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A Review of Neonatal Morbidity and Mortality in an Intensive Care Unit of a Paediatric Health Facility in Lagos, Nigeria

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Abstract

Introduction: Neonatal period in developing countries is characterized by various infectious diseases that make up leading causes and significant contributors to dismal morbidity and mortality statistics in this period of life. The diagnosis of neonatal sepsis in sub-Saharan Africa represents a challenge due to unavailability or scarcity of laboratory aids. The clinical diagnosis of sepsis may be difficult without laboratory aids irrespective of where the infant is born due to the fact that other non-infectious conditions can present with sepsis-like picture.

Objectives : The main objectives of this study were to document frequently diagnosed illnesses, record the management of the ill neonates and present the leading causes of death during the neonatal period for the purpose of future planning.

Methodology : This was a retrospective review of the medical records of children admitted into the Intensive Care Unit (ICU) of a public health facility between March 2005 and February 2007. Descriptive analysis was used to illustrate findings. The study was conducted between March 31, 2009 and June 30, 2009.

Results: Majority (135, 60.3%) of the study neonates (135 males, 89 females) were aged between 2-7 days. In all, 46 (20.5%) neonates weighed less than 2.5 kg. There was a considerable difference (t=-2.45; p=0.015; CI -0.60, -0.06) in the mean (± SEM) body temperature of 24-hour old neonates (36.7 ± 0.11) compared with those 2-7 days old (37.1 ± 0.06). Fever (56, 44%) was the most frequent presentation among neonates diagnosed with septicaemia (126, 56.3%), yellowness of the eyes (47, 65.3%) among those diagnosed with jaundice (72, 32.1%) and failure to cry (9, 25.7%) among those diagnosed with birth asphyxia (35, 15.6%). Full blood count was the most frequent (207, 92.4%) investigation requested for while antibiotics was the commonest (461, 205.8%) medication prescribed. Medications were administered to the neonates mainly through the intravenous route (538, 240.2%). In all, mortality among the studied neonates was 76 (33.9%).

Conclusion: More effective measures to improve neonatal mortality could be 1) improving access to antenatal care provided by trained medical professionals 2) giving general instructions to mothers who just gave birth regarding when to seek medical attention for her newborn infant 3) assessing local professional competencies 4) reviewing obstetrical procedures and interventions around the time of labour for women who deliver in hospital/private clinic settings, etc. For example appropriate chemoprophylaxis of pregnant mothers colonized with Group B Strep (GBS) proved to be a very effective prophylactic measure for early-onset neonatal GBS sepsis.

Keywords: Neonatology; Tropical Infective Diseases; Septicaemia; Jaundice; Birth Asphyxia; Meningitis; Tetanus; Morbidity; Mortality; Sub-Sahara

Introduction

Determining the levels and medical causes of severe illness and death in a locality can help the health planners identify service priorities, effectively allocate sparse resources and evaluate the impact of health care programs [1]. The vital statistics of Nigeria are still a concern to the government and the international community with an Infant Mortality Rate (IMR) of 75 per 1000 live births, Under-five Mortality Rate (U5MR) of 140 per 1000, Maternal Mortality Rate (MMR) of 704 per 100,000 and Crude Death Rate of 14 per 1000. This worrisome statistics accrue from prevalence rate of malaria being 1858 per 100,000, diarrhoea at 896 per 100,000, pneumonia at 208 per 100,000 and measles at 141 per 100,000. Life expectancy at birth is 52.2 years [2]. Neonates aged 28 days and below presently contribute nearly half of all infant deaths in developing countries [3].

Intervention programmes aimed at infectious diseases are decreasing mortality among older infants and children [3], the relative contribution of neonatal mortality is increasing, and it is becoming more important to gather accurate data about neonatal event. These data could then be used to explain events at different stages of neonatal period for clearer understanding of age-specific morbidity and mortality. In sub-Saharan Africa (SSA), infectious diseases are common causes of morbidity and mortality in the first few days of life. In particular, bacterial infections are one of the most acute and life threatening infections requiring meticulous diagnosis and treatment [4,5]. Septicaemia has been identified as a major cause of death among Nigerian neonates [6,7]. Results of management of neonates with septicaemia in Nigeria remain unsatisfactory as indicated by hospital-based mortality rates of 33% to 41% [8,9]. Jaundice due to un-conjugated hyperbilirubinemia is also a common clinical problem in the neonatal

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period in many parts of the world [10-13] and an important contributor to the very high neonatal mortality in developing countries [14-17]. In certain cases, Neonatal Jaundice (NNJ) could lead to brain damage (kernicterus) when severe [18], leading to neurological handicap and early death of affected infants. The complications of jaundice are not always prevented by phototherapy or Exchange Blood Transfusion (EBT), especially in preterm infants.

Neonatal meningitis, an acute bacterial infection of the central nervous system is associated with remarkable mortality [19] and has long been the focus of studies [20,21]. Other studies [22,23] report that pyogenic meningitis accounted for 2.7% and 3.4 % of infantile and post-neonatal deaths among hospitalised children, respectively in Ilorin and Sokoto, both in Nigeria. Researchers [24] had designed Bacterial Meningitis Score (BMS) for the differential diagnosis of bacterial versus viral meningitis. In the neonatal period, mortality due to meningitis is high, and the clinical course is frequently prolonged and characterized by relapses during or following appropriate antibiotic therapy. Congenital or neonatal malaria remains a disease of major health and economic importance in Africa. Obvious malaria parasitaemia may appear uncommon in neonates but studies have shown that this assumption may be incorrect [25]. Diagnosis of these illnesses in different age groups of the neonates may present a dilemma to both experienced and new clinicians who are not neonatologists but who are in charge of health facilities catering for large population of children and newborn babies. Data is scarce on the combination of early neonatal illnesses in SSA. This study was therefore designed to evaluate common urban neonatal illnesses seen at a secondary health facility and how these illnesses are managed. The objectives of this study were to 1) document frequently diagnosed illnesses, 2) record management of the ill neonates and 3) present the leading causes of death during the neonatal period.

Methodology

Study site

Massey Street Children Hospital (MSCH) where this survey took place is located on one of the major islands of Lagos and has been described in an earlier study [25]. Briefly, MSCH is a 60-bed health facility solely for paediatric population, serving approximately 100,000 residents. Infrastructures in this area have improved significantly over the years with good drainage system, pipe-borne water, tarred roads, electricity and sewage. Most of its clients come from urban Lagos but occasional referrals are from neighbouring cities, towns and villages. There is no delivery service in this public health facility as all admissions come from home or referred from outpatient offices/facilities. There are at least 30 nurses and 15 clinicians running a 24 hour shift. Data for this study were retrieved from the intensive care unit. The health facility setting was (and still) located in a busy densely populated area of metropolitan Lagos where access by vehicle is difficult. There were no patient-friendly signs for directions to the health facility and directions to various units of within the facility. The neonatal intensive care unit was not separated from older children emergency room. Medical, nursing and laboratory staffs that were available covered all children brought into the ICU, hence there was no specialization. Most of the clinicians were fresh graduates from the medical schools and only few overworked consultants were supervising these fresh clinicians. Finally, laboratory support during this study was quite inadequate. The space allocated to laboratory was just a single room with a maximum of 2 laboratory scientists covering the entire population of children from regular admission and for ICU.

