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NEONATAL RESUSCITATION: KNOWLEDGE AND PRACTICES OF NURSES AND MIDWIVES IN TWO HOSPITALS IN MOGADISHU, SOMALIA

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STUDENT'S DECLARATION

This dissertation report is my original work and has not been presented for the award of a degree in any other university.

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LIST OF ABBREVIATIONS AND ACRONYMS

AHA	American Heart Association
CI	Confidence Interval
GEE	Generalized Estimating Equations
HWs	Health Workers
IQR	Interquartile Range
MOH	Ministry of Health
NA	Not Applicable
NBR	Newborn Resuscitation
NLS	Newborn Life Support
OR	Odds Ratio
PALS	Paediatric Advanced Life Support
PI	Primary Investigator
PPV	Positive Pressure Ventilation
SD	Standard Deviation
SSA	Sub-Saharan Africa
UON	University of Nairobi
WHO	World Health Organization

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DEFINITIONS

Resuscitation: neonatal resuscitation is defined as a set of interventions at birth to support the establishment of breathing and circulation.

Basic newborn resuscitation: Provision of warmth, airway clearing (sucking), head positioning, and positive pressure ventilation via bag valve and mask.

Advanced resuscitation: Resuscitation that extends to chest compressions, intubation, or medications.

AGPAR score: scores awarded to check the clinical status of a newborn at 1 minute and 5 minutes of life. It is not a prerequisite for resuscitation.

Birth asphyxia: Failure of a newborn to initiate and sustain breathing at birth.

Newborn: a baby who has just been delivered.

ABSTRACT

Introduction: Annually, 10 million of 136 million births worldwide need resuscitation. Despite improvement in maternal and child health indicators, the rate of neonatal mortality in Somalia is still high (39 in 1000 live births). Resuscitating babies effectively can reverse birth asphyxia, the main basis of neonatal mortality. Assessing knowledge and practices of nurses and midwives in neonatal resuscitation is important for policy makers with regards to needs.

Study Objectives: To measure the knowledge level and practices of nurses and midwives on neonatal resuscitation at two hospitals offering maternity services in the Federal Republic of Somalia, and to evaluate hospital resources required for optimal newborn resuscitation.

Methods: A cross-sectional study was carried out at Banadir maternity & children's hospital and SOS hospital in Mogadishu. Nurses and midwives who had worked in the labour ward for at least one month were eligible while visiting ones were excluded. Forty consenting workers were randomly enrolled. The knowledge on neonatal resuscitation tools was developed based on the Neonatal Textbook of Resuscitation (2015) and WHO basic newborn resuscitation guidelines, while the practice tool was based on the WHO newborn resuscitation protocol observation checklist. Correctly answered items or practices were awarded one point. Hospital resources for neonatal resuscitation were assessed using a checklist derived from WHO newborn resuscitation protocol.

Data Management and Analysis: SPSS version 23 was used to analyze data, and presented as frequencies and proportions for categorical data, means with standard deviation or median with interquartile range for continuous data. Knowledge on neonatal resuscitation was calculated as a percentage, and a score of <50% (poor), (50-74%) moderate and good (≥75%). Practices were graded as good for >75%, fair for 50-75%, poor for 40 - 49% and extremely poor for <40%. Hospital resources required for neonatal resuscitation were analyzed and classified using the WHO standard of classifying hospital equipment and supplies and presented using descriptive tables.

Results: The median age was 24 years with most of the participants being female (92.5%). Degree holders (82.5%) accounted for the majority of participants while most of the participants were midwives (70.0%). On the years of experience, 52.5% had below 2 years of work experience while 42.5% had received refresher training. More than half of the participants, 57.5% (23/40) had poor knowledge levels about neonatal resuscitation, 27.5% (11/40) had moderate while 15.0% (6/40) had good knowledge levels. Of the 98 resuscitation observations made, 14 (14.3%) were good, 15 (15.3%) were fair, 36 (36.7%) were poor while 33 (33.7%) were very poor. Generally, regarding the availability of NBR equipment, Banadir had a compliance rate of 76.2% while SOS Hospital had a compliance rate of 42.9%.

Conclusions and recommendations: Knowledge about newborn resuscitation was poor while the general practices of the nurses and midwives regarding newborn resuscitation were very poor. Both hospitals lacked functional essential basic neonatal resuscitation equipment. The hospitals need to provide regular newborn resuscitation training sessions to allow for better skill retention obtained and better practices towards newborn resuscitation.

CHAPTER ONE: INTRODUCTION AND BACKGROUND

Resuscitation in neonates has previously been explained by the steps involved in assisting the newborn to breathe (1). Every year, 10 million of the 136 million births worldwide need resuscitation (2). In addition, 814,000 deaths among term neonates are related to intrapartum events whereas 1.03 million are related to events following preterm birth (2). On estimate, 6 million neonates annually are resuscitated by use of a bag-and-mask, and this is sufficient even for babies suffering secondary apnea, hypoxemia and respiratory failure (3). Globally, in 2016 alone, approximately 7,000 newborn babies died every day including in Somalia. Over 80% of the deaths could be prevented through essential interventions like quality health care offered by skilled maternal and newborn cadres like nurses, midwives and doctors. In spite of some reduction witnessed in the last few years, the rate of mortality has continued to lag behind the remarkable achievements made for the largely under-five mortality rate. The less than five mortality rate decreased by 62% between 1990 and 2016 which was almost two-thirds compared to 49% of neonatal mortality (4). The mortality rate of newborns increased from 41% in 2000 to 46% of all child deaths.

Moreover, the rates of stillbirth are still high with an annual estimated 2.6 million babies being stillborn. Most of these babies are from low-and middle-income countries, like Somalia. Reports have shown that fifty per cent of the stillborn babies are alive at the start of labour, signifying that with better labour and delivery services these babies could still be saved. Maternal health is interlinked to newborn health and the survival of the newborn depends largely on the mother. The world maternal mortality ratio (MMR) was approximated at 216 per 100,000 live births at the end of the MDG era in 2015. Most of these deaths were reported in LMIC such as Somalia and could have been avoided using the evidence-based high impact interventions.

In sub-Saharan Africa (SSA), neonatal mortality accounts for 38% of global neonatal mortality (4)., In Somalia, the neonatal mortality rate has remained high at 39 per 1000 live births despite increasing improvements in other maternal and child health indicators(5). Latest reports from United Nations have ranked Somalia number four in the list of the ten riskiest nations to be born in and report that the number of skilled professionals (nurses, midwives, doctors etc) per 10,000 of the population is 1 (6). Conflict reduction in many parts of the country has given hope that with targeted focus and commitment from various stakeholders, Somalia can drastically reduce the high rates of neonatal mortality (5).

Even when neonatal death has been linked to several factors, preterm birth, birth asphyxia, sepsis and pneumonia are observed to be the most common causes (7, 8). Findings from a study done in Nigeria revealed that prematurity and perinatal asphyxia were the main causes of death amongst neonates (9).

Interestingly, the problems such as birth asphyxia leading to mortality can be averted by training health workers who attend to neonates on the proper procedures of resuscitating neonates, to guarantee that they acquire the skills and knowledge they need to perform resuscitation timely and effectively (10). Evidence shows that among every 100 neonates who are resuscitated effectively at birth, 30 are saved from dying (protective efficacy = 30%) (2). A study done in Tanzania in 2013 revealed that there was a reduction in the risk of death of newborns by 47% after birth attendants involved in neonatal resuscitation had received training from the Helping Babies Breathe (HBB) program (11).

Elsewhere in Africa, studies conducted in Nigeria and Malawi showed that birth asphyxia was the main cause of mortality in newborns and that to ensure that neonates have positive outcomes, the healthcare attendants had to have skills and knowledge related to resuscitation (12-14).

Training of health workers mainly midwives involved in the resuscitation of neonates is critical given the high numbers of neonates who need help to breathe (15). Moreover, nearly 1 in every 10 neonates need the assistance of some kind like tactile stimulation, airway clearing, or positioning (16). Besides the nurses' and midwives' qualifications, it is mandatory to receive training on Emergency Triage Assessment and Treatment (ETAT) according to the WHO. In detail, the staff should triage all sick children when they arrive at a health facility, into the following groups: neonates with emergency signs, those with priority signs, those who are non-urgent cases, assess a child's airway and breathing and give emergency treatments, assess the child's status of circulation and level of consciousness, manage shock, coma, and convulsions in a child, assess and manage severe dehydration in a child with diarrhoea, then finally plan and implement ETAT in their working area in their hospital (17). Specifically, on neonatal resuscitation, the staff need to be trained on immediate care for the babies after birth, when and who to resuscitate, when suctioning is needed, ventilation using positive pressure, chest compressions, how to end resuscitation and the equipment needed for neonatal resuscitation (10).

According to the UNICEF, whereas Every Newborn Action Plan was launched in 2014 in very many countries, Somalia Every Newborn Action Plan started in 2019. Since 1999, Paediatric Advanced Life Support (PALS) and Newborn Life Support (NLS) has been rising in SSA. However, due to cost and lack of awareness, the nurses and midwives may not be able to access the courses. This, in turn, would imply that the newborns may not receive adequate care due to the attendant's lack of prerequisite skills and knowledge required to carry out the procedures.

Therefore, this study sought to determine the level of knowledge and practices of nurses and midwives on neonatal resuscitation at two hospitals offering maternity services in the Federal Republic of Somalia.

CHAPTER TWO: LITERATURE REVIEW

2.1 Epidemiology

At least one death out of every four among neonates worldwide has been linked to birth asphyxia. Birth asphyxia involves failing to initiate a breath at birth and failing to sustain it. Globally, the need for training workers involved in neonatal resuscitation in a resource-limited environment is evident. WHO identified the gap and in 2012 has updated guidelines on fundamental newborn resuscitation appropriate for settings with inadequate resources (10). Successful implementation of these WHO recommendations at the time of birth intend to advance the quality of care for newborns, contribute to better health outcomes and decline in preventable newborn death and disabilities as a result of birth asphyxia. Effective neonatal resuscitation is achieved through a combination of factors such as proper knowledge, psychomotor skills and other individual characteristics like self-efficacy, effectual team work and leadership.

2.2 World Health Organization recommendations on basic Newborn resuscitation.

This was derived from WHO recommendations on basic newborn resuscitation 2012 and Pocket book Hospital care for children 2nd edition WHO 2013.

2.2.1 Immediate care after birth

At and after delivery, the majority of newborns need simple supportive care like drying the infant with a clean towel, observing the infant while drying and maintaining the infant in a skin-to-skin contact position with the mother.

The WHO recommends that neonates among whom positive-pressure ventilation is not required, clamping of the cord can be done a minute following birth. Furthermore, among neonates requiring positive-pressure ventilation, clamping and cutting of the cord should be done to allow for the

process of effective ventilation. In addition, failure to achieve a spontaneous breath following thorough drying should be mitigated by applying a 2 to 3 times rub on the back before the cord is clamped and positive pressure ventilation is initiated.

2.2.2 Who to resuscitate

For some infants such as those born to mothers with chronic illness, to mothers who had a previous fetal or neonatal death, to mothers with pre-eclampsia, in multiple pregnancies, in preterm delivery, in the abnormal presentation of the fetus, infants with a prolapsed cord, or after prolonged labour, rupture of membranes or meconium-stained liquor, resuscitation may be needed.

According to W.H.O recommendations, all babies who do not cry, do not breathe at all or who are gasping 30 seconds after birth ought to be resuscitated with bag-mask ventilation.

2.2.3 Suctioning needed

Routine mouth and nose suctioning should not be done routinely if the neonates start breathing spontaneously, as there is no benefit, and may lead to adverse effects.

It is recommended that babies who fail to start breathing and are born through a meconium-stained amniotic fluid are suctioned before positive-pressure ventilation is initiated. The WHO also recommends that a baby syringe be used instead of a mucous extractor to aid aspiration in settings where equipment to mechanically cause negative suction pressure may not be accessible.

2.2.4 Ventilation using positive pressure

WHO recommends that ventilation using positive pressure be initiated within one minute following birth among neonates who are faced with difficulty in initiating breathing even when proper drying and additional stimulation have been done. In addition, the WHO also mentions that ventilation can be started with room air and thereafter continued with a self-inflating bag and mask.

Also, WHO recommends that newly born babies requiring PPV are initiated on a face mask that fits the nose and mouth and neonates should be in a sniffing position to maintain airway patency. Monitoring sufficiency of the ventilation process can be checked through measuring heart rate following 60 seconds into the process and with an assessment of the physical movement of the chest. It is also important that adequate ventilation is provided in addition to compressing the newborn's chest when breathing doesn't start one-minute following birth. Recommendations are to ventilate at the rate of 40–60 breaths/min.

2.2.5 Chest compressions

The WHO does not recommend chest compression in essential resuscitation unless two health workers have accurately assessed the heart rate. It is recommended to give chest compressions if the heart rate is < 60/min after 30–60s of ventilation with adequate chest movements: 90 compressions coordinated with 30 breaths/min (three compressions: one breath every 2 s). To give adequate chest compressions, the health worker should place the thumbs, 1 finger breadth below the line connecting the nipples on the sternum and compress downwards to a depth of one-third of the anterior-posterior diameter of the chest.

2.2.6 Decision to end resuscitation

The choice to end resuscitation can be made when the health worker detects no heart rate following 10 minutes of proper ventilation conduct. In instances where the heart rate does not change and is still below 60 beats per minute or where there is no breath spontaneously following resuscitation for 20 minutes, resuscitation can be halted.

2.2.7 Equipment needed for neonatal resuscitation

The equipment required for basic neonatal resuscitation is simple and easy to obtain and include a resuscitation table, two warm towels, source of heat, suction device, and self-inflating bag device with different sizes of face masks.

