

Strengthening Neonatal Mortality and Stillbirths Audits in Zaatari and Azraq Refugee Camps in Jordan

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GHD and EMPHNET: Working together for better health

Global Health Development (GHD) is a regional initiative created to support countries in the Eastern Mediterranean Region (EMR) and to strengthen their health systems to respond to public health challenges and threats. GHD was initiated to advance the work of the Eastern Mediterranean Public Health Network (EMPHNET) by building coordinating mechanisms with Ministries of Health, International Organizations and other institutions to improve population health outcomes. As an implementing arm to EMPHNET, GHD aligns its strategies with national policies and directions. Serving as a collaborative platform, GHD/EMPHNET is dedicated to serve the region by supporting national efforts to promote public health policies, strategic planning, sustainable financing, resource mobilization, public health programs, and other related services.

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Introduction

Neonatal mortality

Neonatal death is defined as any death that occurs in the first 28 days of life. Neonatal deaths account for approximately 44% of all deaths of children under five years in low-middle-income countries¹. Neonatal mortality is a public health problem worldwide primarily in low- and middle-income countries. Although extensive progress has been achieved in reducing neonatal mortality over the last three decades, increased efforts to improve progress are still needed to achieve the 2030 SDG target (3.2) aiming to reduce neonatal mortality to at least as low as 12 deaths per 1,000 live births.² The neonatal death rate is calculated as the number of infant deaths that occur between 0-27 days of life divided by the number of live births, multiplied by 1000.

In low- and middle-income countries, the majority of neonatal deaths occur without a clear cause of death (i.e., pre-maturity).³ Data on causes of neonatal deaths and the timing around neonatal deaths are often sparse and less reliable than all-cause mortality data, and using these data can result in uncertain estimates, which poses substantial challenges to the generation of evidence-based interventions to prevent neonatal deaths. Improved data on where and when neonatal deaths occur and what causes delays in seeking care is a key factor for developing context-specific strategies for vulnerable communities and for the provision of health care.

According to the Jordan Perinatal and Neonatal Mortality study in 2016,⁴ the neonatal mortality rate in Jordan was 14.9 per 1,000 live births. The overall neonatal mortality rate in 2020 was 14.1 per 1,000 live births. Of neonatal deaths, 76% were early neonatal deaths and 24% were late neonatal deaths.⁵ The main causes of neonatal deaths in Jordan occurring pre-discharge include respiratory and cardiovascular disorders (43%) and low birth weight and pre-term (33%). The main maternal conditions attributing to these deaths include complications of the placenta and cord, complications of pregnancy, and medical and surgical conditions.⁶ The main

¹ UNHCR. Improving newborn and neonatal care- <http://www.unhcr.org/57beb81e4.pdf>

² Hug L, Alexander M, You D, Alkema L. National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenariobased projections to 2030: a systematic analysis. *Lancet Glob Health.* (2019) 7:e710–20.

³ Goldenberg RL, Muhe L, Saleem S, Dhaded S, Goudar SS, Patterson J, et al. Criteria for assigning cause of death for stillbirths and neonatal deaths in research studies in low-middle income countries. *J Matern Fetal Neonatal Med.* (2019) 32:1915–23.

⁴ Batiha A, Khader Y, Berdzuli N, Chua-Oon C, Badran E, Al-Sheyab N, et al. Level, causes and risk factors of neonatal mortality, in Jordan: results of a national prospective study. *Matern Child Health J.* (2016) 20:1061–71.

⁵ Al-Sheyab NA, Khader YS, Shattnawi KK, Alyahya MS, Batiha A. Rate, Risk Factors, and Causes of Neonatal Deaths in Jordan: Analysis of Data From Jordan Stillbirth and Neonatal Surveillance System (JSANDS). *Front Public Health.* 2020 Oct 30;8:595379.

⁶ Al-Sheyab NA, Khader YS, Shattnawi KK, Alyahya MS, Batiha A. Rate, Risk Factors, and Causes of Neonatal Deaths in Jordan: Analysis of Data From Jordan Stillbirth and Neonatal Surveillance System (JSANDS). *Front Public Health.* 2020 Oct 30;8:595379.

causes of neonatal deaths occurring post-discharge were low birth weight and pre-term deliveries (42%).

Stillbirths

The estimated average global stillbirth rate decreased from 24.7 per 1000 births in 2000 to 18.4 per 1000 births in 2015.⁷ Although the last 15 years witnessed a 25.5% reduction in the global stillbirth rate, the progress in reducing the stillbirth burden remains slow and insufficient. An estimated 2.6 million stillbirths occur annually, of which 98% occur in low-income and middle-income countries. The stillbirth rate is the number of stillbirths (any fetal death after 22 weeks and/or ≥ 500 g) divided by the number of total births. Half of all stillbirths occur during labor and birth resulting from preventable causes such as maternal infections and obstetric complications. Antepartum stillbirths are those that occur before labor, while intrapartum stillbirths are those which occur after the onset of labor. Although congenital anomalies are one of the leading causes of stillbirths, some of these are also preventable.⁸ Many factors play a role in stillbirths including complications during pregnancy and childbirth and women's characteristics such as age, socioeconomic status, nutritional status, and chronic diseases. Infant risk factors include gestational age, weight at birth, multiple births, sex, birth presentation, and congenital abnormalities.⁹ Stillbirth rates appear to be linked to the economic status of the countries.¹⁰ There is a wide gap in stillbirths between low- and high-income countries, which might be linked to the quality of antenatal, and delivery care and maternal services in these countries. The majority of stillbirths occurring annually are a result of poor maternal care or inadequate management of pregnancy-related care.¹¹

The stillbirth rate is a sensitive marker of the quality of care in pregnancy and childbirth, and the strength of the health system. There is a paucity of quality information on the causes of stillbirth globally. Despite growing up research projects on maternal-child health, still, there is little effort has been made in developing countries to explore the causes of stillbirths. At the country level, accurate data on stillbirths are urgently needed to enable tracking of the quality of antenatal and intrapartum care and understand the causes of these deaths and thus identify areas for prevention.¹² Many countries in the region including Jordan do not include stillbirth in their vital statistics reporting system.

