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Management of bacterial infections in young infants in Ethiopia: facility preparedness, health workers' knowledge, and quality of care

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Abstract

Aim: We assessed primary care facility preparedness, health workers' knowledge, and their classification and treatment of possible serious bacterial infection and local bacterial infection in young infants aged 0-59 days.

Method: A cross-sectional survey was conducted in four regions of Ethiopia, including 169 health posts with 276 health extension workers and 155 health centers with 175 staff. Registers of 1058 sick young infants were reviewed.

Result: Antibiotics to treat possible serious bacterial infection were available in 71% of the health centers and 38% of the health posts. Nine out of ten health extension workers and eight out of ten health center staff mentioned at least one sign of possible serious bacterial infection and local bacterial infection. Among the registered cases with signs of bacterial infections, the health extension workers classified 49% as having possible serious bacterial infection and 88% as local bacterial infection. The health center staff classified 25% as possible serious bacterial infections and 86% as local bacterial infections. One-fourth (26%) of possible serious bacterial infection received the recommended treatment at health posts and 35% at health centers.

Conclusion: Many health posts lacked antibiotics. The classification and treatment of possible serious bacterial infection did not follow guidelines. This lack of medicines and poor adherence compromise the quality of care.

Keywords: Health extension workers, local bacterial infection, possible serious bacterial infection, primary health care

Key notes

- Ethiopia introduced the community-based newborn care program in 2013 to reduce neonatal mortality.
- We found that Ethiopian primary care facilities, in particular health posts, lacked antibiotics, had healthcare providers with suboptimal knowledge and that many young infants with possible serious bacterial infection were misdiagnosed and did not receive the recommended antibiotics, while management of local bacterial infection was more appropriate.
- Identification and management of bacterial infections need to be strengthened.

INTRODUCTION

Globally, there were 5.2 million deaths of children under five years in 2019. Of these, 2.4 million occurred during the first month of life (1). A majority of these neonatal deaths were due to prematurity, birth asphyxia and neonatal infections (2). A meta-analysis covering 1979 to 2019 reported a global incidence of 2824 cases of neonatal sepsis per 100,000 live births, of which 17.6% died (3). Neonatal infections are also a significant cause of neonatal mortality in Ethiopia (4, 5). Access to hospital-based care is difficult for much of the Ethiopian population. In response to this problem, the Ethiopian government initiated the health extension program in 2003. Salaried female community health workers, known as the health extension workers, provide promotive, preventive and curative services to rural areas, including hard-to-reach and vulnerable communities (6). The health extension program includes a number of high-impact interventions at community level to improve access and address the high burden of neonatal mortality (7).

Despite the efforts of the health extension program, neonatal mortality in Ethiopia remains high at 33 deaths per 1000 live births in 2019 and accounting for 56% of all under-five deaths (8). The community-based newborn care program was introduced in 2013. It aimed to reduce neonatal mortality by improving the health extension workers' capacity to provide quality maternal and newborn care services and strengthening the linkages between health posts and their referral health centers (9). Under the community-based newborn care program the health extension workers are trained to provide pre-referral antibiotics for possible serious bacterial infection in 0-59 days old infants or provide a seven-day antibiotic treatment when referral is not possible (10).

Despite the introduction of the community-based newborn care program, service utilisation for possible serious bacterial infection remains low (11, 12). Lack of awareness of the availability of services, inaccessibility of facilities, and socioeconomic and cultural factors have been identified as barriers for service utilisation (13). For those who sought care at health facilities, the quality of care has been suboptimal (14). Poor service quality is a major global driver for excess mortality in the neonatal period and across a range of age groups and conditions (15).

Most neonatal deaths can be prevented when health facilities are equipped with the necessary drugs and supplies, and staffed with trained and skilled health workers to provide quality-care for newborns (2). More evidence is needed to understand some of the barriers to service utilisation, particularly from the health system side. Therefore, we aimed to assess the preparedness of health posts and

their referral health centers, the knowledge of health care providers and their management of bacterial infections in young infants aged 0-59 days in four regions of Ethiopia.

METHODS

Study setting and design

The primary health care unit, the entry point of the Ethiopia three-tiered health-care system, provides primary healthcare services and is comprised of five health posts linked to one health center. The health extension workers stationed at health posts provide community-based newborn care services through outreach and static services.

This study was a secondary analysis of data from a baseline cross-sectional facility-based survey that was conducted for the evaluation of the Optimizing the Health Extension Program intervention, which aimed to increase health service utilization for newborns and under-five children(16). The intervention had three strategies: engaging communities, building the capacity of health extension workers, and enhancing district-level ownership and accountability for childhood services. The baseline survey was conducted from December 2016 to February 2017 in four regions of Ethiopia: Amhara, Oromia, Tigray, and Southern Nations, Nationalities and Peoples' region.