Study design

This is a health facility-based retrospective case review of intensive care unit (ICU) kept records. Patients' records were well-arranged and well-kept manually in the medical records section of the hospital which is supervised by a medical records officer.

Data collection

Authorization to conduct the study was sought from the Lagos State Health Management Board. There was an initial briefing with the senior administrative staffs of MSCH to ascertain research team identification, required documentation and frequency of data collection at the hospital. Two data collectors were recruited to retrieve data from the hospital medical records. A pro-forma data record form was designed for transcription of data from the medical records. Individual ICU admission case file for the reference period was identified and retrieved. The main data collection tool (DCT) designed to collect information about admission of patients into the ICU was a one-sheet form. Information retrieved into this form included patients hospital number, date of admission, patients biodata, presenting complaints, clinicians' diagnosis, investigations requested for, prescribed medications and/or procedures, prognosis of the illnesses, outcome and duration of admission.

Data of all children admitted into the intensive care unit of MSCH between March 2005 and February 2007 were collected over a 3-month period and simultaneously transcribed verbatim into the data record form after close inspection. From this, data for neonates (aged 1 day to 28 days) were extracted for the purpose of this study. Data for neonates who were brought in dead (BID) or diagnosed as dead on arrival (DOA) were not extracted. Core body temperature of all neonates was assessed rectally.

Definitions

For the purpose of this paper, neonatal period was divided into three: (i) early (the first day of life), (ii) mid (the middle 20 days) and (iii) late (the last 7 days). The 20-day mid neonatal period was further subdivided into three: the 1st, 2nd and 3rd week of life, respectively. The rationale behind such categorization and sub-division was to look more closely into events occurring at different stages of the neonatal period as the child adjusts to extra-uterine life. For example, the first 24 hours of life is very decisive because the most crucial and immediate physiological change required of the newborn is the onset of breathing [26]. In this paper, neonatal septicaemia is defined as a clinical syndrome characterized by symptomatic illnesses due to disseminated bacterial infection in the neonatal period; neonatal jaundice as excess bilirubin in the neonatal blood; neonatal meningitis as inflammation of the thin covering of the brain; neonatal tetanus as prolonged contraction of skeletal muscle fibres and birth asphyxia as poor oxygen supply to the neonate before, during and immediately after birth. Prematurity is defined as neonates born at less than 37 weeks' gestation or with birth-weight of less than 1000 gm. Packed Cell Volume (PCV) is defined as the volume of the blood cells in a sample of blood after it has been centrifuged in the hematocrit.

Data analysis

Data of each child was coded for anonymity, ease of reference, avoidance of bias and fed into a lap top computer, cleaned and cross-checked for errors. Mortality rate is provided as raw value with no risk adjustment. Analysis of the cleaned data was done using Statistical Package for Social Sciences version 19 for Windows software. The data

were analysed descriptively obtaining frequencies and percentages, and inferentially using chi-square test to determine associations, where appropriate. Chi-square was used to test association and a p-value ≤ 0.05 was regarded as significant. The five most prominent illnesses that the attending ICU clinicians diagnosed for the neonates–jaundice, meningitis, birth asphyxia, tetanus and septicaemia–are reported in this paper.

Results

A description of the demographic characteristics of the 224 neonates in this study is given in Table 1 including their total number ages, gender differentiation, means of weight and of body temperature. The study neonates were initially grouped into 5 categories: those presenting in the first 24 hours of life (30, 13.4%), those between 2-7 days old (135, 60.3%), those aged 8-14 days (25, 11.2%), neonates15-21 days old (24, 10.7%) and those aged 22-28 days (10, 4.5%) (Table 1).This categorization is to present health-related events occurring in different stages of neonatal life. Six (20.0%) neonates aged 1 day, 29 (21.5%) aged 2-7 days, 6 (24.0%) aged 8-14 days old, 4 (16.7%) aged 15-21 days and 1 (10.0%) aged 22-28 days weighed less than 2.5kg on admission into the ICU. There was no significant statistical difference in the mean (± SEM) weight kg of neonates aged 24-hours (2.9 ± 0.11) and those aged 2-7 days (3.0 ± 0.07; t=-0.40, p=0.7; 95% CI: -0.39, 0.26), those aged 8-14 days (3.1 ± 0.19; t=-0.80, p=0.4; 95% CI: -0.59, 0.26) and those aged 15-21 days (3.0 ± 0.18; t=-0.37, p=0.7; 95% CI: -0.49, 0.33). However, noteworthy difference was observed in the mean weight of 24-hour neonates and those aged 22-28 days (3.5 ± 0.34; t=-2.20, p=0.04; 95% CI: -1.13, -0.04). The overall mean (± SEM) body temperature was 37.1°C (± 0.06) of which that of the 24-hour old neonates was 36.7°C (± 0.11).

Table 2 illustrates the means of age, weight and temperature as well as the frequency distributions of major complaints, laboratory investigations requested for, treatment prescribed and outcome of the illness among neonates diagnosed with jaundice. Among the 72 neonates that presented with jaundice, 65 (90.3%) were aged 2-7 days, 6 (8.3%) were aged 8-14 days and only 1 (1.4%) was 1 day old. There was no statistically significant difference in the mean weight of the 2-7 days old compared with that of the 8-14 days old neonates (df=5.7; t=-0.2, p=0.9) or in the mean temperature (°C) of the two age groups (df=9.05, t=-0.64; p=0.54). Yellowness of eyes was the major presentation in age groups 2-7 days (41, 60.3%) and 8-14 days (5, 83.3%), respectively. Serum bilirubin was the most frequent laboratory investigation requested for among 2-7 days old (55, 84.9%) and among 8-14 days old neonates (5, 83.3%), followed by full blood count (53, 81.5% and 4, 66.7%), respectively. Other investigations request for among 2-7 days old and 8-14 days old neonates, respectively were blood group (26, 40.0%; 4, 66.7%), electrolytes, urea and creatinine (E/U/Cr) (18, 27.7%; 1, 16.7%), Packed Cell Volume (10,15.4%) and malaria parasites (8,12.3%). A total of 123 (189.2%) and 11 (183.0%) prescriptions for antibiotics were written for 2-7 days old and the 8-14 days old neonates or about 2 different antibiotics per neonate in these age groups. Phototherapy was prescribed, respectively for the only 1 day old, for 29 (44.6%) 2-7 days old and for 3 (50.0%) 8-14 days old neonates with jaundice. While 34 (52.3%) and 5 (83.3%) neonates aged 2-7 and 8-14 days in that order were discharged home, 7 (10.8%) among the 2-7 days old neonates were discharged against medical advice (DAMA), 6 were still on admission when the data was recorded into the patient's medical records, 1 was referred, 2 absconded, nothing was recorded as the outcome in 3 neonates in this age group and 12 (18.5%) died. Only 1 (16.7%) death was recorded in the 8-14 day old age group.

