

## ORIGINAL ARTICLES

## FACTORS CONTRIBUTING TO NEONATAL ADMISSIONS AND OUTCOMES AT EFFIA NKWANTA REGIONAL HOSPITAL: JANUARY TO DECEMBER 2015

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**Abstract**

**Objectives:** To investigate factors contributing to neonatal admission outcomes at Effia Nkwanta Regional Hospital (ENRH)

**Method:** All neonatal admissions to the Neonatal & Intensive Care Unit (NICU) of the hospital that were entered into the DHIMS2 database were extracted and complemented with additional information from patients' folder review. The data from the two sources were merged and analysed using SPSS version 21. Univariate and multivariate regression analysis was performed to identify factors associated with admission outcomes, taking statistical significance as  $p < 0.05$ . ARC-GIS version 10.1 was used to describe the geospatial distribution of health facilities referring to ENRH.

**Setting:** Neonatal & Intensive Care Unit of ENRH

**Participants:** All neonates admitted to NICU between January and December 2015.

**Intervention:** None

**Results:** Nine Hundred and Ninety-Three out of the 1150 neonatal admissions were entered into DHIMS2.

Fifty-two percent were males, 57.3% were delivered through Caesarean Section, 72% were admitted within 2 days of birth, and 56.8% had normal birth weight. Fifty-Eight percent of the neonates were delivered at the ENRH, whilst 39.9% were referred from health facilities located within Sekondi-Takoradi Metropolis. At 1 minute, only 14% of the neonates had normal Apgar score (8-10), and this improved to 50% at 5 minutes. The main causes of neonatal admission were birth asphyxia 21.0%, followed by prematurity 17.5%, neonatal jaundice 17.1% and neonatal sepsis 14.5%. The death rate was 18% with more than 80% of the deaths occurring during the early neonatal period. More than 80% of deaths were due to four admission diagnoses: birth asphyxia, prematurity, neonatal jaundice, neonatal sepsis. Factors associated with adverse admission outcome are: low birth weight, delivery by Caesarean Section and low Apgar score at 5 minutes.

**Conclusions:** The institution of appropriate interventions to reduce or manage the four major causes of adverse neonatal admission outcomes will significantly reduce neonatal mortality in the hospital.

**Key Words:** neonatal, mortality, admission outcomes, Ghana

**Introduction**

In spite of the recent global efforts and resources put into prevention and reduction of morbidity and mortality among children aged  $\leq 5$  years, neonatal morbidity and mortality remains unacceptably high. In 2015, of the 5.9 million deaths that occurred globally among children aged  $\leq 5$  years, 2.7 million (45%) were neonates.<sup>1</sup> Over two-thirds of the global neonatal deaths occur in developing countries, particularly in Asia and Africa.<sup>2-3</sup> Most of these deaths occur during the antepartum or intrapartum period, and the rest during the first week of life.<sup>3</sup>

In the African region, under-five mortality decreased by 54% between 1990 and 2015, compared to 38% decrease in neonatal mortality within same period.<sup>4</sup> In Ghana, under-five mortality decreased from 80/1000 live births in 2008 to 60/1000 in 2014. However, neonatal mortality only declined from 30/1000 live births in 2008 to 29/1000 in 2014.<sup>5-6</sup> In the Western Region (WR), under five mortality reduced from 65 to 56/1000 live births, while neonatal mortality reduced from 40 to 28/1000 live births.<sup>5-6</sup>

In 2014 institutional under five mortality in the WR was 10.1/1000 live births, compared with the national average of 8.4/1000 live births. Similarly, institutional neonatal mortality for the region was 6.7/1000 live births compared with the national average of 4.3/1000. WR was thus the second worst performing region in the country that year.<sup>7</sup>

Majority of the neonatal admissions and mortality in the WR occurred at the Effia Nkwanta Regional Hospital (ENRH), a secondary referral hospital with a

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neonatal and intensive care unit (NICU). In 2014, 119 out of 394 (30.2%) neonatal mortality occurred in the NICU.<sup>8</sup>

The hospital initiated some interventions to reduce the morbidity and mortality. These interventions include training on neonatal resuscitation, infection prevention and control (IP&C), with emphasis on cord care, and Kangaroo Mother Care (KMC). In spite of these interventions, neonatal mortality continued to increase. In 2015, 179 out of 295 (60.7%) neonatal mortality in the region occurred at the NICU.<sup>8</sup>

This study therefore sought to find out the factors contributing to neonatal admission outcomes at ENRH so as to institute appropriate interventions to reverse the trend.