The rate of stillbirth in Jordan is 9.9 per 1000 total births. The main contributing fetal conditions of antepartum stillbirths were antepartum death of unspecified cause (33.7%), acute antepartum event (hypoxia) (33.7%), congenital malformations and chromosomal

7 Blencowe H, Cousens S, Jassir FB, et al. National, regional, and worldwide estimates of stillbirth rates in 2015, with trends from 2000: a systematic analysis. *Lancet Glob Health*. 2016;4:e98–ee108.

8 Lawn JE, Blencowe H, Pattinson R, et al. Stillbirths: where? When? Why? How to make the data count? *Lancet*. 2011;377:1448–1463

9 Liu LC, Wang YC, Yu MH, et al. Major risk factors for stillbirth in different trimesters of pregnancy – a systematic review. *Taiwan J Obstet Gynecol*. 2014;53: 141–145.

10 Aminu M, Unkels R, Mdegela M, et al. Causes of and factors associated with stillbirth in low- and middle income countries: a systematic literature review. *BJOG*. 2014; 121(Suppl 4):141–153.

11 Reinebrant HE, Leisher SH, Coory M, et al. Making stillbirths visible: a systematic review of globally reported causes of stillbirth. *BJOG*. 2018;125:212–224.

12 Lawn JE, Blencowe H, Waiswa P, et al. Stillbirths: rates, risk factors, and acceleration towards 2030. *Lancet*. 2016;387:587–603.

abnormalities (13.3%), and disorders related to the length of gestation and fetal growth (10.8%).¹³ The main contributing maternal conditions of antepartum stillbirths included complications of the placental cord and membranes (48.7%), maternal complications of pregnancy (23.1%), and maternal medical and surgical conditions (23.1%).

Neonatal death and stillbirth audits

Neonatal death and stillbirth audits are the processes of systematically capturing information on the number and causes of all neonatal deaths and stillbirths and the potentially avoidable factors linked to deaths, to provide data for decision-making and responding effectively to make changes.¹⁴ These are conducted in a no-blame, interdisciplinary setting to improve the care provided to all mothers and babies. Neonatal deaths and stillbirth reviews provide opportunities to examine the circumstances surrounding, as well as the immediate and contributing factors leading to neonatal deaths and stillbirths and inform the delivery of health services and quality of health care for women and babies during pregnancy and delivery, and ultimately to prevent future morbidity and mortality.¹⁵ Auditing neonatal deaths and stillbirths can encourage stakeholders to enhance the quality of care during the antenatal period and labor, thus improving birth outcomes. One way to accomplish this is through the recognition of modifiable risk factors and the development of initiatives to improve care. In specific, auditing provides a better understanding of root causes that allows the prevention of similar deaths in the future.

Neonatal mortality and stillbirth audits are particularly important as care often falls short between different providers and even between different departments or units. However, audits alone cannot improve the quality of care and outcomes; unless the recommendations contained within the audit process are effectively implemented, maternal and neonatal outcomes will not improve.^{16,17}

Neonatal death and stillbirth audits in Syrian refugee camps

Collectively, Zaatari and Azraq camps host approximately 113,752 refugees; 76878 live in Zaatari camp and 36874 live in Azraq camp. Pregnant women receive regular checkups in the camps' clinics throughout their pregnancy. They usually deliver their babies in camp hospitals. However, complicated cases are referred to other health facilities based on defined criteria depending primarily on the facilities capacities. In line with The United Nations High Commissioner for Refugees (UNHCR)'s global strategy, UNHCR Jordan has established a

13 Shattnawi KK, Khader YS, Alyahya MS, Al-Sheyab N, Batiha A. Rate, determinants, and causes of stillbirth in Jordan: Findings from the Jordan Stillbirth and Neonatal Deaths Surveillance (JSANDS) system. *BMC Pregnancy Childbirth*. 2020 Sep 29;20(1):571

14 Kerber et al. *BMC Pregnancy and Childbirth* 2015, 15(Suppl. 2): S9 Counting every stillbirth and neonatal death through mortality audit to improve quality of care for every pregnant woman and her baby. <http://www.biomedcentral.com/1471-2393/15/S2/S9>

15 <http://www.who.int/pmnch/knowledge/publications/summaries/ks27/en/>

16 Pattinson R1, Kerber K, et. al. Perinatal mortality audit: counting, accountability, and overcoming challenges in scaling up in low- and middle-income countries. *Int J Gynecology Obstet*.2009 Oct;107 Suppl 1: S113-21, S121-2.

17 EJ Buchmann. Towards greater effectiveness of perinatal death audit in low- and middle-income countries. *BJOG*. Volume 121, Issue Supplement s4, pages 134–136, September 2014

neonatal death audit system in camps in collaboration with the Centers for Disease Control and Prevention (CDC). EMPHNET started to conduct audits in the Zaatari camp in June 2016 and in the Azraq camp in April 2016. Stillbirth audits started in July 2018. The audit form was pilot tested and reviewed by EMPHNET, UNHCR, and The United Nations Population Fund (UNFPA). They agreed upon a new audit form for stillbirth to be used starting from 1 January 2019. Revision of the audit forms took place in late 2019 to capture more significant data; questions were added to highlight the challenges in transportation for the mother in addition to the baby. More questions were added to specify treatment protocols used for anemia during pregnancy.

The main purpose of death auditing is to decrease neonatal mortalities and stillbirths, among Syrian refugees by conducting the following activities:

- Conduct periodic review meetings with stakeholders about the findings and recommendations in a manner that is acceptable to all.
- Investigate possible causes of death/ and factors affecting the coverage and quality of babies' care.
- Improve neonatal care in refugee camps and prioritize action to save the lives of babies.

Neonatal death and stillbirth in 2022

Figure 1 shows the neonatal mortality rate per 1000 live births in Zaatari and Azraq Camps by year from 2017 to 2023.

