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Quality of neonatal health care in comprehensive specialized hospitals, Amhara Region, Ethiopia: a retrospective study with neonatal death audit

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Abstract

Background Neonatal health is one of the targets for the sustainable development goals (SDGs) that aim to reduce neonatal mortality to at least as low as 12 per 1 000 live births in 2030. However, the world is not on track to achieve this target. The problem has worsened in many low-income countries, including Ethiopia, due to a fragile health system, as well as health crises such as the COVID-19 pandemic, conflict, food insecurity and climate change. According to the Mini Ethiopian Demographic Health Survey, neonatal mortality is unacceptably high in Ethiopia in general, and in Amhara region in particular. Despite these facts, there is a paucity of information on the quality of neonatal health service provision in comprehensive specialized hospitals in Amhara region. Therefore, this study is aimed at assessing the quality of neonatal health services in terms of outcome (neonatal mortality) and its causes in comprehensive specialized hospitals in Amhara region.

Methods A multi-center retrospective study was conducted (from September 1–30/2022) on 315 neonates in four comprehensive hospitals with chart review. Data were collected through death audit with standardized neonatal death audit tool. Data were entered into Epi-data 3.1 and exported to SPSS 20 for analysis. Descriptive analysis was used to describe and summarize the data in an informative manner.

Results From 315 neonatal deaths, about two-thirds, 205 (65.1%), were from rural areas. Nearly half, 151 (48%), of the mothers had complications and delivered outside a health facility. About 36 (11.4%), 45 (14.3%), and 21 (6.7%) neonates' mothers had 1st, 2nd, and 3rd delays, respectively. About 59 (19%) of mothers had membrane rupture before the onset of labor and 23 (7.3%) had meconium-stained liquor. Almost three-fourths, 226 (71.7%), of the deaths were low birth weight (< 2500 gram). About 25 (8%) of neonates had congenital anomalies, 65% of them had fast breathing and 54.6% were preterm.

Conclusion Higher proportions of neonatal deaths were observed among neonates with rural residence, low birth weight, mothers' complications and neonates admitted for fast breathing. Histories of abortion, complications, congenital anomalies, and the 3 delays contributed to neonatal deaths.

Keywords Neonatal health, Quality, Hospital, Amhara, Ethiopia

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Introduction

Despite global and national efforts to prioritize neonatal health, neonatal mortality (NM) remains a significant challenge. This issue is reflected in Sustainable Development Goal 3.2 (SDG3.2), which aims for a target of 12 neonatal deaths per 1000 live births by 2030 [1]. Additionally, Ethiopia's Health Sector Transformation Plan (HSTPII) sets a target of 21 neonatal deaths per 1000 live births by 2025 [2]. NM is defined as the occurrence of death within the first four weeks of life after birth. NM is classified as Early Neonatal Mortality (ENM) and Late Neonatal Mortality (LNM), which refer to deaths occurring within the first 7 days and between 8 and 28 days of life after birth, respectively [3–5]. The first month of a child's life is the most critical time for neonatal survival, and it significantly contributes to morbidity and mortality in children under the age of five [5].

Globally, NM currently contributes 47% of under-five mortality. This contribution is particularly high in low-income countries. For instance, South Asia and Sub-Saharan Africa (SSA) together accounted for 79% of all neonatal deaths. Specifically, 36% of these deaths occurred in South Asia, while 43% occurred in SSA. The annual Neonatal Mortality Rate (NMR) in these regions was 23 and 27 neonatal deaths per 1000 live births, respectively [1].

Notably, SSA countries, including Ethiopia, have the highest NMR, with a regional average of 27 neonatal deaths per 1000 live births. In a recent study, it was found that the annual NMR in SSA countries was 10 times higher than that of high-income countries [1, 6].

Based on the Ethiopian Demographic Health Survey (EDHS) reports from 2016 and the mini EDHS report from 2019, the Neonatal Mortality Rate (NMR) was 29 and 33 neonatal deaths per 1,000 live births, respectively [7, 8]. There was a slight increase in the NMR between these two periods. Moreover, there are variations across regions of Ethiopia, with a range of 22 neonatal deaths per 1000 live births in the Harari region to 33 neonatal deaths per 1000 live births in the Amhara region [8].