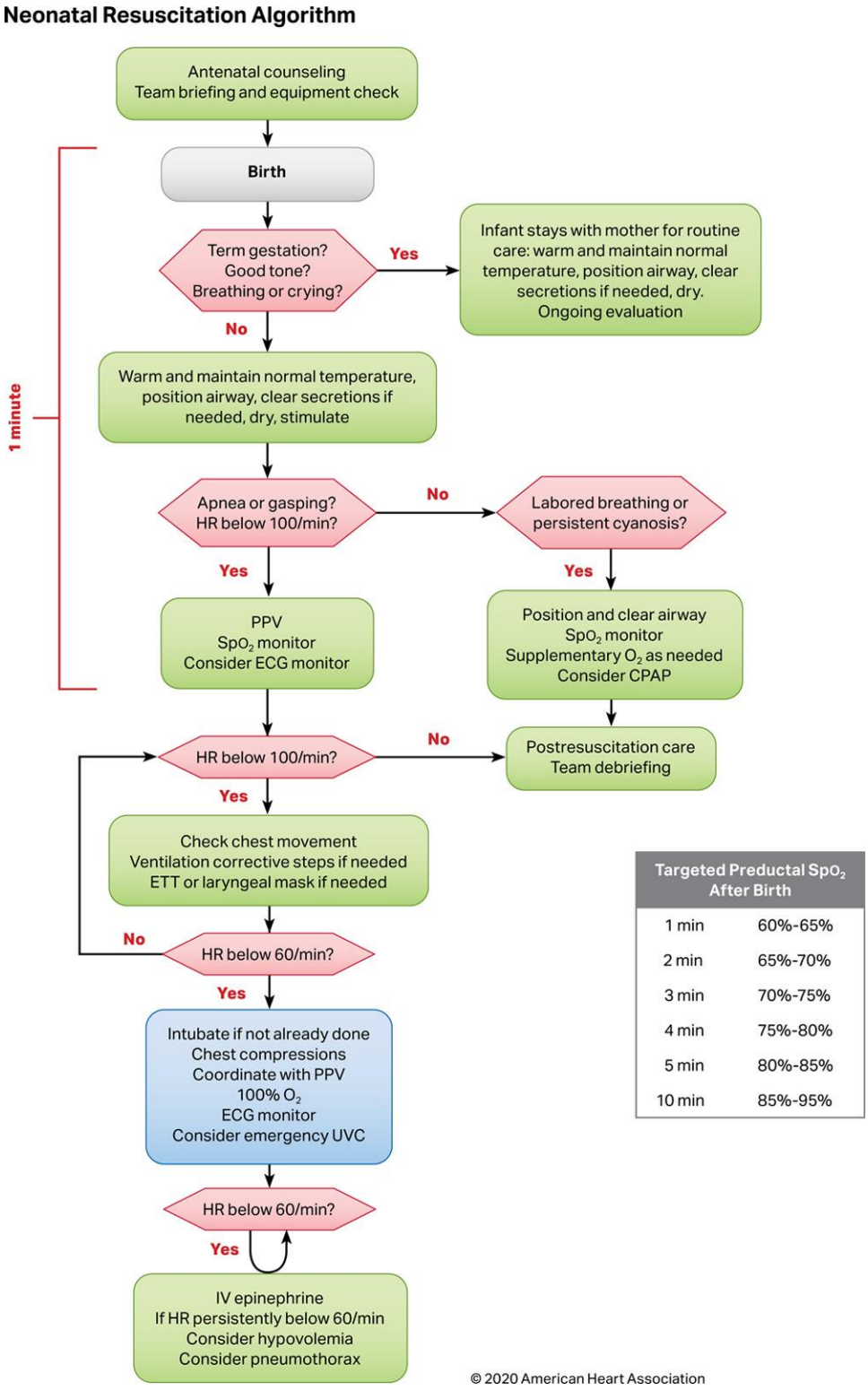


Figure 1: Neonatal Resuscitation Algorithm

2.3 Health worker knowledge and skills on neonatal resuscitation

Even when the need for resuscitating the baby and baby progress is guided by Apgar scores, conveying complete status information and how the baby is responding to resuscitation at the different sessions is important. Scores at 1 minute correlate with acidosis and survival whereas scores at 5 minutes can or cannot predict the neurological outcome (18-20).

A study done by O'Hare et al at a teaching hospital in Kampala Uganda demonstrated that the risk of asphyxia was decreased by performing basic steps of resuscitating babies. In the study, asphyxia was defined by an APGAR score below seven at 5 minutes. Overall, the scores increased after resuscitating the babies and the risk of death was also significantly reduced among neonates heavier than 2kgs (21).

The health workers' level of neonatal resuscitation skills and knowledge has been found in some studies to be sub-standardized. Cross-sectional study results by Gebreegziabher et al., who used a structured questionnaire based on the 2010 United Kingdom Resuscitation Council Guidelines at a referral hospital in Northwest Ethiopia in 2014 showed that the mean score of knowledge (mean ± sd) were 19.7 ± 3.03 among midwives, 20.2 ± 2.94 among nurses, 19.7 ± 4.4 among residential paediatricians and 19.6 ± 3.3 among residential gynaecologists. The mean scores for the skills among the same participants were 7.1 ± 4.17 among midwifery workers, 6.7 ± 3.75 among nursing staff, 5.7 ± 4.17 among residential paediatricians and 6.6 ± 3.97 among residential gynaecologists (22).

A cross-sectional survey conducted among midwives at public hospitals in Ghana found that 98.1% did not have sufficient knowledge of neonatal resuscitation. The survey questions were based on standard references drawn from the WHO Guidelines on Neonatal Resuscitation,

American Heart Association's Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC) of Paediatric and Neonatal Patients, and a textbook on neonatal resuscitation. Midwives whose first-degree training was in midwifery, who possessed a post-NAC/NAP certificate and who had received prior training on resuscitating neonates had significantly higher knowledge (23).

Of the 41 midwives and nurses participating in a cross-sectional study at the labour ward and maternity theatre in Kenyatta national hospital in 2010 by Alwar et al., who assessed knowledge through a harmonized self-designed questionnaire and a guiding checklist, found that when categorized by >50% as a pass and <50% as a failure, 60.9% of the respondents failed the assessment of knowledge on neonatal resuscitation while 47.2% had appropriate practice in neonatal resuscitation (24).

In another study done in all counties in Kenya by Murila et al., in 2012, who gave a written test copied from the standard test contained in the American Heart Association/ American Academy of Paediatrics (AHA/AAP) Textbook of Neonatal Resuscitation, found out that of the 192 health workers including nurses and midwives who were assessed on their knowledge toward neonatal resuscitation demonstrated that more than 70% (134) of the participating health workers were found to have inadequate knowledge about neonatal resuscitation due to insufficient medical training (25).

A study done in Kenya in 2017 by Duncan et al., who used a structured direct observation checklist adapted from the Ministry of Health (Kenya) on Basic Paediatrics Protocols for ages up to 5 years for Neonatal Resuscitation, to determine the skills of neonatal resuscitation by observing 28 healthcare providers showed that from the diverse neonatal steps of resuscitation, clearing of the

airway was the commonly performed step (85%), drying and stimulation was fairly done (60%) while BMV was the least (45%) (26).

In Western Nigeria, a cross-sectional study was done by Ogunlesi et al., to assess the knowledge of nurses about neonatal resuscitation based on the American Heart Association (AHA) Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC) of Paediatrics and Neonatal Patients, showed 95.5% of participants had enough knowledge to evaluate neonates while 50.3% had inadequate knowledge of appropriate decisions and actions (27). A similar cross-sectional study done by Naila Khalid et al., in Pakistan using a self-structured questionnaire designed after extensive literature search and context analysis, found that amongst 49 midwives, only 49% were knowledgeable. From this study, only 42.85% of midwives were aware of the right order of first steps of resuscitation and BMV; 26.53% of midwives knew the right rate of PPV. Nevertheless, 67.34% and 69.38% of midwives had better knowledge in the preparation and the right sequences of suctioning correspondingly (28).

2.4 Effects of training on healthcare workers in neonatal resuscitation

An assessment by Waisman, et al., on the impact of the PALS course on neonatal resuscitation knowledge among health workers found that the course had a significant effect on health workers during training and the content of the tool was easily grasped. From the study, it was demonstrated that their practice significantly improved after completing the course (29).

In a study done in Israel, researchers approved the worthiness of advanced life support courses to improve knowledge and outcomes. It was recommended that the guidelines must serve as the gold standard of care for life-threatening situations and resuscitation in children and adults (30).

Opiyo et al., (2007) did a study at Pumwani Maternity Hospital in Nairobi and found that newborn resuscitation practice enhanced following a one-day health workers' training at the hospital (31).

Carbine and colleagues in 2000 used video recordings to determine neonatal resuscitation under Neonatal Resuscitation Programme (NRP) guidelines among a mixed group of practitioners. It was established that 54% of the practitioners deviated from the NRP guidelines (32).

At Ashington hospital in the UK, researchers set out to establish whether nurse practitioners were knowledgeable in resuscitating neonates. Results from the study suggest that nursing staff who work within the obstetric unit in absence of residential paediatricians can acquire proficiency in resuscitating babies at birth (33).

2.5 Availability of Resuscitation Equipment in the hospitals

Equipment is a vital structural constituent to offer quality newborn care in most low-income countries and the absence of essential supplies is the main challenge to carry out an effective newborn resuscitation.

According to the WHO technical specifications of neonatal resuscitation devices of 2016, which is a complimentary support manual for the acquisition of the right and suitable neonatal resuscitation equipment listed and recommended the following life-saving commodities as shown in the table below:

Table 1: Resuscitation devices for newborn asphyxia

1	Self-inflating neonatal resuscitation bag with masks for pre-term (size 0) and term (size 1) babies

2	Electric or foot-operated suction machine/pump, negative pressure less than 100mm Hg, with 1 bottle
3	Suction catheter, length 50 cm, single-use, conical tip, Fr #8
4	Single-use suction bulb
5	Multi-use suction bulb that can be opened, cleaned and sterilized
6	Training mannequin/simulator for neonatal resuscitation
7	Infant stethoscope

Source: WHO Technical Specification of Neonatal Resuscitation Devices (2016)

A study done by Opondo et al., in 2009, across eight first referral level (district) hospitals in Kenya indicated that vital equipment such as resuscitates and bag-valve-mask devices were often unavailable. The study also showed improving the knowledge and skills of health care workers will be largely irrelevant if inadequate structure limits the possibility of improving outcomes of care (34).

Another cross-sectional study was done by Naila Khalid et al., at a primary health care centre of Pakistan assessed the accessibility of basic newborn resuscitation equipment in the health facilities found that they are well equipped including newborn resuscitation table, source of warmth, bulb sucker, stethoscope, infant Ambu-bag and mask but had ample supplies of bag and mask devices for ventilation as well as most basic equipment for neonatal resuscitation (28).

Table 2. Summary of the reviewed studies on Knowledge and practice of HCWs on Newborn resuscitation

Study, Title, Author, Year, Country.	Study Design, Study Population.	Results
Florence Murila et al., Kenya 2007	N=192 health providers in 47 counties in Kenya.	More than 70% of the participants considered their knowledge of NR inadequate
Teresa Alwar Nairobi, Kenya Dissertation UON, 2010.	Descriptive Cross-sectional study N= 41 nurse-midwives 178 resuscitation episodes.	60.9 % (25) of participants failed to pass assessment of knowledge on neonatal practice while 47.2% had appropriate practice in NR.
Gebreegziabher et al., Northwest Ethiopia 2014	Institution-based cross-sectional N=135 nurses, midwives, residents	The mean knowledge scores of midwives and nurses were 42.8% and 43.9% respectively and the mean skill scores of midwives and nurses were 59.2% and 55.8% respectively.
Ogunlesi et al., Western Nigeria 2006	Cross-sectional survey N= 179 nurses	95% of the respondents had adequate evaluation while 50.3 % had inadequate knowledge for appropriate decisions and actions.
Tamale, Afizu et al., Ghana 2018	Cross-sectional survey N=160 midwives	98.1 % of midwives had insufficient knowledge of NR.

Duncan et al., **Kenya 2017**	Direct observation study of 138 newborn resuscitations by 28 healthcare providers	had indicated that from the different neonatal resuscitation steps, airway clearance was the most commonly performed step (85%), drying and stimulation fairly performed (60%) while BMV was the least (45%) performed step of neonatal resuscitation.
Carbine et al., **San Diego, California-USA, 2000**	Video Recording as a Means of Evaluating Neonatal Resuscitation Performance.	The study revealed that 54% of the practitioners deviated from the NRP guidelines.
Esan et al., Ekiti State, **Nigeria, 2020**	Descriptive cross-sectional design N = 89 midwives	More than half of the midwives (56.2%) had a good knowledge of immediate newborn care. About 62.9% had good practices of immediate newborn care.

Table 3. Studies that assessed Hospital Adequacy of Equipment and Supplies for Neonatal Resuscitation

Opondo et al., Kenya, 2009	Study across eight first referral level (district) hospitals in Kenya	indicated that vital equipment such as resuscitators and bag-valve-mask devices were often unavailable.
Naila Khalid et al., Pakistan. 2013	Cross-sectional survey conducted in District Sheikhupura of Pakistan's Punjab province	the health facilities were well equipped including a newborn resuscitation table, source of warmth, bulb sucker, stethoscope, infant Ambu-bag and mask they also had ample supplies of bag and mask devices for ventilation as well as most basic equipment for neonatal resuscitation

CHAPTER THREE: STUDY JUSTIFICATION/ UTILITY

Initiating a breath is critical and useful physiology as a baby moves from life in the uterus to life outside the uterus. Nearly 1 in every 10 newly born babies need to be assisted to breathe (2, 35). In addition, the babies may require to be warmed, dried, stimulated and resuscitated in a bid to reduce the risk of early sickness and death. In resource-limited settings, it may be difficult to differentiate between a stillbirth and a baby born with severe depression. Furthermore, it is estimated that over a million newly born babies die as a result of preterm birth-related complications like respiratory distress syndrome as they may also need to be assisted to breathe (36).

