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Assessment of the Ethiopian health center staff knowledge on neonatal care: Identifying the gaps, DAGU survey data.

Master's thesis in Master of Science in Public Health
Specializing in Global Health

Supervisor: Marlen Toch-Marquardt PhD, Department of Public Health and Nursing Faculty of Medicine and Health Sciences

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ABSTRACT

Background: The neonatal period – a period between the time of birth and 28-days of life – is the most vulnerable time for a child’s survival and health. A large share of neonatal deaths take place in low income countries, where access to quality health care is low. Even though Ethiopia has implemented policies supporting quality of care improvement through several national initiatives, Ethiopia still belongs to one of the countries with the highest neonatal mortality in in the world, with a current average neonatal mortality rate of 26.7 per 1000 live births.

Methodology: Knowledge was assessed in 175 health centre staff from 4 Ethiopian regions based on a baseline Dagu survey data. The association of participants knowledge was assessed between in-service training, supervision and technical support and length of service years. Analysis was done using SPSS. Ethical clearance was obtained from REK and Dagu data committee.

Result: Generally, from 175 health center staff who participated in the study, adequate knowledge was found: in none of the participants regarding immediate newborn care; in 40% regarding low birth weight care; 22% in feeding problem determination; 21% in care for newborn with feeding problem; 37%, 86%, 67%, 50% regarding identification of signs for severe disease, management of severe disease, identification of signs for and management of bacterial infection respectively; 90% regarding jaundice sign; 2% care for jaundiced newborn; 71% sign of dehydration and 40% regarding dehydration management. Only knowledge regarding care for low birth weight newborns and severe disease and bacterial infection were found to have a statistically significant association with training.

Conclusion: Knowledge regarding immediate newborn care among participants was insufficient. The highest deficit of knowledge was found in immediate newborn care components, identifying and stabilizing newborns with feeding problems and management of jaundice. Efforts are needed to orientate health centre staff regarding immediate newborn care, especially the offer of immediate care after birth and jaundice management. Periodic assessment coupled with refreshment training should be conducted regularly.

Key words: Newborn Care, Adequate Knowledge, Health Centre Staff, Quality of Care

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Abbreviations

BCG	Bacillus Calmette–Guérin
CNBC	Community Based Newborn Care
CSPRO	Census and Survey Processing System
EBP	Evidence Based Practice
EDHS	Ethiopian Demographic and Health Survey
HEW	Health Extension Workers
ICCM	Community Case Management of Childhood Illness
IFHP	Integrated Family Health Program
IMCN	Integrated Management of Newborn and Childhood illness
IMRAD	Introduction Methodology Result and Discussion
MDG	Millennium Development Goal
OHEP	Optimizing Health Extension Program
ORS	Oral Rehydration Salt
QOC	Quality of Care
SDG	Sustainable Development Goal
SNNPR	Southern Nations Nationalities and Peoples Representative
TFR	Total Fertility Rate
TTC	Tetracycline
UN	United Nations
UNICEF	United Nations International Children’s Emergency Fund
WDA	Women Development Army
WHO	World Health Organization

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1 Introduction

Even though the rate and absolute number of neonatal deaths are going down, the proportion of neonatal deaths among all under-5 deaths is going up. In 2017, the number of neonatal deaths that occurred globally has reached 2.5 million increasing by seven percent when compared to 1990 and newborn health remains a priority in the sustainable development goals (SDG) agenda.[1-3] Deaths within the first 28 days of life (neonatal period) occurs from conditions and diseases associated with lack of quality of care at birth and treatment immediately after birth and the first days of life.[1, 4] With a population size of >100 million, Ethiopia is one of the African countries with the highest number of neonatal deaths globally.[5] Through the years, several initiatives from governmental and non-governmental organizations have been taking place in Ethiopia in order to reduce the high neonatal mortality and achieve a better neonatal health standard. Community Based New Born Care (CNBC) program and Community Case Management of Childhood illnesses (ICCM) were among several initiatives taken to reduce newborn mortality and childhood illness respectively through strengthening a primary health care unit.[6] This thesis is based on a thorough review and analysis of current relevant scientific literature and the original Dagu survey which was conducted for evaluation of improved integrated community case management and community-based newborn care in Ethiopia.[7] The word Dagu is an Afar word for communication, and it is a consortium of London School of Hygiene and Tropical Medicine, the Ethiopian Public Health Institute, and the universities in Gondar, Mekelle, Jimma, and Hawassa. To provide a framework for the rationale, this thesis first provides background information on current situation of neonatal health globally and specifically in Ethiopia, particularly relating to practices taking place to reduce neonatal mortality in meeting the United Nation (UN) SDG's. The background also addresses, the health system structure of Ethiopia, the role of health center staffs at health posts, and their practice to deliver standard of care. Furthermore, this thesis also provides information about Integrated Management of Newborn and Childhood Illnesses (IMNCI) and other guidelines which served as a basis for the assesement of health center staff knowledge about neonatal health and management of illnesses. Information is provided on quality of neonatal care and how it should be prioritized and assessed through time to measure progress, indicate existing gaps, and introduce interventions to improve performance and achieve goals.

This thesis provides an assessment of health center staff knowledge based on the questionnaire responses which particularly focuses on essential newborn care practices including management of illnesses by health care providers (midwives, nurses, health officers and urban health extension workers) in four regions of Ethiopia.

Research question

- On what level of neonatal care knowledge are the health center staffs among four regions of Ethiopia operating?
- Is there a knowledge gap among health center workers about neonatal health conditions and management of illness? Is there an association between better knowledge and longer service periods; between better knowledge and receiving supervision; and last, between better knowledge and training?

This thesis aims to assess health center staffs knowledge about key neonatal lifesaving interventions, identify knowledge gaps, update knowledge, and provide baseline information about the level of knowledge on which health workers are operating, and provide recommendations on how to improve quality of care for better neonatal health outcomes.

According to evidence-based practices (EBP) and experiences from various countries who achieved the lowest neonatal mortality rate, it is known that a rapid decline in neonatal mortality can be achieved without the need for sophisticated and advanced medical technology.[8] Evidence-based practice is a term increasingly used to describe the application of empirically acquired knowledge in health care practice and it is well known to improve patient outcomes, the quality and safety of healthcare.[9] While providing basic neonatal health service does not require extensive equipment like other health care sectors, well-trained and competent professionals are vital to provide appropriate care at appropriate time. Therefore, simple life-saving interventions undertaken by skilled birth attendants has the capacity to bring a difference between life and death for countless newborns.[10-12]

Because of the extensiveness of the data, the design of the study, and data collection tool of the Dagu survey (see Appendix), a decision to conduct a very detailed descriptive analysis was made in order to provide a general information to better understand the competency level of health center staffs in four regions of Ethiopia by assessing their knowledge about neonatal care

practices with the potential to be used to assess health system readiness to provide quality neonatal care services, to support further planning of continuous assessment of provider skills, their training needs and research. The result from this thesis can be used for future comparative studies with other similarly assessed regions, including the midline and end line survey which will be conducted in the near future by the DAGU consortium.

1.1 Background

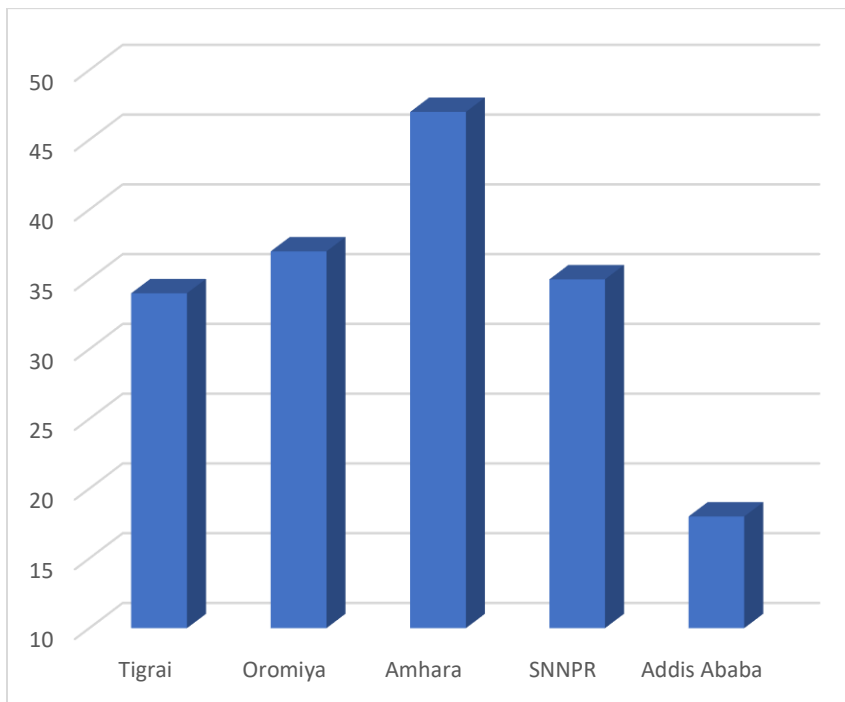
1.1.1 Current situation in the world, Africa, East Africa, and Ethiopia.

The neonatal period – a period between the time of birth and 28-days of life – is the most vulnerable time for a child’s survival and health.[1, 13] Today, 2.6 million deaths of babies less than one month old occur globally every year. Nearly 46% of deaths occur during the first day of life and 75% of all deaths occur during the first week of life. The vast majority of these deaths are preventable and uncomplicated and cost effective proven interventions exist.[14] Premature birth, complications during labor and delivery, infections such as sepsis, meningitis, and pneumonia are the major contributors to these high number and account for more than 80% of new born deaths.[15] A large share of neonatal deaths take place in low income countries, especially the poorest and the most underdeveloped parts, where access to quality health care is low and the chances of newborn survival in these areas could greatly be increased with skilled health care during pregnancy, childbirth and in the postnatal (immediately following birth) period.[16]

We have witnessed an impressive decline in global neonatal mortality rate; from 30 deaths per 1000 live births in 2000 to 18 deaths per 1000 live births in 2018.[17] Nevertheless, this decline is much slower when compared to a mortality decline achieved in children aged 1 – 59 months.[3] Even though, there has been an impressive decline in neonatal morbidity and mortality globally, the numbers remain very high in low income countries such as Sub-Saharan, West, and central Africa, and South Asia.[18] Especially, in sub-Saharan Africa, the reduction in mortality is lagging behind due to limited or no availability of adequate health care facilities, and health care professionals that could possibly provide a quality health care.[17, 19] The lack of quality of care and inadequate health worker performance is also identified as a particular problem that needs special attention in the journey of delivering life- saving interventions.[12, 19-22]

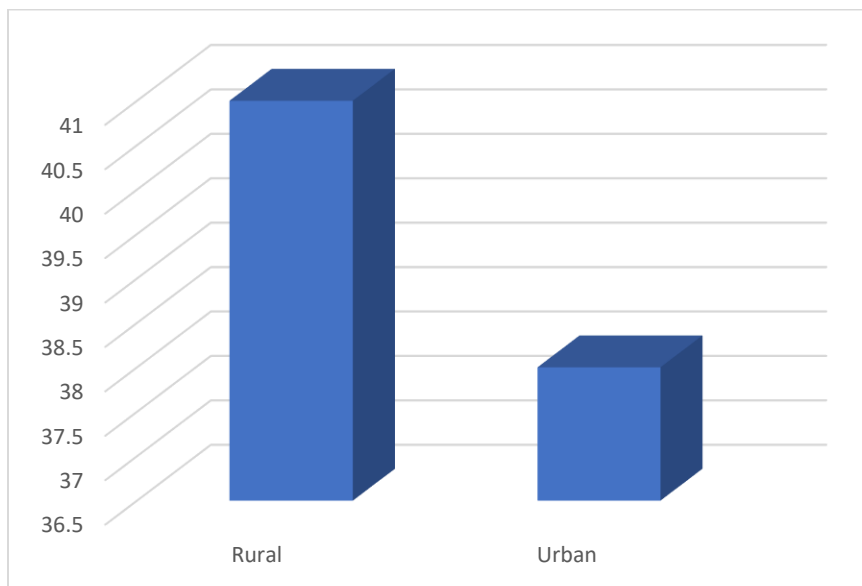
Despite the fact that Ethiopia has implemented policies supporting quality of care improvement through several national initiatives, according to Ethiopian Demographic and Health Survey (EDHS)[5], Ethiopia still belongs to one of the countries with the highest neonatal mortality in in the world, ranking number 12 with a current average neonatal mortality rate of 26.7 per 1000 live births.[5, 17, 23, 24] It is also important to note that neonatal mortality trends vary largely from region to region within Ethiopia. Furthermore, large variations have also been observed by background characteristics such as mother’s education and birth interval with the highest neonatal mortality occurring in population that is less educated, having short birth interval period and residing in rural areas.[5] Figure 1 and 2 illustrate the differences in the neonatal mortality rate by residence and region. Mortality is dramatically higher among neonates born in Amhara region than Addis Ababa and neonates in rural area are more likely to die than neonates in urban areas.