Amhara region faces a significant burden of neonatal deaths, with 91% of these deaths occurring in health facilities, including hospitals. Among these facilities, tertiary care settings account for 95% of neonatal deaths [9]. Previous studies revealed that the Neonatal Mortality Rate (NMR) in the Amhara region is among the highest compared to other Ethiopian regions [6, 8, 10–12].

Contributing factors to neonatal mortality encompass a range of interconnected elements. These include poor decision-making by mothers when seeking healthcare, low postnatal visit rates among women, the occurrence of home births, delayed breastfeeding after birth, the impact of multiple births, and various medical conditions such as neonatal sepsis, birth asphyxia, low birth weight, prematurity, and congenital factors [10]. Additionally, the mode of delivery, the presence of meconium staining, and congenital anomalies play significant roles in determining neonatal outcomes. Addressing these factors through improved healthcare access, awareness, and timely interventions is crucial for enhancing neonatal well-being [11].

Despite progress, neonatal mortality continues to be a challenge in the Amhara region during the 21st century. The lack of comprehensive and timely evidence regarding the actual causes of neonatal deaths at the tertiary health system level (comprehensive specialized hospitals) highlights the necessity for a neonatal death audit. The aim of this audit was to assess neonatal deaths and identify preventable factors in Amhara region, Northwest Ethiopia, in 2022.

Methods and materials

Setting and period

The study was conducted in four randomly selected tertiary hospitals (Felege Hiwot, Debere Markos, Debre Birhan and University of Gondar teaching hospitals) of Amhara region, North West Ethiopia from September 1–30/2022. Amhara region is one of the most populous regional states in Ethiopia; it has 14 zones, 8 city administrations and 180 districts (139 rural and 41 urban). According to the Ethiopian Central Statistics Agency, the region has a projected population of 30.9 million. About 80% of them are rural dwellers [13]. The region has 98 hospitals, 8 of which are comprehensive specialized hospitals with level three NICU services, 917 health centers, and 3,725 health posts. All health facilities provide neonatal health services [9].

Study participants

The study included all neonatal deaths that occurred in selected comprehensive specialized hospitals of the Amhara region from September 1–30/ 2022. The study excluded neonatal charts that lacked sufficient information (cause of death and death summary sheet).

Sample size determination and sampling technique

From the 8 comprehensive specialized hospitals, we selected half (four) of them, assuming that all comprehensive specialized hospitals are homogeneous. Subsequently, we included all neonatal deaths that occurred in the selected comprehensive specialized hospitals of the Amhara region between September 1, 2021, and August 31, 2022, for the study. In total, we identified 315 neonatal deaths with sufficient information (cause of death and death summary sheet) available in their charts.

Neonatal related factors

Neonatal birth weight, birth asphyxia, prematurity, congenital anomaly, early initiation of breast feeding, neonatal sepsis (infection), respiratory distress syndrome, APGAR score, jaundice, hypothermia and hypoglycemia.

Maternal and obstetrics factors

Parity, number of ANC visit, obstetric complications (preeclampsia, PPH, APH, gestational DM and PROM), tetanus toxoid vaccine, duration of labor, duration of rupture of membrane, place of delivery, mode of delivery, onset of labor and PNC care.

Socioeconomic and demographic variables

Mother's age at birth, place of residence, maternal comorbidity (HIV, DM, HTN), neonatal age, neonatal sex.

Data collection procedure

We used a standardized tool for neonatal death auditing, adapted from the World Health Organization, to collect information on neonatal deaths and their causes. A data collection checklist consisted of sociodemographic information, maternal or obstetric characteristics, and neonatal risk factors of neonatal deaths. We reviewed neonatal records (registers and charts) for essential information such as gestational age at birth, sex, birth weight, APGAR scores, and neonatal complications. We also reviewed maternal records for demographic data, medical and obstetrical histories, maternal complications, and course of pregnancy and delivery. A multidisciplinary team composed of pediatricians, obstetricians/gynecologists, and public health experts participated in data collection.