Training of midwives and nurses on neonatal resuscitation techniques can therefore be very important as far as reducing neonatal mortality is concerned in resource-limited settings like Somalia. For the past two decades, Somalia has not had a centrally functioning government, leading to the collapse of the health system thereby affecting neonatal care. Somalia is ranked the fourth riskiest country to be born as it has a high neonatal mortality rate. It is important to document the basic knowledge, practices and experience of Nurses and Midwives in resuscitating neonates as this would offer insight to policy makers especially those in government to create programs to facilitate training on neonatal resuscitation. There is a scarcity of data related to neonatal resuscitation in Somalia. This study, therefore, sought to document the Nurse's and Midwives' knowledge and practices on neonatal resuscitation in two hospitals in Somalia. In addition, the study established the factors associated with their knowledge.

3.1 Research Questions and Objectives

1. What is the knowledge level of nurses and midwives on neonatal resuscitation at Banadir maternity & children's hospital and SOS hospital in Mogadishu, Somalia?
2. What are the practices of nurses and midwives on neonatal resuscitation at Banadir maternity & children's hospital and SOS hospital in Mogadishu, Somalia?
3. Do the participating hospitals have the minimum required equipment and supplies for conducting neonatal resuscitation?

General Objective

To evaluate the level of knowledge and practices on neonatal resuscitation amongst nurses and midwives at Banadir maternity & children's hospital and SOS hospital in Mogadishu, Somalia, and the adequacy of hospital equipment and supplies for neonatal resuscitation.

Specific Objectives

1. To determine the knowledge level of nurses and midwives on neonatal resuscitation at Banadir maternity & children's hospital and SOS hospital in Mogadishu, Somalia.
2. To establish the practices of nurses and midwives on neonatal resuscitation at Banadir maternity & children's hospital and SOS hospital in Mogadishu, Somalia.
3. To find out if participating hospitals have the minimum required equipment and supplies for conducting neonatal resuscitation.

CHAPTER FOUR: METHODOLOGY

4.1 Study Design

A hospital-based cross-sectional study was adopted to provide a snapshot of the proportion of the Nurses and Midwives with a good or poor level of knowledge and practice at a given point in time. By assessing the knowledge and practices of these particular sets of health workers it would lead to the formulation of the necessary training needs.

4.2 Study site/ Setting

The study was done at the Banadir maternity and children's hospital and the SOS hospital both in Mogadishu, Somalia, where the former is located in the Wadajir district of Mogadishu, while the latter in Heliwa district in South Mogadishu.

Banadir Maternity & Children's Hospital is a national referral and teaching hospital that was built in 1977 as part of government development projects, it is a 600-bed capacity hospital and composed pediatric and maternity ward with 2 postnatal wards having 150 admission beds. The facility registers nearly 300 deliveries monthly and has 25 midwives and nurses. The facility is run by specialist doctors (paediatricians and gynaecologists), medical officers, nurses, midwives, laboratory technicians, the administrators among others. It serves vulnerable populations and low socioeconomic families; they handle normal deliveries and complicated obstetrics and gynaecology surgeries.

SOS hospital is an EU donor-supported facility that is a tertiary referral hospital specializing in maternity and paediatric which offers a full range of comprehensive health services which is free of charge and it serves poor urban patients mainly those referred from peripheral facilities. SOS hospital registers close to 400 deliveries monthly including normal delivery and emergency obstetrics and has a 60-bed capacity. The facility is run by specialist doctors (paediatricians and

gynaecologists), medical officers, nurses, midwives, laboratory technicians, the administrators among others. Of special interest, is that the facility has 19 midwives and nurses. These two hospitals are the biggest referral hospitals for mothers and children in Mogadishu and serve free of charge.

4.3 Study Population

Target Population

Nurses and midwives who work in labour wards and/or maternity centres in health facilities in Mogadishu, Somalia.

Accessible Population

Degree / Diploma holders in Nursing/Midwifery who were working at Banadir maternity & children's hospital and SOS hospital in Mogadishu, Somalia.

Study Population

Study participants were Degree / Diploma holders in Nursing/Midwifery who were working at Banadir maternity & children's hospital and SOS hospital in Mogadishu, Somalia between March and April 2021 and who met the eligibility criteria.

Inclusion Criteria

- Degree / Diploma holders in Nursing/Midwifery who had worked in labour ward during their professional lives
- Had worked at Banadir maternity & children's hospital or SOS hospital in Mogadishu, Somalia for no less than 4 weeks.
- Those who had given informed permission

Exclusion criteria

- Nurses or midwives who had never attended to deliveries either at the labour ward or at the newborn unit. Visiting midwives or nurses who were not employees of the study hospitals

4.4 Sample size estimation

The sample size for knowledge on newborn resuscitation based on primary objective 1 – determination of the proportion of HCW with good knowledge.

Using Fisher's formula for one proportion,

$$N = \frac{Z^2{}_{\alpha/2}\, p(1-p)}{d^2}$$

N is the required sample size

$Z^2_{\propto/2}$ is the standard normal value corresponding to the 95% level of confidence i.e., 1.96

d is tolerable sampling error (precision) set at 0.05

P is the expected proportion of midwives and nurses who have adequate knowledge on neonatal resuscitation which is estimated at 61% based on the findings of Alwar et al in a study done at the Kenyatta National Hospital (23).

Substituting the values,

$$n = \frac{1.96^2 x\ 0.61(1-0.61)}{0.05^2} = 366$$

The overall available number of midwives and nurses was however 44. The use of the finite population correction formula for population sizes of less than 10,000.

Where:

n_o represents the unadjusted sample size estimated at 366

nf represents the required sample size corrected for finite populations.

N represents the available size of the finite population; this is 44 at the two study hospitals.

$$nf = \frac{n_0}{1 + \frac{n_0 - 1}{N}} = \frac{366}{1 + \frac{366-1}{44}} = 40$$

We thus required minimum sample size of 40 participants to assess knowledge.

Objective 2: Sample size estimation for HCW observed practices on newborn resuscitation

The sample size was calculated using the formula;

$$n = \frac{Z^2 x\ P(1-P)}{d^2}$$

Where,

n = Desired sample size

Z = value from standard normal distribution corresponding to desired confidence level (Z=1.96 for 95% CI)

P = expected true proportion of HCWs with correct newborn resuscitation practices. This is estimated at 47%, based on the study conducted in Nairobi, Kenya at the Kenyatta National Hospital by Alwar T (23)

d = desired precision (0.05)

$$n \quad = \frac{1.96^2 x\ 0.47(1-0.47)}{0.05^2} = 383$$

The calculated sample size must account for potential correlation in the data, and this was done by multiplying it by an estimate of the design effect which was calculated with the use of the formula:

Design effect, $DEFF = \rho\ (m-1) + 1$

Where ρ is the intraclass correlation and m is the average number of observations per health care worker. The value of ρ was not available to estimate the design effect, therefore the estimate of the design effect was assumed to be 1.4, a median design effect gotten from a study published by Rowe K.A. et al in 2002. Multiplying this value to the sample size gave the final sample size:

Final sample size = 383 x 1.4 = 537 observations.

It was assumed that at least 3 observations will be done per healthcare worker. Multiplying this by the sample of 40, gave 120 total observations. Adjusting this for finite population correction.

$$nf = \frac{n_0}{1 + \frac{n_0 - 1}{N}} = \frac{537}{1 + \frac{537-1}{120}} = 98$$

A total sample size of 98 observations was needed for this study, with a minimum of 2 and a maximum of 3 observations per HCW.

4.5 Sampling method

Random selection of health workers from the complete roster of nurses and midwives in the two health facilities was used. The health workers were accessed from their workstations and requested to participate in the study. If they accepted and consented to participate, a questionnaire was administered to them.

4.6 Study tools, and Definitions of Outcomes of Interest

4.6.1 Knowledge of Nurses and Midwives on Newborn Resuscitation

The knowledge on neonatal resuscitation was based on recommendations provided by the WHO guidelines and the Neonatal Textbook of Resuscitation. The participants circled their answers from a set of 16 questions. Individuals' knowledge was thus assessed using a structured questionnaire (appendix II) on the following aspects:

i. what to do when babies do not require or when they require positive-pressure ventilation (3 points)
ii. what to do when newly born babies do not initiate breathing even after being dried thoroughly, what to do when neonates are born through the clear amniotic fluid and they either start or fail to start breathing on their own after birth, (3 points).
iii. suctioning in the presence of meconium-stained amniotic fluid (2 points).
iv. What is the best way to establish if a newborn needs resuscitation (2 points)?
v. when to initiate, positive-pressure ventilation after birth (1 point).

vi. when to initiate ventilation and with what, how to measure heart rate (3 points)

vii. what to do in neonates without a detectable heart rate even when ventilation has been done effectively for 10 minutes (2 points).

Adequacy of Knowledge was scored and categorized as follows - One positive response to a question attracted 1 point, whereas a negative response was not awarded any point. Individuals who scored less than 50% were termed as having inadequate knowledge, 50% - 80% was moderately adequate knowledge and greater than 80% was adequate knowledge.

4.6.2 Practice of Nurses and Midwives on New Born Resuscitation

Similarly, the practices of participants were assessed based on the WHO Paediatric Emergency Triage, Assessment and Treatment 2016 (WHO. Paediatric Emergency Triage, Assessment and Treatment, Care of Critically Ill Children (ETAT). Geneva: 2016 (37) and recorded on a structured record form. The flow chart for the ETAT+ algorithm on newborn resuscitation is provided in appendix III. Seven practices on NBR were assessed on preparation for newborn resuscitation, drying/ stimulation, airway clearance, bag and mask ventilation for breathing and circulation. Assessment of practices entailed “yes (done)” or “no (not done)” or “NA (not applicable)” or “wrong action” for the observations.

The newborns were stratified by their resuscitation requirements and analyzed separately. In cases where a baby only required drying, the practices were followed for only steps involved in drying. In other babies requiring ventilation, CPR and oxygen, the steps involved in each were looked out for respectively.

Correct Practice was scored and categorized as follows - Each positive (yes/ done) observation was awarded a score of 1 was as a “not done” observation attracted a 0 score. Individuals who

scored less than 50% were termed as having poor practices, 50% - 74% being fair practice and 75% and above being good practice.

4.6.3 Adequacy of equipment and supplies in the Health Facility for Newborn Resuscitation

Health facility equipment and supplies adequacy for newborn resuscitation was assessed based on a basic neonatal resuscitation equipment checklist that is provided by the ETAT+ guidelines (WHO Technical specifications of Neonatal Resuscitation Devices, 2016) (38). The checklist lists basic equipment, and emergency supplies required for effective newborn resuscitation and are provided in appendix IV. The principal investigator visited each labour ward and conducted a detailed assessment of the available equipment and supplies at each relevant station within the labour ward, including storage rooms/cupboards, as well as at the point of care in rooms where newborns are delivered. These were documented on the checklist which is provided in appendix IV. In addition, random delivery sessions were identified on different days of the week, and at different times of the day or night, and equipment and supplies at the point of care were assessed and documented. Both permanent and temporary equipment was checked for and reported as absent or present. If present, the equipment was also checked for functionality and reported as functional or non-functional.

4.7 Study procedures of HCW on knowledge on NB resuscitation

A written formal letter was presented to the administration of the participating hospitals to obtain permission from them. The PI identified staff to be research assistants, and they were trained on data collection for 3 days before the study. Before administering consent, the PI or the research assistant informed the participants about the relevant key issues of the study to allow them to voluntarily participate. The nurses and midwives were approached at their places of work and

invited to participate, and an informed consent form was taken from those who were willing. Each participant was given a unique code to identify their questionnaire and then they filled the biodata form upon signing the consent form. The questionnaire captured socio-demographics, positive pressure ventilation requirements, resuscitation procedures, suctioning procedures, heart rate measurements and detection. The questionnaires were self-administered and filled with the presence of the principal investigator or the research assistants and this was done at their different work stations at the convenience of the HCW.

Study procedure of HCWs on practice and facility preparedness on NBR

Two research assistants (one for night shift and one for day shift) were recruited and trained for three days on how to observe resuscitations alongside a predetermined checklist before the study. The RAs were nurses recruited from amid the nursing staff at the antenatal ward to lessen the Hawthorne impact related to observational studies. This is on the supposition that the HCWs were less likely to change their practices when being observed by another HCW in the same unit as opposed to an observer from another hospital.

We started with one hospital by random selection, and after, we started on the other one in the same procedure. On the second day after the completion of the questionnaire from each participant, the research assistants approached the nurses and midwives at their work stations (i.e., labour ward and theatre) during both the day and night shifts, to assess their skills on newborn resuscitation against the predetermined observation checklist as shown in the appendix. The research assistants were available in the area of resuscitation each time delivery was being done either in the theatre or the delivery room. Observation check list focused on basic steps of newborn resuscitation (preparation of newborn resuscitation, drying and stimulation, airway clearance, bag and mask ventilation for breathing and circulation).

Assessment of Equipment and Supplies for Newborn Resuscitation

The principal investigator visited each labour ward and conducted a detailed assessment of the available equipment and supplies at each relevant station within the labour ward, including storage rooms/cupboards, as well as at the point of care in rooms where newborns are delivered. These were documented on the checklist which is provided in appendix IV. In addition, random delivery sessions were identified on different days of the week, and at different times of the day or night, and equipment and supplies at the point of care were assessed and documented.

Also before resuscitation, we collected information about the availability, functionality and accessibility of the necessary NR equipment at the resuscitaires using the basic NR equipment checklist in the appendix.

4.9 Data management

A data dictionary that clearly describes the study variables was created using Epidata in a secure password-protected computer before the commencement of data collection. Data collected was checked for accuracy and completeness before letting the participant leave to minimize missing data in the analysis stage. A database was then set up using Epidata with in-built quality control checks. Data was double entered to ensure that errors were avoided. The questionnaires were kept under lock and key, and only reachable to the principal investigator as well as the research assistants. The data was regularly backed up on Google drive.