Figure 1: Neonatal mortality rate by region



Source: Ethiopian Demographic and Health Survey (EDHS) 2016

Figure 2: Neonatal mortality rate by residence



Source: Ethiopian Demographic and Health Survey (EDHS) 2016

The decline in neonatal mortality in Ethiopia could be accelerated, and millions of lives could be saved if quality of care around the time of birth for mothers and newborns could be improved and become affordable.[25] Therefore, the first step in achieving significant reductions in newborn mortality is improving access to maternal and newborn services. However, the quality of service is very crucial and, the simple presence of health facilities and availability of health workers is inadequate to exert significant impact and make the difference between life and death.[24] It requires adequately skilled and educated workers and well-equipped health centers to achieve success and save most lives.[24, 26]

Quality of care is defined as the extent to which health care services provided to individuals and patient populations improve desired health outcomes by service provision through health care workers to provide timely, effective and respectful treatment for every mother and child.[27] In 2014, at the World Health Assembly, an ambitious goal was set by 194 member states for all countries to reach a target of 12 or less newborn deaths per 1,000 live births by 2030 and to further reduce death and disability of newborns and strengthen improvement measures to ensure that every newborn has a chance at live.[23]

No intervention is as viable as a professional care during the critical 24 hours after birth to maximize success in reduction of neonatal mortality.[3] The interventions mentioned below have been proposed by a Lancet series [28] as a key evidence-based interventions which if

implemented to scale, could greatly contribute to saving newborn lives in low resource settings. Support and service from a skilled provider through simple but very crucial steps such as organizing care and early detection of complications, referral to obstetricians when needed, promoting breast feeding, kangaroo mother care, resuscitation of newborn babies, prevention and management of hypothermia, play a significant role, where millions of lives could be saved.[28] These important health care services should be available around-the-clock, and the provision of individual-oriented care entails that those health care providers: Be knowledgeable, adequately trained, equipped and supervised. Furthermore, providers need to respond promptly to complaints from individuals and exercise discretion in assigning a diagnosis and choosing a treatment.[19, 28]

Governments and non-governmental organizations spend significant amounts of resources to improve health systems and support health workers with the aim of producing better health care to societies.[29, 30] Evidence show that the use of health facilities among vulnerable populations will remain low as long as poor health worker practices remain, and actions taken to improve them might have a positive impact in increasing the utilization of services by users.[29, 31] Harmful practices, such as missing important diagnoses or prescribing unnecessary or wrong medication, might also result from faulty health worker practices, which need to be avoided.[32-34]

If a health facility fails to provide a quality care in a setting where barriers such as culture, traditional beliefs and practices which cause delay in seeking care exist, it would be unrealistic to expect utilization of available service and achieve a better level of health for neonates.

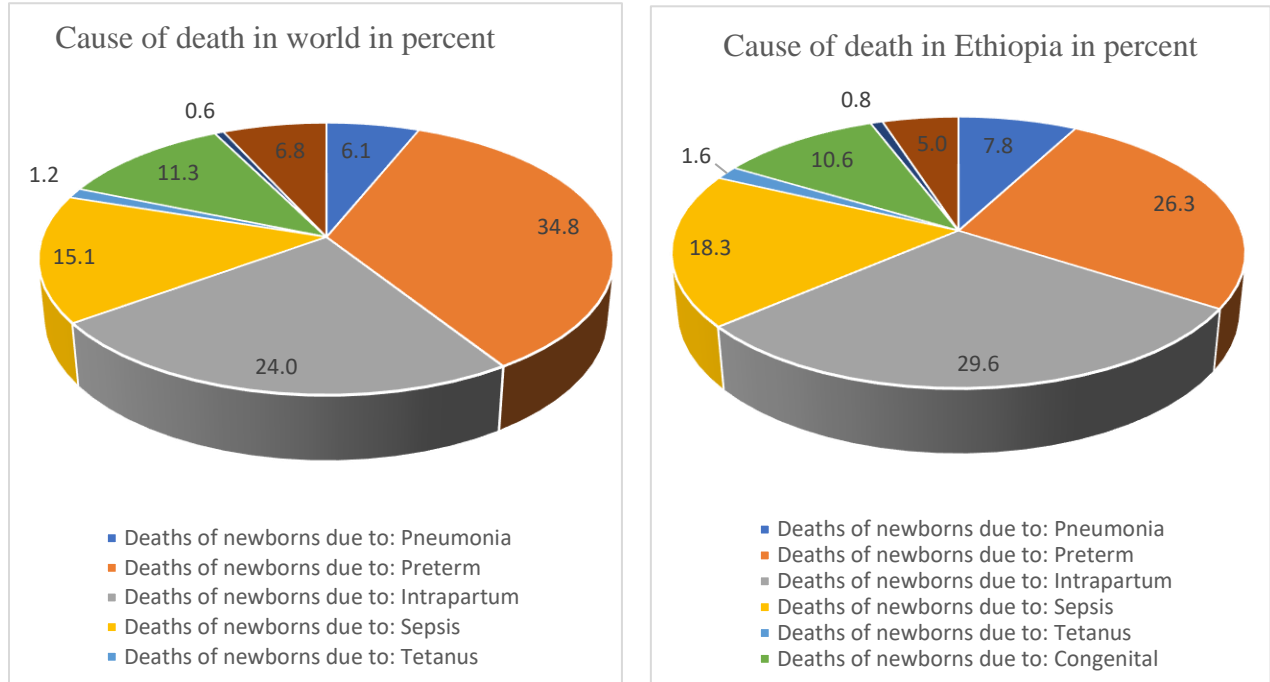
Demonstrating good professional skills, avoiding poor attitudes, communicating effectively and actively, and encouraging communities to choose skilled providers, are few of the many required quality skill sets towards improving quality of care delivery by health workers. Better health care worker practices bring higher rate in service utilization by communities and it is fundamental to improve and sustain results for long term.[35]

1.1.2 Causes of Neonatal mortality: globally and in Ethiopia.

Nearly 80% of neonatal deaths occur during the first week of the newborn life. Therefore, making the time of child delivery and the period immediately after birth, most critical for

neonatal survival and well-being. The two figures below describe causes of neonatal mortality in world and Ethiopia.[5, 36]

Figure 3: Cause of newborn deaths globally and in Ethiopia



Source: United Nations International Children’s Emergency Fund (UNICEF) 2018[36]

The figures show that more than 70% of neonatal deaths could be prevented through evidence-based interventions and neonatal health care providers in need to have adequate knowledge about the different interventions and procedures to implement and use them.[28] Continuous training and educational programs targeting health center staff have shown to increase and improve the skills and knowledges of staffs and brought better health care outcomes.[11, 37] Therefore, it is primarily important to identify and assess whether health center staff have the required knowledge or not. Current studies in Ethiopia are mainly focused in assessing the quality of care in terms of availability of facility infrastructure, equipment, necessary medication and personnel. Due to this reason, this research aims to focus on quality of care assessment from a different angle by understanding the level of health center staff knowledge in an effort to improve quality of care (QOC).

1.1.3 Quality of care challenges with projected fertility increase

Based on World Health Organization (WHO) estimates, a shortage of healthcare workers is expected to rise by about 12.9 million globally by 2035. Thus, further exacerbating the quality of

care challenges in low resource settings.[38] Furthermore, with the projected increase in fertility rate of sub-Saharan African countries, and existing challenges which resulted in the lowest health indicators, a robust movement and more emphasis on quality of care is needed to achieve the lowest neonatal mortality rate. Between the year 2015 and 2050 it is projected that almost 2 billion babies will be born in Africa.[39] The driving forces behind this increase are continued high rates of fertility and increased number of women of reproductive age.[39, 40] Although differences appear between countries in the continent and regions within countries, The highest fertility rates are observed in Sub-Saharan and West Africa.[41] According to a recent world bank report, women in Ethiopia will have on average 4.2 children and the number of babies born will continue to expand as the number of women of reproductive age continues to increase.[42] With a population of nearly 108 million, Ethiopia is the second most populous country in Africa with the largest increase in absolute number of both, birth and child population.[41] This fact will make it even harder to ensure child survival, creating an enormous challenge to provide quality health care service.[42, 43] Not only fertility rates are high, close to 1.12 million newborn deaths occur annually in the African region, where nearly 80% of the deaths are caused due to prematurity and low-birth-weight, infections, lack of oxygen at birth, and birth trauma.[44] In the region, almost half of all the newborns do not receive skilled care during and immediately after birth. Ethiopia, together with Nigeria, Democratic republic of Congo, United republic of Tanzania, and Uganda account for half of the continents newborn deaths.[42, 44] In all age groups of women in Ethiopia, fertility rates are higher in rural areas than in urban areas.[5] Rural Ethiopian women have 2.9 more children than the ones in urban area. Over the years, the Total Fertility Rate (TFR) in Ethiopia has declined from 5.5 children per women in 2000 to 4.2 children per women in 2017.[5] There is also a visible difference in TFR decline between women living in rural and urban areas. As the number of newborns increases, so has the need to have a skilled health professional that could provide quality health care. Although Ethiopia has achieved substantial improvement in under-5 mortality reduction and infant survival, the decline in neonatal mortality remained slow, currently constituting larger portion of all infant deaths and under-5 deaths.[5] It is the aim of this thesis to pay attention to the translation of knowledge in relation to the achievement of neonatal health.

1.1.4 The sustainable development goals (SDG) on neonatal health

Despite the major progress during Millennium Development Goal (MDG) era, reducing child mortality was among the major challenges that remained. More than 40 % of under-5 deaths globally are accounted to neonatal deaths. Causes other than neonatal mortality, as a share of under-five deaths declined far more rapidly during the MDG period (1990-2015), a period that recorded a great drop in under-5 mortality. In spite of the implementation of several national policies to complement and strengthen health care delivery, inadequately prepared and weak health systems remain the main obstacles in several countries especially Sub-Saharan African countries particularly Ethiopia, resulting in extra difficulty to achieve a rapid progress.[45, 46]

In September 2015, the United Nations general assembly adopted the 2030 agenda for sustainable development: embracing 17 sustainable development goals which are designed to benefit all. With one comprehensive goal – SDG 3, health is centrally positioned within the agenda explicitly stating to ensure healthy life's and promote well-being for all at all ages. 13 targets were included in SDG 3 covering all major health priorities, including unfinished and expanded MDG's agenda.[45]

Ending preventable newborn mortality is a high priority within the SDG movement and it is specifically listed in SDG goal 3.2, targeting the reduction of neonatal mortality rate to 12 or fewer per 1000 live births in all countries by 2030.[47] To reach these targets and ensure available, accessible and quality of care, it is crucial that countries need to strengthen engagement, action and partner harmonization efforts.[45] As the agenda is being implemented and underway, many governments, institutions, and organizations have already started to translate the new agenda into their development plans, strategies and visions. Ethiopia belongs to the list of several other countries moving forward with a road map of strategic actions to end preventable newborn mortality. A clear path has been set out with a specific milestone for activities to greatly reduce newborn deaths by 2030.[23, 47]

It is stressed that tracking progress and identifying areas that require greater efforts are vital in maintaining momentum towards the SDG's. Therefore this thesis has given a strong emphasis on identifying a knowledge gap which possibly could hinder the achievement of the ambitious goal and might provide an insight to the performance and the quality of care delivered in the context of knowledge for newborn health in health centers within the four regions of Ethiopia.

1.1.5 Organization and structure of health system in Ethiopia

To improve the delivery of quality care services, Ethiopia adopted a decentralized three-tier health care system which decentralizes decision making power to for public service delivery from central to regional governments.[48]

Figure 4: Health system structure in Ethiopia

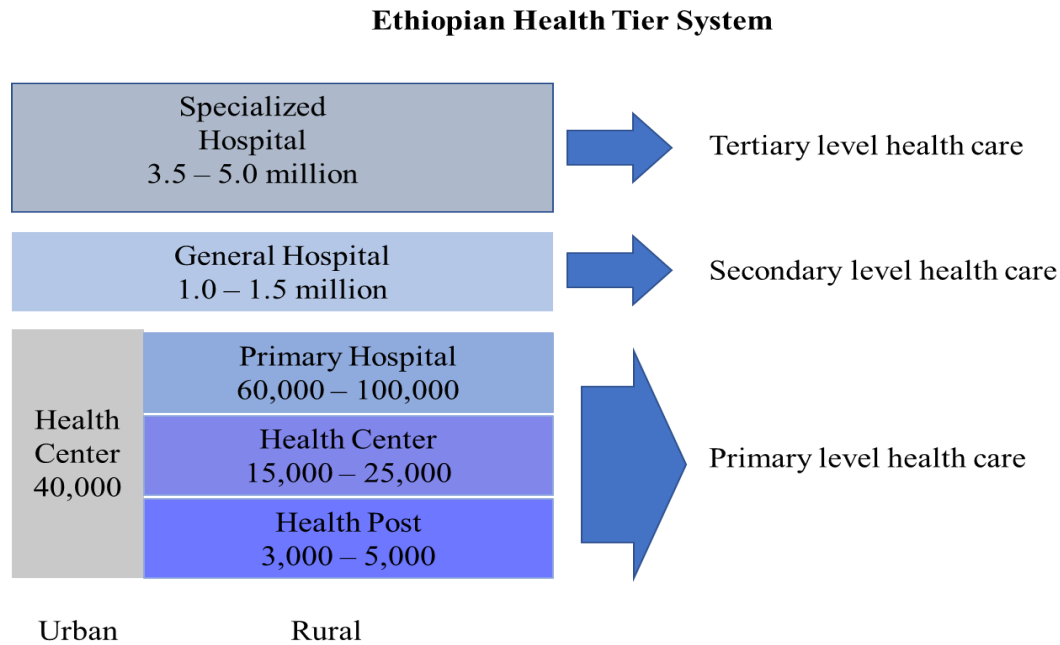


Figure 4 depicts the three-tier structure of the Ethiopian health system. The primary level health care unit is the lowest level of referral system and it comprises one primary hospital per district, 4-5 health center and five satellite health posts for each health center.[48] The secondary and tertiary levels are comprised of general and specialized hospitals, and the coverage of each extend to larger portions of the population. The management, coordination, and distribution of technical support in each and every level is the responsibility of the Woreda District Health offices and the Regional Health Bureaus, whereas policy and significant decision making is the responsibility of the Ethiopian Federal Ministry of Health.[48-50]