Of the 19 neonates diagnosed with meningitis, 12 were aged 2-7 days, 3 age 15-21 days and 1 in each of the other age groups (Table 3). Major presentation among the 2-7 and 15-21 days old neonates was difficulty in breathing (3, 25.0%; 33.3%). One of the two 1 day old

	By sex			By age (days)				
	ALL	Male	Female	0-1	2-7	8-14	15-21	22-28
Number	224	135	89	30	135	25	24	10
%	100	60.3	39.7	13.4	60.3	11.2	10.7	4.5
Age (days)								
Mean	7.3	7.0	7.7	1.0	4.2	11.2	19.7	27.8
± SEM	0.5	0.6	0.8	0.0	0.2	0.4	0.4	0.1
Gender								
Male	135	-	-	19	80	17	15	4
Female	89	-	-	11	55	8	9	6
Weight (kg)								
Mean	3.0	3.1	3.0	2.9	3.0	3.1	3.0	3.5
± SEM	0.06	0.06	0.11	0.11	0.07	0.19	0.18	0.34
Min.	1.3	1.3	1.6	1.7	1.5	1.6	1.3	2.0
Max.	7.9	6.4	7.9	4.3	7.9	6.4	5.4	5.8
Weight <2.5 kg								
Frequency	46	25	21	06	29	06	04	01
%	20.5	18.5	23.6	20.0	21.5	24.0	16.7	10.0
Temperature °C								
Mean	37.1	37.2	37.0	36.7	37.1	37.4	36.9	37.2
± SEM	0.06	0.8	0.8	0.7	0.7	1.1	0.7	1.0
Min.	35.0	35.5	35.0	35.0	35.5	36.0	35.5	36.0
Max.	40.0	40.0	39.8	38.0	40.0	40.0	38.0	39.0

Table 1: Characteristics of neonates admitted into intensive care unit of a secondary health facility in the survey.

	Age-group (days)		
	0-1	2-7	8-14
	(n=1)	(n=65)	(n=6)
Mean Age	1.0	4.6	11.0
± SEM	0.0	0.2	0.7
Median	1.0	4.0	11.0
Range	1.0-1.0	2.0-7.0	9.0-14.0
95% CI	0.0	4.2, 4.9	9.2-12.8
Mean weight (kg)	2.9	3.0	3.4
± SEM	0.0	0.1	0.3
Median	2.9	2.9	3.4
Range	2.9-2.9	1.9-5.0	1.9-3.8
95% CI	0.0	2.8, 3.2	2.3-3.9
Mean temp (°C)	37.2	37.1	36.9
± SEM	0.0	0.1	0.2
Median	0.0	37.0	37.0
Range	0.0	35.5-40.0	36.0-37.4
95% CI	0.0	36.9, 37.3	36.4, 37.4
Major presentations			
	Freq. (%)	Freq. (%)	Freq. (%)
Yellowness of eyes	1 (100.0)	41 (60.3)	5 (83.3)
Yellowness of body	0 (0.0)	7 (10.3)	2 (33.3)
Fever	0 (0.0)	20 (29.4)	1 (16.7)
Poor sucking	0 (0.0)	8 (11.8)	0 (0.0)
Weakness	0 (0.0)	3 (4.4)	0 (0.0)
Laboratory investigation requested for			
Serum bilirubin	0 (0.0)	55 (84.9)	5 (83.3)
Full blood count	1 (100.0)	53 (81.5)	4 (66.7)
Blood group	1 (100.0)	26 (40.0)	4 (66.7)
Malaria parasite	0 (0.0)	8 (12.3)	0 (0.0)
Electrolytes/Urea/Creatinine	0 (0.0)	18 (27.7)	1 (16.7)
Packed Cell Volume	0 (0.0)	10 (15.4)	0 (0.0)
G-6-P-D	0 (0.0)	6 (9.2)	3 (50.0)
Cerebro-spinal fluid analysis	0 (0.0)	3 (4.6)	0 (0.0)
Blood culture	0 (0.0)	1 (1.5)	0 (0.0)
Urinalysis	0 (0.0)	2 (3.1)	0 (0.0)
Treatment prescribed			
Phototherapy	1 (100.0)	29 (44.6)	3 (50.0)
Antibiotics	1 (100.0)	123 (189.2)	11 (183)
Exchange Blood Transfusion	0 (0.0)	5 (7.7)	0 (0.0)
10% Dextrose water	0 (0.0)	13 (20.0)	1 (16.7)
50% Dextrose water	0 (0.0)	3 (4.6)	0 (0.0)
Antimalarial	0 (0.0)	2 (3.1)	0 (0.0)
Phenobarbitone	0 (0.0)	4 (6.2)	1 (16.7)
Mannitol	0 (0.0)	2 (3.1)	0 (0.0)
Outcome of illness			
Discharged home	0 (0.0)	34 (52.3)	5 (83.3)
DAMA	1 (100.0)	7 (10.8)	0 (0.0)
Were still on admission	0 (0.0)	6 (9.2)	0 (0.0)
Referred	0 (0.0)	1 (1.5)	0 (0.0)
Absconded	0 (0.0)	2 (3.1)	0 (0.0)
Outcome not recorded	0 (0.0)	3 (4.6)	0 (0.0)
Died	0 (0.0)	12 (18.5)	1 (16.7)

There was no statistically significant difference between the means of weight of the 2-7 days old and 8-14 days old neonates with jaundice (df=5.7; t= -0.2, p=0.9) or in the mean temperature (°C) of the two age groups (df=9.05, t= -0.64; p=0.54); DAMA=Discharged against medical advice; CI=confidence interval; SEM=Standard Error of Mean

Table 2: Distribution of major presentations, clinical investigations, treatments and outcomes of neonates with jaundice according to affected age groups.

	Age-group (days)				
	0-1	2-7	8-14	15-21	22-28
	(n=2)	(n=12)	(n=1)	(n=3)	(n=1)
Mean Age	24	3.8	8.0	19.3	27.0
± SEM	0.0	0.6	0.0	1.7	0.0
Median	24	3.0	8.0	21.0	27.0
Range	24.0-24.0	2.0-7.0	8.0-8.0	16.0-21.0	27.0-27.0
95% CI	24.0, 24.0	2.6, 5.1	0.0	12.2, 26.5	0.0
Mean weight (kg)	2.9	2.5	3.2	3.2	3.1
± SEM	0.4	0.4	0.0	0.5	0.0
Median	2.9	2.5	3.2	3.1	3.1
Range	2.6-3.1	1.9-3.3	3.2-3.2	2.4-3.1	3.1-3.1
95% CI	0.3, 6.0	2.3, 2.8	0.0	1.2, 5.2	0.0
Mean temp (°C)	37.5	37.0	37.2	37.3	36.9
± SEM	0.5	0.3	0.0	0.4	0.0
Median	37.5	36.9	37.2	37.1	36.9
Range	37.0-38.0	35.5-39.0	37.2-37.2	36.7-38.0	36.9-36.9
95% CI	31.2, 43.9	36.3, 37.6	0.0	35.6, 38.9	0.0
Major presentations					
	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Difficulty in breathing	0 (0.0)	3 (25.0)	0 (0.0)	1 (33.3)	0 (0.0)
Failure to cry	0 (0.0)	3 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)
Fever	1 (50.0)	2 (16.7)	0 (0.0)	0 (0.0)	1 (100.0)
Poor sucking	1 (50.0)	1 (8.3)	0 (0.0)	1 (0.0)	1 (100.0)
Weakness	0 (0.0)	2 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)
Convulsion	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	0 (0.0)
Eye discharge	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Jerky body movement	1 (50.0)	0 (0.0)	0 (0.0)	1 (33.3)	1 (100.0)
Stooling and vomiting	0 (0.0)	0 (0.0)	1 (100.0)	1 (33.3)	0 (0.0)
Rigid body	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	1 (100.0)
Investigation requested for					
Serum bilirubin	0 (0.0)	3 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)
Full blood count	2 (100.0)	8 (66.7)	1 (100.0)	2 (66.7)	1 (100.0)
Malaria parasite	1 (50.0)	2 (16.7)	0 (0.0)	1 (33.3)	0 (0.0)
E/U/Cr	1 (50.0)	7 (58.3)	1 (100.0)	1 (33.3)	1 (100.0)
G-6-P-D	0 (0.0)	6 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
CSF analysis	1 (50.0)	6 (50.0)	1 (100.0)	0 (0.0)	0 (0.0)
Blood culture	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	0 (0.0)
Random blood sugar	1 (50.0)	2 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)
ESR	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)
Treatment prescribed					
Antibiotics	3 (150.0)	24 (200.0)	2 (200.0)	6 (200.0)	2 (200.0)
10% Dextrose water	1 (50.0)	3 (25.0)	1 (100.0)	2 (66.7)	0 (0.0)
50% Dextrose water	1 (50.0)	2 (16.7)	1 (100.0)	0 (0.0)	0 (0.0)
Phenobarbitone	0 (0.0)	6 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
Paraldehyde	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)
Mannitol	1 (50.0)	3 (25.0)	0 (0.0)	1 (33.3)	0 (0.0)
Vitamin k	1 (50.0)	2 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)
Antitetanus serum	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Oxygen	0 (0.0)	5 (41.7)	0 (0.0)	1 (33.3)	0 (0.0)
Outcome of illness					
Discharged home	2 (100.0)	4 (33,3)	0 (0.0)	2 (66.7)	1 (100.0)
DAMA	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	0 (0.0)
Died	0 (0.0)	7 (58.3)	0 (0.0)	1 (33.3)	0 (0.0)
Not available	0 (0.0)	0 (0.0)	1 (0.0)	0 (0.0)	0 (0.0)