4.10 Data Analysis

Data was analyzed with the use of SPSS version 23 statistical software. Descriptive characteristics of the health workers was analyzed and presented as frequencies and proportions for categorical data, and means with standard deviation or median with interquartile range for continuous data.

The level of knowledge and practices of the health workers were computed as the sum of their scores, divided by possible total scores and converted to a percentage. They were categorized as inadequate (<50%), moderate (50-74%), and adequate (≥75%) for knowledge, as well as poor (<50%), fair (50-74%), and good (≥75%) for practices. The adequacy of equipment and supplies (preparedness) of participating hospitals to conduct neonatal resuscitation was summarized to give hospital adequacy overall, and also at the point of care for those sessions that were assessed.

4.11 Ethical considerations

The University of Nairobi / Kenyatta National Hospital Ethics Research Committee provided ethical permission. Administrative written consent was also sought from the leadership of Banadir hospital and SOS hospital. Written informed approval was obtained from every participant and confidentiality was upheld throughout the study. Regardless of the findings, the principal investigator offered one-day training on newborn resuscitation using WHO ETAT guidelines at the end of the study, with special emphasis on areas where gaps in knowledge and practice were identified. All personal information was strictly kept confidential and only a study code for each health worker was used.

Any resuscitation practice that may be deemed extremely harmful to the baby was immediately interrupted to ensure the safety of the newborn. We anticipated that a small subset of newborns required significant resuscitation - those with Apgar scores below 5. For this subset of newborns, the research assistant observed without interfering if the resuscitation was proceeding appropriately. However, if the newborn had a life-threatening illness and the primary care team were failing to provide required resuscitation, for ethical reasons the observer was authorized to step in and assist the team. The assistance was provided in a none-judgmental or non-threatening manner and was treated as providing friendly support to the team. The practice was then classified

as poor for the given case based on observation up to the point of the research assistant stepping in. This was the standard approach of grading a trainee during the WHO newborn resuscitation course. At the end of the study, those HCWs identified to have poor KAP were offered training on newborn resuscitation.

4.12 Quality control

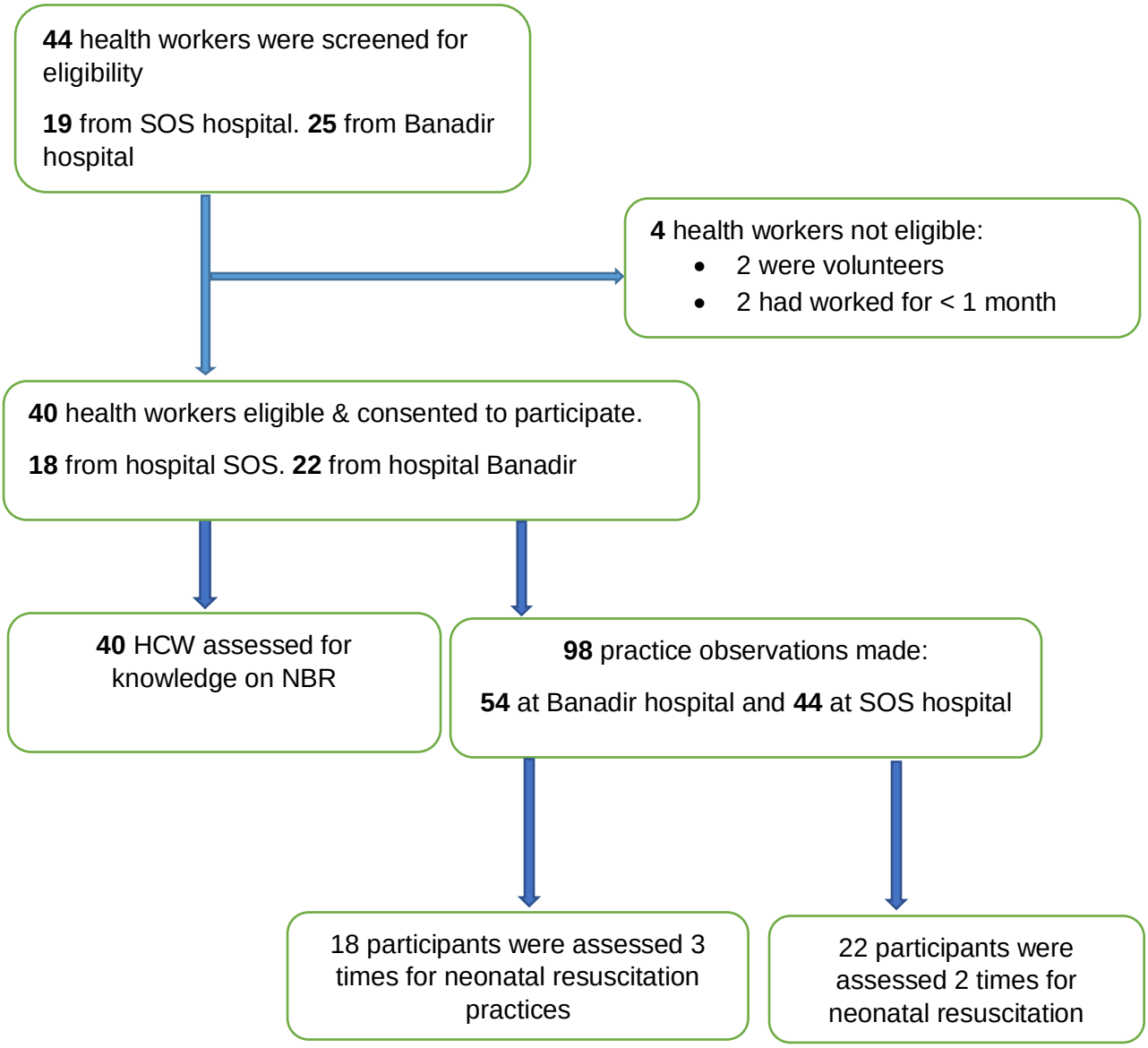
Research assistants were trained to ensure the quality of data. Double data entry and validation was done to ensure data quality.

4.13 Dissemination

Study results will be disseminated to the study hospitals, the University of Nairobi-Department of Paediatrics and Child Health, the university library, the Ministry of Health of Somalia and peer-reviewed Medical Journals and conferences.

CHAPTER FIVE: RESULTS

5.1 Flow Chart on screening and enrolment of the health care workers at study hospitals



The results of the demographic characteristics show that most of the participants were female (92.5%), and age majority of them were less than 25 years (52.5%) of age. The median age was 24.0 years (IQR 22.0 – 28.5), where the minimum observed age was 20.0 years and the maximum age was 60.0 years. Degree holders (82.5%) accounted for the majority of participants, and in their profession, most of the participants were midwives (70.0%). On the years of experience, about 52.5% had less than 2 years of working experience. Less than half (42.5%) had received refresher training. These results are as shown in table 1.0.

Table 4: Descriptive Characteristics of Health Care Workers at the Two Study Hospitals

Characteristic	Detail	Banadir	SOS	All	
		Freq. (%)	Freq. (%)	Freq.	Percent
Sex	Male	1 (4.5)	2 (11.1)	3	7.5
	Female	21 (95.5)	16 (88.9)	37	92.5
Age	<25	12 (54.5)	9 (50.0)	21	52.5
	25 – 35	7 (31.8)	8 (44.4)	15	37.5
	>35	3 (13.6)	1 (5.6)	4	10.0
Education	Diploma	3 (13.6)	4 (22.2)	7	17.5
	Degree	19 (86.4)	14 (77.8)	33	82.5
Profession	Midwife	17 (77.3)	11 (61.1)	28	70.0
	Nurse	5 (22.7)	7 (38.9)	12	30.0
Years of work experience	< 2 years	12 (54.5)	9 (50.0)	21	52.5
	2 - 5 years	9 (40.9)	4 (22.2)	13	32.5

	> 5 years	1 (4.5)	5 (27.8)	6	15.0
Received refresher training	Yes	11 (50.0)	6 (33.3)	17	42.5
	No	11 (50.0)	12 (66.7)	23	57.5

Table 5: Neonatal outcome

	Banadir		SOS	
	Frequency	%	Frequency	%
Survived and well	33	61.1	27	61.4
Survived and sick	16	29.6	15	34.1
Succumbed	5	9.3	2	4.5

Health Care Worker Knowledge on Newborn Resuscitation (Objective 1)

We interviewed the 40 HCWs on 16 aspects of newborn resuscitation. The results of the 16 items assessed on the knowledge of the study participants have been summarized in Table 2.0. The columns indicate the number of HCWS who gave a correct and those with an incorrect answer to the specific question.

Table 6: Knowledge of study participants

		Banadir		SOS	
		Cor.	Inc.	Cor.	Inc.
		n (%)	n (%)	n (%)	n (%)
1.	The best way to determine if a newborn needs resuscitation is to	14 (64)	8 (36)	7 (39)	11 (61)
2.	Immediate care for a normal newborn include	3 (14)	19 (86)	7 (39)	11 (61)
3.	The correct way to stimulate a new-born	16 (73)	6 (27)	9 (50)	9 (50)
4.	The steps of neonatal resuscitation are as follows	16 (73)	6 (27)	12 (67)	6 (33)
5.	Which baby is positioned properly for positive pressure ventilation	14 (64)	8 (36)	5 (28)	13 (72)
6.	When ventilating a new-born, you should provide positive pressure ventilation at a rate of	9 (41)	13 (59)	3 (17)	15 (83)
7.	In newborn babies, the cord should not be clamped earlier than one minute after birth if they do not require positive-pressure ventilation	17 (77)	5 (23)	13 (72)	5 (28)
8.	When newborn babies require positive-pressure ventilation, the cord should be clamped and cut to allow effective ventilation to be performed	12 (55)	10 (45)	11 (61)	7 (39)
9.	Which of the following is the most essential equipment for basic neonatal resuscitation	5 (23)	17 (77)	5 (28)	13 (72)

10.	In newly-born babies who do not start breathing despite thorough drying and additional stimulation, positive-pressure ventilation should be initiated within one minute after birth	13 (59)	9 (41)	12 (67)	6 (33)
11.	In newly-born babies requiring positive-pressure ventilation, ventilation should be provided using a self-inflating bag and mask	18 (82)	4 (18)	11 (61)	7 (39)
12.	In neonates born through clear amniotic fluid who start breathing on their own after birth, suctioning of the mouth and nose should not be performed	11 (50)	11 (50)	9 (50)	9 (50)
13.	In neonates born through clear amniotic fluid who do not start breathing after thorough drying and rubbing the back 2-3 times, suctioning of the mouth and nose should not be done routinely before initiating positive pressure ventilation. Suctioning should be done only if the mouth or nose is full of secretions	15 (68)	7 (32)	7 (39)	11 (61)
14.	All the following are indications of chest compressions except	4 (18)	18 (82)	2 (11)	16 (89)
15	Regarding chest compression in newborn all are true except	6 (27)	16 (73)	8 (44)	10 (56)
16.	In newly-born babies with no detectable heart rate after 10 minutes of effective ventilation, resuscitation should be stopped	16 (73)	6 (27)	9 (50)	9 (50)

The combined score for knowledge on newborn resuscitation

Each of the 16 items had a score of 1 mark making the maximum score to be 16 if all answers are correct, and the minimum score of 0 if all answers are wrong. The total score of each HCW obtained out of 16 was then converted into a percentage. We then categorized the level of knowledge according to their overall percentage score as poor (<50%), moderate (50 – 74%) and good (75-100%). This is displayed in table 4.0

More than half of the participants, 57.5% (23/40) had poor knowledge about neonatal resuscitation. Overall, the knowledge levels of the study participants were below average, 42.5% (17/40). The overall results of the assessment on the knowledge of the participants is summarized in table 4.0.

As noticed that poorly scored questions are questions 2, 6,9,12,14,15.

Table 7.0 Overall knowledge of the HCWs on Newborn Resuscitation

Participants scores	Frequency (n=40)	Percent
<50% (Poor)	23	57.5
50-75% (Moderate)	11	27.5
>=75% (Good)	6	15.0

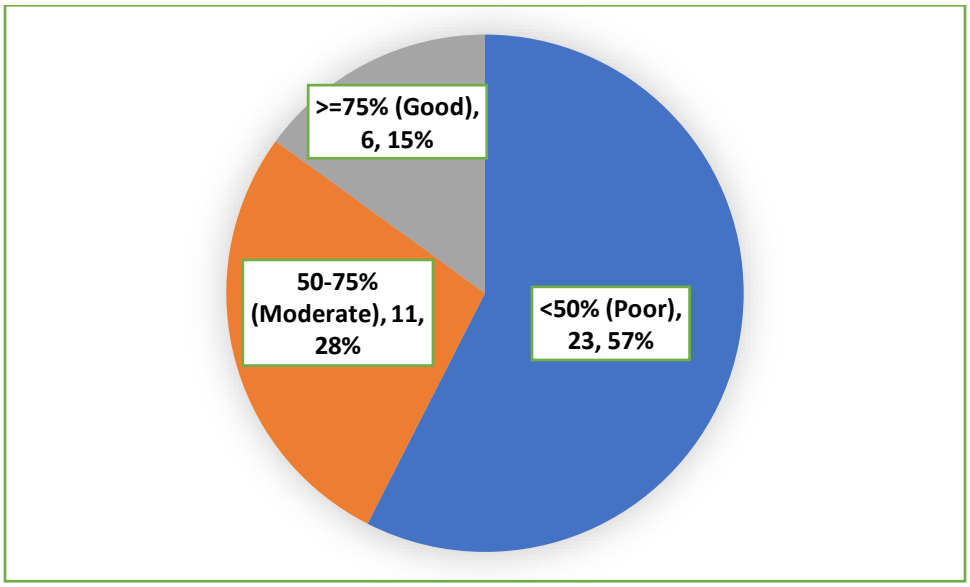


Figure 1.0: Overall knowledge of the participants

Health Care Worker Practices on Newborn Resuscitation (Objective 2)

This section of the study examined the practices of the HCW on the steps of newborn resuscitation, starting with the preparation for newborn resuscitation, then on drying/Stimulation (immediately after the birth for the newborn), airway clearance, bag and mask ventilation for breathing, and finally on circulation.