The primary care level is established on the district level (or ‘Woreda’ level in Amharic) and includes a primary hospital, local health centers, and rural health posts. Health centers are staffed with a health professional team including midlevel health professionals; health officers, nurses, midwives, sanitarians and laboratory technicians. A health center provides comprehensive

primary health care which includes preventive, curative, inpatient and ambulatory services, and treatment of common psychiatric conditions and dental services. The health centers also play a crucial role in providing referral care, technical and practical support to the health extension workers at health posts. The Health Extension Workers (HEWs) refer cases which are beyond their capacity, that need medical, and surgical interventions to the health center or hospital. HEWs refer patients who require laboratory or other diagnostic techniques which are not available at the health post, for expert advice at the health center [49, 51] One health center supervises and receives referrals from five satellite health posts. A health post is the operational center for two HEWs.[49, 52] This decentralized primary system functions due to the implementation of Health Extension Workers that can refer patients to health centers or the primary hospital for more serious health issues, monitor health and disease on a local level, educate their fellow Ethiopians about sanitation, how to avoid spreading communicable disease, childcare and nutrition, and family planning.[50, 53, 54] They also provide basic primary care services like contraceptives, immunizations, and treatment for common childhood illnesses. Each health center coordinates 5 health posts, and there are two health extension workers and one health post per community. The Health Extension Program uses task-shifting and ‘community ownership’ to provide basic health services at the grassroots.[49, 52, 55]

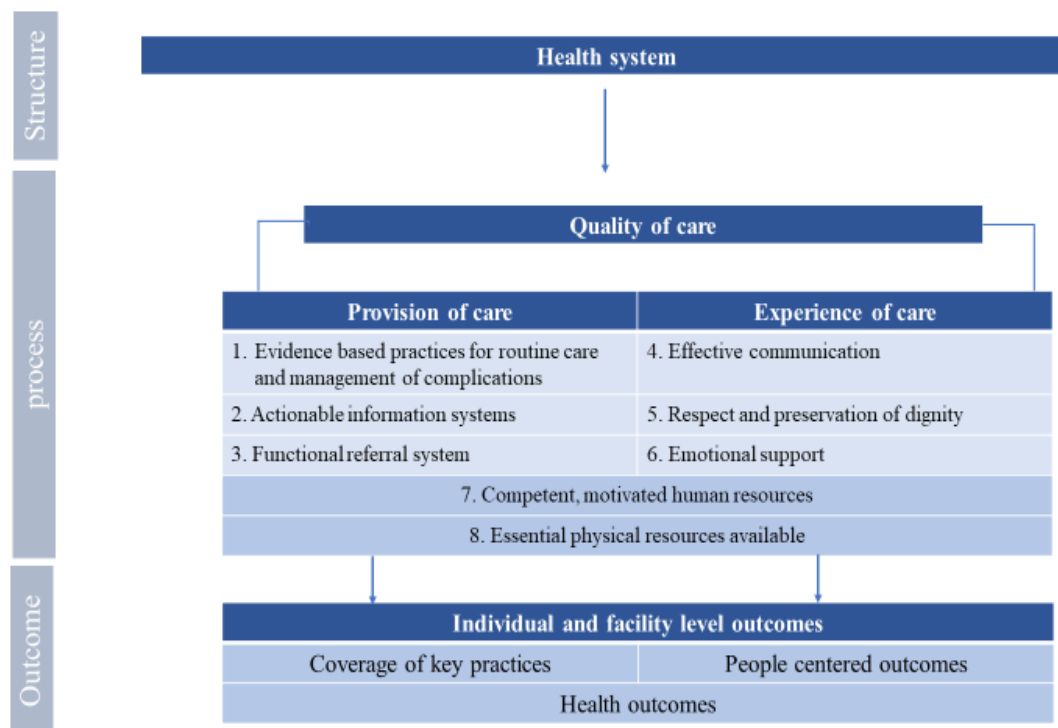
1.1.6 Quality of care /what is good performance?

As efforts to reduce maternal and newborn adverse outcomes has increased significantly in low income countries, the proportion of deliveries attended by skilled health personnel has increased significantly resulting in increased utilization of health care services.[56] Poor quality of health care in facilities becomes a bottle neck in the mission to end preventable newborn morbidity and mortality.[44]Therefore, in order to end preventable newborn morbidity and mortality, and create a positive experience of health service seekers, good quality of care is vital, and it requires the use of acceptable and effective use of evidence-based interventions, strengthened health facility infrastructure and optimum knowledge, skills and attitude of health providers.[56]

But what is quality of care? To provide a common understanding, WHO defines it as “the extent to which health care services provided to individuals and patient populations improve desired health outcomes. In order to achieve this, health care need to be safe, effective, timely, efficient, equitable, and people-centered.”[57] With the aim of ensuring that every newborn receives

quality care, in 2016, WHO released standards for improving quality of newborn care in health care facilities to be integrated in countries national quality improvement plans.[58] The implementation framework identifies eight domains of quality of care that needs to be assessed, improved and monitored in the health system (see Figure 5).[23, 57]

Figure 5: WHO Quality of Care Framework 2016 [56]



According to this framework, assuring quality of care for newborns in health facilities requires competent, knowledgeable and motivated health workforce and the availability of essential physical resources. The strategy serves as a roadmap for continuous quality improvement in provision and experience of care.[56]

1.1.7 Ethiopia’s action on quality of care improvement and the SDG

New quality of care plans, standards and guidance have been developed as part of the Ethiopia’s general health sector growth and transformation plan and implementation of strategies have begun in a year 2015/2016 focusing on quality of care as a core element.[23] The clear road map with a strategic focus is provided by the Ethiopian National Health Care Quality Strategy and much progress is being made in establishing the structures, governance, standards and guidance as well as establishing a numerous baseline health facility assessment over time.[23, 59]

In 2013, the government of Ethiopia in collaboration with UNICEF, Last 10kilometres, Integrated Family Health Program-IFHP, and Save the Children launched and started implementation of Community-Based Newborn Care (CBNC) program with the aim to reduce neonatal mortality through strengthening the primary health care unit and health extension program.[6] In addition to improving the performance of Health Extension Workers (HEW) and Women Development Army (WDA), the main goal was to improve communication between health centers and health posts.[6, 50, 51]

As part of implementing the national health care quality strategy, Ethiopia has completed the integration of Every Newborn Action Plan in 2017 and defined a newborn mortality reduction target. In addition, the strategy has also been expanded in the education sector through development of a master level quality improvement course. National to district quality of care governance structure has also been established; providing orientation to 2500 participants from several hospitals within the region on health service transformation for quality guidelines, the Ethiopian health service transformation guide and quality improvement methods. This study aims to contribute to Ethiopia's quality of care improvement action through assessment of health center staff knowledge. Results from this study could then be used as an input for policy makers and program implementers, at regional as well as national level, to design evidence-based intervention strategies to tackle the problems of neonatal mortality.[23]

1.1.8 Structure of thesis

This thesis is formatted in accordance with scientific publication standard, following IMRAD structure. A review of scientific literature has been included throughout the introduction to provide an evidence-based context for the research question and support the rationale behind the research aim.

1.2 Rationale

In a qualitative barrier analysis study [23] conducted in 2015 in Ethiopia's four regions (Amhara, Oromia, Southern Nations, Nationalities, and Peoples (SNNP), and Tigray), factors such as: low quality of care, cost of care and traditional beliefs, and healing practices were identified as a root cause of low utilization of services. Most importantly, limited knowledge and skills of health Extension workers were identified as barriers for service utilization. Thus, the above mentioned

factors strengthened the rationale for this study's research question that if health center staff (midwives, nurses, and health officers), who are mainly responsible for supervising and training the health extension workers [54, 60], have the required knowledge to manage newborn health care needs and possess adequate knowledge to train the health extension workers under their health center.

The need for periodic assessment and data collection were mentioned in several strategic plans as crucial points to support country work into achieving a greater momentum towards improving the quality of care in neonatal health and progress large-scale quality improvement learning activities. Furthermore, there is also an urgent need to improve national data specifically the need for programmatically relevant data to understand quality gaps and design improvement plans.[45]

Although progress in multi-country multi-partner data gathering is being made, it is indicated that there is a major measurement gap in service readiness for the small and sick newborn as well as a survey of practitioners around the world that will support the development of new guidance to improve the quality of care for small and sick newborns. Thus, to accelerate progress, it is highly recommended that countries need to update their health management information systems with key quality of care indicators as well as exposure to innovations in data collection and use. Hence, the reason for the use of this available DAGU data; a joint result of multi-institute partnerships (gathered by the effort of multi-partners) to assess the knowledge gap and support Ethiopia's quality of care improvement work in neonatal health sector.[45]

1.2.1 Objectives and purpose of the study

The general aim of the study was to identify the level of knowledge about neonatal health among health care providers, in Ethiopia's four regions: Amhara, Oromia, SNNP and Tigray. Therefore, providing information to plan further improvement strategies and act accordingly to fill the potential gaps.

1.2.1.1 Purpose of the study

The purpose was to assess training needs of health care providers in health centers and accurately identify gaps in knowledge in managing neonatal emergency conditions with a purpose to increase understanding on where to point the focus. For example, in training allocations to

improve health center staff knowledge and practices about neonatal health, contributing towards increasing quality of service.

1.2.1.2 Objectives

The specific objectives are:

1. To assess health center staff knowledge on six broad areas of newborn care: immediate newborn care, care for low birth weight newborns, feeding problems, bacterial infection, jaundice and diarrhea in four regions of Ethiopia.
2. To determine if there is an association between level of knowledge with longer period of service, availability of supervision and staff training.
3. To increase understanding of where to focus resources to improve quality of newborn care in Ethiopia, contributing towards decreasing global neonatal mortality.

2 Description of dataset and methodology

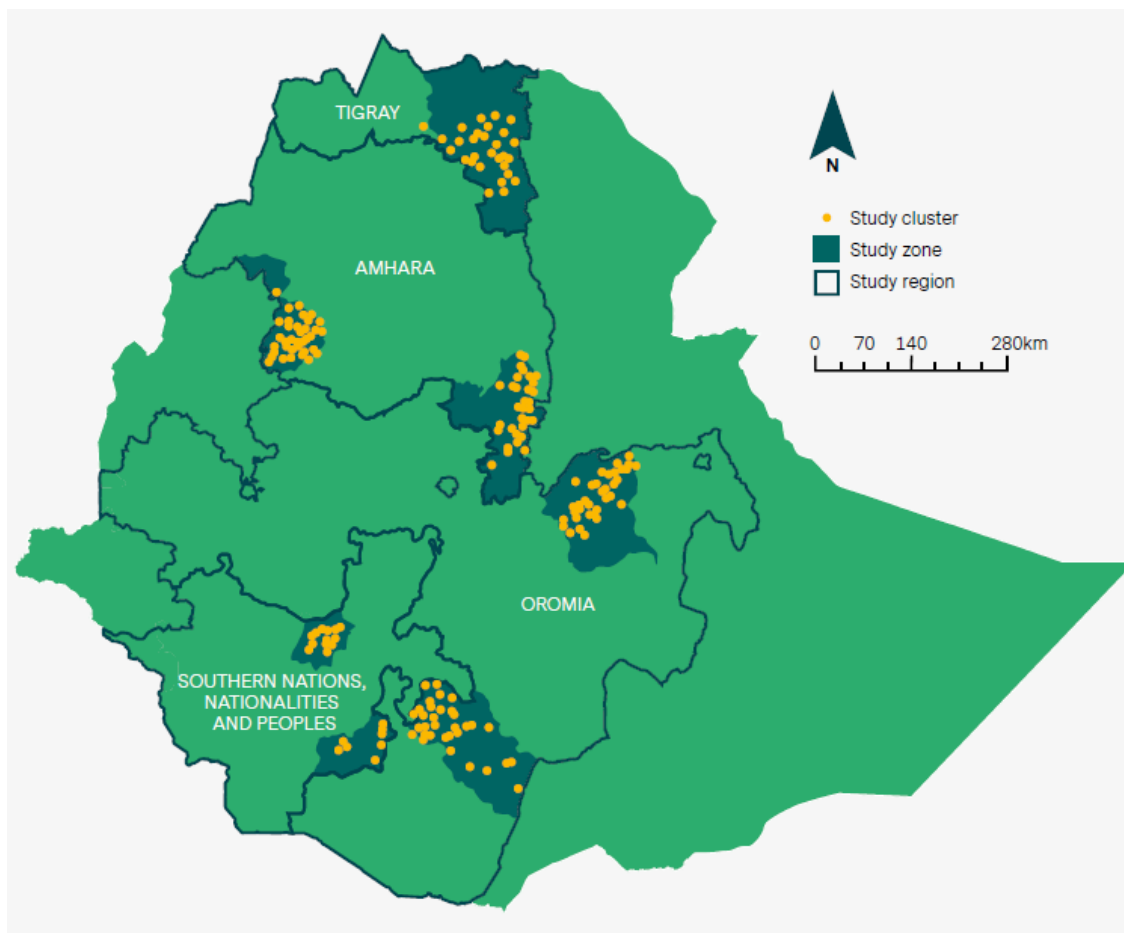
Primary data from the first Dagu survey (December 2016-February 2017) was used for this study. Dagu is a project working on developing Ethiopian excellence for public health evaluation: measurement, learning and evaluation of improved integrated community case management and community-based newborn care in Ethiopia.[44] Dagu survey was conducted with the specific aim of evaluating the effect of ‘optimizing the health extension program’ (OHEP): a project that is addressing the critical underutilization of community-based services, particularly the use of Integrated Community Case Management (ICCM) services and Community Based Newborn Care (CBNC) services in four regions of Ethiopia. Samples in this survey were representing intervention areas of the OHEP program which was implemented in all Woredas and primary health care units located within the four regions of Ethiopia.[48]