SEM=Standard Error of Mean; CI=confidence interval; E/U/Cr=electrolytes/Urea/Creatinine; G-6-P-D=Glucose-6-Phosphate-Dehydrogenase; CSF=Cerebro-spinal fluid; ESR=Erythrocyte sedimentation rate. The difference in the means of weight as well as in the means temperature among 1-day old and 2-7 days old neonates respectively were not statistically significant (df= 1.5; t= -1.2; p=0.4; df=1.8; t= -0.9; p=0.5)

Table 3: Distribution of major presentations, clinical investigations, treatments and outcomes of neonates diagnosed with meningitis according to affected age groups.

neonates and the only neonates in the 22-28 days age group presented with fever (1, 50.0%; 1, 100.0%) and poor sucking(1, 50.0%; 1, 100.0%). Requests for laboratory investigations were inconsistent as FBC was requested for all neonates aged 1 day, 8-14 days, 22-28 days but for only 8 (66.7%) and 2 (66.7%) neonates aged 2-7 days and 15-21 days, respectively. Cerebrospinal fluid analysis was not requested for older neonates but for 1 (50.0%) of the 2 neonates aged 1 day, for 6 (50.0%) neonates aged 2-7 days and for the only neonate aged 8-14 days. For every neonate, 2 prescriptions were written, except for neonates aged 1 day old for whom, on the average 1.5 antibiotics were written per neonate. Intravenous fluids such as 10% dextrose water and 50% dextrose water were prescribed for each neonate aged 1 day, for 3 (25.0%) and 2 (16.7%) neonates aged 2-7 days, for all neonates aged 8-14 days and for 2 (66.7%) aged 15-21 days. Five (41.7%) neonates aged 2-7 days received oxygen. While 2 (100.0%), 4 (33.3%), 2 (66.7%) and 1 (100.3%) neonates aged 1 day, 2-7, 15-21 and 22-28 days, respectively were discharged home, 1 (8.3%) neonate aged between 2-7 days old neonates was DAMA, nothing was recorded as the outcome in the only 8-14 days old neonate. Of the 8 deaths recorded, 7 (58.3%) were aged 2-7 days and 1 was aged 15-21 days.

Out of the 30 neonates in the first day of life, 19 (63.3%) were diagnosed as having birth asphyxia while 15 (11.1%) and 1 (4.0%) of neonates age 2-7 days and 8-14 days, respectively were equally diagnosed with the same illness (Table 4). Failure to cry (7, 31.8%), difficulty in breathing (4, 21.1%) weak cry (2, 10.5%) and fever (1, 5.3%) were the major presentations among 1-day old neonates whereas difficulty in breathing (5, 33.3%), fever, (5, 33.3%), failure to cry (2, 13.3%) and weak cry (2, 13.3%) were the major presentations among the 2-7 days old neonates. The only neonate aged 8-14 days presented with fever, poor sucking and vomiting. Full blood count (11, 57.9%), E/U/Cr (8, 42.1%), thick and thin blood smear for malaria parasites (4, 21.1%) and serum bilirubin (2, 10.5%) were the most frequent laboratory investigations requested for among the day old neonates while FBC (13, 86.7%), followed E/U/Cr (7, 46.7%), CSF analysis (4, 26.7%), blood culture (2, 13.3%) random blood sugar (2, 33.3%), serum bilirubin (2, 33.3%) and erythrocyte sedimentation rate (ESR) (2, 33.3%) were the most frequent laboratory investigations requested for among those aged 2-7 days. Antibiotics were the most common prescription for day old neonates (24, 126%), for those age 2-7 days (24, 160.0%) and for the only neonate aged 8-14 days (2, 200%). Incidentally suction of the airway was written for only 2 (10.5%) neonates age 1 day and for no other neonates. A total of 17 prescriptions were written including 10% dextrose water for 9 (47.4%) neonates aged 1 day and for 7 (46.7%) neonates aged 2-7 days; 9 prescriptions were written for 50% dextrose water including 6 (31.6%) for 1 day old neonates and 2 (13.3%) for 2-7 days old neonates. Oxygen was written for 11 (57.9%) 1 day old and for 2 (13.3%) 2-7 days old neonates. Of the 5 neonates discharged against