Table 8: Practices of study participants

The results in the table are a descriptive analysis of the observations for the number of HCW that performed certain actions for each step. In the results table, the "Yes" denotes that the action was correctly undertaken, "No" denotes that it was not done, "Wrong action" implies that the step was incorrectly performed, while "NA" implies that the action was not required for the particular case.

	Practice	**Frequency, n (%)**			
1.	**Preparation for newborn resuscitation**	**Yes**	**No**		
	Prepares area for resuscitation	81 (82.7)	17 (17.3)		
	Check availability of resuscitation equipment	57 (58)	41 (42)		
2.	**Drying/Stimulation (immediately after the birth for the newborn)**	**Yes**	**No**	**Wrong Action**	
	Was the baby dried thoroughly by gently rubbing the back?	49 (50)	15 (15)	34 (35)	
	Was Wet cloth removed?	44 (45)	54 (55)		
	Was the baby kept warm?	40 (41)	58 (59)		
3.	**Airway clearance score**	**Yes**	**No**	**Wrong Action**	**NA**
	Were the airways checked and cleared?	47 (48)	14 (14)	23 (24)	14 (14)
	Was meconium suctioned before stimulation?	26 (27)	20 (20)	20 (20)	32 (33)
	Was suction done by direct vision?	24 (25)	15 (15)	27 (28)	32 (33)
	Was the baby's head put in a neutral position?	24 (25)	23 (24)	19 (19)	32 (33)

4.	**Bag and Mask Ventilation for Breathing score**	**Yes**	**No**	**Wrong Action**	**NA**
	Was BMV initiated all the newborns who didn't initiate breathing or gasping? at 40-60 breath/min?	20 (20)	18 (18)	29 (30)	31 (32)
	Was started at the golden time?	38 (39)	29 (30)		31 (32)
	Was the mask size fit for the newborn?	25 (26)	42 (43)		31 (32)
	Was chest moving adequately each ventilation?	36 (37)	31 (32)		31 (32)
	Was resuscitator shouted for help?	38 (39)	29 (30)	31 (32)	
5.	**Circulation**	**Yes**	**No**	**Wrong Action**	**NA**
	Was the baby's heart rate checked at 1 minute?	49 (50)	13 (13)	6 (6)	30 (31)
	Was CPR started when HR is below 60bpm after 30-60 seconds of ventilation (3 chest compressions: one breath for 1 minute)	15 (15)	2 (2)	21 (21)	60 (61)
	Was supplemental oxygen provided?	24 (25)	14 (14)		60 (61)
	Was the thumb put in the correct position?	11 (11)	7 (7)	20 (20)	60 (61)
	Reassessment?	22 (22)	16 (16)		60 (61)

Scoring for the HCW practices on newborn resuscitation

For preparation for newborn resuscitation (0–2 points), the practice was either good if all two steps were correctly done, poor if one, very poor if none of the steps was performed correctly. For drying/simulation (0–3 points), the practice was categorized as good if all the three steps were performed correctly, fair if two steps, poor if one, and very poor if none of the steps was performed correctly. For airway clearance (0–4 points), the practice was categorized as good if all four steps were performed correctly, fair if three, poor if only one or two steps and very poor if none of the steps were performed correctly. For bag and mask ventilation for breathing (0–5 points), the practice was categorized as good if all five steps were performed correctly, fair if three to four, poor if only one to two, and very poor if none of the steps were performed correctly. For circulation (0–5), the practice was categorized as good all five steps, fair if three to four, poor if only one to two, and very poor if none of the steps were performed. The total maximum score possible was 19 if all the steps are taken and correctly performed, and 0 if all steps were taken and incorrectly performed. However, not all participants took all the steps, and therefore each participant was graded by calculating the sum for each correct steps taken over the total number of attempted steps and reported as a percentage. Practice for the participant was categorized as good if the score was 75% and above, fair if between 50-74%, or poor if the score was below 50%. For the 98 deliveries observed the breakdown for the scores are as shown (Table 6 – Table 10).

Table 9: Preparation for newborn resuscitation

PRACTICE OBSERVED (N = 98 deliveries observed)	SCORE ATTAINED FOR EACH PRACTICE, Number of HCW-observations attaining the score (%)			
Preparation for newborn resuscitation (score 0 – 2)	Score 0 No. (%)	Score 1 No. (%)	Score 2 No. (%)	Scored 3 No. (%)
1. Prepares the area for resuscitation 2. Check availability of resuscitation equipment	8 (8.2)	42 (42.9)	48 (49.0)	NA
Grading of Preparation for Resuscitation	Very poor 8 (8.2)	Poor 42 (42.9)	Good 48 (49.0)	NA

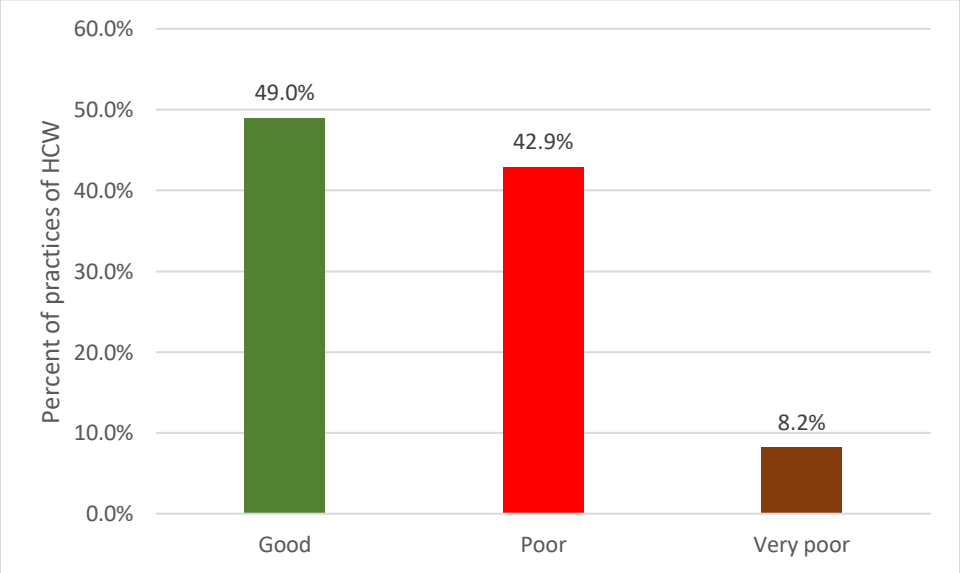


Figure 2.0: Preparation for newborn resuscitation

Table 10: Drying/Stimulation immediately after birth

PRACTICE OBSERVED (N = 98 deliveries observed)	SCORE ATTAINED FOR EACH PRACTICE, Number of HCW-observations attaining the score (%)			
Drying/Stimulation immediately after the birth (score 0 – 3)	Score 0 No. (%)	Score 1 No. (%)	Score 2 No. (%)	Scored 3 No. (%)
3. Was the baby dried thoroughly by gently rubbing the back? 4. Was Wet cloth removed? 5. Was the baby kept warm?	42 (42.9)	12 (12.2)	11 (11.2)	33 (33.7)
Grading of drying/stimulation	Very poor 42 (42.9)	Poor 12 (12.2)	Fair 11 (11.2)	Good 33 (33.7)

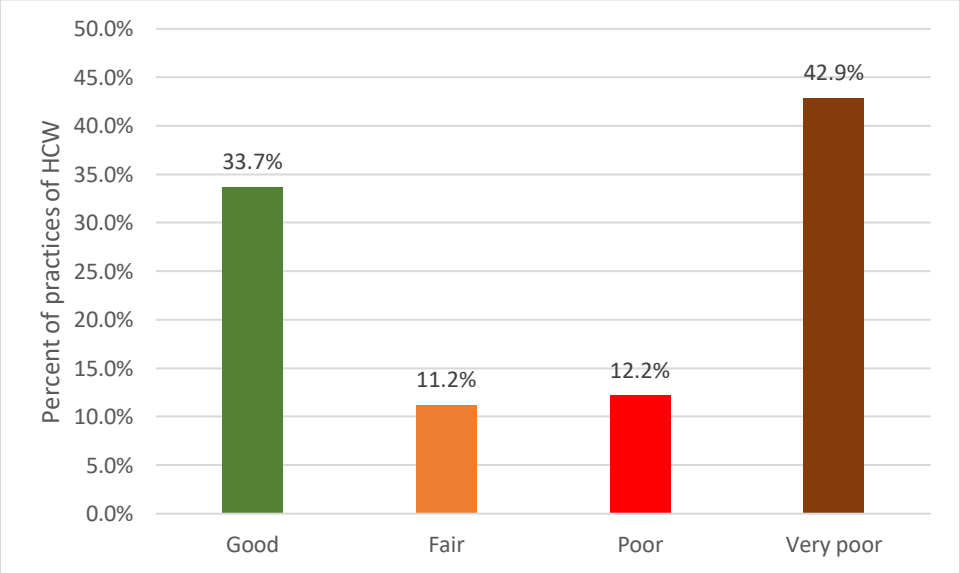


Figure 3.0: Drying/Stimulation immediately after birth

Table 11: Airway clearance

PRACTICE OBSERVED (N = 98 deliveries observed)	SCORE ATTAINED FOR EACH PRACTICE, Number of HCW-observations attaining the score (%)				
Airway clearance (score 0 – 4)	Score 0 No. (%)	Score 1-2 No. (%)	Score 3 No. (%)	Scored 4 No. (%)	NA No. (%)
6. Were the airways checked and cleared? 7. Was meconium suctioned before stimulation? 8. Was suction done by direct vision? 9. Was the baby's head put in a neutral position?	18 (18.4)	32 (32.7)	12 (12.2)	8 (8.2)	28 (28.6)
Grading of airway practice	Very poor 18 (25.7)	Poor 30 (42.9)	Fair 12 (17.1)	Good* 10 (14.3)	

*Instance of some HCW performing less steps hence changing their categorization e.g. if an HCW does only 1 step in this section and does it correctly the category was good

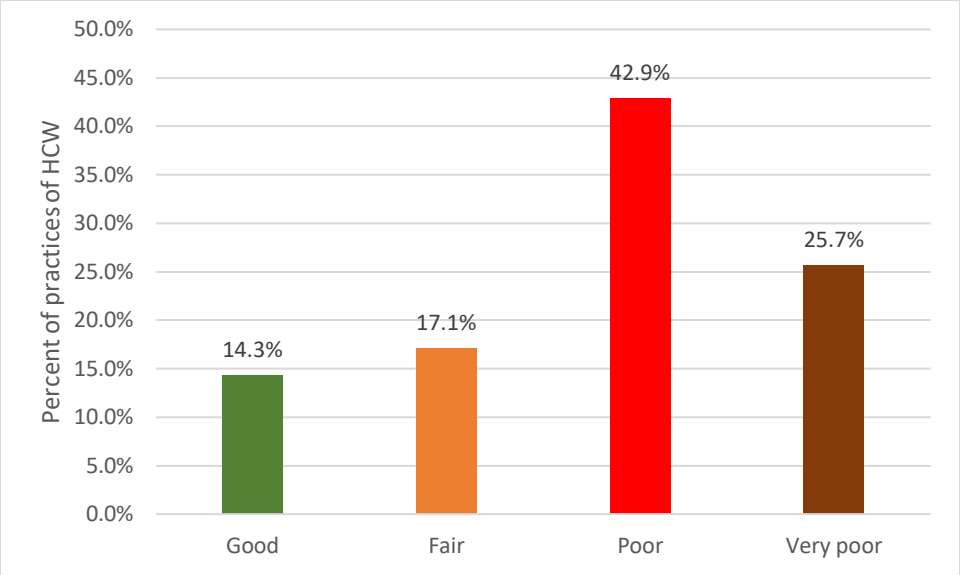


Figure 4.0: Airway clearance

Table 12: Bag and Mask ventilation for breathing

PRACTICE OBSERVED (N = 98 deliveries observed)	SCORE ATTAINED FOR EACH PRACTICE, Number of HCW-observations attaining the score (%)				
Bag and Mask Ventilation for Breathing (score 0 – 5)	Score 0 No. (%)	Score 1-2 No. (%)	Score 3-4 No. (%)	Scored 5 No. (%)	NA No. (%)
10. Was BMV initiated all the newborns who didn't initiate breathing or gasping? at 40-60 breath/min? 11. Was started at the golden time? 12. Was the mask size fit for the newborn?	8 (8.2)	27 (27.6)	29 (29.6)	3 (3.1)	31 (31.6)

13. Was the chest moving adequately for each ventilation? 14. Was resuscitator shouted for help?					
Grading of Bag and Mask Ventilation for Breathing	Very poor 8 (11.9)	Poor 27 (40.3)	Fair 29 (43.3)	Good 3 (4.5)	