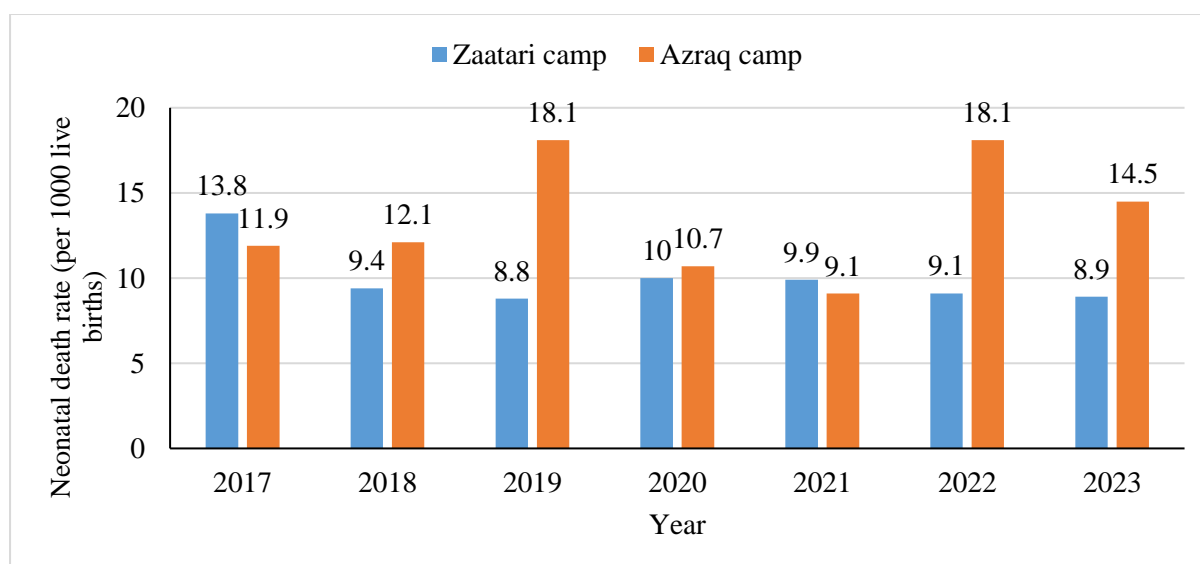


Figure 1. Neonatal Mortality Rate Per 1000 live births in Zaatari and Azraq Camps, 2017-2023

In 2022, a total of 45 neonatal deaths (25 in Zaatari camp and 20 in Azraq camp) and 6 stillbirths (all in Azraq camp) born to Syrian parents were reviewed. Of all neonatal deaths, 27 (60.0%) were early neonatal deaths (12 in Azraq camp and 15 in Zaatari camp) and 18 (40.0%) were late neonatal deaths (8 in Azraq camp and 10 in Zaatari camp). All stillbirths were

antepartum stillbirths. The total number of perinatal deaths was 33 deaths (18 in Azraq and 15 in Zaatari).

In 2022, delay in problem recognition and deciding to seek care outside the home (Delay 1) was the greatest contributor to neonatal deaths. The most frequent factors that affected women's problem recognition/ decision to seek care outside the home were low socio-economic status and lack of knowledge. Almost half (60.0%) of women had low socioeconomic status and 100% had inadequate knowledge and poor understanding of complications and risks associated with pregnancy and when to seek medical help. Other frequent delays were not using family planning methods by at-high-risk women or by young women to delay their first pregnancy (42.2%), not recognizing the risk associated with early marriage/ teenage pregnancy (35.6%), and women's poor compliance (not following medical advice or non-compliance to routine ANC visits or non-compliance to medications/ supplements) (35.6%). Other delays (for neonatal deaths) related to the recognition of danger signs and the decision to seek care. Most delays were more frequent among women living in Azraq camp compared to those living in the Zaatari camp.

The second major contributor to neonatal deaths was delays in receiving adequate and quality care at the health facility (Delay 3). The main problems identified were not receiving optimal health care during the ANC period (68.9%), inadequate investigations for women with past history of frequent miscarries (60.0%), poor investigation of past obstetric history (66.7%), and poor management of high-risk pregnancies, inadequate follow up, and not referring high-risk pregnancies in the right time (66.7%). Other less frequent problems included poor staff attitude/ negligence/ not respecting patients' rights (44.4%), inadequate assessment of the condition of the neonate and delay in the diagnosis of neonates' medical problems (35.6%), and clinician non-adherence to standards of care (31.1%). These factors contributed more to deaths in Azraq camp compared to those in Zaatari camp.

For delays related to reaching an appropriate source of care, almost one third (34.1%) of women who were transferred by ambulance had faced problems with transportation, mainly a complaint of not allowing relatives to accompany them. For 4.2% of women, it took them more than 2 hours to get to the nearest health facility/hospital.

The most frequent delays associated with the six stillbirths in 2022 were patient/family lack of knowledge, not recognizing the risk associated with early marriage/ teenage pregnancy, and poor investigation of past obstetric history.

Methods

All stillbirths (fetal deaths after 22 weeks of gestation and/or birth weight >500g) and neonatal deaths (any infant death within the first 28 completed days of life) in Zaatari and Azraq camps occurring during the reporting period between January 1 and December 2022 were investigated by EMPHNET group. Neonatal mortality and stillbirth cases were reported to EMPHNET from the International Medical Corps (IMC) in Zaatari and Azraq camps. Whenever EMPHNET was alerted about a new case of neonatal mortality or stillbirth, the EMPHNET team conducted the death audit within 72 hours of the reported death.

Death audits were conducted by physicians and midwives. During the visit, the team filled out the death audit form. The audit form was designed to collect data quantitatively and qualitatively by interviewing caregivers/mothers, reviewing the medical files of the newborn and mother, reviewing the mother's ANC card, and meeting with the attending physician/midwife.

Once the forms were completed, they were sent to a consultant who reviews the full information on the cases, verifies the accuracy of the data, identifies information on the modifiable risk factor and delays, and suggests relevant recommendations. After that, the completed forms were submitted electronically to UNHCR who provided their feedback and comments. All UNHCR comments were addressed and the forms were revised before they are entered into the Excel sheet. All the information in the audit form is kept confidential. Any reported neonatal death or stillbirth that is found under primary investigation to be living outside the camps but reported to the camp for covering delivery services was excluded.

For data analysis, the data in an Excel sheet were exported to IBM SPSS version 24. Data were mainly analyzed using descriptive statistics. Data were stratified by the camp.