2.1 Study setting

With a population of 108 million, Ethiopia is the second most populous country on the African continent. The survey was carried out from December 2016 to February 2017 in optimizing the health extension program (OHEP) intervention areas namely, Tigray, Amhara, Oromia, and SNNP (see Figure 6). Ethiopia is a country comprising two administrative counsels and 9

regions. The regions are further subdivided into 62 zones and 523 districts/woredas.[61, 62] The four regions were selected for the OHEP program because they account for more than 85 percent of Ethiopia's total population.[63] A total of 46 woredas were included in the study. An estimated total population of 80 million people live in the study regions and over 6 million people reside in the selected woredas within the regions and out of this population, nearly a quarter are women of reproductive age with estimated 210,368 pregnancies annually.[7, 62] The study location map shows the enumeration areas and the study zones

Figure 5: Study location map



2.2 Study design

The Dagu survey was comprised of households, health care providers, health facilities and district administrators survey modules. The health facility/center module from the baseline survey was used to answer the questions of this study. The survey was performed in a

representative (of Woredas) sample of 194 enumeration areas (clusters) based on the 2007 Ethiopian housing and population census as a sampling frame. Clusters were selected with probability proportional to size from 46 districts (Woreda's) across four regions (Amhara, Oromia, Tigray, and SNNP). Health centers and staff providing services for under-five children serving the selected cluster were surveyed.

The health center survey used in this study comprised of information on overall facility level preparedness to provide and fulfil the health service needs of under-five children's in the regions. Existing large-scale survey tools such as the Demographic and Health Survey tools and safe motherhood survey tools were used to provide a basis for the questions and contents of survey modules.

2.3 Data collection

A total of 60 data collectors were recruited and grouped in to 15 data collection teams and each team consisted of two enumerators, one observer and one re-examiner. Data were collected by trained professionals (with a minimum requirement of completion of first degree), using a questionnaire with the aim of collecting information on overall facility-level preparedness to provide child health services and comprised of five sections: (1) background information of the health facility; (2) an inventory of equipment and supplies available and functioning on the day of survey; (3) an inventory of staff employed at the facility, and the training they received; (4) an interview with the in-charge of the facility about the services offered at that facility, and about recent supervision visits they had received; (5) data extraction from facility registers, including the numbers and outcomes of all child health services provided at the facility during the previous three months.

All data collectors were trained about interview, data collection techniques and study procedures. In addition, they also received a field manual, clinical guidelines, quality assurance procedures and ethics regarding the study. Pilot-testing was performed for all survey tools during field training. 175 health-center staff, which provided newborn and child health services, was interviewed from 155 health centers located across Amhara, Oromo, Tigray and SNNP regions. Participants responded to a question that certifies that the interviewer have read the health workers the informed consent form and confirms that they agreed to voluntarily participate in the

survey. Using a public domain software; Census and Survey Processing System (CSPPro) [64], all survey questioners were written on Toshiba Click 10 Lx5w-c-109 tablet computers and all questionnaires were translated to local language for all regions included in the study area. All interviews were held in field offices at the location of each health centers and interview was administered in person to each health center staff on site.

2.4 Instrumentation used from the data

The questionnaire focusing on health center staff which was developed from ICCM clinical guidelines was selected from the survey to answer the research questions of this study. The questions selected from the health center staff questionnaire were the ones that assess knowledge on six domain areas of newborn care: immediate newborn care, care for low birth weight newborns, feeding problems, bacterial infection, jaundice and diarrhea. The selected domain areas were based on the current causes of neonatal mortality in Ethiopia. The questionnaire included a letter of consent form letting participant know the purpose of the study, the procedure, confidentiality, and benefits of the study. A total of nineteen unprompted (participants were not provided with possible response options) question variables which were believed to assess the knowledge of health center staff on newborn care were selected from the questionnaire tool and categorized into six major themes. Appropriate responses mentioned by participants were coded as yes = 1 while code no = 0 was assigned for responses failed to be mentioned. For the purpose of this study the questionnaire variables were classified in to four sections.

Section -1 identifies the general socio-demographic characteristics of health center staff such as their age, qualification of occupational category, working experience and region. Some of the socio-demographic characteristics specifically, service years (experience) was used as independent variables for analysis.

Section -2 measures the health center staff knowledge about neonatal health. It includes unprompted questions (where health center staff were required to think and come up with the answers), on: the main components of immediate new born care, components of first post-natal care visit, special care for low birth weight newborns, feeding problems, signs for severe disease in newborns, bacterial infections with possible antibiotic treatment including their

contraindication, symptoms of severe jaundice and severe diarrhea in newborns. Every single question was treated as a single variable and used in the analysis.

Section -3 determines services provided by the study participants and in-service trainings received about newborn care. It identifies if participants provide antenatal and postnatal care services and if they received training updates in the topics of integrated management of pregnancy and childbirth, comprehensive emergency obstetric care, neonatal resuscitation, and newborn infection management. Received training was used as independent variable for analysis.

Section -4 asks about the working conditions in the health center by identifying the personal supervisions that participants received, and possible incentives or promotions received for the work they do. Technical support/supervision received by participants was used as an independent variable for analysis.

2.5 Dependent variables

Six composite themes were constructed from the selected health center staff questionnaire to measure levels of knowledge in six domains of neonatal care. Immediate new born care (components of immediate new born care, first and subsequent postnatal care visit); care for low birth weight newborns (care for neonates weighing less than 1.5 kg and between 1.5-2.5 kg); feeding problems (determining feeding problems in neonates and care for neonates with feeding problems); bacterial infection (identifying very severely diseased neonates, signs of local bacterial infection and its management); jaundice (main signs of jaundice, severe jaundice and initial steps to be taken); and diarrhea (main signs for dehydration caused by diarrhea and its management).

For each theme, crucial answers to the knowledge questions were identified and whether health center staff had adequate knowledge or not was rated for each of the themes, based on essential newborn practices derived from Integrated Community Case Management, Integrated Management of Newborn and Childhood Illness guidelines and the World Health Organization definition of essential newborn care (clean delivery and clean cord care, thermal protection, early and exclusive breastfeeding, initiation of breathing and resuscitation, eye care, immunization, care for low birth weight newborn, and management of newborn illnesses).[65-67]

Health center staffs were rated to have adequate knowledge if they mentioned the following steps:

For theme one: consists of two group variable groups: main components of immediate newborn care and first post-natal care. The first group variable contains 11 items, whereas the second one had 13 items under it. Respondents had to mention to assess breathing, tie and cut the cord appropriately, apply chlorhexidine on cord, dry and wrap the baby, immediate breastfeeding, skin to skin contact, apply tetracycline (TTC) eye ointment and delay cord clamping as components of immediate newborn care in order to be judged as having adequate knowledge. Outcome ranges from 0 for no correct answer and 8 for all correct answer. For components of first post-natal care visit for newborn, respondents were rated as having adequate knowledge if they listed check for danger signs, measure temperature, measure weight, vaccinate for polio and Bacillus Calmette–Guérin (BCG), encourage exclusive breast feeding, advice delay bathing for 24 hours, advice washing hands before touching baby, provide cord care and teach mother to recognize danger signs. For these groups, outcome ranges from 0 for no correct answer and 9 for all correct answers.

For theme two: two groups of variables (care for <1.5kg and for 1.5-2.5 kg) were included in these themes with each group variable containing 5 items. Health workers had to mention to urgently refer the mother to health center or hospital and hold close to mother together with any two of the other four options under special care for newborns that weigh less than 1.5 kg with a gestational age of less than 32 weeks. Answer ranged from 0 for no correct answer to 4 for all correct answers. For newborns that weigh between 1.5-2.5kg, interviewees had to mention any three of the five options. Answers ranged from 0 for no correct answer to 3 for all correct answer.

For theme three: feeding problem determination and initial steps for newborn with a feeding problem were treated as separate group variables, each containing 7 items. Respondents had to mention any four of the five possible signs for determining feeding problems and any four of the seven initial steps to take. For each group variables answer with a range of 0 for no correct answer and 4 for all correct answers were recorded.

For theme four: four different group variables were identified for theme four. Main signs for severe disease with seven items under it; initial steps for newborn with very severe disease

containing 6 items under it; main signs for local bacterial infection with 3 response items; initial steps for local bacterial infection management which had 6 items under it. Health center staff had to mention any five of the seven signs for very severe disease and a response range of 0 for not correct answer and 5 for all correct answers was recorded. Under initial steps, refer urgently had to be mentioned together with any three of the possible interventions (range 0 for no correct answer and 4 for all correct answer). For local bacterial infection, they had to mention any two of the three possible signs (range of 0 for no correct answer and 2 for all correct answers) and for managing bacterial infection they had to mention give Amoxicillin syrup for 5 days together with any two of the possible steps (range of 0 for no correct and 3 for all correct answers). Additionally, the variable assessing whether interviewees have the knowledge of possible side effect of using antibiotics for non-severe illness was presented under this theme.

For theme five: four group variables were included. Signs of jaundice (containing 2 items); initial steps when newborn presents with jaundice (5 items under it); signs for severe jaundice (4 items under it); initial steps when newborn presents with severe jaundice (containing 3 items). Participant had to mention any one of the possible answers for the main signs and symptoms of jaundice and severe jaundice (0 for no correct and 1 for correct answer). For the initial steps, they had to mention expose to sunshine 20 to 30 minutes every day, advice mother to keep the baby warm, follow up in two days and breastfeed more frequently (0 for no correct and 4 for all correct answer).

For theme six: four different group variables were included (see Table 7). Sunken eyes and skin pinch goes back slowly had to be mentioned for main signs of dehydration caused by diarrhea (0 for no correct answer and 2 for all correct answers). For the initial steps, give oral rehydration salt (ORS), zinc treatment and advice mother to breastfeed more frequently had to be mentioned (0 for no correct answer and 3 for all correct answer).

2.6 Independent variables

Three independent variables were recorded. Whether the health center staff received a technical support or supervision; whether they received training in integrated management of newborn and childhood illness (IMNCI); and finally, the length of period health center staff served (service years). The first two independent variables are dichotomous and were coded as 0 and 1. The third

variable (length of service period), was originally a continuous variable and for the purpose of analysis, the average of the values was taken as a cut of value and was dichotomized as <5years and >5years of service.

2.7 Data analysis

Obtained data was exported to IBM SPSS statistics version 25. With the primary aim of describing the overall knowledge of health center staff and exploring particular areas of weakness and strength, frequency tables were generated. The results of each question are presented as percentages and association between each individual knowledge variables in each of the main themes were explored with independent variables. In addition, association between each combined knowledge variables (separate themes) was explored. For each test of association, the level of significance was examined using a chi-square statistic test. Since multiple comparisons tends to increase the chances for finding significant variables [68], Bonferroni adjustment was applied to estimate levels of significance.

2.8 Ethical approval

Ethical approval was obtained from the Regional Committee for Medical and Health Research Ethics (REC) in Norway. Informed consent was obtained from all study participants for participating in Dagu survey. Approval to work on the data was also obtained from the Dagu data committee at Ethiopian Public Health Institute.

3 Result

3.1 Characteristics of respondents

Among a total of 175 health center staff in the sample, 42.9% are from Amhara region, 32.6% from Oromia, 9.7% from SNNPR, and 14.9% from Tigray region (Table 1). The largest proportion of respondents were between the ages of 20 and 30, and small proportions between the ages of 41 and 50 (6.3%) or over 51 years old (2.3%). The vast majority of respondents were nurses (75.4%). Midwives and urban health extension workers constituted the smallest proportion of respondents. More than half (53.1%) of the participants reported that they have received in-service training or training updates on topics related to newborn care, whilst 46.9% of the respondents reported they have not received any newborn care related trainings or updates.

Their years of service/experience ranged from 2 to 28 years; median 5 years [interquartile range: 3 – 6].