Study participants and sampling

This study used data from a baseline survey for the evaluation of the Optimizing Health Extension Program. The survey was conducted in 26 districts that later received the intervention and 26 districts that served as comparison areas. The study protocol for the evaluation of the Optimizing Health Extension Program intervention has been published (16). Briefly, a two-stage cluster sampling was used. First, a list of enumeration areas in the 52 selected districts were obtained from the 2007 Ethiopian Housing and Population census to select 200 enumeration areas proportional to the population size of the district. Each enumeration area formed a cluster. Second, from each of the 200 clusters, a systematic random sampling was used to select 30 households. The health posts and the health extension workers serving each cluster, along with their referral health centers and staff working with the under-five health services were included in the survey. In addition, we reviewed the registers of young infants aged 0-59 days at health posts and health centers. For the purpose of this paper, the young infants managed at these health posts and health centers were our primary units of analysis.

Data collection

The tools for the survey were adapted from previous survey tools, pre-tested and adapted to the local context. The questionnaires were initially prepared in English and translated into the local languages, Amharic, Oromiffa and Tigrigna, and then back-translated into English. The questionnaires were piloted and modified. There were 12 data collection teams, each team comprised of a supervisor and four data collectors. They were all health professionals with a minimum Bachelor of Science degree. They were trained for ten days on data collection techniques, quality assurance procedures and study ethics. Data were collected using tablet computers. Data from the field were sent daily to the Ethiopian Public Health Institute and checked for completeness and consistency.

Health posts and health centers were observed to collect data on infrastructure, availability of necessary drugs, equipment, supplies and job-aids at the time of survey. Health extension workers and health center staff were interviewed to capture data on their background characteristics, their training, supervision in the past three months and mentoring in the six months prior to the survey, and their unprompted knowledge on identification and management of possible serious bacterial infection and local bacterial infection. In addition, we reviewed the integrated Community Case Management registers at health posts and the Integrated Management of Newborn and Childhood Illnesses registers at health centers to capture data on young infants 0-59 days old seen in the last three months before the survey. We abstracted data on infants' age, sex, recorded signs of illnesses, classification, treatment and outcomes of possible serious bacterial infection and local bacterial infection using a structured instrument mirroring the integrated Community Case Management and Integrated Management of Newborn and Childhood illnesses guidelines (Annex 1).

Data measurement

The health facility preparedness was assessed as the proportion of health posts and health centers that had the necessary equipment, supplies, drugs and job aids for the management of bacterial infections in young infants. We estimated the proportion of health workers at health posts and health centers that correctly mentioned the signs and management of possible serious bacterial infection and local bacterial infection in young infants. We compared the recorded classification and treatment of possible serious bacterial infection and local bacterial infection in young infants with the national guidelines. A recorded classification in line with guidelines was defined as the proportion of young infants registered to be classified as having these infections when their recorded signs or symptoms indicated possible serious bacterial infection and local bacterial infection, respectively. Treatment as

per the national guidelines was defined as the proportion of young infants who had recorded classification of possible serious bacterial infection and local bacterial infection, in the presence of any relevant signs and symptoms, who were registered to have received the recommended antibiotic treatment. Table 1 shows the summary of disease classification with the corresponding signs and symptoms and the recommended treatment according to the national guidelines.

Statistical analysis

Descriptive statistics, frequencies, percentages and proportions with their 95% confidence interval (CI) were used to characterize study participants and health facilities and display facility preparedness as well as health workers' knowledge, classification and management of young infants' bacterial infections. Data analysis was done using STATA version 14.1 (StataCorp LLC, College Station, Texas, USA).

Ethical considerations

The purpose of the study was well explained to the study participants and written informed consent was obtained from health extension workers and health center staff. Ethical approval was obtained from the Ethiopian Public Health Institute (protocol number SERO-012- 8-2016, August 2016), the London School of Hygiene & Tropical Medicine (protocol number 11235, June 2016), and the University of Gondar (VP/RTT/05/2941/2021).

Results

This study was conducted in 194 clusters; six were excluded due to civil unrest. Twenty-five of the clusters shared health post with another selected cluster. In total, 169 health posts with 276 health extension workers and 155 health centers with 175 health center staff were included. We reviewed a total of 1058 records of sick young infants seen in the three months before the survey. Of these, 216 were seen across 55 health posts and 114 health posts had no sick young infants seen in the three months prior to the survey. Similarly, 842 sick young infants were seen across 115 health centers and 40 health centers had no sick young infants seen during the three last months prior to the survey. The sick young infants' records seen at facilities range from 0-26 across 169 health posts and 0-30 across 155 health centers.

Facility preparedness

The study showed that 71% (95% CI: 63–78) of the health centers had ampicillin and gentamycin, and 38% (95% CI: 31–46) of the health posts had amoxicillin and gentamycin (Table 2). Over 80% of health posts had job-aids and the required equipment to manage young infants, except for stopwatch for counting respiratory rate. Similarly, more than 90% of health centers had job-aids and major equipment, except stopwatch.