Age-group (days)			
	0-1	2-7	8-14
	(n=19)	(n=15)	(n=1)
Mean Age	1.0	2.7	14.0
± SEM	0.0	0.3	0.0
Median	1.0	2.0	0.0
Range	1.0-1.0	2.0-6.0	14.0-14.0
95% CI	1.0-1.0	2.0, 3.4	0.0
Mean weight (kg)	3.0	2.8	2.9
± SEM	0.1	0.1	0.0
Median	3.0	2.7	0.0
Range	1.9-4.3	2.0-4.0	2.9-2.9
95% CI	2.7, 3.3	2.5, 3.1	0.0
Mean temp (°C)	36.6	37.0	0.0
± SEM	0.2	0.2	0.0
Median	36.8	37.0	0.0
Range	35.0-37.8	36.0-38.0	37.8-37.8
95% CI	36.3, 37.0	36.6, 37.3	0.0
Major presentations			
	Freq. (%)	Freq. (%)	Freq. (%)
Failure to cry	7 (31.8)	2 (13.3)	0 (0.0)
Weak cry	2 (10.5)	2 (13.3)	0 (0.0)
Difficulty in breathing	4 (21.1)	5 (33.3)	0 (0.0)
Rapid breathing	0 (0.0)	1 (6.7)	0 (0.0)
Fever	1 (5.3)	5 (33.3)	1 (100.0)
Blue body colour	1 (5.3)	0 (0.0)	0 (0.0)
Fast breathing	1 (5.3)	1 (6.7)	0 (0.0)
Poor sucking	0 (0.0)	0 (0.0)	1 (100.0)
Vomiting	0 (0.0)	0 (0.0)	1 (100.0)
No complaint recorded	3 (15.8)	1 (6.7)	0 (0.0)
Investigation requested for			
Serum bilirubin	2 (10.5)	2 (13.3)	0 (0.0)
Full blood count	11 (57.9)	13 (86.7)	1 (100.0)
Malaria parasite	4 (21.1)	0 (0.0)	0 (0.0)
E/U/Cr	8 (42.1)	7 (46.7)	1 (100.0)
Packed Cell Volume	1 (5.3)	3 (0.2)	0 (0.0)
G-6-P-D	0 (0.0)	0 (0.0)	0 (0.0)
CSF analysis	1 (5.3)	4 (26.7)	0 (0.0)
Blood culture	1 (5.3)	2 (13.3)	0 (0.0)
Random blood sugar	0 (0.0)	2 (13.3)	0 (0.0)
Urinalysis	0 (0.0)	0 (0.0)	0 (0.0)
ESR	2 (10.5)	2 (13.3)	0 (0.0)
Treatment prescribed			
Suction	2 (10.5)	0 (0.0)	0 (0.0)
Antibiotics	24 (126.3)	24 (160.0)	2 (200.0)
10% Dextrose water	9 (47.4)	7 (46.7)	1 (100.0)
50% Dextrose water	6 (31.6)	2 (13.3)	0 (0.0)
4.3% dextrose saline	1 (5.3)	0 (0.0)	0 (0.0)
Phenobarbitone	0 (0.0)	4 (26.7)	0 (0.0)
Paraldehyde	0 (0.0)	0 (0.0)	0 (0.0)
Mannitol	1 (5.3)	3 (0.2)	0 (0.0)
Vitamin k	5 (26.3)	4 (26.7)	0 (0.0)
Antitetanus serum	2 (10.5)	0 (0.0)	0 (0.0)
Oxygen	11 (57.9)	2 (13.3)	0 (0.0)
Frusemide	0 (0.0)	2 (13.3)	0 (0.0)
Sodium bicarbonate	0 (0.0)	1 (6.7)	0 (0.0)
Calcium gluconate	0 (0.0)	1 (6.7)	0 (0.0)
Outcome of illness			
Discharged home	7 (36.8)	8 (53.3)	0 (0.0)
DAMA	3 (15.8)	2 (13.3)	0 (0.0)
Died	8 (42.1)	5 (33.3)	0 (0.0)
Not available	1 (5.3)	0 (0.0)	1 (100.0)

There was no statistically significant difference between the means of weight of the 1 day old and 2-7 days old neonates with birth asphyxia (df= 31.7; t= 0.75; p=0.5)

Table 4: Distribution of major presentations, clinical investigations, treatments and outcomes of neonates diagnosed with birth asphyxia according to affected age groups.

medical advice, 3 were 1 day old and 2 were 2-7 days old. Eight (42.1%) of the 1 day old neonate and 5 (33.3%) of those age 2-7 days died.

Neonatal tetanus had the lowest frequency (16, 7.1%) of diagnoses among the subjects of study (Table 5). A high proportion (11, 68.8%) of all neonates diagnosed with this illness was aged between 2-7 days, followed by those aged 8-14 days (3, 18.8%). The solitary neonates in age brackets 1 day and 15-21 days diagnosed with tetanus presented with fever and with difficulty in breathing and with rigid body, respectively. Fever and poor sucking (2, 66.7%, respectively) were the most common presentation among those aged 8-14 days. However, among those aged 2-7 days, seizures (4, 36.4%), failure to cry, fever, poor sucking (3, 27.2%, respectively) and weak cry (2, 18.2%) were the predominant presentations. In all, 12 laboratory requests were made for FBC among which 8 (72.7%), 3 (100.0%) and 1 (100.0%) were for those aged 2-7 days, 8-14 days and 1 day old neonates, respectively. The most frequent treatment prescribed for 1 day old neonates were antibiotics (2, 200.0%), and anti-tetanus serum (1, 100.0%), for 2-7 days old neonates were antibiotics (13, 118.2%), diazepam (7,63.6%), antitetanus serum (6, 54.6%) and tetanus toxoid (5, 45.5%). Oxygen was prescribed for the only neonate aged 15-21 days diagnosed with tetanus. Out of the 16 neonates diagnosed with neonatal tetanus, 10 (62.5%) died. The highest mortality (9, 81.8%) was among those aged 2-7 days followed by those aged 8-14 days (1, 33.3%).

More than half (126, 56.3%) of the neonates in the study were diagnosed with neonatal septicaemia (Table 6) distributed as follows: 9 aged 1 day, 81 aged 2-7 days, 14 aged 8-14 days, 20 aged 15-21 days and 2 aged 22-28 days. Fever (3 (33.3%), convulsion (2, 22.2%) and weak cry (2, 22.2%) were major presentations among the 1 day old neonates; fever, (33, 40.7%), yellow eyes (24.7%), difficulty in breathing and refused feeds (9.9%, respectively) and convulsion (8.6%) were common presentations among those aged 2-7 days old. Fever was also more characteristic presentation among those aged 8-14 (8, 57.1%), 15-21 (11, 55.0%) and 22-28 (1, 50.0%) days. The most frequent investigations requested for among the 1 day old neonates were FBC (6, 66.7%), E/U/Cr (4, 44.4%) and both serum bilirubin and malaria (2, 22.2%, respectively). Among those aged 2-7 days, FBC (63, 77.8%), E/U/Cr (31, 38.3%), serum bilirubin (30, 37.0%), ESR (14, 17.3%), Packed Cell Volume (11, 13.6%) and thick and thin blood slides for malaria parasitaemia (10 (12.3%) were the recurrent laboratory investigations requested for. Antibiotics outweighed other prescriptions in all age groups being 16 (177.8%), 146 (180.2%), 30 (214.2%), 31 (155.0%) and 4 (200.0%) among those aged 1 day, 2-7 days, 8-14 days, 15-21 days and 22-28 days, respectively. Oxygen, exchange blood transfusion and phototherapy were prescribed mostly for 12 (14.8%), 3 (3.7%) and 15 (18.5%) neonates aged 2-7 days than for other age groups. The highest mortality of diagnosed septicaemia was among those aged 8-14 days (5, 35.7%) followed by among those aged 2-7 days (23, 28.4%). In all, 13 (10.3%) neonates diagnosed with septicaemia were discharged against medical advice while 3 (2.4%) absconded.