## Methods

### *Study setting*

The study was conducted at ENRH in the Western Region of Ghana. The ENRH is located in Sekondi and it is the largest and the only secondary health care facility in the region. The Hospital has a bed complement of 308, with 21 in the NICU. The unit admits approximately 1007 patients annually. It serves as a major referral centre for the region and provides specialist care to patients referred from other health facilities.

### *Study type*

The study was retrospective and cross-sectional in design and used routine health facility service data within the District Health Information System 2 (DHIMS2) platform of the Ghana Health Service. The DHIMS2 is developed on District Health Information System version 2 (DHIS2) application platform and it is a free open source software used to capture facility level aggregated service data for all service delivery in Ghana. Client based anonymous transactional data is also captured for inpatient morbidity and mortality, returns of deliveries and cause of death certificate data.

Data of all neonates admitted to the NICU of the hospital from January to December 2015 were extracted from the DHIMS2 database. In order to answer key research questions, additional data was extracted from the patients' folders to complement what was extracted from DHIMS2. The folders were retrieved using the patients' unique ID as entered in to DHIMS2.

The variables that were extracted from DHIMS2 were: date of admission or discharge; gender; principal and additional diagnoses; and outcomes of admission. The variables extracted from the patients' folders were: source of referral; Apgar scores; facility of delivery; mode of delivery and birth weight.

### *Data Processing and Analysis*

The data from the two sources were merged and imported into Microsoft excel 2016 and analysed using Statistical Package for Social Sciences (SPSS) version 21.

Using accepted standard definitions and formats, various categorization of the data was done.

Birth weight was categorized as follows: < 2500 grams as underweight, 2500 to 3999 grams as normal weight and > 4000 grams as overweight. Varied levels of underweight were also defined as follows: < 1000g as extremely low birth weight (ELBW); 1000 -1499g as very low birth weight (VLBW); and 1500 – 2499g as low birth weight (LBW). Apgar score at 1 and 5 minutes were also categorized as follows: 0-2 (severe); 3-5 (moderate); 6-7 (mild) and 8-10 (normal). The age on admission and discharge were also categorized as follows: 0-2; 3-7; 8-14; 15-28 days

Frequencies, percentages and graphical presentation were used to display findings. In order to identify the factors associated with admission outcomes, univariate and multivariate regression analysis was performed. Statistical significance was taken as  $p < 0.05$ .

ARC-GIS version 10.1 was used to describe the geospatial distribution of health facilities that referred the neonates to the NICU of the hospital

### *Study Limitations*

Since secondary data was used, the accuracy and completeness of the data may not be optimum. The findings may also not be generalizable to the whole community and region as a whole since the data is health facility based.

### *Ethical Consideration*

Ethical Clearance was given by the Ghana Health Service Ethics Review Committee with ID No. GHS-ERC: 23/09/15. Permission was also sought from the Western Regional Health Directorate and Effia-Nkwanta Regional Hospital for use of the data.

## Results

### *Neonatal Characteristics*

Between January and December 2015, the NICU of ENRH recorded 1150 admissions in the Admissions and Discharges (A&D) register, of which 993 were entered in DHIMS2. 519 (52.7%) were males. 869 (57.3%) were delivered through either elective or emergency Caesarean Section. The age on admission ranged between 0 to 28 days with a mean of 2.7 days. Majority 701 (72%) were admitted within 2 days of birth.

The birth weight ranged from 405 to 7000 grams, with a mean of 2803.60grams. Majority 506 (56.8%) had normal birth weight (2500 – 3999g), whilst 295 (33.1%) had low birth weight (< 2500g) as shown in Table 1.