Results

Number, time, and place of deaths

A total of 37 neonatal deaths (22 in Zaatari camp and 15 in Azraq camp) and 5 stillbirths (all in Azraq camp) born to Syrian parents in 2023 were reviewed. Of all neonatal deaths, 20 (54.1%) were early neonatal deaths (9 in Azraq camp and 11 in Zaatari camp) and 17 (45.9%) were late neonatal deaths (6 in Azraq camp and 11 in Zaatari camp). Four stillbirths were antepartum stillbirths.

For neonatal deaths, 35 (94.6%) deaths occurred in the referral facility and 2 deaths (5.4%) occurred in the camp health facility. Of the five stillbirths, 3 (60.0%) occurred in the referral facility and 2 (40%) occurred in camp health facility. Almost 18.9% of neonatal deaths occurred on the first day of life and 54.1% occurred in the first week of life. Figure 2 shows the distribution of neonatal deaths according to age at death in days.

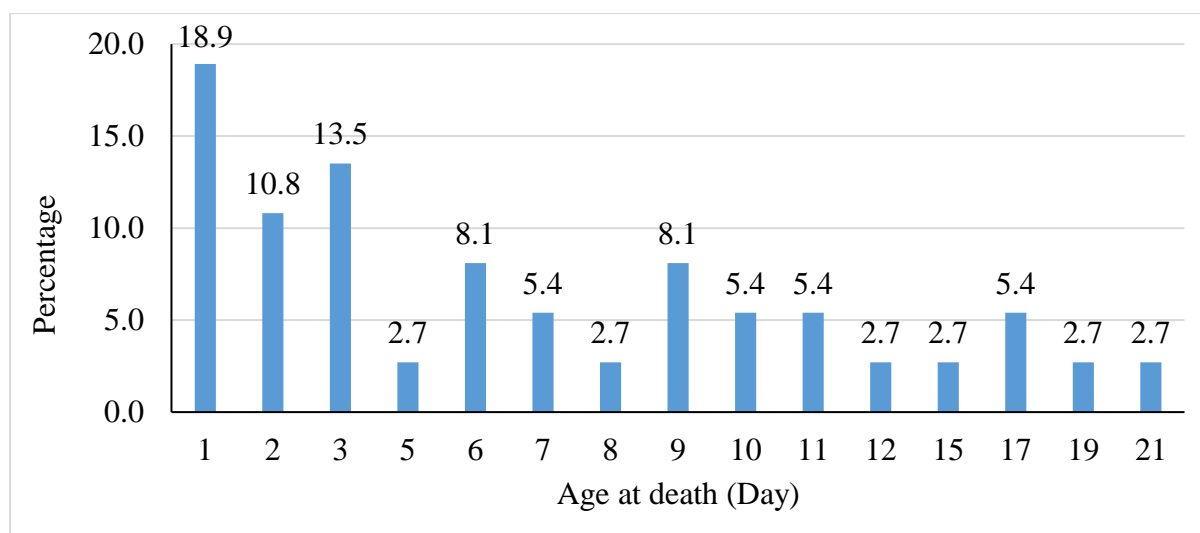


Figure 2. The distribution of 37 neonatal deaths occurred in 2023 according to age at death (day).

Newborns' clinical characteristics

Almost three quarters (72.9%) of babies who died in the neonatal period and 4 (80%) stillbirths were delivered preterm (<37 weeks). Birth weight was missing for one neonatal death and one stillbirth. For neonatal deaths whose birthweights were registered, their birthweight ranged from 700 to 3200 g (mean = 1713.4 g) and 80.5% weighed less than 2500 grams.

For the 4 stillbirths whose birthweights were registered, 2 (50%) weighed less than 2500. Four stillbirths (75%) were fresh stillbirths at the time of delivery. Table 1 shows the demographic and clinical characteristics of neonatal deaths in each camp. Figure 3 shows the birthweight and gestational age of neonatal deaths in Azraq and Zaatari camps.

Table 1. The demographic and clinical characteristics of neonatal deaths in each camp

Variable	Azraq (n = 15)		Zaatari (n = 22)		Total (N = 37)	
	n	%	n	%	N	%
Sex						
Female	6	40.0	9	40.9	15	40.5
Male	9	60.0	13	59.1	22	59.5
Time of neonatal death						
Early neonatal death	9	60.0	11	50.0	20	54.1
Late neonatal death	6	40.0	11	50.0	17	45.9
Birth weight (gram)*						
<1500	6	42.9	11	50.0	17	47.2
1500-<2500	4	28.6	8	36.4	12	33.3
≥2500	4	28.6	3	13.6	7	19.4
Gestational age (week)						

<32	7	46.7	9	40.9	16	43.2
32-<37	3	20.0	8	36.4	11	29.7
≥37	5	33.3	5	22.7	10	27.0
Neonatal resuscitation required	14	93.3	20	90.9	34	91.9
*Birth weight was missing for 1 baby						

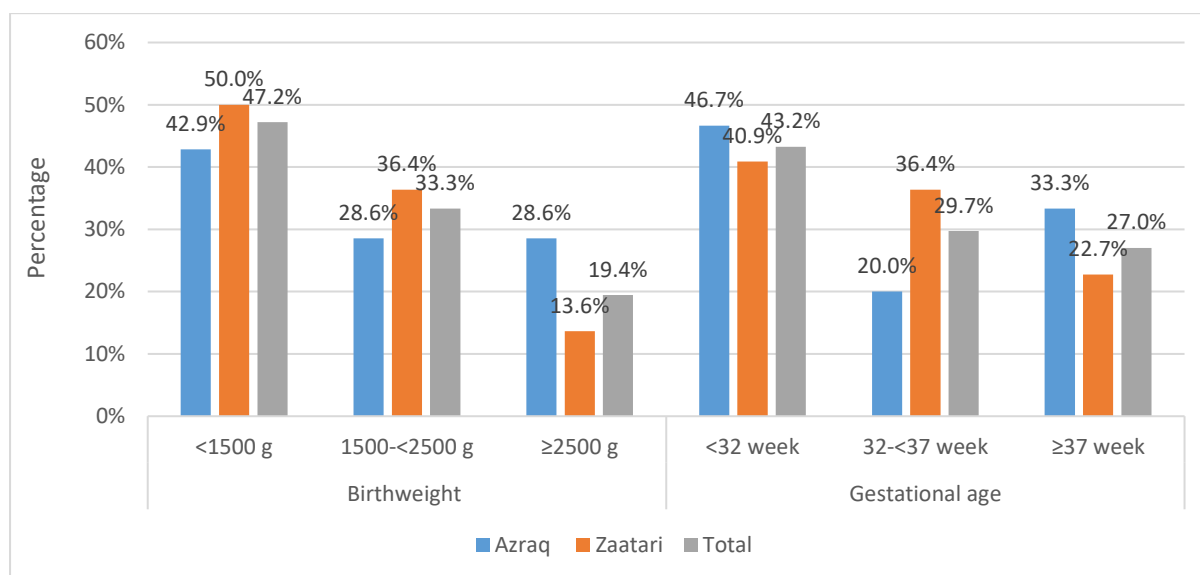


Figure 3. The birthweight and gestational age of neonatal deaths in Azraq and Zaatari camps.