Table 7 illustrates common routes through which medications were administered to the neonates of study. Oral administration was the least frequent (14, 2.1) of all the routes route of medication administration to all the neonates of study, followed by intranasal administration (35, 5.4%) and intramuscular (65, 10%) administration. There was no recommendation for oral administration of medication among 1 day old and 2-7 days old neonates; there was no recommendation for intranasal route of medication for neonates aged 8-14 days and 15-21 days and no intramuscular route of medication administration was recommended for 22-28 day old neonates. However, intravenous administration

	Age-group (days)			
	0-1	2-7	8-14	15-21
	(n=1)	(n=11)	(n=3)	(n=1)
Mean Age	1.0	5.7	11.0	16.0
± SEM	0.0	0.7	1.2	0.0
Median	1.0	7.0	11.0	16.0
Range	1.0-1.0	2.0-7.0	9.0-13.0	16.0-16.0
95% CI	1.0-1.0	4.3, 7.2	6.0, 16.0	0.0
Mean weight (kg)	2.7	2.7	2.8	3.1
± SEM	0.0	0.4	0.5	0.0
Median	0.0	2.7	2.5	3.1
Range	2.7-2.7	2.2-3.5	2.5-3.3	3.1-3.1
95% CI	0.0	2.5, 3.1	1.6, 3.9	0.0
Mean temp (°C)	36.7	37.3	38.1	37.1
± SEM	0.0	0.8	0.9	0.0
Median	36.7	37.0	37.4	37.1
Range	36.7-36.7	36.0-38.5	37.0-40.0	37.1-37.1
95% CI	0.0	36.8, 38.5	34.1, 42.2	0.0
Major presentations				
	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Failure to cry	0 (0.0)	3 (27.3)	1 (33.3)	0 (0.0)
Weak cry	0 (0.0)	2 (18.2)	0 (0.0)	0 (0.0)
Excessive crying	0 (0.0)		0 (0.0)	0 (0.0)
Difficulty in breathing	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Fever	1 (5.3)	3 (27.3)	2 (66.7)	0 (0.0)
Poor sucking	0 (0.0)	3 (27.3)	2 (66.7)	0 (0.0)
Weakness	0 (0.0)	2 (18.2)	0 (0.0)	0 (0.0)
Seizures	0 (0.0)	4 (36.4)	0 (0.0)	0 (0.0)
Stiff neck	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
Rigid body	0 (0.0)	1 (9.1)	0 (0.0)	1 (100.0)
Investigation requested for				
Serum bilirubin	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)
Full blood count	1 (100.0)	8 (72.7)	3 (100.0)	0 (0.0)
Malaria parasite	0 (0.0)	3 (27.3)	0 (0.0)	0 (0.0)
E/U/Cr	0 (0.0)	4 (36.4)	2 (66.7)	0 (0.0)
Packed Cell Volume	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
CSF analysis	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
ESR	0 (0.0)	3 (27.3)	1 (33.3)	0 (0.0)
Treatment prescribed				
Antibiotics	2 (200.0)	13 (118.2)	5 (166.7)	2 (200.0)
10% Dextrose water	0 (0.0)	1 (9.1)	1 (33.3)	0 (0.0)
50% Dextrose water	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
4.3% dextrose saline	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
Phenobarbitone	0 (0.0)	0 (0.0)	2 (66.7)	0 (0.0)
Paraldehyde	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)
Mannitol	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
Vitamin k	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
Antitetanus serum	1 (100.0)	6 (54.5)	2 (66.7)	0 (0.0)
Oxygen	0 (0.0)	1 (9.1)	1 (33.3)	1 (100.0)
Tetanus toxoid	0 (0.0)	5 (45.5)	1 (33.3)	0 (0.0)
Diazepam	0 (0.0)	7 (63.6)	2 (66.6)	0 (0.0)
Outcome of illness				
Discharged home	1 (100.0)	2 (18.2)	2 (66.7)	1 (100.0)
DAMA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Died	0 (0.0)	9 (81.8)	1 (33.3)	0 (0.0)

Table 5: Distribution of major complaints, clinical investigations, treatments and outcomes of neonates diagnosed with neonatal tetanus according to affected age groups.

	Age-group (days)				
	0-1	2-7	8-14	15-21	22-28
	(n=9)	(n=81)	(n=14)	(n=20)	(n=2)
Mean Age	1.0	4.2	11.2	19.6	28.0
± SEM	0.0	0.2	0.7	0.5	0.0
Median	1.0	4.0	11.0	21.0	28.0
Range	1.0-1.0	2.0-7.0	8.0-14.0	15.0-16.0	28.0-28.0
95% CI	1.0-1.0	3.8, 4.6	9.8, 12.6	18.6, 20.6	28.0-28.0
Mean weight (kg)	3.0	3.0	2.9	2.9	3.3
± SEM	0.2	0.1	0.1	0.2	0.7
Median	3.0	2.9	2.9	2.8	3.3
Range	2.3-3.5	1.5-5.0	2.3-4.2	1.3-5.4	2.6-3.9
95% CI	2.6, 3.3	2.8, 3.1	2.6, 3.2	2.5-3.4	-5.0, 11.51
Mean temp (°C)	36.8	37.0	37.8	36.9	36.5
± SEM	0.2	0.1	0.3	0.2	0.5
Median	36.7	37.0	37.2	36.9	36.5
Range	36.0-38.0	35.6-39.0	36.0-40.0	35.5-38.0	36.0-37.0
95% CI	36.3, 37.2.0	36.9, 37.2	37.0, 38.5	36.6, 37.2	30.1, 42.9
Major presentations					
Failure to cry	0 (0.0)	4 (4.9)	1 (7.1)	0 (0.0)	0 (0.0)
Weak cry	2 (22.2)	3 (3.7)	0 (0.0)	0 (0.0)	0 (0.0)
Excessive crying	0 (0.0)	4 (4.9)	1 (7.1)	1 (5.0)	1 (50.0)
Difficulty in breathing	1 (11.1)	8 (9.9)	2 (14.3)	0 (0.0)	0 (0.0)
Fast breathing	0 (0.0)	6 (7.4)	0 (0.0)	0 (0.0)	0 (0.0)
Yellow eyes	0 (0.0)	20 (24.7)	2 (14.3)	0 (0.0)	0 (0.0)
Yellow body	0 (0.0)	5 (6.2)	0 (0.0)	0 (0.0)	0 (0.0)
Fever	3 (33.3)	33 (40.7)	8 (57.1)	11 (55.0)	1 (50.0)
Cough	0 (0.0)	0 (0.0)	0 (0.0)	2 (14.3)	1 (50.0)
Catarrh	0 (0.0)	0 (0.0)	0 (0.0)	3 (15.0)	1 (50.0)
Refused feeds	1 (11.1)	8 (9.9)	1 (7.1)	2 (10.0)	0 (0.0)
Poor sucking	0 (0.0)	6 (7.4)	0 (0.0)	0 (0.0)	0 (0.0)
Stooling	0 (0.0)	1 (1.2)	2 (14.3)	1 (5.0)	1 (5.0)
Vomiting	1 (11.1)	1 (1.2)	1 (7.1)	0 (0.0)	0 (0.0)
Convulsion	2 (22.2)	7 (8.6)	1 (7.1)	3 (15.0)	0 (0.0)
Eye discharge	1 (11.1)	5 (6.2)	0 (0.0)	2 (10.0)	0 (0.0)
Investigation requested for					
Serum bilirubin	2 (22.2)	30 (37.0)	2 (14.3)	0 (0.0)	0 (0.0)
Full blood count	6 (66.7)	63 (77.8)	13 (92.9)	15 (75.0)	1 (50.0)
Malaria parasite	2 (22.2)	10 (12.3)	5 (35.7)	8 (40.0)	1 (50.0)
E/U/Cr	4 (44.4)	31 (38.3)	8 (57.1)	5 (25.0)	0 (0.0)
Packed Cell Volume	0 (0.0)	11 (13.6)	2 (14.3)	2 (10.0)	0 (0.0)
CSF analysis	1 (11.1)	8 (9.9)	1 (7.1)	0 (0.0)	1 (50.0)
ESR	0 (0.0)	14 (17.3)	1 (7.1)	5 (25.0)	0 (0.0)
Random blood sugar	1 (11.1)	7 (8.6)	0 (0.0)	2 (10.0)	0 (0.0)
Urinalysis	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.0)	0 (0.0)
Chest x-ray	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.0)	0 (0.0)
Blood culture	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (50.0)
Treatment prescribed					
Antibiotics	16 (177.8)	146 (180.2)	30 (214.2)	31 (155.0)	4 (200.0)
10% Dextrose water		24 (29.6)	3 (21.4)	5 (25.0)	1 (50)
50% Dextrose water	4 (44.4)	7 (8.6)	2 (14.3)	2 (0.0)	0 (0.0)
4.3% dextrose saline	1 (11.1)	1 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)
Phenobarbitone	0 (0.0)	1 (1.2)	1 (66.7)	0 (0.0)	0 (0.0)
Paraldehyde	0 (0.0)	0 (0.0)	0 (0.0)	2 (10.0)	1 (50)
Mannitol	1 (11.1)	5 (6.2)	0 (0.0)	1 (5.0)	0 (0.0)
Vitamin k	2 (22.2)	8 (9.9)	0 (0.0)	2 (10.0)	0 (0.0)