Data quality control

To ensure the quality of data, we involved senior pediatricians, obstetricians/gynecologists, and public health experts in data collection. We also consulted experts including neonatologist, discussed, and agreed on the data collection tool and approach among the team members before conducting the assessment/audit. We used a standardized death audit checklist and verified the records twice.

Data management and analysis

Data were coded, cleaned, entered, and analyzed using SPSS version 20. We used descriptive statistics (frequencies, percentages) to measure the characteristics of the study participants. We presented the results using tables with textual highlights.

Results

Maternal sociodemographic and obstetric characteristics

We audited 315 cases that occurred in one year (from September 1, 2021 to August 31, 2022) from four comprehensive specialized hospitals. The audited cases included 82 from Felege Hiwot hospital, 80 from Debre Markos hospital, 73 from University of Gondar teaching hospital, and 80 from Debre Birhan hospital.

Of the mothers, 205 (65.1%) lived in rural areas. Regarding parity, 109 (34.6%) were para 1, and 40 (12.7%) were para 5 or above. About 3.5% of the mothers had a history of abortion. Most mothers (92.7%) had at least one ANC visit, but 23 (7.3%) had none. Of the mothers who had ANC follow-up, 58.1% went to a health center, 7.3% to a primary hospital, 5.4% to a specialized hospital, and the rest to general hospitals or private clinics. Of the mothers who had ANC follow-up, 68.6% were screened for all types of STI. PICT was performed for 82.5% of them, basic investigations (CBC, urine test, ultrasound scanning) for 85.7%, and 79.4% received at least one tetanus toxoid vaccination. Additionally, 82.5% of the mothers received iron and folic acid supplementation.

Of the mothers of neonates who were audited, 51 (47.9%) had a risk of complication. Of these, 20 (6.3%) had hypertension (HTN), 17 (5.4%) had diabetes mellitus (DM), 12 (3.8%) had antepartum hemorrhage (APH), and 68 (21.6%) had multiple pregnancy. Of the mothers, 119 (37.8%) had premature rupture of membranes, 91 (28.9%) had preterm labor, and 20 (6.3%) had post-term pregnancy. About 102 (33%) of the participants had a delay, of which 36 (11.4%) had a delay in seeking care, 45 (14.3%) had a delay in reaching care, and 21 (6.7%) had a delay in receiving care. Most of the labor onset was spontaneous 270 (85.7%).

Of the mothers, 59 (18.7%) had membrane rupture before labor onset, and 23 (7.3%) had meconium-stained liquor. The fetal presentation was cephalic in 259 (82.2%), breech in 48 (15.2%), and not documented in the rest. The place of delivery was a specialized hospital for 33%, a health center for 27.9%, a primary hospital for 21.6%, and home for 12 (3.8%). The mode of delivery was spontaneous vaginal delivery for 222 (70.5%), emergency cesarean section (CS) for 64 (20.5%), instrumental delivery for 19 (6%), and elective CS for 10 (3.2%). Of the participants with fully documented charts, 61 (19.4%), 34 (10.8%), 12 (3.8%), and 4 (1.3%) births were attended by midwives, obstetricians/gynecologists, integrated emergency surgical officers (IESOs), and traditional birth attendants (TBAs), respectively (Additional file 1).

Neonatal characteristics

Of the neonates, 192 (61%) were male. About 79 (25.1%) were resuscitated immediately after delivery. More than half of the neonates (53.3%) arrived at the facilities during daytime. About 25 (7.9%) had congenital anomalies. Of the neonates audited, 127 (40.3%) delivered from the study facilities (transfer in), 160 (50.8%) were referred from other health facilities, and the rest were

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Table 1 Referral diagnosis of the audited neonate's in selected tertiary settings of Amhara region, 2024

		Frequency	Percent
PNA	No	243	77.1
	Yes	72	22.9
Preterm	No	157	49.8
	Yes	158	50.2
Sepsis	No	244	77.5
	Yes	71	22.5
RDS	No	207	65.7
	Yes	108	34.3
NEC	No	304	96.5
	Yes	11	3.5
Hypothermia	No	268	85.1
	Yes	47	14.9
Hypoglycemia	No	309	98.1
	Yes	6	1.9
Apnea	No	312	99
	Yes	3	1