Health care providers' characteristics, training, supervision and knowledge

A majority of the health extension workers (55%) had six or more years, whereas most of the health center staff (48%) had two or fewer years of working experience. Sixty-five percent (95% CI: 58–71) of the health extension workers were trained in community-based newborn care and 74% (95% CI: 67–80) had received supportive supervision in the three months prior to the survey. Less than half (43%, 95% CI: 37–50) of the health extension workers had participated in performance review and clinical mentoring meetings in the six months before the survey. In addition, 89% (95% CI: 82–94) of the health center staff was trained in the integrated management of newborn and childhood illnesses and 63% (95% CI: 56–71) had received supportive supervision in the three months prior to the survey (Table 3). Health centers staff are intended to support health extension workers with the community-based services they provide. Of the 155 health centers, 52% (95% CI: 44–59) had at least one trained staff on community-based newborn care.

Ninety-seven percent (95% CI: 94–98) of health extension workers and 98% (95% CI: 95–100) of health center staff correctly mentioned at least one sign of possible serious bacterial infection. Very few (16%, 95% CI: 12–21) health extension workers recommended the provision of a pre-referral dose of amoxicillin and gentamycin for possible serious bacterial infection and even fewer (2%, 95% CI: 1–4) mentioned treating with these drugs for seven days when referral was not possible. Eight in ten (81%) health extension workers and health center staff mentioned at least one sign of local bacterial infection to identify the illness, and its treatment with amoxicillin for five days was mentioned by most health center staff (87%, 95% CI: 81–92), but less so by the health extension workers (44%, 95% CI: 38–50) (Table 3).

Characteristics of young infants

The review of the registers indicated that newborns in their first week of life were more frequently seen at health posts, while older sick young infants were mostly seen at health centers. Over half (57%) were boys (Table 4).

Classification and management of bacterial infection in young infants

The review of registers showed that 80 sick young infants examined at health posts had at least one recorded sign of possible serious bacterial infection. Among the registered cases with signs of infection, the health extension workers classified 49% (95% CI: 26–73) as having possible serious bacterial infection. Among these young infants with recorded classification of possible serious bacterial infection, 54% (95% CI: 31–76) were referred to health centers. Of these referred young infants, 14% (95% CI: 3–37) received the recommended pre-referral antibiotics, while 52% (95% CI: 17–85) were referred without any pre-referral antibiotics. Among all young infants with a recorded sign of possible serious bacterial infection 16% (95% CI: 7–35) received the recommended antibiotics, of which 26% (95% CI: 9–53) were among those classified as having the illness. Among those young infants classified as not having possible serious bacterial infection, in spite of the recorded signs, 93% (95% CI: 58–99) did not receive the recommended antibiotics treatment (Figure 1a). Two-thirds (67%, 95% CI: 30–90) of young infants who were treated at health posts completed gentamicin injections. Three-fourth (77%, 95% CI: 41–94) of young infants were recorded as having had an improved outcome while 23% (95% CI: 6–59) had unknown outcome.

At health centers, of the 330 young infants registered with signs of possible serious bacterial infection, 25% (95% CI: 18–33) were classified as having possible serious bacterial infection. One-third (34%, 95% CI: 22–48) of the young infants with recorded classification of possible serious bacterial infection were referred to hospitals, where 14% (95%CI: 5–34) of these young infants did not receive any pre-referral antibiotics. Among all young infants with recorded signs of possible serious bacterial infection, 12% (95%CI: 8–16) received the recommended antibiotics and 35% (95% CI: 21–54) of the young infants were among those cases with recorded classification of the illness. A majority (96%, 95% CI: 93–98) of the misclassified young infants did not receive the recommended antibiotics (Figure 1b). One-third (33%, 95%CI: 19–51) of the young infants were recorded as having improved after the visit to the health facility, whereas treatment outcome were unknown for 67% (95% CI: 49–81) of young infants.

The register review indicated that the recorded classification of local bacterial infection was similar among health extension workers (88%, 95% CI: 59–97) and health center staff (86%, 95% CI: 78–91). Among young infants recorded as having local bacterial infection, 77% (95% CI: 42–94) at

health posts and 68% (95% CI: 54–80) at health centers were treated with the recommended antibiotics (Table 5). At health posts, three young infants were referred to health centers.

Discussion

This study in four Ethiopian regions evaluated the preparedness of facilities and the knowledge of healthcare providers to manage young infants with bacterial infection. In addition, registers were reviewed to assess the quality of care provided to young infants with bacterial infection. Drugs necessary to provide care for young infants with an infection were available in seven out of ten of health centers, but only four out of ten health posts had the necessary antibiotics. The health extension workers and health center staff had suboptimal knowledge on signs of bacterial infection in young infants. Register reviews showed that half of the young infants with at least one sign of possible serious bacterial infection at health posts and a quarter at health centers had received the corresponding classification of illness. One-fourth of young infants with possible serious bacterial infection at health posts and a one-third of those cases at health centers received the recommended treatment. Health extension workers and health center staff classified nine out of ten young infants with local bacterial infection.