Table 1. Characteristics of participants

Characteristics		Frequency	Percent
Region	Amhara	75	42.9
	Oromia	57	32.6
	SNNPR	17	9.7
	Tigray	26	14.9
occupational category	Health officer	40	22.9
	Midwife	2	1.1
	Nurse	132	75.4
	Urban Health Extension Worker	1	0.6
Age	20 to 30	120	68.6
	31 to 40	40	22.9
	41 to 50	11	6.3
	51 and above	4	2.3
Service years	1 to 5 years	115	65.7
	6 to 10 years	50	28.6
	11 to 15 years	4	2.3
	16 and above	6	3.4
Received training on IMNCI	Yes	82	46.9
	No	93	53.1
Received supervision/technical support	yes	141	80.6
	no	34	19.4
Non monetary incentives received	Time off, vacations	53	30.8
	Uniform, backpacks, caps etc	62	36
	Training	44	25.6
	Subsidized housing	18	10.5
	Other	2	1.2
Non monetary incentives received	None	65	37.8
	Monthly or daily salary	89	51.1
	Per diem when attending training	61	35.1
	Duty allowance	135	77.6
	Payment for extra activities, not routinely provided	14	8
	Other	12	6.9
	None	15	8.6

3.2 Theme one - Immediate newborn care

Regarding unprompted knowledge of health center staff on components of immediate newborn care (Table 2), large proportion of the participants mentioned tie and cut cord appropriately (78%), dry and wrap baby (73%) and assess breathing (69%). However, only 4.6% of participants could mention the application of chlorhexidine on cord as immediate newborn care practice. While 50% of respondents listed four of the most important immediate newborn care components, only 12% of health workers were able to mention five of the eight most important components. Overall, none were found to have adequate knowledge on immediate newborn care components.

About 60% of health center staff mentioned encouraging mothers for exclusive breast feeding as a first post-natal care visit component. A small proportion (8%) mentioned check for congenital abnormalities and teach mother for danger signs (7%). On the other hand, 83 respondents knew that they have to vaccinate for polio and BCG, and check for danger signs on first post-natal care visit. Out of 175 health center staff, only 9 of them were able to list five of the nine crucial components of first post-natal care visit. 25% mentioned four, and 33% mentioned three out of nine crucial components. Similar to the knowledge of health center staff on contents of immediate newborn care, the general knowledge of health center staff on first post-natal care visit components was not adequate.

When comparing each knowledge variables independently for immediate newborn care, breathing assessment were found to be statistically significantly associated with training (47.5% no and 52.5% yes with p-value 0.024). The knowledge of giving vitamin K and measuring a weight of a newborn were found to be statistically significant with (22.5% no and 77.5% yes with p-value of 0.047) (27.4% no and 72.6% yes with p-value 0.011) respectively (table 4). Respondents with service year period of <5 years have statistically significant association with knowledge of TTC eye ointment application (23.5% >5yrs and 76.5% <5yrs with p-value 0.05). There was no statistically significant difference in the combined knowledge of immediate newborn care among respondents with training, supervision and service period years.

Table 2. Descriptive statistics and Chi-square tests of knowledge on components of immediate newborn care

Theme one: Immediate components of newborn care	Total n(%)	Training			supervision and technical support			Service years			
		No	Yes	P-val	No	Yes	P-val	>5	<5	P-val	
Components of immediate newborn care	Deliver baby onto mother's abdomen	94(53%)	51.1%	48.9%	0.553	39.4%	60.6%	0.913	29.8%	70.2%	0.177
	Dry and wrap baby	128(73%)	50.0%	50.0%	0.169	35.9%	64.1%	0.123	34.4%	65.6%	0.967
	Assess breathing	122(69%)	47.5%	52.5%	0.024	36.9%	63.1%	0.280	35.2%	64.8%	0.685
	Delay cord clamping for three minutes	52(29%)	48.1%	51.9%	0.383	30.8%	69.2%	0.226	28.8%	71.2%	0.324
	Tie and cut cord appropriately	138(78%)	48.6%	51.4%	0.019	37.0%	63.0%	0.813	34.1%	65.9%	0.902
	Skin to skin contact	64(36%)	50.0%	50.0%	0.527	37.5%	62.5%	0.703	28.1%	71.9%	0.192
	Initiate breastfeeding	50(28%)	62.0%	38.0%	0.138	38.0%	62.0%	0.911	40.0%	60.0%	0.314
	Apply TTC eye ointment	57(32%)	54.4%	45.6%	0.819	31.6%	68.4%	0.378	38.6%	61.4%	0.404
	Apply chlorhexidine on cord	8(4.6)	62.5%	37.5%	0.587	25.0%	75.0%	0.910	37.5%	62.5%	0.845
Give Vitamin K	40(22%)	62.5%	37.5%	0.177	22.5%	77.5%	0.047	37.5%	62.5%	0.626	
Weight baby	24(13%)	58.3%	41.7%	0.583	37.5%	62.5%	0.249	41.7%	58.3%	0.412	
Components of first post-natal care visit	Advice washing hands before touching baby	40(22%)	52.5%	47.5%	0.926	40.0%	60.0%	0.427	25.0%	75.0%	0.159
	Check for danger signs	80(45%)	51.3%	48.8%	0.645	36.3%	63.8%	0.742	27.5%	72.5%	0.083
	Check for congenital abnormalities	14(8%)	64.3%	35.7%	0.384	35.7%	64.3%	0.344	21.4%	78.6%	0.291
	Measure temperature	60(34%)	50.0%	50.0%	0.547	31.7%	68.3%	0.159	36.7%	63.3%	0.632
	Measure weight	62(35%)	53.2%	46.8%	0.987	27.4%	72.6%	0.011	33.9%	66.1%	0.932
	Apply TTC eye ointment	51(29%)	60.8%	39.2%	0.194	27.5%	72.5%	0.184	23.5%	76.5%	0.055
	Encourage exclusive breast feeding for baby	106(60%)	51.9%	48.1%	0.680	38.7%	61.3%	0.710	34.9%	65.1%	0.830
	Advice delay bathing 24 hrs	26(14%)	50.0%	50.0%	0.728	30.8%	69.2%	0.913	46.2%	53.8%	0.167
	Encourage skin to skin contact	26(14%)	57.7%	42.3%	0.614	23.1%	76.9%	0.263	34.6%	65.4%	0.969
	Provide cord care (Chlorhexidine)	40(22%)	47.5%	52.5%	0.415	30.0%	70.0%	0.727	42.5%	57.5%	0.213
	Education on appropriate cord care (Chlorhexidine)	22(12%)	54.5%	45.5%	0.888	45.5%	54.5%	0.658	22.7%	77.3%	0.222
	Vaccinate for polio and BCG	83(47%)	53.0%	47.0%	0.974	38.6%	61.4%	0.282	32.5%	67.5%	0.642
	Teach mother recognize danger signs, family health card	13(7%)	38.5%	61.5%	0.270	46.2%	53.8%	0.764	30.8%	69.2%	0.781
Group Chi-square test (p-value)				0.452			0.633			0.539	

3.3 Theme two - Low birth weight

Health center staff unprompted knowledge of special care for newborns weighing less than 1.5kg or less than 32 weeks of gestation was better than the previous two knowledge questions (Table 3). About 86% of participants mentioned to refer the low birth weight newborn with mother to health center or hospital and almost 50% of respondents listed to hold the newborn close to

mother. At least 14% of health center staffs were able to mention all the components of special care for low birth weight newborns. Overall, 70/175 (40%) were judged to have adequate knowledge about special cares for newborns who weigh less than 1.5 kg.

Table 3. Descriptive statistics and Chi-Square tests of knowledge regarding low birth weight

		Total n(%)	Training			Supervision and technical support			Service years		
			No	Yes	p-value	No	Yes	p-value	>5	<5	p-value
Theme two: low birth weight											
Special care for <1.5 kg baby	Continue feeding expressed breast milk	72(41%)	54.2%	45.8%	0.820	36.1%	63.9%	0.414	30.6%	69.4%	0.385
	Monitor ability to breastfeed	56(32%)	44.6%	55.4%	0.122	28.6%	71.4%	0.294	28.6%	71.4%	0.275
	Cover baby well including head	91(52%)	48.4%	51.6%	0.186	42.9%	57.1%	0.339	30.8%	69.2%	0.308
	Hold close to mother	84(48%)	44.0%	56.0%	0.021	35.7%	64.3%	0.615	33.3%	66.7%	0.799
	Refer urgently with mother to health center or hospital	150(85%)	56.0%	44.0%	0.064	36.0%	64.0%	0.737	36.7%	63.3%	0.104
Special care for b/n 1.5-2.5 kg baby	Make sure the baby is warm	140(80%)	50.7%	49.3%	0.198	36.4%	63.6%	0.854	32.9%	67.1%	0.426
	Educate on optimal breastfeeding	128(73%)	49.2%	50.8%	0.086	34.4%	65.6%	0.525	35.2%	64.8%	0.689
	Monitor the ability to breastfeed	110(62%)	51.8%	48.2%	0.648	37.3%	62.7%	0.287	36.4%	63.6%	0.451
	Monitor baby for the first 24 hours	38(21%)	47.4%	52.6%	0.420	34.2%	65.8%	0.081	28.9%	71.1%	0.433
	Educate on infection prevention	30(17%)	56.7%	43.3%	0.671	36.7%	63.3%	0.640	20.0%	80.0%	0.070
Group Chi-square test (p-value)					0.037			0.740			0.332

Regarding unprompted knowledge of special care for newborns weighing between 1.5 to 2.5 kg or with a gestational age of 32 to <37, vast majority of respondents mentioned making sure the baby is warm (87%), educating mother on optimal breast feeding (79%), and monitoring the ability of newborn to breastfeed(68%). However, less than 42% of respondents could mention monitoring baby for the first 24 hours and only 18% of them could mention to educate mother on infection prevention. Very few (4%) respondent listed all special care components. On the other hand, 8% of respondents failed to mention at least one component of special care and 10% mentioned only one component. Overall, 98/175 (55%) of health center staff were judged to have adequate knowledge on special care for newborns weighing between 1.5 to 2.5kg.

When comparing low birth weight care component variables each, independently, a statistically significant association was found between respondents who mentioned to hold newborn close to mother and who received training (44.0% n0 and 56.0%yes with p-value of 0.021). A statistically significant difference with a p-value of 0.037 was found in the combined knowledge variables between health center staff who had received training and not.

3.4 Theme three – Newborn feeding problems

Health center staff unprompted knowledge of thrush as a sign of feeding problem was rather low, with only 6% of respondents able to mention it (Table 3). Over 70% of respondents mentioned the newborn as not being able to suckle properly as a sign of feeding problem. Additionally, not well attached to breast was mentioned by 57% of respondents. Less than a quarter of respondents could mention at least three feeding problem signs. Just about 40/175 (22%) were judged to have adequate knowledge on determining feeding problems in newborns.

Table 4. Descriptive statistics and Chi-Square tests of knowledge regarding newborns feeding problem

		Total n(%)	Training			Supervision and technical support			Service years		
			No	Yes	p-value	No	Yes	p-value	>5	<5	p-value
Theme three: newborns feeding problem											
How do you determine feeding problem	Not well attached to breast	99(56%)	53.5%	46.5%	0.905	36.4%	63.6%	0.995	34.3%	65.7%	0.985
	Not suckling effectively	133(76%)	52.6%	47.4%	0.809	33.1%	66.9%	0.139	32.3%	67.7%	0.332
	Less than 8 breastfeeds in 24 hours	70(40%)	58.6%	41.4%	0.240	31.4%	68.6%	0.413	31.4%	68.6%	0.516
	Switching to another breast before one is emptied	39(22%)	53.8%	46.2%	0.920	23.1%	76.9%	0.198	25.6%	74.4%	0.197
	Receives other foods or drinks (even	30(17%)	50.0%	50.0%	0.705	40.0%	60.0%	0.208	33.3%	66.7%	0.904
	Underweight for age	72(41%)	51.4%	48.6%	0.697	43.1%	56.9%	0.349	36.1%	63.9%	0.671
	Thrush (ulcers or white patches in	11(6%)	45.5%	54.5%	0.598	54.5%	45.5%	0.261	27.3%	72.7%	0.613
Initial steps for feeding problem	Advise mother to breastfeed as often and as long as infant	109(62%)	55.0%	45.0%	0.517	38.5%	61.5%	0.622	33.9%	66.1%	0.906
	Teach mother correct positioning and attachment	126(72%)	47.6%	52.4%	0.019	36.5%	63.5%	0.718	31.0%	69.0%	0.136
	Educate on exclusive breastfeeding	106(60%)	48.1%	51.9%	0.098	36.8%	63.2%	0.264	40.6%	59.4%	0.030
	Teach the mother to treat thrush at	30(17%)	46.7%	53.3%	0.435	26.7%	73.3%	0.698	33.3%	66.7%	0.904
	Follow-up any feeding problem	50(28)	48.0%	52.0%	0.389	36.0%	64.0%	0.271	30.0%	70.0%	0.450
	Follow-up any thrush in two days	22(12%)	54.5%	45.5%	0.888	36.4%	63.6%	0.825	27.3%	72.7%	0.459
	Follow-up under weight for age in 14	13(7%)	53.8%	46.2%	0.958	30.8%	69.2%	0.516	23.1%	76.9%	0.376
Group Chi-square test (p-value)					0.652	0.384			0.538		

Over 70% of health center staff mentioned teaching mothers about correct positioning and attachment of newborn as initial step to take when feeding problems were detected. A low proportion of respondents mentioned to follow-up under-weight for age newborns in 14 days (8%) and to follow-up any thrush in two days (13%). On the other hand, a large proportion of respondents mentioned to educate mothers on exclusive breastfeeding (66%) and to advise mothers to nurse as often and as long as the newborn desires (68%). Less than 11% of respondents could name at least five initial steps out of seven possible responses. About 38/175

(21%) of respondents were judged to have adequate knowledge on measures to be taken when newborns presented with feeding problem.