Table 2 Immediate causes of death recorded vs. external auditor's decision in selected tertiary settings of Amhara region, 2024

Ser. No	Immediate cause of Death	By managing Team		By external auditing team	
		Frequency	Percentage	Frequency	Percentage
1	Complication of prematurity	8	2.5	36	11.4
2	Respiratory failure	116	36.8	92	29.2
3	Uncontrolled sepsis	33	10.5	41	13
4	Multiorgan failure	114	36.2	112	35.6
6	Asphyxia	5	1.6	20	6.3
7	Others	15	4.8	14	4.4

self-referred. The reasons for admission/transfer in were failure to suck (60%), fast breathing (65%), fever (3%), and vomiting (2%). Most of the referral forms (95.2%) were incomplete. The referral diagnoses of the audited neonates were preterm (158 or 50.2%), respiratory distress syndrome (RDS) (108 or 34.3%), pneumonia (PNA) (72 or 22.9%), and sepsis (71 or 22.5%) (Table 1).

The neonates received various management strategies, such as Continuous Positive Airway Pressure (CPAP) for respiratory support (44.1%), IV Fluid for hydration and electrolyte balance (9.8%), Radiant warmer for thermoregulation (22.5%), IV Antibiotics for infection treatment (89.5%), Blood transfusion for anemia or blood loss correction (5.7%), Phototherapy for bilirubin reduction (8.6%), Intranasal oxygen for supplemental oxygen delivery (35.9%), Incubator for controlled environment provision (3.5%), Aminophylline for apnea of prematurity treatment (2.4%), Anticonvulsant for seizure prevention (11.4%), and Calcium gluconate for hypocalcemia treatment (17.1%).

The changes after management were not documented in most of the cases, and only 5.7% of the cases showed some improvement. Among the neonates audited, only 58.1% had appropriate fluid balance documented, 74.6% had medication sheet attached, and 76.8% had physician order and medication sheet matched. The time of death was during the night time for about 30.1% of the cases.

Cause of admission and contributing factors for neonatal death

The immediate causes of death documented by the treating team were as follows: complication of prematurity (2.5%), respiratory failure (36.8%), uncontrolled sepsis (10.5%), multi-organ failure (36.2%), and incompatible

to life (0.3%). However, the auditing team (pediatricians, obstetricians/gynecologists, and public health experts) agreed on different causes: complication of prematurity (11.4%), respiratory failure (29.2%), uncontrolled sepsis (13%), multi-organ failure (35.6%), asphyxia (6.3%), and others (4.4%) (Table 2).

Identified pit falls

Based on auditing the charts of neonates who died, the investigators identified several pitfalls that contributed to the mortality. These included delay during referral (44.4%), delayed management after admission (21%), lack of oxygen (4.4%), lack of blood products (4.1%), misdiagnosis (7.3%), mismanagement (15.2%), lack of supplies and medical equipment (14%), and delay in surgical decision (4.4%). The death auditing team agreed that about 73.7% of the deaths were preventable. The gaps were categorized into two themes: clinical related (66%) and health system related (34%) (Table 3).

Discussion

The aim of this assessment was to describe the neonatal deaths and identify potentially avoidable factors that are linked to neonatal deaths. These factors are central for designing and implementing strategies to reduce neonatal mortality at tertiary hospitals in the Amhara region, Northwest Ethiopia.