Mothers' characteristics

The 37 neonatal deaths were born for 35 women. Women aged between 16 and 40 years (Mean (SD) = 25.7 (6.8) years). Eight women (22.9%) aged <20 years and 4 women (11.4%) aged >35 years. A total of 17 (50.0%) women had 4 or more pregnancies and 12 (34.3%) women gave birth to 4 babies or more. Almost 82.9% of pregnancies were singletons. Table 2 shows the characteristics of the 35 mothers whose newborns died during the neonatal period.

The mothers who delivered stillbirths aged between 23 and 36 years (Mean = 21 years). None of women aged <20 years and 1 woman aged >35 years. Four women (80%) had primary education or less. All women had 4 or more pregnancies and all gave birth to 4 babies or more.

Table 2. The characteristics of 35 mothers whose newborns died during the neonatal period.

Variable	Azraq (N = 15)		Zaatari (N = 20)		Total (N = 35)	
	n	%	n	%	N	%
Age of mother (year)						
<20	3	20.0	5	25.0	8	22.9
20-35	10	66.7	13	65.0	23	65.7
>35	2	13.3	2	10.0	4	11.4
Gravida (number of pregnancies)						

<4	5	33.3	12	63.2	17	50.0
4-6	7	46.7	3	15.8	10	29.4
>6	3	20.0	4	21.1	7	20.6
Parity (number of births)						
<4	8	53.3	15	75.0	23	65.7
4-6	6	40.0	4	20.0	10	28.6
>6	1	6.7	1	5.0	2	5.7
Type of pregnancy						
Singleton	14	93.3	15	75.0	29	82.9
Twin	1	6.7	5	25.0	6	17.2

Antenatal care

All mothers of neonatal deaths received antenatal care (ANC) before delivery. Table 3 shows the ANC utilization, pregnancy danger signs identified during the antenatal period, and interventions applied after danger signs were identified. The number of ANC visits varied according to the gestational age and women's conditions. Almost half of women (45.7%) visited the health facility 7 times or less.

Compared to 2022, the percentage of women who received tetanus toxoid has decreased and the percentages of those who received iron supplement and folic acid have increased in 2023. In 2023, about 65.7% (75.0% in 2022) of women received tetanus toxoid, 100.0% received iron supplements (95.5% in 2022), and 100.0% received folic acid (90.9% in 2022).

The vast majority of women had at least one pregnancy danger sign. The most common pregnancy danger sign was abdominal pain (71.4 %). The most common intervention received was referral (82.9%). During the antenatal period, all women received the following services: blood pressure measurement, blood sugar measurement, checking fetal heart, and blood group and RH factor.

All women who delivered stillbirths received antenatal care before delivery. All women received folic acid and iron supplement. All women had their blood pressure and blood sugar measured. One woman had prolonged premature rupture membranes and oligohydramnios and another woman had vaginal spotting, cough and severe attacks of shortness of breath. All women were referred. Antibiotics were given to two women. One woman was diagnosed with hypertension, one diagnosed with diabetes, two women diagnosed with anemia. Two women did not use family planning methods and three women used family planning methods when they became pregnant.

Table 3. Antenatal care utilization, pregnancy danger signs identified during the antenatal period and interventions applied after danger signs identified for mothers of neonatal deaths

Variable	Azraq (N =15)		Zaatari (N =20)		Total (N = 35)	
	n		n		N	
Received ANC	15	100	20	100	35	100
Number of ANC visits ≤ 7	4	26.7	12	60.0	16	45.7
Medications received during the antenatal period						
Tetanus toxoid	6	40.0	17	85.0	23	65.7
Iron supplement	15	100	20	100	35	100
Folic Acid	15	100	20	100	35	100
Pregnancy danger signs identified during the antenatal period						
Fever	0	0.0	1	5.0	1	2.9
Abdominal pain	9	60.0	16	80.0	25	71.4
Blurred vision	0	0.0	2	10.0	2	5.7
Vaginal bleeding	3	20.0	6	30.0	9	25.7
Elevated blood pressure	0	0.0	2	10.0	2	5.7
Interventions applied after danger signs identified						
Referral	11	73.3	18	90.0	29	82.9

Delivery characteristics

Almost three quarters of women (74.3%, n = 26) delivered via cesarean section, and 9 (25.7%) via vaginal delivery (skilled birth attendant). Table 4 shows the delivery and other relevant characteristics for mothers who had their babies died during the neonatal period. The majority of women (82.9%, n = 29) were delivered at the referral hospitals, 5 (14.3%) in the camp hospital, and 1 (2.9%) in the clinic/health center. The majority (97.0%) of deliveries were attended by a gynecologist and one delivery was attended by a midwife. All delivered women were alive at the time of home visits.

For women with stillbirths, one woman delivered via cesarean section and 4 women were delivered via vaginal delivery (skilled birth attendant). Three women were delivered at the referral hospitals and two women delivered in the camp hospital. Three deliveries were attended by a gynecologist and two were attended by a midwife.