### *Apgar Scores at 1 and 5 minutes*

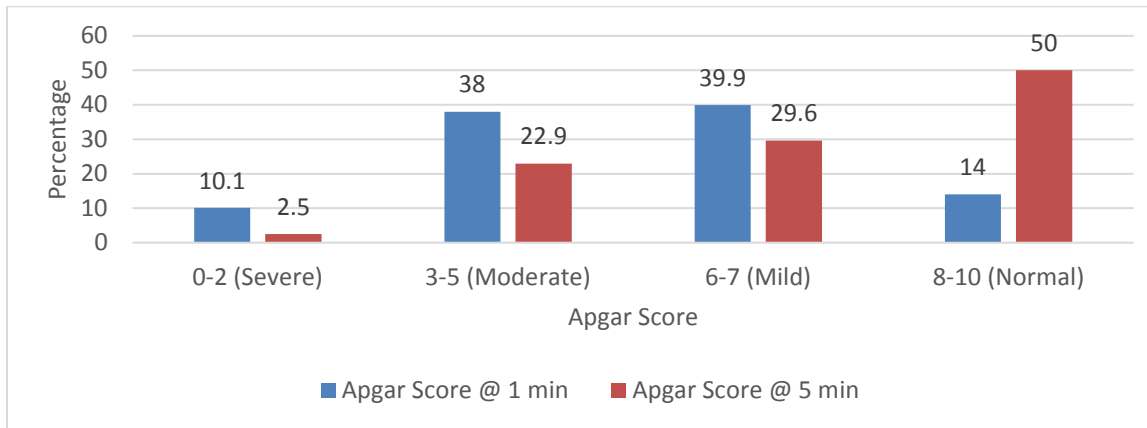
Apgar score at one and five minutes was recorded for 834 (84.0%) of the neonates. The mean scores at one and five minutes were 5.34 and 6.82 respectively. The modal score was 7 at one minute and 8 at five minutes. At 1 minute, only 14% of the neonates had a normal Apgar score of 8-10 which improved to 50% at 5 minutes (Figure 1).

### *Place of delivery*

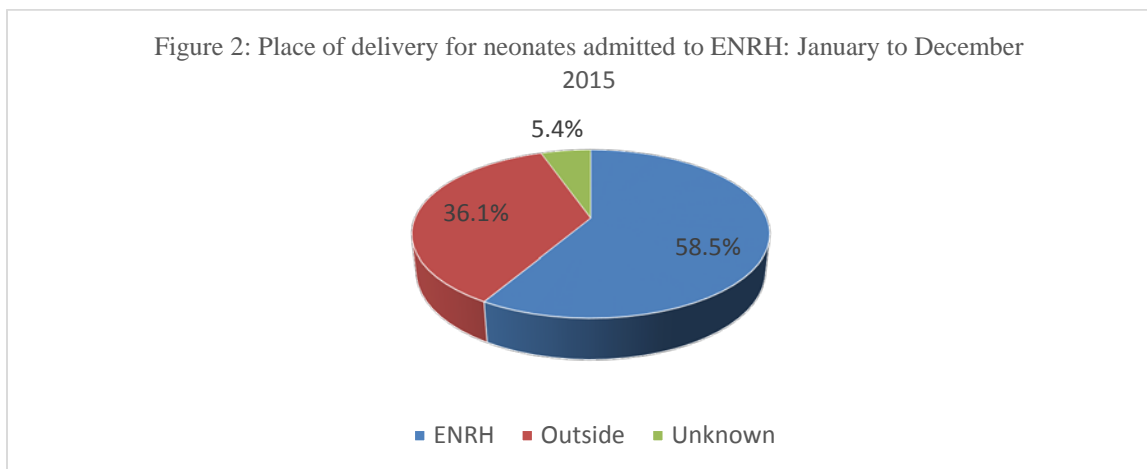
Majority 581 (58.5%) of the neonates, were delivered at the ENRH (Figure 2).

**Table 1:** Characteristics of neonates admitted to the NICU of Effia-Nkwanta Regional Hospital (January-December, 2015)

Variable		Frequency	Percentage
<b>Sex</b> N=985	Male	519	52.7
	Female	466	47.3
<b>Mode of Delivery</b> N=993	Caesarean Section	869	57.3
	Spontaneous Vaginal Delivery	396	39.9
	Vacuum Extract	4	0.4
	Unknown	24	2.4
<b>Age on Admission(days)</b> N=973	0-2	701	72.0
	3-7	179	18.4
	8-14	52	5.3
	15-28	41	4.2
<b>Birth Weight (g)</b> N=891	0-999	19	2.1
	1000-1499	61	6.8
	1500-2499	215	24
	2500-3999	506	56.8
	≥4000	90	10.1



**Fig 1:** Comparison between Apgar scores at one and five minutes for neonates admitted to the NICU of ENRH, January to December 2015