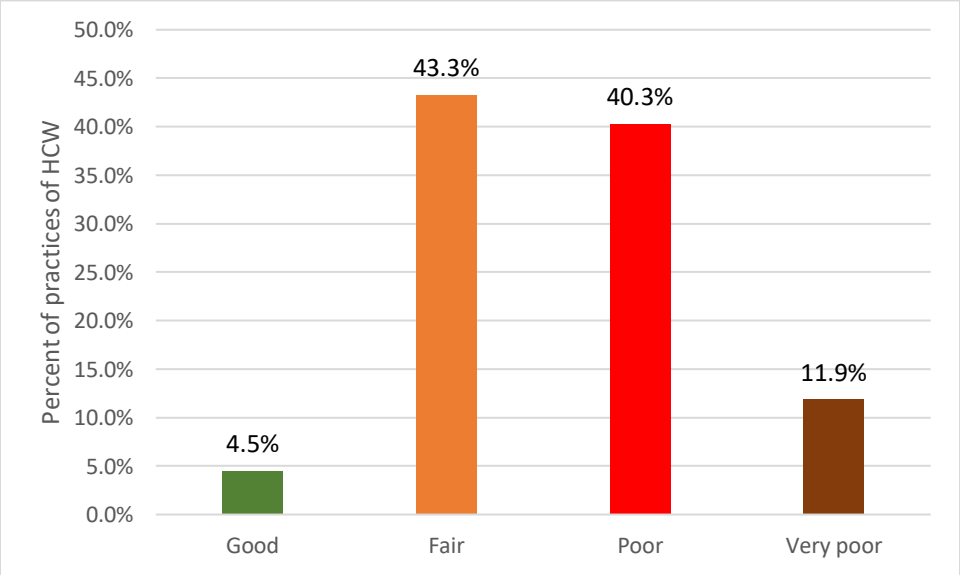


Figure 5.0: Bag and Mask ventilation for breathing

Table 13: Circulation

PRACTICE OBSERVED (N = 98 deliveries observed)	SCORE ATTAINED FOR EACH PRACTICE, Number of HCW-observations attaining the score (%)				
Circulation (score 0 – 5)	Score 0 No. (%)	Score 1-2 No. (%)	Score 3-4 No. (%)	Scored 5 No. (%)	NA No. (%)
15. Was the baby's heart rate checked at 1 minute? 16. Was CPR started when HR is below 60bpm after 30-60 seconds of ventilation (3 chest compressions: one breath for 1 minute) 17. Was supplemental oxygen provided? 18. Was the thumb put in the correct position? 19. Reassessment?	11 (11.2)	38 (38.7)	15 (15.3)	4 (4.1)	30 (30.6)
Grading of circulation	Very poor 10 (10.2)	Poor 18 (26.9)	Fair 15 (22.4)	Good* 24 (35.8)	

*Instance of some HCW performing less steps hence changing their categorization e.g. if an HCW does only 1 step in this section and does it correctly the category was good

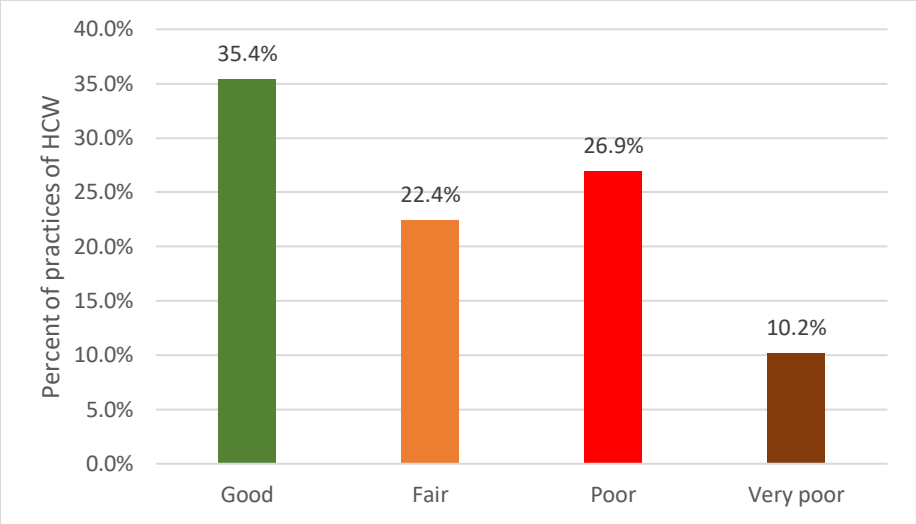


Figure 6.0: Circulation

Table 14: Assessment of practices of the participants

	Frequency (n=98)	Percent
Good score >75%?	14	14.3
Fair score 50-75%	15	15.3
Poor score 40 - 49%	36	36.7
Extremely poor score <40%	33	33.7

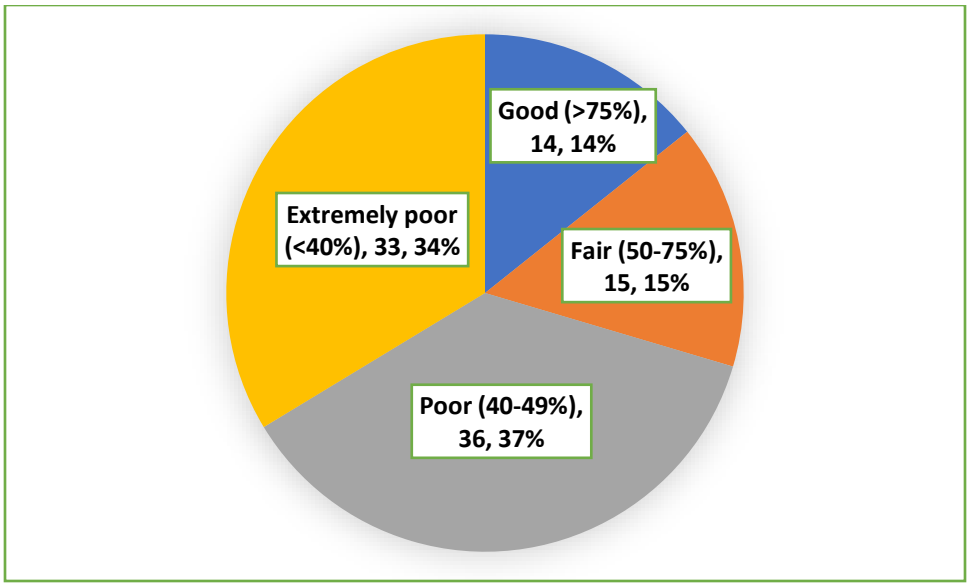


Figure 7.0: Overall grading of newborn resuscitation practices of the Health Care Workers

Hospital equipment and supplies for newborn resuscitation (Objective 3)

There were a total of 14 key hospital equipment and supplies for newborn resuscitation that are required in three areas of the hospital – labour ward, newborn unit, and maternity ward. We inspected the three areas in both hospitals for the presence or absence of each piece of equipment, and also if they were functional if present. The results are shown in Table 12.

Table 15: Hospital equipment and supplies for newborn resuscitation

Warmer/resuscitaires	Banadir Hospital	SOS Hospital
Labour ward	Present/Functional	Absent
Newborn unit	Present/Functional	Present/Functional
Maternity ward	Present/Non-functional	Absent
Oxygen source		
Labour ward	Absent	Absent

Newborn unit	Present/Functional	Present/Functional
Maternity ward	Present/Functional	Absent
Suction machine		
Labour ward	Present/Functional	Present/Non-functional
Newborn unit	Present/Functional	Present/Functional
Maternity ward	Present/Functional	Absent
Ambu bag		
Labour ward	Present/Functional	Absent
Newborn unit	Present/Functional	Present/Functional
Maternity ward	Present/Functional	Absent
Clock		
Labour ward	Absent	Absent
Newborn unit	Present	Absent
Maternity ward	Absent	Absent
Stethoscope		
Labour ward	Present/Functional	Absent
Newborn unit	Present/Functional	Present/Functional
Maternity ward	Present/Functional	Absent
Suction tube	Banadir	SOS
Labour ward	6F, 12F	Absent
Newborn unit	6F, 8F	Absent
Maternity ward	6F, 12F	Absent
Bulb suction device		

Labour ward	Present	Absent
Newborn unit	Absent	Present
Maternity ward	Present	Absent
Face mask		
Labour ward	Preterm: size 0 (P), size 1 (A)	Absent
Newborn unit	Preterm: size 0 (P), size 1 (P)	Preterm: size 0 (A), size 1 (P)
Maternity ward	Preterm: size 0 (P), size 1 (P)	Absent
Mode of oxygen delivery		
Labour ward	Absent	Absent
Newborn unit	Nasal prongs	Nasal prongs
Maternity ward	Nasal prongs	Absent
Clean dry towels		
Labour ward	Present	Present
Newborn unit	Present	Present
Maternity ward	Absent	Present
Oxygen tubing		
Labour ward	Absent	Absent
Newborn unit	Present	Present
Maternity ward	Absent	Absent
Gloves		
Labour ward	Present	Present
Newborn unit	Present	Present

Maternity ward	Absent	Present
Weighing scale		
Labor ward	0-10kg (P)	0-10kg
Newborn unit	0-20kg	30kg
Maternity ward	0-10kg	0-10kg (P)

Overall Hospital equipment and supplies for newborn resuscitation compliance

There were a total of 14 key hospital equipment and supplies for newborn resuscitation that were inspected for their presence or absence, and also if they were functional if present. The frequencies denote only present and functional equipment within the three departments of the participating hospitals. The overall compliance is calculated as a proportion of total equipment and supplies available divided by the total of the expected present and functional equipment and supplies i.e. 42.

Table 16a: Availability of required equipment and supplies for newborn resuscitation in Study Hospitals

Unit in Hospital	No. of required equipment items	Banadir No. items present & functional (%)	SOS Hospital No. items present & functional (%)
Labor ward	14	10 (71.4)	3 (21.4)
Newborn Unit	14	13 (92.9)	12 (85.7)
Maternity Ward	14	9 (64.3)	3 (21.4)
All Units	42	32 (76.2)	18 (42.9)

Overall compliance		76.2%	42.9%

The equipment and supplies were grouped into 3 main categories. The first category was the warmth and general equipment which consisted of the radiant warmer/rescucitators, clean dry towels, weighing scale, clock and gloves. The second category was for airway which consists of bulb suction device, suction machine, suction catheter/tubes. The last category was breathing circulation which consists of BVM 250ml/500ml, face mask sizes, oxygen supply source, mode of oxygen delivery, oxygen tubing, and stethoscope.

Table 16b: Availability of required equipment and supplies for newborn resuscitation in Study Hospitals

	No. of required equipment items	Banadir No. items present & functional (%)	SOS Hospital No. items present & functional (%)
Warmth and general equipment	15	10 (66.7)	10 (66.7)
Airway	9	8 (88.9)	2 (22.2)
Breathing &circulation	18	14 (77.8)	6 (33.3)
All units	42	32 (76.2)	18 (42.9)
Overall compliance		76.2%	42.9%

CHAPTER SIX: DISCUSSION

6.1 Introduction

Despite increasing improvements in maternal and child health indicators, neonatal mortality in Somalia remains high (39 in 1000 live births). In addition, the number of births needing resuscitation also remains high. Effective resuscitation of babies effectively can revert birth asphyxia, a major cause of neonatal mortality. Assessing knowledge and practices of nurses and midwives in neonatal resuscitation is important for policy makers on training needs. In this study, therefore, we sought to assess the level of knowledge and practices of nurses and midwives on neonatal resuscitation at two hospitals offering maternity services in the Federal Republic of Somalia, and also to evaluate hospital resources required for optimal newborn resuscitation. To answer these objectives, we conducted a cross-sectional study at Banadir maternity & children's hospital and SOS hospital in Mogadishu. Eligible nurses and midwives were those working in the labour ward for at least one month. Overall, the knowledge levels of the study participants were below average while the majority of the participants had poor practices.

6.2 Level of knowledge of nurses and midwives on neonatal resuscitation

Results from the analysis of the knowledge levels of the participants indicated that the majority of the health workers (57.5%) had poor knowledge levels. This level of knowledge of the study participants is below average, inadequate and worrisome given the challenges and outcomes of improper resuscitation of babies that require the procedure. Health workers who lack sufficient knowledge on neonatal resuscitation will most likely fail to perform the procedure thus leading to poor consequences such as birth asphyxia and eventual neonatal mortality. Studies have noted that effective resuscitation of babies can revert birth asphyxia which is a major cause of neonatal mortality. Evidence shows that among every 100 neonates who are resuscitated effectively at birth,

30 are saved from dying (protective efficacy = 30%) (2). Elsewhere in Africa, studies conducted in Nigeria and Malawi showed that birth asphyxia was the most common cause of mortality in newborns and that to ensure that neonates have positive outcomes, the healthcare attendants had to have skills and knowledge related to resuscitation (12-14). It is therefore important that nurses and midwives are trained to equip them with good knowledge on neonatal resuscitation thus averting the risk of death. A study done in Tanzania in 2013 revealed that there was a reduction in the risk of death of newborns by 47% after birth attendants involved in neonatal resuscitation had received training from the Helping Babies Breathe (HBB) program (11). Other researchers also affirm that the problems such as birth asphyxia leading to mortality can be averted by training health workers who attend to neonates on the proper procedures of resuscitating neonates, to ensure that they acquire the knowledge and skills they need to perform resuscitation timely and effectively (10).

The findings from the current study are similar to those obtained from the study by Alwar among nurses and midwives at Kenyatta National Hospital where only 39.0% had adequate knowledge about newborn resuscitation (24). Low knowledge levels among nurses and midwives have also been reported by Alhassan et al in Tamale, Ghana (23) of which 56.5% had received prior training, Gebreegziabher et al in Northwest Ethiopia of which there was no mention of prior training except for the undergraduate training (22) and Murila et al., among health care providers in Kenya of which 85.0% had received some information of neonatal resuscitation, out of which only 12.0% had formal training (25). The findings of the current study however differ from those reported by Kim et al in Afghanistan (39) whereby midwives scored an overall 66% on knowledge questions about newborn resuscitation. The difference in the levels of knowledge could be because over 80% of the midwives in Kim's study reported having received prior training on newborn resuscitation

which was not the case among the midwives in the current study. The knowledge findings of the current study also differ from those reported in the study by Ogunlesi et al in West Nigeria where the nurses scored 78% on knowledge questions thus demonstrating adequacy of newborn resuscitation knowledge (27). The reason for the contrasting results could be because the study in West Nigeria focused on secondary health care level nurses who often attended to obstetric cases that were being referred from a primary health care level. The results could also have varied because majority of the nurses in the Nigeria study had attended NR training courses and had worked in the special care baby units for quite a while thus having the exposure to the newborns who required resuscitation. There was no significant association between knowledge levels and age, gender, education level, profession, years of experience and receiving a NR refresher training. Several studies have reported an association between the profession, receiving a NR refresher training and knowledge (23-25, 27). The current study may not have found significant associations because of limitations of sample size when compared to these other studies. Even when there was no statistical significance, in comparison to the nurses, midwives were 2.5 times more likely to have good knowledge about NBR.