Antitetanus serum	1 (11.1)	5 (6.2)	1 (7.1)	2 (10.0)	
Oxygen	0 (0.0)	12 (14.8)	1 (7.1)	3 (15.0)	1 (50)
Tetanus toxoid	0 (0.0)	4 (4.9)	2 (14.3)	0 (0.0)	0 (0.0)
Aminophyllin	1 (11.1)		1 (7.1)	0 (0.0)	0 (0.0)
Exchange blood transfusion	0 (0.0)	3 (3.7)	0 (0.0)	0 (0.0)	0 (0.0)
Phototherapy	0 (0.0)	15 (18.5)	0 (0.0)	0 (0.0)	0 (0.0)
Outcome of illness					
Discharged home	7 (77.8)	37 (45.7)	4 (28.0)	14 (60.0)	2 (100.0)
DAMA	1 (11.1)	7 (8.7)	3 (21.4)	2 (10.0)	0 (0.0)
Referred	0 (0.0)	3 (3.7)	0 (0.0)	0 (0.0)	0 (0.0)
Absconded	0 (0.0)	3 (3.7)	0 (0.0)	0 (0.0)	0 (0.0)
Were still on admission	0 (0.0)	4 (4.9)	1 (7.1)	0 (0.0)	0 (0.0)
Not recorded	0 (0.0)	4 (4.9)	1 (7.1)	1 (5.0)	0 (0.0)
Died	1 (11.1)	23 (28.4)	5 (35.7)	3 (15.0)	0 (0.0)

There was no statistically significant difference in the mean weight of the 1-day old and with 2-7 days old (df=12.2; t= -0.2; p=0.9), between 2-7 days old and with 8-14 days old (df= 12.2; t= -0.2; p=0.9), between 8-14 days old and 15-21 days old (df-31.1; t=0.2; p=0.9) and between 15-21 days old and 22-28 days old (df-1.2; t= -0.5; p=0.7) neonates diagnosed with septicaemia.

Table 6: Distribution of major complaints, clinical investigations, treatments and outcomes of neonates diagnosed with neonatal septicaemia according to affected age groups.

	Age-group (days)					
Route	0-1 (n=30)	2-7 (n=125)	8-14 (n=25)	15-21 (n=24)	22-28 (n=10)	Total
	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)
Intravenous	67 (223.3)	327 (261.6)	60 (171.4)	60 (250)	24 (240.0)	538 (82.5)
Intramuscular	12 (250.0)	39 (31.2)	7 (20.0)	7 (29.2)	0 (0.0)	65 (10.0)
Intranasal	11 (272.7)	21 (16.8)	0 (0.0)	0 (0.0)	3 (30.0)	35 (5.4)
Oral	0 (0.0)	0 (0.0)	5 (14.3)	5 (20.8)	4 (40.0)	14 (2.1)

Table 7: Common routes of medication administration according to age group of neonates in intensive care unit.

was the dominant (538, 82.5%) route by which medications were administered to the neonates in the study.

Discussion

The most profound physiologic change required of the neonate is transition from foetal or placental circulation to independent respiration [26]. This transition occurs immediately after birth and may be jeopardized by maternal risk factors such as hypertension, diabetes, by neonatal risk factors such as placental insufficiency, obstructions to the birth canal, meconium aspiration and infant risk factors such as compromised respiration, or birth trauma. There is a significant concern for misclassification of diagnoses by the attending clinician as only about 2% of infants with fever had a blood culture collected. The fact that the causative organisms in culture-positive sepsis cases could not identify is a significant problem in this study. In addition many congenital heart disorders such as Patent ductus arteriosus (PDA), inborn errors of metabolism such as Renal tubular acidosis, and other metabolic disorders for example Hypothyroidism can present with a sepsis-like picture, therefore can be falsely placed in the sepsis diagnosis category. However the treatment for all these disorders is very specific and proper diagnosis and therapy can be life-saving. Likewise certain congenital malformations can present early in life, and some carry high mortality risk.

The most common risks to the health of neonates that were found in this study were septicaemia, jaundice, meningitis, birth asphyxia and tetanus. Each clinical diagnosis, investigation and management of these conditions in neonatal period was supported with laboratory investigation which determined the subsequent survival or death of the neonate. The interpretation of each laboratory result obtained was utilized to direct appropriate management of the neonatal illness. The high neonatal mortality in Nigeria is probably due to inappropriate diagnosis and in management of these diseases. Neonatal medicine in sub-Saharan Africa deserves more attention and should be classified as one of the most important public health concern. Septicaemia, meningitis and tetanus are directly attributable to intra-uterine, vaginal and external infections while jaundice and birth asphyxia may be related to physiological irregularity in the neonate's system. Attempts were made to get blood culture and cerebrospinal fluid through lumbar puncture from neonates with the diagnosis of fever for the confirmation of septicaemia. However, the 2.2% request for blood culture among neonates that presented with fever and other debilitating illnesses falls drastically short of desired investigations in a situation where almost 47% of all diagnoses were septicaemia. This calls for constant management of patients' data and health information sharing among the management of health facilities in Nigeria. It is not certain if the intensive care unit of secondary health facilities in Nigeria have guidelines for care and management of common neonatal conditions.

The present survey confirms septicaemia, either of early or late onset, as a major health problem in perinatology and paediatric infectious diseases in Nigeria. This study could not ascertain the causative organisms of neonatal septicaemia because results of blood culture and of cerebro-spinal fluid analysis were not available, though Group B Streptococcus, Escherichia coli, Coagulase-negative *Staphylococcus,* Haemophilus influenzae and Listeria monocytogenes have been identified as common causes of neonatal septicaemia in other parts of the world [27]. Studies in Nigeria however reported 33% of septicaemia among neonatal tetanus cases [28] and 49% of septicaemic neonates in eastern Nigeria [29]. The 61.5% prevalence of

neonatal septicaemia reported in this study far exceeds the 3% reported from Finland [30], 9% reported from Saudi Arabia [31], the 37.5% reported from Uganda [32] and the 22% reported from elsewhere in Nigeria [33]. There are plausible environmental and socio-cultural reasons for the high prevalence of neonatal septicaemia in urban Lagos. Most deliveries were carried out where there were no trained staffs and where cords were cut with unsterilized instruments. Maternal pre-partum poor hygienic conditions were possible sources of infection at intra- and post-partum periods for the neonates. Pregnant women from low social strata are often malnourished and are more attached to socio-cultural dietary habits associated with pregnancy and childbirth. Pre-labour rupture of the membrane (PROM) could be an important factor in mother-infant bacterial colonization in early life [33,34]. Serial evaluation of early-onset and late-onset sepsis by complete blood count (CBC) and differential, blood and cerebrospinal fluid (CSF) cultures, and measurement of levels of C-reactive protein (CRP) and possibly other infection markers may be appropriate [35]. Polymerase chain reaction (PCR) could help achieve faster identification of causative organism [36].