**Fig 2:** Place of delivery for neonates admitted to ENRH: January too December 2015

**Level of facilities referring to ENRH**

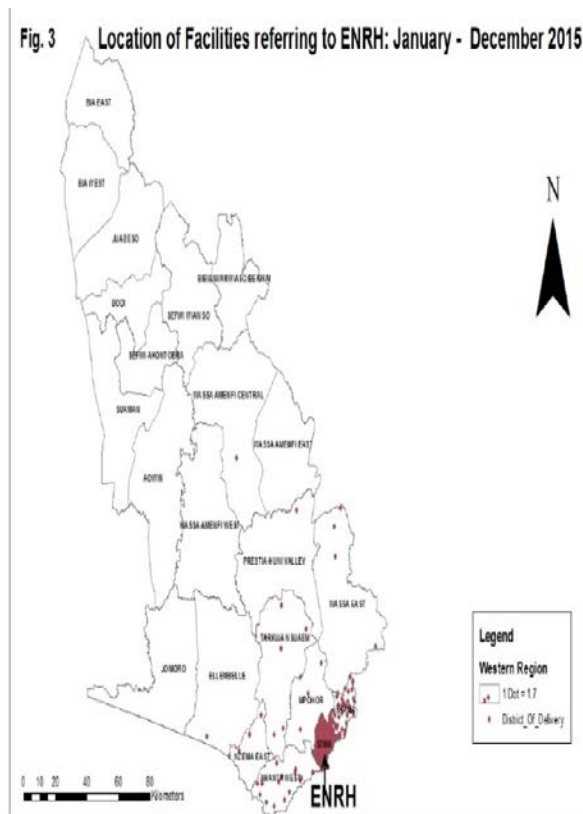
Of the 358 neonates that were referred from other health facilities, majority 220 (61.4%) were referred from various hospitals within the region. Forty-nine (13.7%) neonates were either delivered at home or by a TBA and later referred to the ENRH (Table 2).

**Table 2:** Level of facilities referring to the NICU of ENRH: January to December 2015

Facility	Number	Percentage
Hospital	220	61.5
Health Centre	56	15.6
Home/TBA	49	13.7
Clinic	22	6.1
Maternity Home/CHPS	11	3.1

**Location of referring facilities**

The health facilities that referred to the NICU of ENRH are located in ten different districts within the region, with the majority 143 (39.9%) located within Sekondi-Takoradi Metropolis (Figure 3).



**Causes of neonatal admissions**

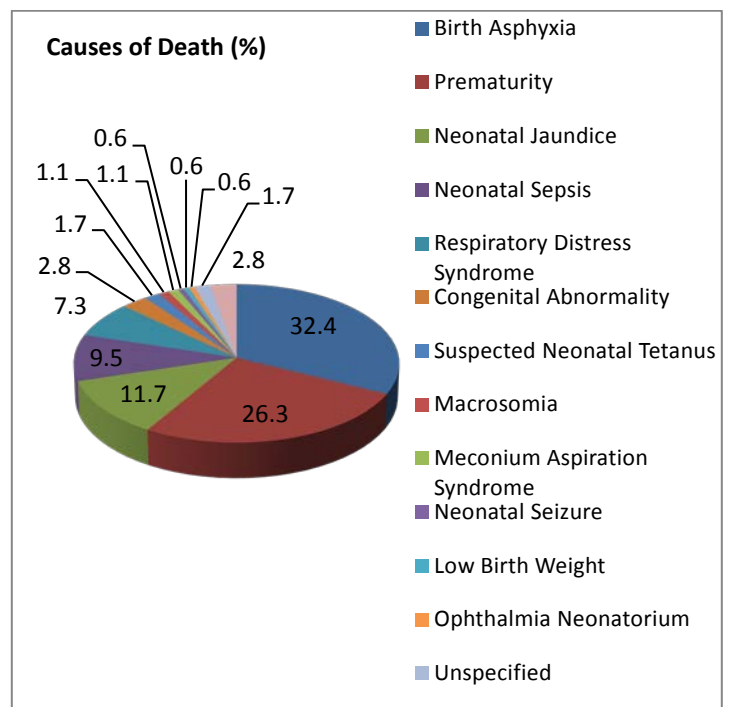
Reasons for neonatal admissions were birth asphyxia 209 (21.0%), prematurity 174 (17.5%) and neonatal jaundice 170 (17.1%). (Table 3).