Table 4. Delivery characteristics for mothers of neonatal deaths

Variable	Azraq (N =15)		Zaatari (N =20)		Total (N = 35)	
	n	%	n	%	N	%
Mode of delivery						
Caesarean section	10	66.7	16	80.0	26	74.3
Vaginal delivery (skilled birth attendant)	5	33.3	4	20.0	9	25.7
Delivery location						
Camp hospital (clinic)	4	26.7	1	5.0	5	14.3
Clinic/health center	0	0.0	1	5.0	1	2.9
Referral hospital	11	73.3	18	90.0	29	82.9
Birth attendant						
Gynecologist	14	93.3	18	90.0	32	97.0
Midwife	1	6.7	0	0.0	1	3.0

Mothers' and babies' transportation to the health facility

For mothers of neonatal deaths, 6 (17.1%) women were delivered in the camp, 25 (71.4%) women were transferred by ambulance and 4 (11.4%) women were transferred by private car (6.8% transferred by private care in 2022). Almost 42.9% of women who were transferred by ambulance had faced problems with transportation (34.1% in 2022), mainly a complaint of not allowing relatives to accompany them. For one woman, it took them more than 2 hours to get to the nearest health facility/hospital. Four (11.4%) women encountered challenges in the health facility (15.9% in 2022). Table 5 shows the transportation to the health facility for mothers of neonatal deaths.

For mothers of stillbirths, 2 women were transferred by ambulance and one woman was transferred by private car. Two women stated that they have faced problems with transportation to the health facility, mainly complaining of having no companion, and none of women encountered challenges in the health facility.

Table 5. The transportation to the health facility for mothers of neonatal deaths

Variable	Azraq (N =15)		Zaatari (N =20)		Total (N = 35)	
	n	%	n	%	N	%
Mothers' transportation to the health facility						
Ambulance	10	66.7	15	75.0	25	71.4
NA (delivered in the camp)	4	26.7	2	10.0	6	17.1
Private taxi	1	6.7	3	15.0	4	11.4
Experienced problems with transportation to the health facility	5	33.3	10	50.0	15	42.9
Not allowing any family member to go with the patient to the referred hospital	3	20.0	10	50.0	13	37.1

The ambulance made an additional stop at another health facility to drop off patients at another location, prolonging the trip and increasing exhaustion.	1	6.7	0	0.0	1	2.9
The ambulance was very crowded	1	6.7	0	0.0	1	2.9
Took more than 2 hours to get to the nearest health facility/hospital	1	6.7	0	0.0	1	2.9
Encountered challenges in the health facility	1	6.7	3	15.0	4	11.4
The patient believed that the medical staff forced her to leave the hospital before Eid Al-Feter .	0	0.0	1	5.0	1	2.9
The patient felt she needed more attention and explanations about what happened to her baby and what to do after a caesarean delivery	0	0.0	1	5.0	1	2.9
The patient felt that the care was not appropriate for her	0	0.0	1	5.0	1	2.9
Upon arrival, the patient was scheduled for an urgent delivery (pregnancy termination). However, there was a delay of 12 hours before the patient underwent an urgent cesarean section (C/S) as the medical staff requested the patient's husband's approval for the procedure.	1	6.7	0	0.0	1	2.9

Prophylaxis and interventions administered to newborns

Table 6 shows the prophylaxis administered at birth and interventions provided to newborns. Of all newborns who died in the neonatal period, 89.2% (n = 33) received Vitamin K and antibiotic eye ointment/drops as prophylaxis at birth. In 2022, the majority of newborns received Vitamin K (97.8%) and antibiotic eye ointment/drops (93.3%) as prophylaxis at birth. Almost 27.0% of babies needed oxygen, reflecting their critical conditions. The most common interventions provided to newborns included IV fluids (89.2%) and parenteral antibiotics (8.3.8%).

Table 6. The prophylaxis administered at birth and interventions provided to newborn

Variable	Azraq (n = 15)		Zaatari (n = 22)		Total (N = 37)	
	n	%	n	%	N	%
Prophylaxis administered at birth						
Vitamin K	12	80.0	21	95.5	33	89.2
Antibiotic eye ointment/drops	12	80.0	21	95.5	33	89.2
Interventions provided to newborn						
Oxygen	5	33.3	5	22.7	10	27.0
Parenteral antibiotics	13	86.7	18	81.8	31	83.8
IV fluids	14	93.3	19	86.4	33	89.2
Parenteral anticonvulsants	1	6.7	0	0.0	1	2.7
Phototherapy	1	6.7	6	27.3	7	18.9
Blood transfusion	3	20.0	5	22.7	8	21.6

Reasons for admission

Table 7 shows the reasons for the admission of newborns who died in the neonatal period. All babies were critically ill on admission. The main reasons for admission were prematurity (67.6%), low birth weight (62.2%), and dyspnea (91.9%).

Table 7. Reasons for admission of newborns who died in the neonatal period

	Azraq		Zaatari		Total	
Reason for admission	(n = 15)		(n = 22)		(N = 37)	
	n	%	n	%	N	%
Prematurity	11	73.3	14	63.6	25	67.6
Fever						
Refusal to suck	0	0.0	2	9.1	2	5.4
Neonatal sepsis	0	0.0	1	4.5	1	2.7
Low birth weight	9	60.0	14	63.6	23	62.2
Congenital anomaly	3	20.0	1	4.5	4	10.8
Jaundice	0	0.0	1	4.5	1	2.7
Dyspnea	14	93.3	20	90.9	34	91.9

Causes of death

The immediate causes of neonatal death, as documented by the attending physician, were cardiopulmonary arrest for all deaths (Table 8). The main underlying causes of death were RDS (62.2%), pulmonary hemorrhage (21.6%) and congenital anomalies (13.5%). For stillbirths, the cause of death was unknown or determined as IUID by the attending physician.