The availability of antibiotics is essential to treat or refer young infants with infections. In our study, most of the health posts had amoxicillin, while gentamycin was available in less than half of the health posts. Moreover, both gentamycin and amoxicillin were available in only a third of the health posts, indicating that the other two-thirds were not able to provide the recommended treatment. Drugs for the community-based newborn care program were to some extent purchased and distributed by the implementing partners rather than through the existing health system. This indicates that insufficient effort was put to strengthen the supply chain system along with the scale up of the program (17). The health system has to be strengthened to ensure the availability of these essential drugs (18).

The health extension workers and health center staff are frontline care providers in Ethiopia. Their knowledge on prevention of illness and early identification of danger signs and referral or treatment is vital (19). Our findings indicate that a majority of the health extension workers and health center staff knew at least one sign of possible serious bacterial infection but very few knew most signs. This was also reflected in the register reviews, where only half of young infants with a recorded sign of a possible serious bacterial infection were correctly classified by health extension workers and a

quarter by health center staff. In line with this finding, a study that evaluates the health system response to community-based newborn care program in Ethiopia reported that the health extension workers correctly classified only 30% of young infants with severe bacterial infection compared to the re-assessment made by a clinical officer (14). Similarly, in another sub-study of this project, the health extension workers missed the correct classification of 41% of children aged 2-59 months with acute respiratory infection (20). The health extension workers and health center staff were not expected to memorize the signs and management guidelines. Rather, they were expected to follow the chart booklet, which provides an algorithm for the identification, classification and treatment of young infants. Nevertheless, they should know the danger signs that require them to refer to the chart booklet (9). Our findings underline the importance of following the chart booklet, which provides a guide to health facility staff for the assessment, classification and treatment.

The correct classification of bacterial infections depends on the capacity of the health care provider to recognize and interpret the presenting clinical signs. We found that most health extension workers and health center staff in this study knew the signs of local bacterial infection, and register reviews showed that they also correctly classified a similar proportion of the children with a recorded sign of such illness. Although not as high, the aforementioned study that evaluated the health system response to community-based newborn care program found that 55% of young infants with local bacterial infection were correctly classified by health extension workers (14). This is promising, indicating that with proper skill-based training and support, the health extension workers and health center staff could improve their recognition and management of severe bacterial infections.

Early initiation and appropriate treatment with antibiotics are essential for the survival of neonates (21). Our study showed that health extension workers' unprompted knowledge of then provision of antibiotics according to guidelines was low. In practice, only a quarter of young infants classified as having possible serious bacterial infection at health posts received the recommended antibiotics as reflected in the register review. In contrast, three-quarters of young infants who the health extension workers classified to have local bacterial infection received antibiotics according to the guidelines. Previous studies have also reported that treatment of possible serious bacterial infection in young infants was not according to the guidelines (9, 10, 22). Other studies have also reported a similar low provision of pre-referral antibiotics (23) or referral without pre-referral antibiotics (22, 24). The low use of the recommended antibiotics for treatment of possible serious bacterial infection could be due to insufficient skills or lack of drugs. Two out of three health posts did

not have the needed combination of gentamicin and amoxicillin. Moreover, we also found that one-third of young infants with recorded signs of possible serious bacterial infection at health posts and more than half at health centers were treated with inappropriate antibiotics. Similarly, a quarter of young infants with recorded signs of local bacterial infection and four out of ten at health centers received inappropriate antibiotics. This misuse of antibiotics shows a need to supply essential medicines and provide focused training on antibiotic use, ensuring adequate infection management and minimizing the risk of increased antibiotic resistance (21).

The high proportion of misclassification and low compliance with standard treatment guidelines for severe bacterial infection observed in this study could be due to the limited exposure the health extension workers have to such cases. Parents prefer taking their sick infants to higher-level health facilities (25, 26). Furthermore, in this study, one-third of the health extension workers had not been trained in the community-based newborn care program and over half of them had six or more years of experience, which indicates a need for regular training to improve their knowledge and skills. Less than half of the health extension workers had attended a clinical mentoring meeting in the previous six months. Supervision combined with clinical mentorship can improve the quality of care provided by the health extension workers (27).

Health center staff should also be trained and be knowledgeable on the community-based newborn care program to provide supervision and mentorship to the health extension workers (28). There was an insufficient number of staff trained in the community-based newborn care at health centers, indicating the difficulty they face in providing the required quality supervision of health extension workers. This finding is consistent with a previous Ethiopian study (9). We also found that half of the health center staff had only two or less years of experience, indicating a high turnover of staff. This finding suggests a need for continued in-service training. Training, clinical mentoring and supervision of health center staff is also necessary to improve their capacity to identify and treat serious bacterial infections (29, 30).