**Table 3:** Reasons for admission to the NICU of ENRH: January – December 2015

Reasons for admission	No.	%
Birth Asphyxia	209	21.0
Prematurity	174	17.5
Neonatal Jaundice	170	17.1
Neonatal Sepsis	144	14.5
Macrosomia	62	6.2
Congenital Abnormality	36	3.6
Respiratory Distress Syndrome	27	2.7
Neonatal Seizure	16	1.6
Emesis in Newborn	16	1.6
Meconium Aspiration Syndrome	13	1.3
Birth Trauma	13	1.3
Low Birth Weight	12	1.2
Ophthalmia Neonatorum	13	1.3
Suspected Neonatal Tetanus	4	0.4
Unspecified	45	4.5
Others	39	3.9
Total	993	100

**Admission outcomes**

Of the 993 neonates admitted, mortality was 179 (18%), comprising 144 (80.4%) early neonatal deaths (0-7days). More than 80% of the mortalities were due to four conditions: birth asphyxia 58 (32.4%), prematurity 47 (26.3%), neonatal jaundice 21 (11.7%) and neonatal sepsis 17 (9.5%). Fig 4).



**Fig 4:** Causes of Death among neonates admitted to NICU of ENRH, January to December 2015

**Factors associated with admission outcomes**

Mortality is significantly associated with low birth weight, delivery by caesarean section and lower Apgar score at 5 minutes ( $p = 0.001, 0.001, \text{ and } 0.001$  respectively).

Neonates delivered outside ENRH, those referred from lower levels of health facility and those with lower Apgar score at 1 minute have a higher mortality,

but this was not statistically significant during linear and multiple regression analyses ( $p = 0.54/0.71, 0.254/0.371$  and  $0.601/0.952$  respectively).

There was no difference in admission outcomes among male and female neonates ( $p=0.382$  and  $0.359$ ) respectively during linear and multiple regression analyses (Table 4).

**Table 4:** Factors Associated with neonatal admissions outcomes at the NICU of ENRH, January -December 2015

Variable	Discharged	Died	Total	Univariate P-Value (95% CI)	Multivariate P-Value (95% CI)
<b>Sex (N=980)</b>					
Male	427 (82.3%)	92 (17.7%)	519		
Female	379 (82.2%)	82 (17.8%)	461	0.382 (-.070 to 0.027)	0.358 (0.797 to 1.868)
<b>Birth Weight (g) (N=887)</b>					
<1000	1 (5.3%)	18 (94.7%)	19		
1000-1499	40 (65.6%)	21 (34.4%)	61		
1500-2499	176 (81.9%)	39 (18.1%)	215		
2500-3999	437 (86.7%)	67 (13.3%)	504		
4000 and above	83 (94.3%)	5 (5.7%)	88	0.001 (-.113 to -.051)	0.001 (1.411 to 2.323)
<b>Mode of delivery (N=964)</b>					
Caesarean section	426 (75.5%)	138 (25.5)	564		
Spontaneous Vaginal Delivery	358 (90.4%)	38 (9.6%)	396		
Vacuum	3 (75.0%)	1 (21.0%)	4	0.001 (-.133 to -.033)	0.001 (1.4 to 3.457)
<b>Place of Delivery (N=988)</b>					
ENRH	499 (86.3%)	79 (13.7%)	578		
Outside	260 (72.8%)	97 (27.2%)	352		
Unknown	50 (94.3)	3 (5.7%)	53	0.054 (-.001 to .175)	0.071 (.264 to 1.057)
<b>Level of Facility of Delivery (N=988)</b>					
ENRH	499 (86.3%)	79 (13.7%)	578		
Hospital	162 (74.0%)	57 (26.0%)	219		
Health Centre	42 (75.0%)	14 (25.0%)	56		
Home/TBA	32 (65.3%)	17 (34.7%)	49		
Clinic	13 (61.9%)	8 (38.1%)	21		
Maternity Home/CHPS	10 (90.91)	1 (9.09)	11		
Unknown	51 (94.4%)	3 (5.6)	54	0.254 (-.058 to .015)	0.371 (.850 to 1.546)
<b>Apgar score 1 (N=831)</b>					
0-2	42 (50%)	42 (50%)	84		
3-5	261 (82.6%)	55 (17.4%)	316		
6-7	282 (89.8%)	32 (10.2%)	314		
8-10	105 (89.7%)	12 (10.3%)	117	0.601 (-.033 to .058)	0.952 (.656 to 1.487)
<b>Apgar score 5 (N=831)</b>					
0-2	6 (28.6%)	15 (71.4%)	21		
3-5	124 (64.9%)	67 (35.1%)	191		
6-7	219 (89.8%)	25 (10.2%)	244		
8-10	341 (90.9%)	34 (9.1%)	375	0.001 (-.163 to -.072)	0.001 (1.563 to 3.405)

