigeria. *Ann Biomed Sci* 2016;15:151-9.
- Ekwochi U, Ndu IK, Nwokoye IC, Ezenwosu OU, Amadi OF, Osuorah D. Pattern of morbidity and mortality of newborns admitted into the sick and special care baby unit of Enugu State

- university teaching hospital, Enugu State. *Niger J Clin Pract* 2014;17:346-51.
30. Omoigberale AI, Sadoh WE, Nwaneri DU. A 4 year review of neonatal outcome at the University of Benin Teaching Hospital, Benin City. *Niger J Clin Pract* 2010;13:321-5.
 31. Okechukwu AA, Achonwa A. Morbidity and mortality patterns of admissions into the special care baby unit of University of Abuja Teaching Hospital, Gwagwalada, Nigeria. *Niger J Clin Pract* 2009;12:389-94.
 32. March of Dimes, Partnership for Maternal, Newborn and Child Health (PMNCH), Save the Children, WHO. In: Howson CP, Kinney MV, Lawn JE, editors. *Born Too Soon: The Global Action Report on Preterm Birth*. Geneva; World Health Organization; 2012.
 33. WHO: Every Newborn: An action plan to End Preventable Deaths. Available from: http://www.who.int/maternal_child_adolescent/topics/newborn/every-newborn-action-plan-draft.pdf. [Last accessed on 2015 Dec 04].
 34. Lee SK, McMillan DD, Ohlsson A, Pendray M, Synnes A, Whyte R, *et al*. Variations in practice and outcomes in the Canadian NICU network: 1996-1999. *Pediatrics* 2000;106:1070-9.
 35. Duncan H, Hutchison J, Parshuram CS. The Pediatric Early Warning System score: A severity of illness score to predict urgent medical need in hospitalized children. *J Crit Care* 2006;21:271-8.
 36. Onwujekwe O, Hanson K, Uzochukwu B, Ichoku H, Ike E, Onwughalu B. Are malaria treatment expenditures catastrophic to different socio-economic and geographic groups and how do they cope with payment? A study in Southeast Nigeria. *Trop Med Int Health* 2010;15:18-25.
 37. Oluwafemi RO, Abiodun MT. Incidence and outcome of preterm deliveries in Mother and Child Hospital Akure, Southwestern, Nigeria. *Sri Lanka J Child Health* 2016;45:11-7.