Statistically significant differences were observed in only two of the single knowledge variables: respondents who mentioned correct positioning and attachment with the ones who received training (47.6 no and 52.4% yes p-value 0.019) and between respondents who mentioned education on exclusive breastfeeding and served <5yrs (40.6% >5yrs and 59.4% <5yrs with p-value 0.030). There was no statistically significant difference between the combined knowledge variables and independent variables.

3.5 Theme four – Severe disease and bacterial infection

Over half of the respondents mentioned convulsion, fast breathing, and a temperature of 37.5 degree Celsius or above as possible signs of severe disease in newborns (Table 5). Nearly 75% of the respondents also mentioned significantly reduced or stopped feeding as severe disease sign. Only one respondent was able to mention six out of the seven possible signs of severe disease. However, 65/175 (37%) of respondents correctly mentioned over four of the possible correct signs therefore judged as having adequate knowledge of identifying signs of severe disease in newborns.

Urgently referring neonates to the hospital was recorded as the highest response (85%) among other possible initial steps. Almost 60% of health center staff also mentioned to begin a dose of gentamycin before referral. Treatment of severe disease with amoxicillin when referral is not possible was mentioned by smallest proportion (8%) of respondents. Overall, 146/175 (86%) were judged to have adequate knowledge on initial steps to take when presented with severely diseased newborn.

Table 5. Descriptive statistic and Chi-Square tests of knowledge regarding severe disease and bacterial infection

		Training			Supervision and technical support			Service years			
		Total n(%)	No	Yes	p-value	No	Yes	p-value	>5	<5	p-value
Theme four: severe disease and bacterial infection											
Main signs for very severe disease	Convulsions	100(57%)	50.0%	50.0%	0.336	33.0%	67.0%	0.836	29.0%	71.0%	0.089
	Stopped feeding or significantly reduced feeding	121(69%)	51.2%	48.8%	0.450	33.1%	66.9%	0.486	33.9%	66.1%	0.867
	Severe chest indrawing	68(38)	67.6%	32.4%	0.002	33.8%	66.2%	0.376	33.8%	66.2%	0.918
	Fast breathing	102(58)	57.8%	42.2%	0.141	35.3%	64.7%	0.062	36.3%	63.7%	0.512
	Temperature 37.5 or more	93(53%)	52.7%	47.3%	0.898	36.6%	63.4%	0.779	36.6%	63.4%	0.500
	Temperature less than 35.5	30(17%)	46.7%	53.3%	0.435	46.7%	53.3%	0.125	36.7%	63.3%	0.763
	No or very limited movement on stimulation	44(25%)	54.5%	45.5%	0.829	29.5%	70.5%	0.320	38.6%	61.4%	0.482
Initial steps for very severe disease	Continue to breastfeed or if impossible expressed breastmilk	48(27%)	56.3%	43.8%	0.613	31.3%	68.8%	0.845	25.0%	75.0%	0.112
	Begin a dose of amoxicillin pre-referral	79(45%)	58.2%	41.8%	0.221	29.1%	70.9%	0.445	36.7%	63.3%	0.540
	Begin a dose of gentamycin pre-referral	101(57%)	55.4%	44.6%	0.476	38.6%	61.4%	0.638	31.7%	68.3%	0.397
	Refer urgently	146(83%)	53.4%	46.6%	0.867	38.4%	61.6%	0.771	34.9%	65.1%	0.686
	When referral is not possible treat with amoxicillin 7 days	14(8%)	85.7%	14.3%	0.011	28.6%	71.4%	0.446	35.7%	64.3%	0.907
	When referral is not possible treat with gentamycin 7 days	22(12%)	54.5%	45.5%	0.888	59.1%	40.9%	0.000	45.5%	54.5%	0.238
Main signs for local bacterial infection	Umbilicus red	121(69%)	51.2%	48.8%	0.540	33.9%	66.1%	0.643	32.2%	67.8%	0.391
	Umbilicus draing pus	116(66%)	50.9%	49.1%	0.397	33.6%	66.4%	0.505	32.8%	67.2%	0.551
	Skin pustules	101(57%)	46.5%	53.5%	0.041	32.7%	67.3%	0.417	32.7%	67.3%	0.600
Initial steps for local bacterial infect	Give amoxicillin syrup for 5 days	153(87%)	52.9%	47.1%	0.888	35.9%	64.1%	0.623	33.3%	66.7%	0.484
	Follow-up care on 2nd day from initial visit	46(26%)	60.9%	39.1%	0.221	28.3%	71.7%	0.652	30.4%	69.6%	0.522
	Advice mother when to return	51(29)	58.8%	41.2%	0.334	31.4%	68.6%	0.154	43.1%	56.9%	0.114
	Breast feed more frequently	59(33%)	61.0%	39.0%	0.137	33.9%	66.1%	0.369	30.5%	69.5%	0.453
	Advice mother to give breast milk more frequently	35(20%)	48.6%	51.4%	0.545	22.9%	77.1%	0.398	28.6%	71.4%	0.426
	Advice mother to keep baby worm	16(9%)	56.3%	43.8%	0.794	37.5%	62.5%	0.278	37.5%	62.5%	0.776
Is there side effect of antibiotic	Side effects of using antibiotics for non severe disease	76(43%)	43.4%	56.6%	0.024	38.2%	61.8%	0.220	36.8%	63.2%	0.532
	What is the side effects of using antibiotics for non severe disease	54(30%)	37.0%	63.0%	0.079	35.2%	64.8%	0.115	35.2%	64.8%	0.639
Group Chi-square test (p-value)					0.024			0.164			0.854

Only 84% of respondents were able to mention at least one local bacterial infection sign in newborns. Out of those, 81% mentioned umbilical redness and 78% mentioned umbilicus

draining pus. Just about 118/175 (67%) of participants were judged to have adequate knowledge on the topic. For the question addressing initial steps to be taken for management of local bacterial infection, over 90% of respondents were able to mention at least one of the measures to be taken. Higher proportion of respondents (96%) mentioned to give amoxicillin syrup for five days and a smaller proportion (10%) listed advice mother to keep baby warm as initial step. Overall, 88/175 (50%) of health center staff were judged to have adequate knowledge on management of local bacterial infection.

Only 43% of health center staff were able to mention that there is a possible side effect of using antibiotics (injectable gentamicin or amoxicillin) for non-severe neonatal illness, out of which, 71% mentioned the side effect as being drug resistance.

Statistically significant differences were found between training and respondents knowing there is a side effect of using antibiotics for non-severe disease (43.4% yes and 56.6% with p-value 0.024); mentioning severe chest indrawing as a sign of severe disease (67.6% no and 32.4% with p-value 0.002); knowing to treat cases with amoxicillin for seven days when referral is not possible (85.7% no and 14.3% yes with p-value 0.011); mentioning skin pustules (46.5% no and 53.5% yes with p-value 0.041). A statistically significant difference with a p-value of 0.024 was recorded between training and combined severe disease and bacterial infection knowledge.

3.6 Theme five - Jaundice

In general, 90% of the respondents mentioned at least one of the two signs of jaundice and out of those, 81% mentioned yellow skin and 84% mentioned yellow eyes (Table 6). Large proportions of respondents (90%) were judged to have adequate knowledge of signs of jaundice in newborns. Over 70% of health center staff mentioned to breastfeed more frequently as an initial step when signs of jaundice present. About 22% were able to mention to follow up the newborn with jaundice in two days. A little over 2% of the respondents mentioned all four critical components of care for jaundice therefore, judged as having adequate knowledge.

Table 6. Descriptive statistics and Chi-Square tests of knowledge regarding jaundice

		Total n(%)	Training			Supervision and technical support			Service years		
			No	Yes	p-value	No	Yes	p-value	>5	<5	p-value
Theme five: Jaundice											
Main signs of jaundice	Yellow skin	129(73%)	49.6%	50.4%	0.117	36.4%	63.6%	0.407	33.3%	66.7%	0.657
	Yellow eyes	135(77%)	52.6%	47.4%	0.789	32.6%	67.4%	0.268	31.1%	68.9%	0.104
Initial steps for signs of jaundice	Breastfeed more frequently	71(40%)	53.5%	46.5%	0.934	43.7%	56.3%	0.104	26.8%	73.2%	0.083
	Advice the mother to keep the baby warm	54(30%)	46.3%	53.7%	0.225	44.4%	55.6%	0.131	27.8%	72.2%	0.226
	Expose to sunshine 20 to 30 minutes every day	27(15%)	63.0%	37.0%	0.266	33.3%	66.7%	0.156	22.2%	77.8%	0.151
	Advice the mother to return if jaundice	22(12%)	63.6%	36.4%	0.291	31.8%	68.2%	0.716	18.2%	81.8%	0.089
	Follow-up in 2 days	21(12%)	61.9%	38.1%	0.391	19.0%	81.0%	0.430	14.3%	85.7%	0.040
main signs of severe jaundice	Jaundice in newborns of age 14 days or more	40(22%)	55.0%	45.0%	0.789	42.5%	57.5%	0.654	20.0%	80.0%	0.030
	Jaundice in newborns of age less than 24 hours	22(12%)	45.5%	54.5%	0.440	36.4%	63.6%	0.330	13.6%	86.4%	0.029
	Palms yellow	109(62%)	54.1%	45.9%	0.737	34.9%	65.1%	0.642	26.6%	73.4%	0.006
	Soles yellow	94(53%)	52.1%	47.9%	0.772	34.0%	66.0%	0.550	30.9%	69.1%	0.302
Initial steps for severe jaundice	Breastfeed more frequently	52(29%)	51.9%	48.1%	0.833	36.5%	63.5%	0.123	23.1%	76.9%	0.042
	Refer urgently hospital	146(83%)	53.4%	46.6%	0.867	36.3%	63.7%	0.871	30.1%	69.9%	0.009
	Keep the baby warm	29(16%)	55.2%	44.8%	0.810	41.4%	58.6%	0.426	27.6%	72.4%	0.405
Group Chi-square test (p-value)					0.690			0.397			0.002

As main signs of severe jaundice in newborns of age less than 24 hours and age 14 days or more, 62% percent of respondents mentioned yellow palms and 53% mentioned yellow soles. Nearly 30% of participants mentioned breastfeeding more frequently as initial step for severe jaundice and 83% mentioned to refer the newborn urgently to hospital. On the other hand, a small proportion (16%) of respondents mentioned to keep the baby warm.

There was statistically significant (p-value 0.002) difference between combined knowledge of health center staff regarding jaundice and the length of service years. Looking at each jaundice knowledge variables independently, statistically significant difference was found: between service years and knowledge of urgent referral (30.1% >5 years and 69.9% <5years with p-value 0.009); between service years and mentioning yellow palms as sign of jaundice(26.6% >5 years and 73.4% <5years with p-value 0.006); between service years and mentioning more breastfeeding as initial step(23.1% >5 years and 76.9% <5years with p-value 0.042); between service years and mentioning to follow-up newborns with signs of jaundice in two days (14.3% >5 years and 85.7% <5years with p-value 0.040).

3.7 Theme six – Dehydration and diarrhea

Over 86% of health center staff knew to recognize sunken eyes as a sign of dehydration caused by diarrhea and 86% mention a skin pinch to go back slowly as a sign (Table 7). Over half (56%) of the respondents listed restlessness and irritability as additional sign of dehydration. Just about 125/175 (71%) mentioned both critical signs of diarrhea and were judged as having adequate knowledge. Almost all respondents knew to give Oral Rehydration Salt (ORS) fluid as an initial step for dehydration caused by diarrhea. A large proportion (76%) mentioned to give zinc treatment for ten days. Only a small proportion of respondents mentioned to keep the baby warm (8%) and to follow up in two days (19%). Less than half of respondents (40.6%) had adequate knowledge about initial steps to be taken when newborn presents with dehydration caused by diarrhea.

As a sign of severe dehydration, limited number of movement (56%), sunken eyes (88%), and skin pinch going back very slowly (93%) were mentioned. As initial steps for severe dehydration, ensuring the mother gives the child ORS on the way to hospital was mentioned by 58% of respondents and referring urgently to hospital was listed by 68% of participants. None of the participants were able to mention all four critical components of initial steps to be taken for dehydration.

Supervision and support had statistically significant association with knowledge of mentioning sunken eyes as a sign of severe dehydration (37.3% no and 62.7% yes with P-value 0.026) and knowledge of urgently referring newborns to hospital (36.1% no and 63.9% yes with P-value 0.024) as initial step to take. Additionally, statistically significant difference was found between length of service years and advising mother to breastfeed more frequently and longer as initial steps to be taken for dehydration (26.4% >5 years and 73.6% <5years with P-value 0.022), between service years and mentioning to give zinc treatment for ten days (30.1% >5 years and 69.9% <5years with P-value 0.037). Overall, there was no statistically significant difference between combined knowledge and all three independent variables.