Table 8. The immediate and underlying causes of neonatal deaths

	Azraq		Zaatari		Total	
Cause of Death	(n = 15)		(n = 22)		(N = 37)	
	n	%	n	%	N	%
The immediate cause of death						
Cardiopulmonary arrest	15	100	22	100	37	100
Underlying cause of death						
RDS	12	80.0	11	50.0	23	62.2
Pulmonary Hemorrhage	0	0.0	8	36.4	8	21.6
Congenital anomaly	4	26.7	1	4.5	5	13.5
Persistent pulmonary hypertension of the newborn and neonatal pneumonia	0	0.0	1	4.5	1	2.7
Sepsis	0	0.0	3	13.6	3	8.1
Suffocation	0	0.0	1	4.5	1	2.7

Unknown	0	0.0	1	4.5	1	2.7
Severe Necrotizing Enterocolitis (NEC)	0	0.0	1	4.5	1	2.7

Delays contributed to neonatal deaths and stillbirths

Delay in problem recognition and deciding to seek care outside the home (Delay 1) was the greatest contributor to neonatal deaths. The most frequent factors that affected women's problem recognition/ decision to seek care outside the home was lack of knowledge. All women had inadequate knowledge and poor understanding of complications and risks associated with pregnancy and when to seek medical help. Other frequent delays were not using family planning methods by at-high-risk women or by young women to delay their first pregnancy (51.4%), not recognizing the risk associated with early marriage/ teenage pregnancy (54.1%), and women's poor compliance (not following medical advice or non-compliance to routine ANC visits or non-compliance to medications/ supplements) (37.8%), and receiving ANC from different facilities (no continuity of ANC) (37.8%). Other delays (for neonatal deaths) related to the recognition of danger signs and the decision to seek care are shown in Table 9.

Table 9. Delays related to recognition of danger signs and decision to seek care (Delay 1)

Delays	Azraq		Zaatari		Total	
	(n = 15)		(n = 22)		(N = 37)	
	n	%	n	%	N	%
Delay in seeking ANC services	3	20.0	7	31.8	10	27.0
Low socioeconomic status	0	0.0	1	4.5	1	2.7
Patient/family lack of knowledge	15	100	22	100	37	100
Not recognizing the risk associated with early marriage/ teenage pregnancy	6	40.0	14	63.6	20	54.1
Not using family planning methods by high risk women or to delay first pregnancy	8	53.3	11	50.0	19	51.4
Not following medical advice, not compliant with routine ANC visits, not compliant with medications/supplements	7	46.7	7	31.8	14	37.8
Delay recognizing the need for care	4	26.7	6	27.3	10	27.0
Poor feeding practices	1	6.7	2	9.1	3	8.1
Receiving ANC from different facilities (no continuity of ANC)	8	53.3	6	27.3	14	37.8

The second major contributor to neonatal deaths was delays in receiving adequate and quality care at the health facility (Delay 3). Table 10 shows the various delays related to receiving adequate and quality care at the health facility. The main problems identified were inadequate counseling during ANC (86.5%), not receiving optimal health care during the ANC period (75.7%), poor management of high-risk pregnancies, inadequate follow up, and not referring high-risk pregnancies in the right time (62.2%), clinician non-adherence to standards of care (54.1%), inadequate investigations for women with past history of frequent miscarries (40.7%), and poor investigation of past obstetric history (40.7%). Other less frequent problems included

poor staff attitude/ negligence/ not respecting patients' rights (29.7%) and inadequate assessment of the condition of the neonate and delay in the diagnosis of neonates' medical problems (27.0%).

Table 10. Delays related to receiving adequate and quality care at the health facility

Delays	Azraq		Zaatari		Total	
	(n = 15)		(n = 22)		(N = 37)	
	n	%	n	%	N	%
Inadequate counseling during ANC	14	93.3	18	81.8	32	86.5
Not receiving optimal health care during the ANC period	10	66.7	18	81.8	28	75.7
Poor management of high-risk pregnancies, inadequate follow-up, and not referring high-risk pregnancies at the right time	9	60.0	14	63.6	23	62.2
Clinician non-adherence to standards of care	7	46.7	13	59.1	20	54.1
Inadequate investigations for women with the past history of frequent miscarries	7	46.7	8	36.4	15	40.5
Poor investigation of past obstetric history	7	46.7	8	36.4	15	40.5
Poor staff attitude/ negligence/ not respecting patients' rights	2	13.3	9	40.9	11	29.7
Inadequate assessment of the condition of the neonate and delay in the diagnosis of neonates' medical problems	3	20.0	7	31.8	10	27.0
Delay in referral/ poor coordination and arrangement between the referral sites	5	33.3	4	18.2	9	24.3
Delay in receiving adequate care in the hospital when a facility is reached	3	20.0	3	13.6	6	16.2
Inadequate management of uncontrolled gestational diabetes	2	13.3	1	4.5	3	8.1
Not provide women with folic acid	1	6.7	1	4.5	2	5.4
Poor management of UTI/ Vaginitis	0	0.0	1	4.5	1	2.7

For delays related to reaching an appropriate source of care by mothers of neonatal deaths, 6 (17.1%) women were delivered in the camp, 25 (71.4%) women were transferred by ambulance and 4 (11.4%) women were transferred by private car (6.8% transferred by private care in 2022). Almost 42.9% of women who were transferred by ambulance had faced problems with transportation (34.1% in 2022), mainly a complaint of not allowing relatives to accompany them (n=13). One woman complained of that the ambulance made an additional stop at another health facility to drop off patients at another location, prolonging the trip and increasing exhaustion. Another woman complained of that the ambulance was very crowded. For one woman, it took them more than 2 hours to get to the nearest health facility/hospital.

Table 11 shows the delays associated with the five stillbirths. The most frequent delays were patient/family lack of knowledge and not receiving optimal health care during the ANC period.

Table 11. Delays associated with the five stillbirths

Delay	n	%
Delay in seeking ANC services	4	80
Patient/family lack of knowledge	5	100
Not recognizing the risk associated with early marriage/ teenage pregnancy	2	40
Not following medical advice, not compliant to routine ANC visits, not compliant to medications/supplements	3	60
Delay recognizing the need for care	3	60
Receiving ANC from different facilities (no continuity of ANC)	1	20
Not receiving optimal health care during the ANC period	5	100
Poor management of high-risk pregnancies, inadequate follow-up, and not referring high-risk pregnancies at the right time	3	60
Inadequate management of uncontrolled gestational diabetes	1	20
Inadequate investigations for women with a history of frequent miscarries	4	80
Poor investigation of past obstetric history	3	60
Poor staff attitude/ negligence/ not respecting patients' rights	2	40

Recommendations

Based on the study findings, several recommendations can be made to address the identified factors contributing to neonatal deaths and delays in seeking care. These recommendations are aimed at improving women's knowledge, promoting family planning, raising awareness about the risks associated with early marriage and teenage pregnancy, and enhancing women's compliance with medical advice and antenatal care (ANC). Effective community engagement and mobilization is key to the success of any health program. The purpose of community-based intervention is to generate and sustain the community's interest in the services offered by the healthcare delivery system and to improve their health-seeking behaviors. Healthcare delivery systems in parallel should meet the essential health services delivery standards to ensure the delivery of health services of optimal quality.