Strengths and limitations

Data were drawn from facilities in four of the most populous Ethiopian regions. These facilities were selected to represent the intervention and comparison districts in the Optimizing Health Extension Program intervention and were not primarily sampled to represent the four regions. However, we have reasons to believe that the selected districts were typical to these regions and the findings in

our study were similar to another study that included facilities in these regions (14). Our study assessed the health care providers and facilities, which gave a holistic picture of care provision for young infants within the health system. Direct observation of sick young infants' examination by health extension workers, followed by a re-examination with a "gold-standard" health officer could have given a better picture of the quality of care provided, particularly since the register might not include sick young infants whose illness sings were unrecognized or not documented. However, given the longer period of time it would require to see a sufficient number of cases in direct observation, reviewing registers was considered the most feasible method. Moreover, register reviews may not provide the entire picture of correct classification and treatment, since some clinical signs might not have been recognized or signs, classification and treatment might not have been correctly documented. Since our findings were limited to register reviews, misclassification could have been under-reported. Additionally, the treatment outcome for some of the included young infants was missing. This excluded the possibility of including data on mortality.

Conclusion

There was a shortage of antibiotics at primary care facilities to treat possible serious bacterial infection in young infants. This scarcity was more pronounced at health posts. The theoretical knowledge of health extension workers and health center staff on identifying bacterial infection was suboptimal. According to registers, the classification of possible serious bacterial infections did not follow guidelines and was of low quality. Many young infants missed the recommended antibiotics treatment for possible serious bacterial infection. In contrast, health extension workers and health center staff provided better classification and treatment for young infants with local bacterial infection. Overall, the primary care facilities need to be equipped with the necessary drugs and the primary health care providers should have consistent and focused training, supportive supervision and mentoring in order to provide quality care for sick young infants in order to further reduce neonatal mortality.

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Conflict of interest

The authors declared no conflict of interest.

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Data availability

The data for this manuscript were primarily collected by the Ethiopian Public Health Institute and London School of Hygiene and Tropical Medicine. Interested researchers may contact the focal person, Dr. Della Berhanu through email: Della.Berhanu@lshtm.ac.uk.

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Table 1: Bacterial infection classifications and treatment of young infants aged 0-2 months according to the integrated Community Case Management and the Integrated Management of Newborn and Childhood Illnesses chart booklet

Disease classification	Clinical signs and symptoms	Treatment
Possible serious bacterial infection	Convulsion OR Not feeding well OR Fast breathing (>60 breath per minute) OR Severe chest in-drawing OR Fever (temperature 37.5^{o}C or more) OR Low body temperature (less than 35.5^{o}C) OR Movement only when stimulated or no movement even when stimulated	*Refer with pre-referral antibiotics* Pre-referral dose of oral amoxicillin and gentamicin injection at health post Pre-referral dose of injectable ampicillin and gentamicin at health center *When referral is not possible* Amoxicillin twice a day and gentamicin injection once a day for 7 days at health post Ampicillin twice a day and gentamicin once a day at health center
Local bacterial infection	Red umbilicus or pus draining, OR Skin pustule	Amoxicillin twice a day for 5 days

Table 2. Availability of drugs, functional equipment and supplies, job aids and infrastructure at health posts and health centers in four regions of Ethiopia, December 2016 to February 2017 |

	Health posts (N=169)		**Health centers (N=155)**	
	n	**% (95% CI)**	**n**	**% (95% CI)**
Drugs				
Amoxicillin[a]	135	80 (73–85)	152	98 (94–99)
Gentamycin[b]	72	43 (35–50)	140	90 (85–94)
Ampicillin[c]	--	--	117	75 (68–82)

Amoxicillin and gentamycin	65	38 (31–46)	139	90 (84–94)
Ampicillin and gentamycin	--	--	110	71 (63–78)
Functional equipment, supply and job aid				
Thermometer	146	86 (80–91)	153	99 (95–100)
Syringe with needle	140	83 (76–88)	151	97 (93–99)
Infant weight scale	136	81 (74–86)	149	96 (92–98)
Stopwatch or clock	37	22 (16–30)	77	50 (42–58)
Chart booklet	147	87 (81–91)	148	96 (91–98)
Young infant register book	152	90 (84–94)	145	94 (88–97)
Supervision checklist	--	--	143	92 (87–96)
Infrastructure				
Water [d]	105	62 (55–69)	123	82 (75–88)
Electricity	30	18 (13–24)	94	61 (53–68)

[a] *Amoxicillin (dispersible tablet 250mg or 125mg or suspension 125mg/5ml)*

[b] *Gentamycin injection (20mg/2ml or 80mg/2ml)*

[c] *Ampicillin powder for injection (500mg) for health centers,*

[d] *Five missing values from health center*

Table 3: Health care providers' characteristics, training, supervision and knowledge in four regions of Ethiopia, December 2016 to February 2017