6.3 Practices of nurses and midwives regarding neonatal resuscitation

Concerning practice towards NR, categorized as good for >75%, fair for 50-75%, poor for 40 - 49% and extremely poor for <40%, of the 98 resuscitation observations made, there was 14 (14.3%) were good, 15 (15.3%) were fair, 36 (36.7%) were poor while 33 (33.7%) were very poor. This indicates a 70.4% below average practice rate (poor and very poor combined). The 70.4% poor practice rate poses a challenge to the management of neonates requiring resuscitation due to the life-threatening situations that arise from such poor practice. The life-threatening situations could include the experience of a cardiopulmonary arrest, unresolved birth asphyxia among others.

The 70.4% rate of poor practice is not a surprise because without adequate knowledge (as seen in the current study), the practices will most definitely correlate with knowledge levels. As previously stated, nurses and midwives must be trained to equip them with good knowledge on NR which will eventually translate to good practices and skills thus averting the risk of death. Other reasons for the poor practices could be because the majority of the included health workers had had less than 2 years of experience and had not received refresher training on NBR.

Several other studies have reported poor NBR practices among nurses and midwives. The studies include the one by Alwar at Kenyatta National Hospital (24), Alhassan et al in Tamale, Ghana (23), Gebreegziabher et al in Northwest Ethiopia (22) and Duncan et al among health care providers in Kenya (25). Good NBR practices among nurses and midwives have however been reported by Kim et al in Afghanistan (39) and Ogunlesi et al in West Nigeria (27). As earlier mentioned, the participants in these two studies had received in-service training on newborn resuscitation. In Afghanistan, to improve the capacity of midwives in maternal and newborn health, there's an ongoing motive to significantly invest in quality education and graduation of competent professional midwives thus providing them with the skills required to practice. For this reason, the midwives in Afghanistan are most likely to be more skilled as compared to those in Somalia. A report showed that to date, with over 3,000 Afghan midwives have been trained (40). There is therefore need to provide more training opportunities for midwives in Somalia as well in a bid to develop a skilled, professional mid wife force that will eventually translate to good practices towards NBR.

6.4 Basic Neonatal Resuscitation Equipment

Generally, regarding the availability of NBR equipment, both hospitals lacked functional essential basic neonatal resuscitation equipment though Banadir had a higher compliance rate (76.2%)

compared to SOS Hospital which had a much lower below-average compliance rate (42.9%). Such lack of essential equipment could have been the major reason for the poor practice among the midwives and nurses. Other studies have also reported the lack of essential neonatal resuscitative equipment as observed in the current study. The studies include those done by Ogunlesi et al in western Nigeria (27), Kambarami et al in Zimbabwe and Couper et al in South Africa (41).

6.5 Strengths and limitations

6.5.1 Strengths

In the current study, two research assistants (one for day shift and one for night shift) were recruited to be able to minimize selection bias. As such, the study population included both health workers (nurses and midwives) who worked at night and those who worked during the day. Furthermore, in this study, research assistants were given 3 days of instruction/ training on how to observe resuscitations against a predetermined checklist before the study. Therefore, quality data was assured. Finally, to minimize the Hawthorne effect associated with observation studies, the RAs were nurses recruited from among the nursing staff at the antenatal ward. This was on the assumption that the HCWs were less likely to change their practices when being observed by another HCW in the same unit as opposed to an observer from outside the hospital.

6.5.2 Limitations

Some responses from the participants were based on objectivity (self-reports) which could have limited the truthfulness and hence information bias. This may also have led to the overestimation or underestimation of the attributes leading to the measurement of knowledge on NBR. To minimize information bias, the participants were briefed about the study and assured of how the responses would only be used for research purposes.

Selection bias could also be present in this study because data was collected within just a short period. Participants who were selected could have therefore been those who were available at that particular time of the study when they are supposed to be there. To reduce selection bias, participants were selected randomly in a bid to generate a representative sample.

This study may also have been liable to recall bias. In cases where the participants may not have been able to remember some of the information related to NBR. The participants were given enough time to respond to the questions so that the information given was as true as possible.

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- Knowledge about newborn resuscitation was generally poor.

- General practices of the nurses and midwives regarding newborn resuscitation were very poor.
- The overall compliance on essential basic neonatal resuscitation for Banadir hospital was fair, and poor for SOS hospital of which it lacked more than half of them.

7.1 Recommendations

- It is vital for the hospitals to assess the training needs requirements, to provide regular newborn resuscitation training sessions to allow for better retention of the skills acquired and better practices towards newborn resuscitation.
- To the hospitals, it is also recommended that all health care workers involved in newborn resuscitation practices be regularly monitored on their practice.
- To the Ministry of Health of Somalia, it is recommended that it conduct a needs assessment for health facilities in terms of equipment and supplies to the maternity theatre and labour suites for resuscitation episodes.
- To future researchers, it is recommended that a nationwide study involving all health workers is done to obtain a true population picture of the magnitude of the gap in knowledge and practice about NBR is.

REFERENCES

1. Hegenbarth MAJP. Preparing for pediatric emergencies: drugs to consider. Paediatrics. 2008;121(2):433-43.

2. Lee AC, Cousens S, Wall SN, Niermeyer S, Darmstadt GL, Carlo WA, et al. Neonatal resuscitation and immediate newborn assessment and stimulation for the prevention of neonatal deaths: a systematic review, meta-analysis and Delphi estimation of mortality effect. BMC public health. 2011;11(3): S12.

3. Lockyer J, Singhal N, Fidler H, Weiner G, Aziz K, Curran VJP. The development and testing of a performance checklist to assess neonatal resuscitation megacode skill. Pediatrics. 2006;118(6):e1739-e44.

4. Hug L, Sharrow D, You D. Levels & Trends in Child Mortality: Report. Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation. United Nations Inter-Agency Group for Child Mortality Estimation, New York …; 2017.

5. Health Mo. Somalia Every Newborn Action Plan. 2019.

6. IGME UJU, New York. Levels and trends in child mortality: Report 2015. UN, New York. 2015.

7. Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. The lancet. 2010;375(9730):1969-87.

8. Mmbaga BT, Lie RT, Olomi R, Mahande MJ, Kvåle G, Daltveit AKJBp. Cause-specific neonatal mortality in a neonatal care unit in Northern Tanzania: a registry-based cohort study. BMC paediatrics. 2012;12(1):116.

9. Fetuga B, Ogunlesi T, Adekanmbi F, Olanrewaju D, Olowu AJSAJoCH. Comparative analyses of childhood deaths in Sagamu, Nigeria: implications for the fourth MDG. South African Journal of Child Health. 2007;1(3):106-11.

10. Organization WH. Guidelines on basic newborn resuscitation. 2012.

11. Msemo G, Massawe A, Mmbando D, Rusibamayila N, Manji K, Kidanto HL, et al. Newborn mortality and fresh stillbirth rates in Tanzania after helping babies breathe training. Pediatrics. 2013;131(2):e353-e60.

12. Kumbani C, Sundby J, Odland OJJNMR. Factors associated with perinatal deaths in women delivering in a health facility in Malawi. J Nurs Midwifery Res. 2012;1:69-79.

13. Ibekwe P, Ugboma H, Onyire N, Muoneke UJAom, research hs. Perinatal mortality in southern Nigeria; less than half a decade to the millennium developmental goals. Annals of medical health sciences research. 2011;1(2):215-22.

14. Engmann C, Walega P, Aborigo RA, Adongo P, Moyer CA, Lavasani L, et al. Stillbirths and early neonatal mortality in rural Northern Ghana. Tropical Medicine International Health. 2012;17(3):272-82.

15. Wall SN, Lee AC, Niermeyer S, English M, Keenan WJ, Carlo W, et al. Neonatal resuscitation in low-resource settings: what, who, and how to overcome challenges to scale up? International Journal of Gynecology Obstetrics. 2009;107(Supplement):S47-S64.

16. Kattwinkel J, Stewart C, Walsh B, Gurka M, Paget-Brown AJP. Responding to compliance changes in a lung model during manual ventilation: perhaps volume, rather than pressure, should be displayed. Pediatrics. 2009;123(3):e465-e70.

17. World Health Organization. Emergency Triage Assessment and Treatment (ETAT)2005.

18. Owen CJ, Wyllie JPJR. Determination of heart rate in the baby at birth. Resuscitation. 2004;60(2):213-7.

19. O'Donnell CP, Kamlin COF, Davis PG, Carlin JB, Morley CJJAoDiC-F, Edition N. Clinical assessment of infant colour at delivery. Archives of Disease in Childhood-Fetal Neonatal Edition. 2007;92(6):F465-F7.

20. Apgar VJCPiCC. A proposal for a new method of evaluation of the newborn. Classic Papers in Critical Care. 1952;32(449):97.

21. O'Hare B, Nakakeeto M, Southall DJJoTP. A pilot study to determine if nurses trained in basic neonatal resuscitation would impact the outcome of neonates delivered in Kampala, Uganda. Journal of Tropical Pediatrics. 2006;52(5):376-9.

22. Gebreegziabher E, Aregawi A, Getinet HJWjoem. Knowledge and skills of neonatal resuscitation of health professionals at a university teaching hospital of Northwest Ethiopia. World journal of emergency medicine. 2014;5(3):196.

23. Alhassan A, Fuseini A-G, Osman W, Basour Adam AJNr, practice. Knowledge and experience of neonatal resuscitation among midwives in Tamale. Nursing research practice. 2019;2019.

24. Alwar TO. Newborn resuscitation: knowledge and practice among midwives in Kenyatta National Hospital labour ward and maternity theatre: University Of Nairobi; 2010.

25. Murila F, Obimbo MM, Musoke RJPAMJ. Assessment of knowledge on neonatal resuscitation amongst health care providers in Kenya. Pan African Medical Journal. 2012;11(1).

26. Shikuku DN, Milimo B, Ayebare E, Gisore P, Nalwadda GJBri. Quality of care during neonatal resuscitation in kakamega county general hospital, Kenya: a direct observation study. BioMed research international. 2017;2017.

27. Ogunlesi T, Dedeke O, Adekanmbi FA, Fetuga BM, Okeniyi AJJSAJoCH. Neonatal resuscitation: knowledge and practice of nurses in western Nigeria. South African Journal of Child Health. 2008;2(1):23-5.

28. Khalid N, Ahmad M, Tahir A, Mahmood H, Saleem S, Saleem SJJTJotPMA. Basic neonatal resuscitation, knowledge assessment at primary health care centers of district

Sheikhupura in Pakistan—a cross-sectional study. JPMA The Journal of the Pakistan Medical Association. 2015;65(9):990-4.

29. WAISMAN Y, Amir L, MIMOUNI MJPec. Does the pediatric advanced life support course improve knowledge of pediatric resuscitation? Pediatric emergency care. 2002;18(3):168-70.

30. Blumenfeld A, Abraham RB, Stein M, Shapira S, Reiner A, Reiser B, et al. Cognitive knowledge decline after advanced trauma life support courses. Journal of Trauma Acute Care Surgery. 1998;44(3):513-6.

31. Opiyo N, Were F, Govedi F, Fegan G, Wasunna A, English MJPO. Effect of newborn resuscitation training on health worker practices in Pumwani Hospital, Kenya. PLoS One. 2008;3(2).

32. Carbine DN, Finer NN, Knodel E, Rich WJP. Video recording as a means of evaluating neonatal resuscitation performance. Pediatrics. 2000;106(4):654-8.

33. Chan L-C, Hey EJAoDiC-F, Edition N. Can all neonatal resuscitation be managed by nurse practitioners? Archives of Disease in Childhood-Fetal Neonatal Edition. 2006;91(1):F52-F5.

34. Opondo C, Ntoburi S, Wagai J, Wafula J, Wasunna A, Were F, et al. Are hospitals prepared to support newborn survival?–an evaluation of eight first-referral level hospitals in Kenya. Tropical Medicine International Health. 2009;14(10):1165-72.

35. Bang AT, Bang RA, Baitule SB, Reddy HM, Deshmukh MDJJoP. Management of birth asphyxia in home deliveries in rural Gadchiroli: the effect of two types of birth attendants and of resuscitating with mouth-to-mouth, tube-mask or bag–mask. Journal of Perinatology. 2005;25(1):S82-S91.

36. Lawn JE, Cousens S, Zupan J, lancet LNSSTJT. 4 million neonatal deaths: when? Where? Why? The lancet. 2005;365(9462):891-900.

37. World Health Organization. Paediatric emergency triage, assessment and treatment: care of critically-ill children. 2016.

38. Organization WH. WHO technical specifications of neonatal resuscitation devices: World Health Organization; 2016.

39. Kim YM, Ansari N, Kols A, Tappis H, Currie S, Zainullah P, et al. Assessing the capacity for newborn resuscitation and factors associated with providers' knowledge and skills: a cross-sectional study in Afghanistan. 2013;13(1):1-12.

40. Todd C, Mansoor G, Wood M, Gohar F, Mir S, Hashimy PJU, Afghanistan. Evaluation of midwifery retention in Afghanistan. 2012.