The below recommendations are based on the findings of death auditing in Zaatari and Azraq camps in 2023 and guided by the three delay model:

A. Delay in the decision to seek care

A1. Community-level

- Increase the awareness of the refugee population about pregnancy, childbirth, and newborn healthcare to improve their health-seeking behavior for accessing the available services on time

- Increase the awareness of the refugee population about the risks of early marriage and teenage pregnancies and the importance and benefits of family planning
- Address the barriers to modern family planning methods use in the refugee population and strengthen these services
- Involve male members of the family in the awareness interventions related to pregnancy, childbirth and newborn healthcare, early marriage, teenage pregnancies, and family planning
- Examine beliefs and traditional practices related to postnatal care and feeding practices of the infants thoroughly and increase awareness of the identified issues in a targeted manner
- Raise awareness on the availability of the services offered at the PHC facilities and the camp secondary level health facility (hospital) to ensure that the communities are well informed and oriented about the availability of services offered at these facilities including services offered to adolescents
- Inform communities about the availability of TT vaccination at the health facilities in the camps to improve the utilization of these services
- Community health volunteers can have a strong role through the systematic implementation of the maternal newborn community health toolkit on timely referral for cases for ANC, awareness raising on the risks of danger signs during pregnancy, and timely referral. The role of community health volunteers should be further strengthened to perform these functions by providing them with the appropriate training.

A2. Individual-level

- Empower women to actively participate in decision-making regarding their health and pregnancies.
- Establish support groups for pregnant women to share experiences, knowledge, and advice, fostering a sense of community and mutual support.
- Provide non-financial incentives for women to encourage them to seek care
- Improve the communication and linkages with a source of care to encourage women to seek services. In some cases, disrespect of women, violation of human rights (such as not using a phone), and not allowing relatives to accompany women during transfer via ambulance were reported. These aspects might deter women from seeking care in the future.
- Utilize technology, such as mobile applications or SMS reminders, to disseminate crucial information about pregnancy, ANC appointments, and medication schedules.

A3. Health System level

- Strengthening the counseling services during antenatal and postnatal care to:
 - raise knowledge and awareness of women about danger signs during pregnancy,
 - available venues to access services,

- feeding practices for newborns and infants, compliance with the treatment offered,
- adherence to the supplements and medications prescribed during the early stages of the pregnancy,
- importance of family planning, and
- early marriages
- Invest in capacity building programs for health care providers in refugee camps. Training should focus on improving skills in neonatal and maternal care and effective communication.
- Strengthen partnership and collaboration between healthcare providers, NGOs, and community representatives.

B. Delay in reaching care

- Improve ambulance services and make these services more timely and friendly. Challenges have been identified in the transportation of the cases accompanied by a husband or an attendant while referring the cases to the appropriate level of health care facilities to receive the required services. Remedial actions shall be taken led by the UNHCR public health focal point for the camp with the involvement of relevant agencies to address the transportation issues.
- Implement protocols to minimize delays, such as avoiding unnecessary stops and maintaining an efficient and timely route to health facilities.
- Address issues related to overcrowded ambulances by ensuring that they have adequate space to accommodate patients comfortably.
- Develop guidelines and policies to ensure that relatives are allowed to accompany patients in ambulances, addressing concerns raised by mothers in the study.
- Conduct training for ambulance staff to emphasize the importance of patient comfort and support during transportation.
- Establish a feedback mechanism for patients and their families to report issues with transportation services.
- Establish a monitoring and evaluation system to assess the performance of transportation services regularly.

C. Delay in receiving adequate health care

- Improve staff capacity and attitudes through training and supervision. Training the healthcare workers is needed on standards care related to:
 - Referral of high-risk pregnancies
 - Management of high-risk pregnancies in the hospitals
 - Policies and guidelines for postdate pregnancies
 - Proper documentation of information and findings
 - Providing high-quality antenatal care services especially the early detection of medical problems and danger signs.

- Ensure adherence of health professionals to evidence-based practices such as folic acid supplements provision and regular monitoring of adherence to the essential standards
- Establish mechanisms for monitoring and addressing clinician non-adherence to standards of care. This may include regular audits, performance assessments, and feedback systems.
- Develop protocols for conducting thorough investigations for women with a history of frequent miscarriages or other high-risk factors.
- Implement training programs to enhance healthcare providers' interpersonal skills and foster a respectful and compassionate environment within health facilities
- Ensure facilities are suitably equipped with all the essential equipment and supplies to provide services of optimal quality and as per the acceptable standards on par with the national and international standards
- Further strengthening the referral systems between PHC facilities and hospitals especially for high-risk pregnancies
- Evaluate the quality of ANC services and improve adherence to the essential standards on par with national and international standards. Quality of the ANC services should be regularly monitored to ensure adherence to the acceptable standards
- Emphasize patient-centered care by addressing issues such as poor staff attitude, negligence, and the violation of patients' rights.
- Strengthen family planning services, especially for adolescents. Training of the community health workers to provide family planning by using the newly developed family planning App (developed for Jordanians) in camps should be considered
- Women with a history of miscarriages should be investigated for the possibility of identifying the etiology (up to 50% of cases of recurrent losses are expected to have a clearly defined etiology)
- Monitoring and accountability systems for RH services, in general, should be further strengthened by the agencies involved in the delivery of RH services in the camp. Any issues related to the RH service delivery should be included in the agenda of RH coordination and general health coordination forms and tangible actions should be agreed upon by all the relevant agencies to address the identified issues.
- Establish a robust quality assurance system within health facilities to continuously monitor and improve the quality of maternal and neonatal care.
- Encourage the involvement of stakeholders, including patients and community representatives, in the evaluation of healthcare service quality.
- Ensure facilities are suitably equipped to provide safe deliveries
- Ensure discharge notes are properly filled in with details with clear guidance on the follow-ups needed.
- Re-enforce the implementation of the policy on vital signs measurements by the midwives and pediatric nurses to be able to identify critically ill patients to ensure a timely referral.