## Discussion

This study sets out to examine the factors contributing to admission outcomes at the NICU of Effia Nkwanta Regional Hospital using the DHIMS2 platform. The DHIMS2 database offers a good platform for collection of data that can help to generate the necessary information needed to guide interventions aimed at addressing under five mortality, and by extension, neonatal mortality.

The study revealed that the majority of the neonates (72%) were admitted during the first two days of life and that more males were admitted than females. These findings have been reported in other settings.<sup>9-11</sup> However, whilst other studies found an increase survival rates among females compared to males,<sup>12</sup> this study did not find any significant difference in admission outcomes among males and females.

It was observed that the lower the birth weight, the higher the mortality. Similar results were reported in Pakistan and Ghana.<sup>13-14</sup> Low birth weight is usually associated with prematurity which predisposes them to feeding difficulties, poor temperature control, and increased susceptibility to infections. Thus, efforts to reduce mortality among such babies should focus on simple measures, such as improving warmth, good feeding practices and early treatment of infections.<sup>15-16</sup>

Majority (58.5%) of the neonatal admissions to the NICU were babies delivered at the ENRH while the rest were delivered in health facilities located in districts close to the regional hospital. This is consistent with findings from the University of Benin Teaching Hospital and Enugu State University Teaching hospital, where 84.6% and 54.4% of newborn admissions were in-born respectively<sup>10, 17</sup> ENRH being a referral centre, receives complicated obstetric cases which invariably result in neonatal morbidity and mortality.

Mortality among babies delivered by caesarean section was higher than those delivered by spontaneous vaginal delivery (57.3% vs. 39.9%), in contrast to studies in Namibia, where 58.6% of the new-born mortality were delivered by normal vaginal delivery and 23.3% by caesarean section.<sup>18</sup> The decision to do a caesarean section is usually made when adverse conditions are found in either the mother or the baby which contribute to the higher mortality among neonates delivered by caesarean section.

The Apgar score is a screening tool to evaluate a newborn's condition after initial resuscitation<sup>19</sup>. In the study, at 1 minute, 48.1% of the neonates had severe to moderate asphyxia (Apgar score below 6) and this improved to 25.4% at 5 minutes. The lower the Apgar score, the higher the mortality. Mortality was 50% and 71.4% for neonates with severe asphyxia (Apgar Scores of 0-2) at 1 and 5 minutes respectively.

Birth asphyxia, prematurity, neonatal jaundice and neonatal sepsis were the main reasons for admission and mortality during the study period. Similar findings have been reported by other studies<sup>11, 20</sup>. We also found that

more than 80% of the mortalities occurred in the first week of life as reported in other studies<sup>3</sup>.

## Conclusion and recommendations

In conclusion, the institution of appropriate interventions aimed at reducing or managing the four main causes of admission as reported in this study will significantly lead to reduction in neonatal mortality in the hospital. Such interventions should be simple, but effective approaches that have been proven to reduce neonatal morbidity and mortality. Prevention-based interventions such as, administration of antenatal steroids, early initiation of breastfeeding, newborn temperature management using KMC<sup>16, 21-22</sup> are cost effective measures to reduce newborn morbidity and mortality. Clean delivery practices, with strict observance of IPC practices, especially during cord care help reduce neonatal infection, sepsis, and hence mortality.

Treatment-based interventions such as newborn resuscitation and appropriate use of antibiotics are essential for reducing neonatal mortality<sup>23-24</sup>. In this regard, health staff involved in the provision of obstetric and newborn care should be trained in these preventive measures. Critical equipment for resuscitation of the newborn, management of preterm babies and neonatal jaundice should also be provided, routinely maintained and replaced as needed.

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