The total annual number of neonatal deaths (315 per year) in the selected hospitals was very high. This high neonatal mortality may be related to mothers' exposure to COVID-19 infections and adverse reactions to its vaccine, along with other factors, as the study period

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Table 3 Gaps identified by the Auditing Team in selected tertiary settings of Amhara region, 2024

Ser. No	Identified gaps	Frequency	Percentage
Delayed referral	Yes	140	44.4
	No	175	55.6
Delayed management after admission	Yes	66	21
	no	249	79
Lack oxygen	Yes	14	4.4
	No	301	95.6
Lack of blood products	yes	13	4.1
	no	302	95.9
Misdiagnosis	Yes	23	7.3
	No	292	92.7
Mismanagement	Yes	48	15.2
	No	267	84.8
Lack of supplies and medical equipment	Yes	44	14
	No	271	86
Delayed in inter department	Yes	14	4.4
Consultation / surgical	Yes	232	73.7
	No	83	26.3

(September 1, 2021 to August 30, 2022) coincided with the COVID-19 pandemic [14].

The main causes of death were referral delay (44.4%), delayed management after admission (21%), misdiagnosis (7.3%), mismanagement (15.2%), and lack of resources such as oxygen (4.4%), blood products (4.1%), supplies and equipment (14%), and timely surgical decision (4.4%). The death auditing team concluded that 73.7% of the deaths were preventable. The gaps were mainly clinical (66%) and health system (34%) related factors. This implies that better quality of neonatal health care could have prevented three out of four neonatal deaths. As the saying goes, universal health coverage (UHC) without quality is an empty vessel. Health care that lacks quality cannot add value, and may even harm the patients, worsening their existing health problems and increasing the costs of medical errors [15, 16].

The current study showed that neonatal deaths were much higher in rural settings. About two-thirds (65.1%) of neonatal deaths occurred to neonates from rural areas, despite seeking care. These deaths are just the tip of the iceberg, as many neonates died before accessing health care. This finding was consistent with previous studies done at Nekemte referral hospital, East Wollega zone, western Ethiopia, a systematic review and meta-analysis study in SSA, and other studies [10, 17–20]. Neonates from rural areas face a higher risk of death due to low health literacy and low health care seeking behavior, lack of transportation and infrastructure such as roads, and other factors (low mothers' autonomy), to access health care in time [6].

In contrast with the findings of previous studies [21–23] in the current study, only 12 (3.8%) of neonatal deaths were documented from mothers who gave birth at home, which is low compared to those of mothers who delivered in health facilities. This might be because neonates born at home have limited access to health care and their deaths might not be recorded. The current system of Ethiopia only documents neonatal deaths that occur at health facilities, with limited or no vital registration, especially in rural areas where most (80%) of the population lives. Under-reporting of neonatal deaths leads to an underestimation of the actual neonatal mortality in the region.

In contrast to WHO recommendations, that every mother should have access to sufficient ANC visits with comprehensive care, this death audit revealed that only 23 (7.3%) mothers of reviewed neonatal deaths did not have any ANC visit. The literature showed that babies born from mothers with an adequate number of antenatal care visits have a lower risk of death of newborns within the neonatal period than babies born from mothers with an inadequate number of antenatal care visits (48, 49). Specifically, receiving one or more tetanus vaccines during pregnancy affects the death of the neonates. The findings of some studies indicate that neonates born from mothers who received TT vaccines during pregnancy have reduced the probability of dying within 28 days of life [24, 25]. The implication is that since not all mothers are getting ANC services including TT vaccines and other services, more neonatal deaths are likely happening which could be preventable. About 64(20.5%) of mothers of all neonatal deaths had a C/S mode of delivery. Evidence from various studies reports that mothers who delivered by C/S have an increased risk of death for their neonate than mothers who delivered spontaneously. About 67 (21.3%) of mothers of the neonatal deaths had multiple births. In line with this, findings from the literature show that the probability of neonatal death in multiple births is higher than in single birth [23]. In this assessment, a higher proportion, 192(61%), of neonatal deaths were males, which is consistent with previous studies that showed that the sex of the neonate is a risk factor for early neonatal mortality. Being male increased the risk of death for newborns within one month more than being females, suggesting risk-based intervention and focusing on male neonates as an important approach [26, 27]. This neonatal death audit revealed the following immediate causes of neonatal deaths: complications of prematurity (11.4%), respiratory failure (29.2%), uncontrolled sepsis (13%), multi-organ failure (35.6%), asphyxia (6.3%), and other causes (4.4%). This is consistent with the fact that birth asphyxia [28, 29], neonatal respiratory distress syndrome [29, 30], preterm delivery-[28, 29, 31], and neonatal sepsis [29, 30] were consistently found to be the leading causes of admission and early neonatal death

in NICU. This might be the fact that male neonates tend to have higher rates of preterm birth, low birth weight, birth defects, and infections than female neonates [32].