These, however, dependent on availability of skilled workforce, laboratory equipments, reagents and laboratory space. Skilled workforce is inadequate and the few that are available are mostly overworked; diagnostic equipments and other infrastructures need improvement. In addition, out-of-pocket payments for laboratory procedures are occasionally beyond the patients' capacity to afford. Antibiotics, fluids and other medications prescribed by the attending clinicians would have to be purchased by the care-giver of the neonates from near-by "chemists" or "drug stores" since these commodities were almost always out-of-stock.

Jaundice was more prevalent in neonates aged 2-7 days (34.1%) and in those 8-14 (24.0%) days. These figures are less than the 62.2% reported at Ilesha [37], a location approximately 300 km north of our study site in the same geopolitical zone. It is very probable that the jaundice reported in our study was physiological jaundice which could have resulted from increased bilirubin load on the hepatic cells, defective uptake from plasma into liver cell, defective conjugation, decreased excretion and increased entero-hepatic circulation. However, we did not rule out other conditions of jaundice in this age group such as sepsis neonatorun, polycythemia or concealed haemorrhages such as cephalhematoma, extra-hepatic biliary atresia, metabolic disorders and breast milk jaundice or sub-arachnoid bleeding.

The one (3.3%) case of jaundice within 24 hours of life in this study needs further explanation. We are of the opinion that this case was that of pathological jaundice probably due to haemolytic disease of newborn (Rh, ABO and minor group incompatibility), infections (intra-uterine, viral, bacterial and possibly malaria) or G-6PD deficiency. Various myths, misunderstandings and inequitable knowledge pertaining to jaundice in early neonatal life in Nigeria are noteworthy. Not only could herbal remedies in pregnancy be implicated but also, as noted earlier [38] community health workers in south-west Nigeria believed in the efficacy of some herbal remedies for the management of jaundice in early life. A decision support for the management of neonatal jaundice has been suggested for clinicians [39].

That about 14% of neonates should still die of tetanus is worrisome and calls for a more effective policy on environmental management. Figures for neonatal tetanus recorded earlier in Nigeria [40,41] were however higher than what is reported in this study indicating perceived better hygienic conditions, especially of umbilical cord management.

Birth asphyxia among the study neonates, especially those in the first day of life, may have been associated with slow decrease in pulmonary vascular resistance which is high during fetal life thus preventing sufficient pulmonary blood flow and alveolar exchange [42]. Neonates diagnosed with birth asphyxia were given supplemental oxygen (O_2) which is a known pulmonary vasodilator that increases the partial pressure of oxygen (PaO_2) after birth and is regarded as one of the major factors responsible for the rapid decrease in pulmonary vascular resistance during transition from foetal to postnatal life [43]. However, studies have shown that therapeutic use of supplemental O_2 in neonatal period is controversial because of its adverse effects such as oxidative stress and alterations of the glutathione redox cycle enzymes [44,45], myocardial and renal tissue oxidative insult [46] and increased mortality [47]. Birth asphyxia carried a high mortality in this study probably due to use of supplemental O_2 and administration of intravenous infusion of 50% Dextrose water usually not recommended as maintenance/resuscitation fluids for this population, necessitating modern approach to the management of birth asphyxia.

There was no clear pattern in the occurrence of meningitis in this study. The highest number of neonates diagnosed for meningitis was those aged 2-7 days. Mortality of 40% due to meningitis among neonates is another worrisome issue. Early studies in southwest Nigeria identified salmonella species as the cause of neonatal meningitis [21,48] while later studies noted that, Neiserria meningitidis has replaced S. pneumonia as causative organism of neonatal meningitis in Southern Nigeria [49]. For better management of neonatal meningitis and to distinguish between bacterial and viral meningitis, part of the guidelines that should be made available at neonatal emergency ward is a simple Bacterial Meningitis Score (BMS) based on 5 different items: Gram stain, seizure at or before presentation, peripheral white blood cell count (WBC), cerebrospinal fluid (CSF) WBC and CSF protein concentration [24].

Poly-pharmacy within the hospital system is rife. In some cases, two to three antibiotics were prescribed where one could be effective. The dangers with poly-pharmacy include drug-drug interaction and possible displacement of bilirubin from its plasma-protein attachment among these neonates. Most neonates in Nigeria hospitals, especially at secondary and primary care levels, are not attended to by neonatologists. This gives room for wide-card diagnoses and prescription and unnecessary investigations or overlooking investigations when one should be asked for. Perhaps this contributes to the high neonatal mortality in the country's health facilities.

A very high proportion of infants with life-threatening conditions were discharged against medical advice. Hospital management is in a good position to ensure patients' confidence in the operations of the health facility and in ascertaining that health providers give their best. Care of neonates requires well-trained professionals and should not be left in the hands of newly qualified clinicians except when accompanied by more experienced neonatologists. When care-givers notice the presence of a young and inexperienced health care provider and the absence of an experienced and older medical doctor, they most like lose confidence and either abscond or request for discharged against medical advice (DAMA). Patients may also request for DAMA when healthcare provision is not perceived as adequate or when healthcare providers' behaviour is unfriendly.

There are some limitations in this study which must be mentioned. First, this study just reported what was entered into the records of the neonates admitted in the intensive care unit of the secondary paediatric health facility. Some data, such as duration of stay of the patients, were

definitely missing. The non-electronic recording and storage of data is more prone to operator errors. In some cases, data are too few. This was a hospital based study and may not reflect adequately the picture in the community. Finally, data from this paper is not representative of the general population.

In conclusion, this study has shown that neonatal mortality remains high and is mainly due to infectious and other preventable causes such as jaundice, meningitis, birth asphyxia, tetanus and septicaemia. Neonatal mortality remains disturbingly high in sub-Saharan Africa, regardless of significant global decline [50,51]. Though almost all, if not all, neonatal diseases have been recognized and up-to-date technology is available to combat these diseases, still neonates die in an unacceptable large number on account of these diseases. High neonatal mortality in sub-Saharan Africa can be adduced to cultural practices and belief system relating to pregnancy, child-birth and neonatal period. The major challenges before health authorities are (i) establishing neonatal care policy (ii) training of neonatologists (iii) strengthening the health system (iv) including neonates in health insurance and (v) ensuring electronic health recording, transfer and retrieving system. Future direction of neonatal care include (i) availability of modern incubators (ii) new prognostic markers for neonatal sepsis such as proadrenomedullin (iii) appropriate antibiotic therapy to improve neonatal sepsis and (iv) review of the use of O_2 in the management of birth asphyxia.

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