Table 7. Descriptive statistics and Chi-Square tests of knowledge regarding dehydration caused by diarrhea

Theme six: dehydration and diarrhea	Total n(%)	Training			Supervision and technical support			Service years			
		No	Yes	p-value	No	Yes	p-value	>5	<5	p-value	
Signs for some dehydration caused by diarrhea	Restless and irritable	97(55%)	53.6%	46.4%	0.891	40.2%	59.8%	0.590	32.0%	68.0%	0.470
	Sunken eyes	149(85%)	53.0%	47.0%	0.938	35.6%	64.4%	0.416	33.6%	66.4%	0.627
	Skin pinch goes back slowly	147(84%)	51.7%	48.3%	0.381	35.4%	64.6%	0.893	32.0%	68.0%	0.140
Initial steps for dehydration caused by diarrhea	Give ORS fluids	172 (98%)	52.9%	47.1%	0.636	36.6%	63.4%	0.164	33.7%	66.3%	0.233
	Give zinc treatment for 10 days	133(76%)	50.4%	49.6%	0.192	37.6%	62.4%	0.195	30.1%	69.9%	0.037
	Advise mother to breastfeed more frequently and longer	91(52%)	48.4%	51.6%	0.186	37.4%	62.6%	0.777	26.4%	73.6%	0.022
	Keep the infant warm	15(8%)	53.3%	46.7%	0.988	26.7%	73.3%	0.765	40.0%	60.0%	0.626
	Advise the mother when to return	43(24%)	46.5%	53.5%	0.316	34.9%	65.1%	0.779	32.6%	67.4%	0.783
	Follow up in 2 days	33(18%)	60.6%	39.4%	0.340	42.4%	57.6%	0.291	27.3%	72.7%	0.346
Signs of severe dehydration	Limited of no movement even when stimulated	96(54%)	51.0%	49.0%	0.539	38.5%	61.5%	0.515	28.1%	71.9%	0.058
	Sunken eyes	150(85%)	51.3%	48.7%	0.240	37.3%	62.7%	0.026	32.0%	68.0%	0.119
	Skin pinch goes back VERY slowly	159(90%)	51.6%	48.4%	0.189	37.1%	62.9%	0.317	32.1%	67.9%	0.052
Initial steps for severe dehydration	Give first dose of amoxicillin syrup	33(18%)	57.6%	42.4%	0.571	18.2%	81.8%	0.094	36.4%	63.6%	0.780
	Give first dose of IM Gentamycin	33(18%)	54.5%	45.5%	0.858	18.2%	81.8%	0.148	30.3%	69.7%	0.593
	Refer urgently to hospital	108(63%)	54.6%	45.4%	0.617	36.1%	63.9%	0.024	34.3%	65.7%	0.993
	Ensure mother gives child ORS on the way hospital	93(53%)	49.5%	50.5%	0.299	35.5%	64.5%	0.548	28.0%	72.0%	0.060
	Advise mother to breastfeed more frequently and longer	47(26%)	55.3%	44.7%	0.727	27.7%	72.3%	0.355	29.8%	70.2%	0.447
	Advise mother to keep young infant warm	10(5%)	70.0%	30.0%	0.271	40.0%	60.0%	0.514	40.0%	60.0%	0.695
Group Chi-square test (p-value)					0.888	0.309			0.162		

4 Discussion

The neonatal period is the most crucial period in the life of an infant for further growth and development, and it is largely determined by the quality of care that the newborn receives.[69] In this thesis study, an effort has been made to assess neonatal care knowledge of health centre staff in health centers of Amhara, Oromia, Tigray, and SNNPR regions, Ethiopia.

The most striking findings were the general low level of knowledge among health centre staff regarding immediate newborn care, identifying and caring for newborns with feeding problems, whereby none of the health centre staff and fewer than 25% of health centre staff were considered to have adequate knowledge on components of immediate newborn care and

components of newborn feeding problems respectively. Clean cord care is crucial in preventing early neonatal infections. This study revealed that only 4.6% of participants knew chlorhexidine application on cord as immediate newborn care and this result is in line with a Murphy, G.A., et al [70] where only 14% of nurses knew that chlorhexidine as a recommended cord cleaning solution. Knowing the exact timing of clamping and cutting the umbilical cord is important and there are several potential benefits[71]. This study findings show that only 29% of the study participants knew the cord clamping time to be 3 minutes. This is lower compared to Bereka, B., et al [72] and Lulu Makene, C., et al [73] But this study was consistent with another study conducted in Vietnam [74]. A large knowledge gap was observed in the participants knowledge of components of immediate newborn care, especially, in the knowledge of chlorhexidine application on cord (mentioned only by 4.6%); weighing the baby which was mentioned only by 13% of participants; giving vitamin K which was mentioned by 22%; initiating breastfeeding which got mentioned by 28%; and to delay cord clamping for three minutes which was mentioned by 29% of health centre staff. The low level of knowledge (28%) on breastfeeding initiation in this study is lower than the study conducted in eastern Tigray Ethiopia which was 91.5% [75] and Uganda which was 86.4% [76]. The difference might be due to the qualification of participants in the Ugandan study whereby only nurses and midwives were assessed, and the availability of comprehensive in-service training provided to them. A gap in immediate breastfeeding knowledge implies that mothers immediately after birth may not receive important information about breastfeeding and lower level of immediate newborn care knowledge implies that newborns might not receive the desired care during the most crucial period of their life and. This may partly explain why the regions have high neonatal mortality and are struggling to reduce newborn mortality. Another study that examined the knowledge of Pakistani health workers regarding maternal and newborn health found low level of knowledge among health workers [77]. The authors of the Pakistani study suggested periodic training needs assessment for health workers to be able to introduce appropriate training interventions. A similar recommendation can be adopted in the case of the four regions included in this study.

The study findings revealed that only 13% of respondents knew to weigh the baby. This is in line with a similar study conducted in Kenya [70] where the authors found unexpected low level of knowledge. The study findings also revealed that only 22% of the health centre staff knew to give vitamin k for newborns immediately after birth. Contrary to this, in the study conducted in

Kenya [70] over 90% of nurses knew to give vitamin k. This could likely be due to a difference in facility setting where availability of Vitamin k is limited. However this result is in consistent when compared with the results of studies conducted in Jimma [72], Uganda [76] and Egypt [69].

The test of association conducted per each single knowledge variable revealed that there was statistically significant association between respondents who received training on topics related to newborn care and knowledge of assessment of breathing (p-value 0.024), between receiving training and to tie and cut cord appropriately (p-value 0.019) as immediate newborn care component. Supervision and technical support were found to be helpful in knowing giving vitamin k (p-value 0.047) and measuring weight (p-value 0.010) as immediate newborn care component. However, when knowledge variables were combined, the availability of supervision and technical support, training and length of service years did not show any significant difference in knowledge levels. This raises a fundamental concern on the quality of training provided and contents of supervision visits. Given no difference in the level of knowledge between the different categories of service years, the results demonstrate that a longer period of service does not necessarily provide a better knowledge regarding immediate newborn care. Contrary to the findings in this study, a study conducted in Jimma Zone, Ethiopia reported that nurses and midwives working at health centers who received training had a good knowledge of essential newborn care.[72] This discrepancy could be due to the difference in study participants in which only nurses and midwives participated in the Jimma study and this study included health officers and health extension workers.

Just about 40% of health centre staffs were considered to have adequate knowledge in special care for babies with a low birthweight. This is lower than Berhe, A.K., et al (75.6) [75] and Ayiasi, R.M., et al 71%.[76] This difference might be due to the participants professional qualification participated in the other two studies. This low proportion was attributable to lower proportion of health center staff that could correctly mention monitor ability to breastfeed (32%) and continue feeding expressed breast milk (41%). Just over half of health center staffs were rated to have adequate knowledge in special care for newborns weighing between 1.5-2.5kg. This low proportion was attributable to smaller proportions of health centre staff that could correctly mention monitor baby for the first 24 hours (21%) and educate mothers on infection

prevention (17%). Low levels of low birth weight care knowledge among health center staff implies that prematurely born and underweight babies are likely to receive incomplete and low quality of care and hence leaving them vulnerable to hypothermia, infections and poor breastfeeding habits Therefore, increasing the chances of dying from preventable causes.[78, 79]

There were differences in the level of knowledge between participants who received training and those who did not. Health center staff who received training had better knowledge level of care for low birth weight newborns. This result is in consistent with Bereka, B., F et al [72]. On the other hand, no difference in knowledge was observed for respondents in different groups of service years and who received technical support and supervision.

Less than half of the health center staffs were assessed to have adequate knowledge in identifying the signs of severe disease. On the opposite side, 86% of respondents were rated to have adequate knowledge in mentioning steps to take when newborn presents with severe disease. This raises a controversial point, indicating there is more than 50% chance of a health center staff missing the severe disease signs in newborns. It is understood that early detection of severe disease and infection based on common clinical signs, are highly critical for prompt initiation of therapy especially in rural areas, where resources are constrained and precise laboratory technologies are often missing.[80]

Surprisingly, health centre staff who had not received training in neonatal care had better knowledge in identifying and stabilizing newborns with very severe disease and local bacterial infection. In part, this could be explained by lower quality of training or training which took place long time ago. Higher level of knowledge was expected among participants who received training. However, health center staff who received technical support and supervision had better knowledge in mentioning treatment of newborn with gentamycin for seven days to treat very severe disease. This ambiguous finding may relate to in-service training components or supervision aspects not explored in this thesis.

There is a gaping lag of knowledge regarding care for newborns presenting with jaundice with only 2% of health center staff rated to have adequate knowledge. This low proportion was attributable to lower proportions of health centre staff that could correctly mention expose to sunshine 20 to 30 minutes every day (15%), advice the mother to return if jaundice aggravates (12%), and follow up in two days (12%). On the contrary, 90% of health centre staffs were

assessed to have adequate knowledge in identification of signs of jaundice. Low level of jaundice knowledge implies that there might be a higher risk of undertreatment. Especially if jaundice is associated with other findings, it might lead to a serious illness which puts the newborn at significant risk of dying.

There were differences in the level of knowledge between the two service year groups of health centre staff. Surprisingly, higher level of knowledge regarding jaundice was among health center staff who had served below 5 years. Higher level of knowledge was expected among respondents who had served for 6 years or higher. Contrarywise, health centre staff with fewer years of service could be more knowledgeable since their education or training was more recent than the ones who have served for six years or higher. A similar study carried out in Uganda to assess primary health center knowledge related to immediate newborn care found higher level of knowledge among health workers who had fewer years of service. [76]

Only 37% of health center staffs were assessed to have adequate knowledge in identification and management of severe disease and bacterial infection in newborns. This low level of knowledge is similar in a study in Uganda [76] where knowledge regarding infection management was found to be very low with only 7.1% of participants rated to have adequate knowledge. Less than a quarter of participants knew a temperature less than 35.5 as a sign of severe disease and over 60% of respondents failed to mention severe chest indrawing. This result is consistent with that of Jimma. [72] The least recorded responses were to treat newborns with severe disease with amoxicillin and gentamycin when referral to hospital is not possible. Generally, statistically significant difference (p-value 0.024) was observed among respondents who received training when knowledge variables were combined. Surprisingly, the knowledge level was higher among participants who did not receive training. It was expected that health center staff who received training will have a better knowledge.

A large knowledge gap was observed in participant's knowledge regarding identification and management of newborns with feeding problem. Over 75% of participants failed to mention all critical signs of feeding problem and important measures that need to be taken. None of the combined knowledge variables were found to be associated with training, supervision and length of service years. This implies that when health center staffs come in contact with newborn having feeding problem, they might fail to recognize and miss the signs. Additionally, mothers

might not receive the most important formation pertaining feeding problems which compromises the care received by the newborn leading to severe morbidity and mortality.

Health centre staffs were assessed to have a better knowledge regarding identification of jaundice where more than 70% of participants knew yellow skin and yellow eyes as the main signs. This result is higher when compared to a study in Jimma [72] where only 28% mentioned yellow palms and soles. This could be due to a different case load of health centers or a knowledge difference. On the contrary, health centre staff knowledge regarding care for newborns presented with jaundice was very low. This study reveals that only 15% of respondents knew to expose newborn to sunshine 20 to 30 minutes every day, 12% to follow up in two days and only 12% knew to advise mother to return if signs of jaundice aggravates.

Knowledge of health center staff on signs of dehydration caused by diarrhea is very crucial for the survival and wellbeing of the newborns. However, study revealed that, participants have a low knowledge of management of severe dehydration. Though almost all participants knew to give ORS fluid for a newborn suffering from dehydration, only 40% of participants mentioned all crucial initial steps for managing dehydration. On the other hand, this study revealed that participants had a better knowledge on identification of the danger signs where 85% of them knew sunken eyes and skin pinch going back slowly (84%). This result is relatable to the study in Jimma [72] where health workers knowledge of newborn danger signs was low. The low knowledge of dehydration management implies that sick newborn may not receive the proper treatment and newborns might be more prone to major infections which could increase the duration of the illness and lead to fatality.