	Health extension workers (N=276)		**Health center staff (N=175)**	
	n	**% (95% CI)**	**n**	**% (95% CI)**
Years of service				
<=2years	57	21 (16–26)	84	48 (40–56)
2-6 years	68	25 (20–30)	76	43 (36–52)
>=6 years	151	55 (48–61)	15	9 (5–15)
Education background				
Level I-III (Certificate)	180	65 (58–72)	--	--
Level IV (Diploma)	96	35 (28–42)	--	--
Nurse	--	--	132	75 (69–81)
Health officer	--	--	40	23 (17–30)
Midwife	--	--	2	1 (0–5)
Urban health extension worker	--	--	1	1 (0–4)

Training				
CBNC [a]	179	65 (58–71)	--	--
IMNCI [b]	--	--	115	89 (82–94)
Supportive supervision				
In the past 3 months	204	74 (67–80)	111	63 (56–71)
PRCMM [c] participated in the past 6 months	120	43 (37–50)	--	--
Knowledge				
Signs of possible serious bacterial infection				
Stopped or reduced breastfeeding	186	67 (61–73)	121	69 (62–76)
Convulsions	139	50 (44–57)	100	57 (50–65)
Fever (temperature 37.5^{o}C or more)	137	50 (44–56)	93	53 (46–61)
Fast breathing (>60 breath per minute)	116	42 (36–48)	102	58 (51–66)
Movement only when stimulated or no movement at all	71	26 (20–32)	44	25 (19–32)
Severe chest in-drawing	67	24 (19–30)	68	39 (32–47)
Low body temperature (less than 35.5^{o}C)	61	22 (17–28)	30	17 (12–24)
At least one sign of possible serious bacterial infection	267	97 (94–98)	172	98 (95–100)
Management of possible serious bacterial infection				
Refer urgently	239	87 (82–91)	146	83 (76–89)
Pre-referral amoxicillin and gentamycin	44	16 (12–21)	--	--
Amoxicillin and gentamicin for 7 days	5	2 (1–4)	--	--
Signs of local bacterial infection				
Red or pus-draining umbilicus or skin pustules	224	81 (76–86)	148	85 (78–89)
Management of local bacterial infection				
Amoxicillin syrup for 5 days	121	44 (38–50)	153	87 (81–92)

[a] *CBNC- Community-Based Newborn Care*

[b] *IMNCI-Integrated Management of Newborn and Childhood illnesses*

[b] *46 missing values from health center*

[c] *PRCMM- Performance Review and Clinical Mentoring Meeting*

Table 4 Characteristics of sick young infant seen at health facilities during three months before the survey in four regions of Ethiopia, December 2016 to February 2017

	Health post (N=216)		**Health center (N=842)**	
	n	% (95% CI)	n	% (95% CI)
Age of the baby				
0 – 1 weeks	97	45 (30–61)	99	12 (9–15)
2 – 4 weeks	69	32 (21–45)	454	54 (50–58)
5 – 8 weeks	50	23 (15–35)	289	34 (30–39)
Sex				
Boy	123	57 (49–65)	480	57 (53–61)
Girl	93	43 (35–51)	362	43 (39–47)

Table 5- Classification and treatment of local bacterial infection at health posts and health centers in four regions of Ethiopia, December 2016 to February 2017

	Health post		**Health center**	
	n	% (95% CI)	n	% (95% CI)
Recorded signs of local bacterial infections	**N= 216**		**N=842**	
Skin pustules	14	6 (3–14)	56	6 (5–9)
Red umbilicus or draining pus	13	6 (3–13)	68	8 (6–10)
At least one sign	25	12 (6–22)	121	14 (12–18)
Classification among those with the recorded sign of the illness	**N=25**		**N=121**	

Classified as local bacterial infection		22	88 (59–97)	104	86 (78–91)
Not classified as local bacterial infection		3	12 (3–41)	17	14 (9–22)
Treatment					
			N=22		**N=104**
Classified as local bacterial infection	Recommended antibiotics	17	77 (42–94)	71	68 (54–80)
	Inappropriate antibiotics	5	23 (6–60)	26	25 (15–39)
	No antibiotics	0	0	7	7 (3–13)
			N=3		**N=17**
Not classified as local bacterial infection	Recommended antibiotics	0	0	7	41 (21–65)
	Inappropriate antibiotics	2	67 (10–97)	4	24 (8–52)
	No antibiotics	1	33 (3–90)	6	35 (16–61)

Legends to figures

Figure 1a. Possible serious bacterial infection classification and management at health post in four regions of Ethiopia, December 2016 to February 2017