This neonatal death audit provides important insights into the quality of neonatal health care in the comprehensive specialized hospitals in the Amhara region. However, it does not include all the neonatal deaths that occurred at the selected hospitals or at home. Furthermore, the poor culture of documenting events such as neonatal deaths is common in health facilities, due to work overload and lack of awareness about the benefits of documentation and evidence among health care providers. This can lead to underestimating the neonatal deaths at the selected hospitals.

Conclusion

The neonatal death audit revealed a high proportion of neonatal deaths among rural residents, low birth weight neonates, and neonates admitted for fast breathing. Histories of abortion, risk of complication, congenital anomalies, and the three delays (in seeking, reaching, and receiving care) were also more prevalent. The major pitfalls observed were delay in referral, delayed management after admission, lack of oxygen and blood products, misdiagnosis, mismanagement, lack of supplies and medical equipment, and delay in surgical decision. The immediate causes of neonatal death were complications of prematurity, respiratory failure, uncontrolled sepsis, multi-organ failure, and asphyxia. Most of these deaths were preventable. Based on the findings, we recommended the regional health bureau to design an innovative implementation project to intervene at the community, health professional, health facility, and health sector leadership levels to improve the neonatal and maternal health care in the region and achieve the regional and national targets.

Abbreviations

ANC	Ante Natal Care
EDHS	Ethiopian Demographic Health Survey
ENM	Early Neonatal Mortality
FHCSH	Felege Hiwot Comprehensive Specialized Hospital
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus
HIV	Human Immune Virus
KMC	Kangaroo Mother Care
LMICs	Low- and Middle-Income Countries
LMP	Last Menstrual Period
LNM	Late Neonatal Mortality
MRN	Medical Registration Number
NICU	Neonatal Intensive Care Unit
NM	Neonatal Mortality
NMR	Neonatal Mortality Rate
RDS	Respiratory Distress Syndrome
SRSWOR	Simple Randomly Sampling With Out Replacement
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
T°	Temperature
UN	United Nation
UN-IGME	UN Inter-agency Group for Child Mortality Estimation
VDRL	Venereal Diseases Research Laboratory
WHO	World Health Organization
DBCSH	Debre Birhan Comprehensive specialized hospital
UOG	University of Gondar specialized hospital
DMCSH	Debre Markos Comprehensive specialized hospital

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-024-11681-x.

> Supplementary Material 1

Authors' contributions
Conceptualization: Abraraw Tadesse, Gashu Kindu, Girum Meseret Ayenew and Yilkal Tiruneh. Data analysis: Abraraw Tadesse, Gebiyaw Wudie, Girum Meseret Ayenew, Yilkal Tiruneh and Gebeyehu Tsega. Methodology and supervision: Abraraw Tadesse and Yilkal Tiruneh. Writing original draft: Gebiyaw Wudie, Abraraw Tadesse and Gebeyehu Tsega. Review the final draft; Gebeyehu Tsega, Girum Meseret Ayenew and Abraraw Tadesse, Yilkal Tiruneh and Gashu Kindu. Guarantor of the study: Amhara Regional health Bureau. All Authors approved the final version of the manuscript.

Availability of data and materials
All relevant data are found in the manuscript and supplementary file.

Declarations

Ethics approval and consent to participate
The study was approved by the Amhara Public Health Ethical Review Board. A formal letter was written to selected hospitals from the regional health bureau. Informed consent was obtained from all relevant subjects. There is no personal identification information, and only codes were found, in the charts. All methods were performed in accordance with the relevant guidelines and regulations such as Declaration of Helsinki and the latest (2022) Ethiopian health research ethics review guidelines.

Consent for publication
Not applicable, since we use charts with codes, there is no person identification information there.

Competing interests
The authors declare no competing interests.

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