Participants who received supervision and technical support had a better knowledge in identifying sunken eye as a sign of dehydration and referring the newborn urgently to hospital as a step to be taken. However, when knowledge variables were combined no association was found between participants who received training and supervision with the ones who did not. In addition, the length of service year did not affect the knowledge of participants regarding dehydration. This is in contrary to the study done in Jimma [72], where in service training significantly associated with better knowledge.

Overall, this study shows that there is a large knowledge gap among health center staff regarding immediate newborn care, first post-natal visit care, low birth weight care, identification and

management of feeding problems, and identification and stabilization of newborns with severe disease, jaundice and dehydration caused by diarrhea. This indicates that, the health center staffs are operating on a low level of neonatal care knowledge, further indicating that the health care system does not provide the required standard of care for the sick and vulnerable newborns. This low level of knowledge presents a major challenge to neonatal mortality reduction in Ethiopia and compromises a standard of care. Therefore, it should be considered an important concern for the health care system in Ethiopia. An effort should be made to update health centre staff knowledge on recommended newborn care practices.

The main limitation of the study is related to the study design and sampling method of the participants. Because of the design of the questionnaire tools, calculation of total scores of knowledge was not possible. Since participants were asked unprompted questions, they were required to think and come up with the answers themselves, which might have affected the responses and therefore yielding a low level of knowledge. If respondents were offered the response options in the form of choice, the level of knowledge might turn out to be different than what it is now. Comparison of level of knowledge across regions and participants occupation was not possible, because the samples were not statistically representative of the regions. Rather, samples represented the woredas. This study did not specifically assess factors such as, level of qualification, interest to work, number of in-service training, and the use of available guidelines and materials, that could have influenced health centre staff level of knowledge.

The low level of health centre staff knowledge in immediate newborn care, may pose a major challenge to provide effective, safe, quality of newborn care and underlines the urgent need for intensified training. Increasing the frequency and quality of training together with demand driven technical support and improved supervision should be considered to ensure high quality of neonatal care and favorable neonatal outcomes. Furthermore, for health centre staffs to remain informed on neonatal health care topics and update their knowledge, continuous refresher courses and retraining should be provided. Furthermore, accreditation should not only be done when health care workers leave their education program, but also during their service years by introducing a reaccreditation program for maintaining standard of care.

The findings of this study provide detailed information on participants knowledge of newborn care components and management of newborn illnesses. This information can be used to design a training material which gives a great attention and focuses on the knowledge gaps observed.

Unless rigorous measures are taken to train, update and inform health center staff on quality neonatal care, with the predicted fertility of the overall regions and the longstanding quality of care bottlenecks, the regions face a challenge to significantly reduce neonatal morbidity and mortality rates. In order to improve upon the revealed low level of health center staff knowledge throughout the regions, more sustainable and targeted training with a robust supervision and technical support system must be implemented. This effort should involve appropriate review of the current training and supervision strategies together with implementation methods throughout the regions. Future implementation of standardized reaccreditation system for health center staff should be encouraged to ensure high quality of newborn care and increase positive health care outcomes.

In conclusion, knowledge regarding immediate newborn care among health center staff in four regions of Ethiopia is not satisfactory. The highest deficit of knowledge was observed in immediate newborn care components, identifying and stabilizing newborns with feeding problems and management of jaundice. Efforts are needed to orientate health center staff regarding immediate newborn care, especially the offer of immediate care after birth and jaundice management. Although better knowledge was associated with training and shorter service year in some of the knowledge variables, the observed similar levels of combined knowledge between health center staff who received training, technical support and supervision raised important training curriculum and supervision component questions. To address the knowledge gaps and implement targeted interventions, periodic assessment should be conducted, and performance should be monitored regularly.

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Appendix

Appendix A: Questionnaire

Dagu: Health Centre Staff Questionnaire			
This questionnaire should be completed by staff working in the under 5 department trained in IMCI			
100	Unique ID	_ _ / _ _ / _ _ / _ _ / _ _ Region / Zone / Woreda / PHCU / HW code	
101	Date (dd/mm/yyyy) Gregorian Calendar	_ _ / _ _ / _ _ dd / mm / yy	
103	Region Name	_ _ _ _ _ _ _ _ _ _ _ _	
104	Zone Name	_ _ _ _ _ _ _ _ _ _ _ _	
105	Woreda Name	_ _ _ _ _ _ _ _ _ _ _ _	
106	PHCU/Health Center Name	_ _ _ _ _ _ _ _ _ _ _ _	
107	Cluster ID		
108	Facility code	_ _	
109	Health worker Code		
110	GPS Latitude	_ _ : _ _ _ _ _ _ _	
111	GPS Longitude	_ _ : _ _ _ _ _ _ _	
112	Elevation		
113	Interviewer Initials	_ _	
114	Did you read the health worker (HW) the consent form?	1 = Yes 2 = No	_
115	Did the HW agree to be interviewed?	1= Yes – GO TO MODULE 2 2 = No	_
116	If not, why not?	_____	
MODULE 2: EDUCATION AND EXPERIENCE			
113	What is your date of birth?	dd _ _ mm _ _ yyyy _ _ _ _ _ Ethiopian Calendar	
114	What is your qualification or occupational category?	1 = Health officer 2 = Midwife 3 = Nurse 4 = Urban Health Extension Worker 8 = Other	_
115	What year did you graduate / complete your qualification?	YYYY in Ethiopian calendar	_ _ _ _
116	In what year did you start working at this health centre?	YYYY in Ethiopian calendar	_ _ _ _

<p>What are the main components of immediate newborn care? Do not prompt Select all mentioned.</p>	For each: 1 = Yes 2 = No		
	119	Deliver baby onto mother's abdomen	__
	120	Dry and wrap baby	__
	121	Assess breathing	__
	122	Delay cord clamping for three minutes	__
	123	Tie and cut cord appropriately	__
	124	Skin to skin contact	__
	125	Initiate breastfeeding	__
	126	Apply TTC eye ointment	__
	127	Apply chlorohexidine on cord	__
	128	Give Vitamin K	__
	129	Weight baby	__
	999	None mentioned from the list	
	<p>What are the main components of the first PNC visit for newborn? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No	
130		Advice washing hands before touching baby	__
131		Check for danger sings	__
132		Check for congenital abnormalities	__
133		Measure temperature	__
134		Measure weight	__
135		Apply TTC eye ointment	__
136		Encourage exclusive breast feeding for baby	__
137		Advice to delay bathing of baby for 24 hrs	__
138		Encourage skin to skin contact	__
139		Provide cord care (Chlorohexidine)	__
140		Education on appropriate cord care (Chlorohexidine)	__
141		Vaccinate for polio and BCG	__
142		Teach mother on how to recognize newborn danger signs using family health card.	__
999	None mentioned from the list		

<p>When a newborn weighs less than 1.5 kgs or has a gestational age of less than 32 weeks, what special care do you provide? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	150	Continue feeding with expressed breast milk	__
	151	Monitor ability to breastfeed	__
	152	Cover baby well including head	__
	153	Hold close to mother	__
	154	Refer urgently with mother to health center or hospital	__
	999	None mentioned from the list	
<p>When a newborn weighs between 1.5 - 2.5 kgs or has a gestational age of 32- <37 weeks, what special care do you provide? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	155	Make sure the baby is warm	__
	156	Educate on optimal breastfeeding	__
	157	Monitor ability to breastfeed	__
	158	Monitor baby for the first 24 hours	__
	159	Educate on infection prevention	__
	999	None mentioned from the list	
<p>How do you determine feeding problems in a newborn? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	164	Not well-attached to breast	__
	165	Not suckling effectively	__
	166	Less than 8 breastfeeds in 24 hours	__
	167	Switching to another breast before one is emptied	__
	168	Receives other foods or drinks (even water)	__
	169	Underweight for age	__
	170	Thrush (ulcers or white patches in mouth)	__
	999	None mentioned from the list	
<p>When a newborn shows signs of feeding problems or is underweight, what initial steps do you take? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	171	Advise mother to breastfeed as often and as long as infant wants in 24 hours	__
	172	Teach mother correct positioning and attachment	__
	173	Educate on exclusive breastfeeding	__
	174	Teach the mother to treat thrush at home	__
	175	Follow-up any feeding problem	__
	176	Follow-up any thrush in two days	__
	177	Follow-up under weight for age in 14 days	__
999	None mentioned from the list		

<p>What are the main signs for very severe disease in newborns? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	178	Convulsions	__
	179	Stopped feeding or significantly reduced feeding	__
	180	Severe chest in drawing	__
	181	Fast breathing	__
	182	Temperature with 37.5 or more (warm) (Note: if high temperature only mentioned ask for clarification to what extent)	__
	183	Temperature less than 35.5 (cold) (Note: if low temperature only mentioned ask for clarification to what extent)	__
	184	No or very limited movement on stimulation	__
	999	None mentioned from the list	
<p>When the newborn presents signs of very severe disease, what initial steps do you take? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	185	Continue to breastfeed or if unable to suck give breast milk that has been expressed	__
	186	Begin a dose of amoxicillin (pre-referral)	__
	187	Begin a dose of gentamycin antibiotics (pre-referral)	__
	188	Refer URGENTLY	__
	189	When referral is not possible treat with/prescribe amoxicillin for 7 days	__
	190	When referral is not possible treat with gentamycin daily for 7 days	__
	999	None mentioned from the list	
<p>What are the main signs for local bacterial infection in newborns? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	191	Umbilicus red	__
	192	Umbilicus draining pus	__
	193	Skin pustules	__
	999	None mentioned from the list	

<p>When the newborn presents signs of local bacterial infection, what initial steps do you take? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	194	Give amoxicillin syrup for 5 days	__
	195	Follow up care on 2nd day from initial visit	__
	196	Advice mother when to return	__
	197	Breast feed more frequently	
	198	Advice mother to give breast milk more frequently	__
	199	Advice mother to keep baby warm	__
999	None mentioned from the list	__	
<p>Are there any possible additional side effects of using antibiotics (injectable gentamicin or amoxicillin) for non severe neonatal illness?</p>	1= Yes 2 = No	__	
<p>What are those additional side effects of using antibiotics (injectable gentamicin or amoxicillin) for non severe neonatal illness?</p>	1 = Drug resistance 9. Not mentioned	__	
<p>What are the main signs for jaundice in newborns? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	221	Yellow skin	__
	222	Yellow eyes	__
<p>When the newborn presents signs of jaundice, what initial steps do you take? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	223	Breastfeed more frequently	__
	224	Advice mother to keep young infant warm	__
	225	Expose to sunshine 20 to 30 minutes every day	__
	226	Advice mother to return immediately if sign & symptoms of jaundice aggravates	__
	227	Follow-up in 2 days	__
	999	None mentioned from the list	
<p>What are the main symptoms/signs for severe jaundice in newborns? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	228	Jaundice in newborns of Age 14 days or more	__
	229	Jaundice in newborns of Age less than 24 hours	__
	230	Palms yellow	__
	231	Soles yellow	__
	999	None mentioned from the list	

<p>When the newborn presents symptoms /signs of severe jaundice what initial steps do you take? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	232	Breastfeed more frequently	__
	233	Refer URGENTLY to health center /hospital	__
	234	Keep the baby warm	__
	999	None mentioned from the list	
<p>What are the main signs for some dehydration caused by diarrhea in newborns? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	235	Restless and irritable	__
	236	Sunken eyes	__
	237	Skin pinch goes back slowly	__
	999	None mentioned from the list	
<p>When the newborn presents signs of some dehydration caused by diarrhea what initial steps do you take? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	238	Give ORS fluids	__
	239	Give zinc treatment for 10 days	__
	240	Advise mother to breastfeed more frequently and longer	__
	241	Keep the infant warm	__
	242	Advise mother when to return	__
	243	Follow up in 2 days	__
	999	None mentioned from the list	
<p>What are the main symptoms/signs for severe dehydration caused by diarrhea in newborns? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	244	Limited or No movement even when stimulated	__
	245	Sunken eyes	__
	246	Skin pinch goes back VERY slowly	__
	999	None mentioned from the list	
<p>When the newborn presents signs of severe dehydration caused by diarrhea what initial steps do you take? Do not prompt Select all mentioned</p>	For each: 1 = Yes 2 = No		
	247	Give first dose of amoxicillin syrup	__
	248	Give first dose of IM Gentamycin	__
	249	Refer URGENTLY to health center/hospital	__
	250	Ensure mother gives child ORS on the way to health center/hospital	__
	251	Advise mother to breastfeed more frequently and longer	__
	252	Advise mother to keep young infant warm	__
	999	None mentioned from the list	

MODULE 4: SERVICES PROVIDED AND IN-SERVICE TRAINING		
Have you received any in-service training or training updates on topics related to newborn care?	For each: 1 = Yes 2 = No	
	1=yes	
	2=no	
MODULE 5: WORKING CONDITIONS		
<p>Now I would like to ask you some questions about supervision you have personally received. This supervision may have been from a supervisor either in this facility, or from outside the facility. Do you receive technical support or supervision in your work? IF YES, ASK: When was the most recent time?</p>		
Do you receive technical support or supervision in your work	1.yes in the past 3 months 2.yes in the past 4-6 months 3.yes in the past 7-12 months 4.yes more than 12 months ago 5.No	_ _

Appendix B: Figures from result