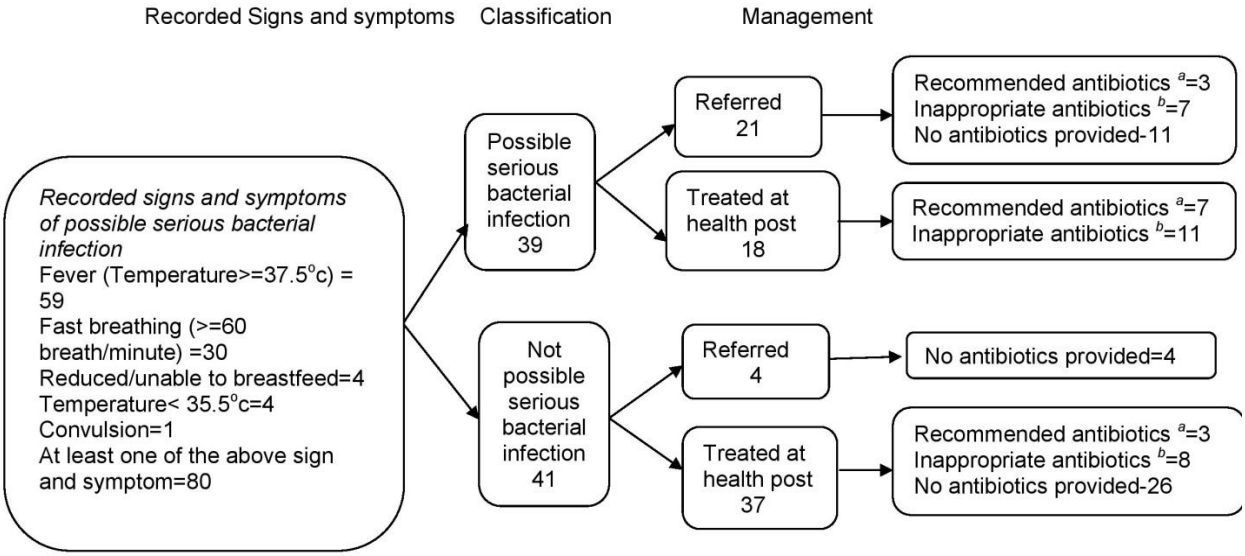
[a] *Recommended antibiotics: Amoxicillin and gentamicin*

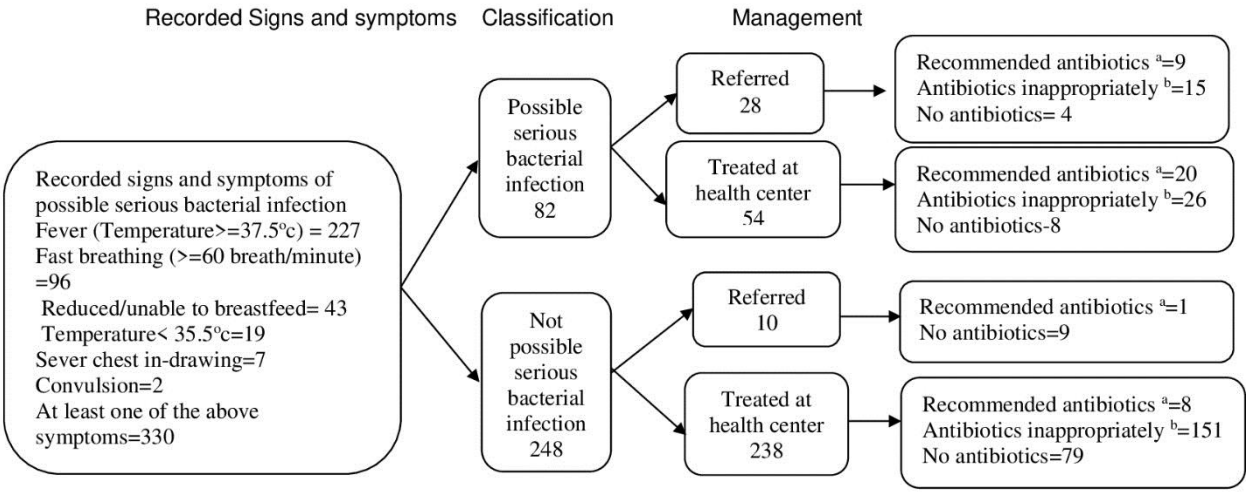
[b] *Inappropriate antibiotics: Amoxicillin or gentamicin*

Figure 1b. Possible serious bacterial infection classification and management at health center in four regions of Ethiopia, December 2016 to February 2017

[a] *Recommended antibiotics: Ampicillin/Amoxicillin and gentamicin*

[b] *Inappropriate antibiotics: Ampicillin or amoxicillin or gentamicin or correct combination, but with incorrect frequency, duration and route of administration*





Annex 1: Integrated Community Case Management/Integrated Management of Newborn and Childhood Illnesses register review form

HEALTH POST/HEALTH CENTER REGISTER REVIEW BY THE DATA COLLECTOR

Obtain data from iCCM/IMNCI 0-2 month registration book for information below for the PAST QUARTER

Record 1

221	How many 0-2 months were seen in the last quarter?		| | | |
222	**Name of child**	First name Last name	
223	**Address of child**	Gote name Keble name	
224	**Date Seen**	*Gregorian calendar (DD/MM/YY)*	| | |/| | |/| | |
225	**Age of baby at the time of consultation in weeks**	*Record age of baby in weeks ranging from 1-8 weeks.* *If unknown 9*	| | weeks
226	**Gender of baby**	*1 = Male 2 = Female*	| |
227	**Weight on the day of consultation in grams**	*If weight is given in KGs record in grams e.g 3.5 KG = 3500 grams.* *If unknown 9999*	| | | | | grams
228	**Birth Weight** **(Written for those less than 7 days)**	*1= < 1,500 grams* *2= 1,500 - < 2,500 grams* *3= >/= 2,500 grams* *9= Unknown*	| |
229	**Gestational Age (in weeks)**	*1= < 32 weeks* *2= 32 – 36 weeks* *3= >/= 37 weeks* *9= Unknown*	| |

230	**Temperature on the day of consultation in degree Celsius**		*Record temperature to one decimal place (e.g. 34.3 °C)* *If unknown 99.9*	| | |.| |°C
231	**Respiratory Rate per minute on the day of consultation**		*If unknown 999*	| | | |
	Signs and symptoms of the newborn at the time of consultation? **Record all that apply**		For each:1 = Yes 2 = No	
		232	Reduced feeding/unable to feed	| |
		233	Convulsion	| |
		234	Severe Chest in-drawing	| |
		235	Vomiting	| |
		236	Fever	| |
		237	Diarrhea	| |
		238	Fast breathing	| |
		239	Coughing	| |
		240	Grunting	| |
		241	Skin pustules	| |
		242	Yellow palms and soles	| |
		243	Yellow eyes and skin	| |
		244	Red umbilicus or draining pus	| |
		245	Movement only when stimulated or no movement even when stimulated	| |
		246	Movement only when stimulated or no movement even when stimulated	| |
		247	Bulging fontanelle	| |
		248	Restless/Irritable	| |
		249	Sunken eyes	| |
		250	Skin pinch goes back slowly	| |
		251	Skin pinch goes back very slowly	| |
		252	Diarrhea lasting 14 days or more	| |
		253	Blood in the stool	| |
		254	Not suckling well	| |
		255	Less than 8 breast feeds in 24 hours	| |

		256	Switching to another breast before one is emptied	| |
		257	Not breast feeding more frequently and longer during sickness	| |
		258	Poor positioning during breast feeding	| |
		259	Not well attached during breast feeding	| |
		260	Receives other foods or drinks (even water)	| |
		261	Low weight for age	| |
		262	Thrush (ulcers or white patches in mouth)	| |
		263	Signs and symptoms not given	| |
		264	Other – GO TO 265	| |
		265	Specify	
	Disease classification of the newborn **Record all that apply**		For each:1 = Yes 2 = No	
		266	Very Preterm and/or very low birth weight	| |
		267	Preterm and/or low birth weight	| |
		268	VSD	| |
		269	Local bacterial infection	| |
		270	Severe Dehydration	| |
		271	Some Dehydration	| |
		272	No Dehydration	| |
		273	Severe Persistent Diarrhea	| |
		274	Dysentery	| |
		275	Jaundice	| |
		276	Severe Jaundice	| |
		277	Malaria	| |
		278	Feeding problem or low weight	| |
		279	Classification not given	| |
		280	Other Go to 281	| |
		281	Specify	
	Treatment given to the newborn **Record all that apply**		For each:1 = Yes 2 = No	
		282	Gentamycin IM first dose	| |
		283	Gentamycin IM for seven days	| |

		284	Amoxicillin suspension/dispersible first dose	| |
		285	Amoxicillin suspension/dispersible for 7 days	| |
		286	Amoxicillin suspension/dispersible for 5 days	| |
		287	ORS (Plan B) – Facility treatment	| |
		288	ORS (Plan A) – Home treatment	| |
		289	Zinc for 10 days	| |
		290	Zinc-ORS combined	| |
		291	Oral chloroquine (Anti-malarial)	| |
		292	Oral quinine (Anti-malarial)	| |
		293	Oral coartem (Anti-malarial)	| |
		294	Rectal Artesunate (Anti-malarial)	| |
		295	IV Quinine (Anti-malarial)	| |
		296	Other Antimalarial (specify)	| |
		297	TTC (Tetracycline) eye ointment	| |
		298	GV paint (Gentian Violet)	| |
		299	Nutritional Counseling	| |
		300	Exposing to sunshine 20–30 minutes everyday	| |
		301	Other treatment GO TO 302	| |
		302	Specify	
303	**Was newborn referred to a higher facility?**		1 = Yes 2 = No	| |
304	**If newborn had VSD and was treated at health post was gentamycin treatment completed?**		1 = Yes 2 = No 3 = Not VSD case	| |
	Outcome of the newborn treatment		For each:1 = Yes 2 = No	
		305	Health improved/healed	| |
		306	Died	| |
		307	Worsened	| |
		308	Same	| |