41. Couper I, Thurley J, Hugo J. The neonatal resuscitation training project in rural South Africa. 2005.

APPENDICES

APPENDIX I: Additional analysis

1. The best way to determine if a newborn needs resuscitation is to:

	Frequency (n=40)	Percent
Dry the baby and observe the response to this stimulation	**21**	**52.5**
Wait until one minute after birth and assign the Apgar score	12	30.0

Listen to the baby's heart rate	6	15.0
Perform resuscitation only if central cyanosis is present	1	2.5

2. Immediate care for a normal newborn includes:

	Frequency (n=40)	Percent
Skin to skin contact followed by placing of the baby in warm incubator	25	62.5
Drying the baby, removing the wet cloth and covering with clean dry cloth	**10**	**25.0**
Deep suctioning to remove the mucus	4	10.0
Squeezing the chest to remove secretions from the airway	1	2.5

3. The correct way to stimulate a new-born:

	Frequency (n=40)	Percent
Slap the back	8	20.0
Rub the back 2-3 times	**25**	**62.5**
Slap the sole of foot	6	15.0
Squeeze the rib cage	1	2.5

4. The steps of neonatal resuscitation are as follows:

	Frequency (n=40)	Percent
Provide warmth→ Dry and stimulate→ Position head and clear airway→ provide positive pressure ventilation →Chest compression →Administer epinephrine	**28**	**70.0**
Provide positive pressure ventilation →Chest compression →Administer adrenaline →Position head and clear airway→ Provide warmth	11	27.5
Administer adrenaline→ Chest compression→ Positive pressure compression→ Position head and clear airway→ Provide warmth	1	2.5

5. Which baby is positioned properly for positive pressure ventilation:

	Frequency (n=40)	Percent
A	8	20.0
B	13	32.5
C	**19**	**47.5**

6. When ventilating a new-born, you should provide positive pressure ventilation at a rate of ----------to---------beats per minute:

	Frequency (n=40)	Percent
40-60	**12**	**30.0**
20-40	11	27.5
60-80	17	42.5

7. In newborn babies, the cord should not be clamped earlier than one minute after birth if they do not require positive-pressure ventilation:

	Frequency (n=40)	Percent
True	**30**	**75.0**
False	10	25.0

8. When new born babies require positive-pressure ventilation, the cord should be clamped and cut to allow effective ventilation to be performed:

	Frequency (n=40)	Percent
True	**23**	**57.5**
False	17	42.5

9. Which of the following is the most essential equipment for basic neonatal resuscitation?

	Frequency (n=40)	Percent
Oxygen cylinder	29	72.5
Adrenaline and sodium bicarbonate	1	2.5
Self-inflating bag- valve mask device	**10**	**25.0**

10. In newly-born babies who do not start breathing despite thorough drying and additional stimulation, positive-pressure ventilation should be initiated within one minute after birth

	Frequency (n=40)	Percent
True	**25**	**62.5**
False	15	37.5

11. In newly-born babies requiring positive-pressure ventilation, ventilation should be provided using a self-inflating bag and mask

	Frequency (n=40)	Percent
True	**29**	**72.5**
False	11	27.5

12. In neonates born through clear amniotic fluid who start breathing on their own after birth, suctioning of the mouth and nose should not be performed

	Frequency (n=40)	Percent
True	**20**	**50.0**
False	20	50.0

13. In neonates born through clear amniotic fluid who do not start breathing after thorough drying and rubbing the back 2-3 times, suctioning of the mouth and nose should not be done routinely before initiating positive pressure ventilation. Suctioning should be done only if the mouth or nose is full of secretions.

	Frequency (n=40)	Percent
True	**22**	**55.0**
False	18	45.0

14. All the following are indications of chest compressions except

	Frequency (n=40)	Percent
No cardiac activity	28	70.0
Heart rate less than 60 pbm	6	15.0
Need for ventilation	**6**	**15.0**

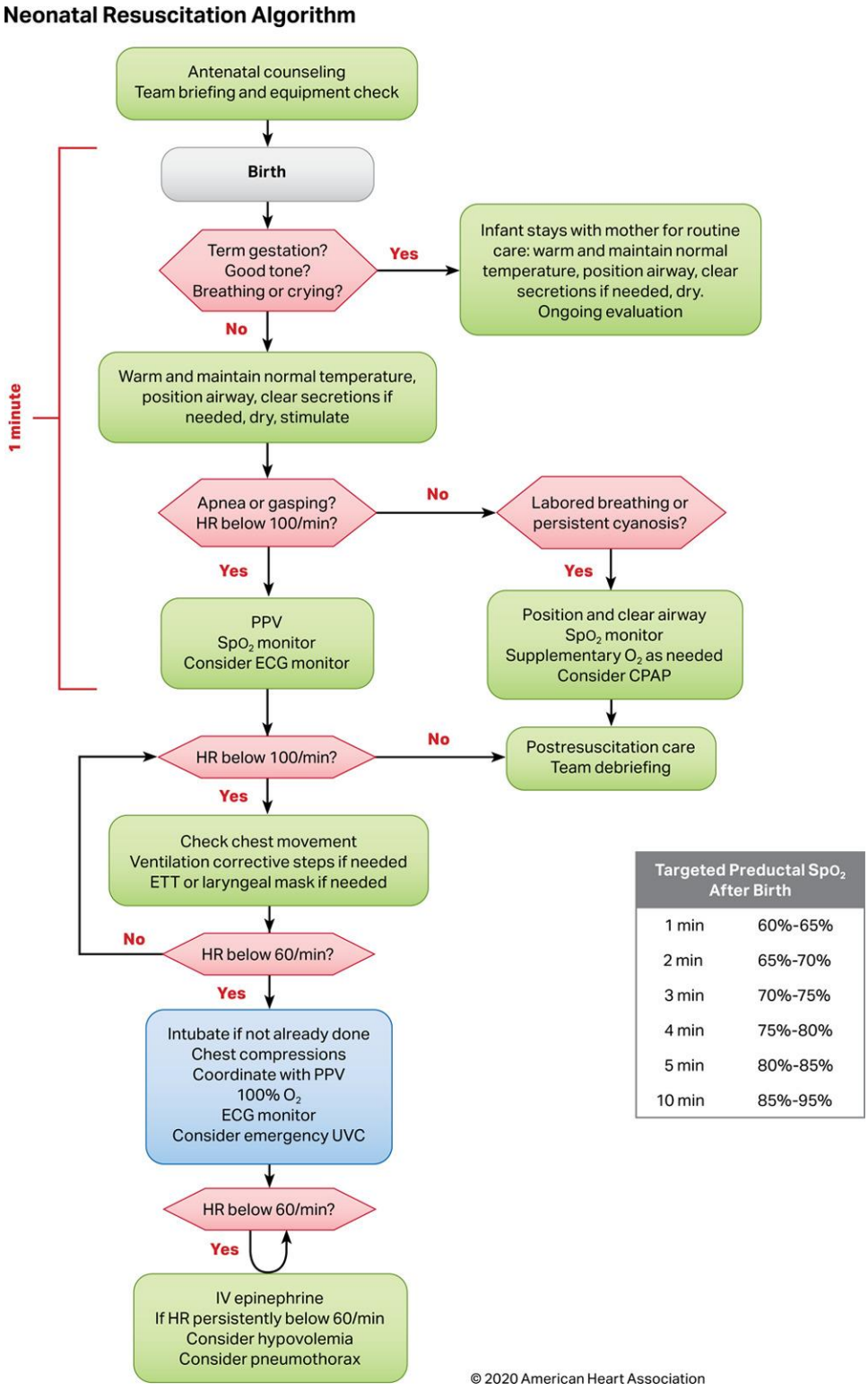
15. Regarding chest compression in newborn all are true except

	Frequency (n=40)	Percent
Ratio of Chest compressions: Ventilation is 15:2	**14**	**35.0**
Place thumbs just below the imaginary line connecting the nipples on the sternum	12	30.0
Compress one third the anterior–posterior diameter of the chest	10	25.0
Stop chest compressions if HR > 60pbm and reassess	4	10.0

16. In newly-born babies with no detectable heart rate after 10 minutes of effective ventilation, resuscitation should be stopped

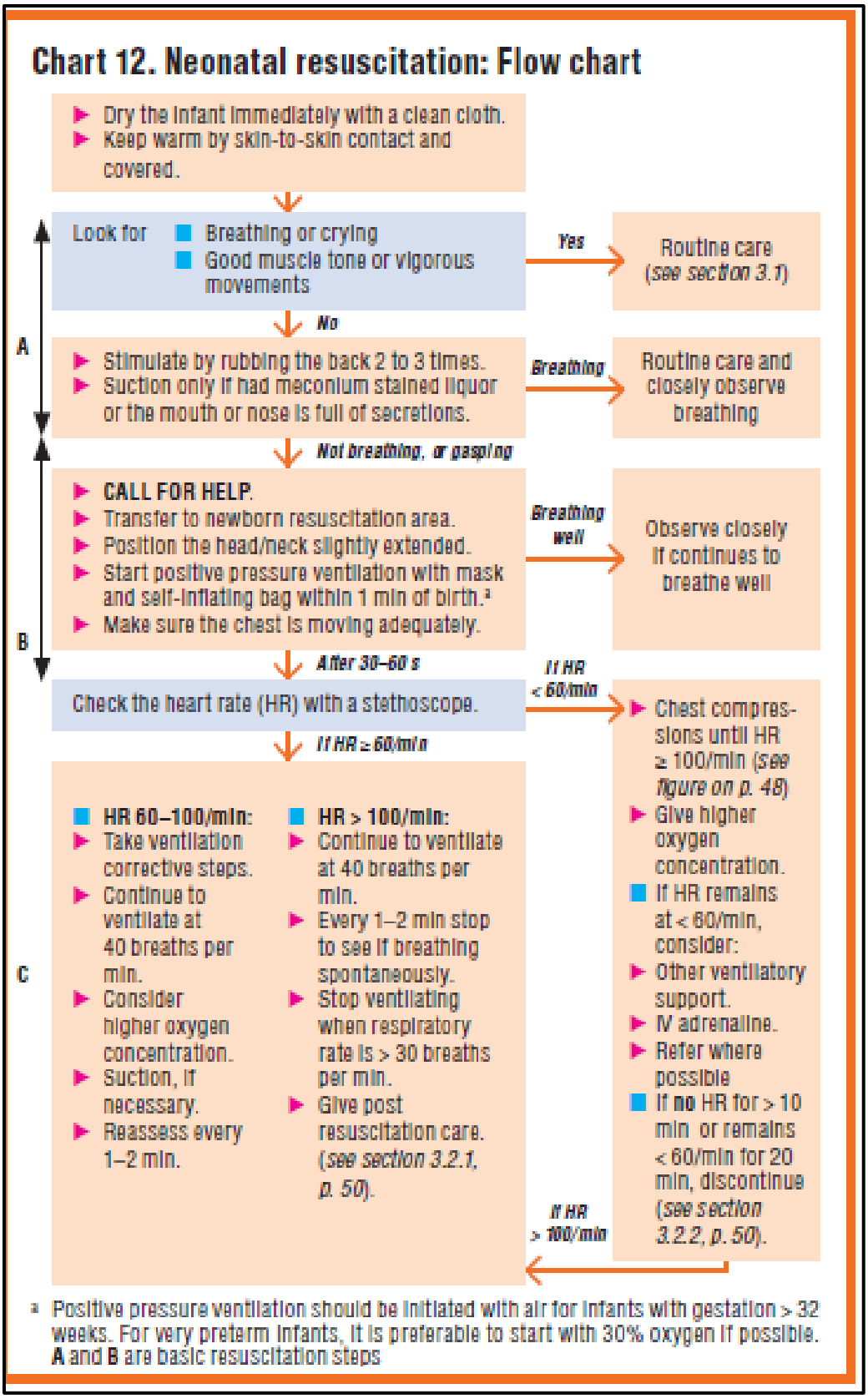
	Frequency (n=40)	Percent
True	**25**	**62.5**
False	15	37.5

APPENDIX II: Initial steps of resuscitation



Appendix II Neonatal Resuscitation Algorithm based on WHO Pocketbook of Hospital Care for Children

Chart 12. Neonatal resuscitation: Flow chart



[a] Positive pressure ventilation should be initiated with air for infants with gestation > 32 weeks. For very preterm infants, it is preferable to start with 30% oxygen if possible.
A and **B** are basic resuscitation steps

Chart 12. Neonatal resuscitation: Steps and process

There is no need to slap the infant; rubbing the back two or three times in addition to thorough drying is enough for stimulation.

A. Airway

- Keep the infant's head in a slightly extended position to open the airway.
- Do not suction routinely. Suction the airway if there is meconium-stained fluid **and** the infant is **not** crying and moving limbs. When the amniotic fluid is clear, suction only if the nose or mouth is full of secretions.
  - Suck the mouth, nose and oropharynx by direct vision; do not suck right down the throat, as this can cause apnoea or bradycardia.

B. Breathing

- Choose a mask size that fits over the nose and mouth (see below): size 1 for normal-weight infant, size 0 for small (< 2.5 kg) infants
- Ventilate with bag and mask at 40–60 breaths/min.
- Make sure the chest moves up with each press on the bag; in a very small infant, make sure the chest does not move too much (danger of causing pneumothorax).

C. Circulation

- Give chest compressions if the heart rate is < 60/min after 30–60 s of ventilation with adequate chest movements: 90 compressions coordinated with 30 breaths/min (three compressions: one breath every 2 s).
- Place thumbs just below the line connecting the nipples on the sternum (see below).
- Compress one third the anterior–posterior diameter of the chest.

Correct head position to open up airway and for bag ventilation.

Do not hyperextend the neck.

Correct position of hands for cardiac massage of a neonate. The thumbs are used for compression over the sternum.

APPENDIX III: Data collection tool

Part A: Social Demographic Characteristics

1. Sex: 1. Male ☐ 2. Female ☐
2. Age in years: .....
3. Level of education: 1. Diploma ☐
   2. Degree ☐
   3. others ☐
4. What is your profession? 1. Mid wife ☐ 2. Nurse ☐
5. How many years of experience do you possess?

1.Less than 2 years ☐ 2.Between 2 and 5 years ☐ 3. More than 5 years ☐

6. Have you received any refresher trainings on neonatal resuscitation

Yes ☐ No ☐

If yes in 6 above, please specify the courses attended …….

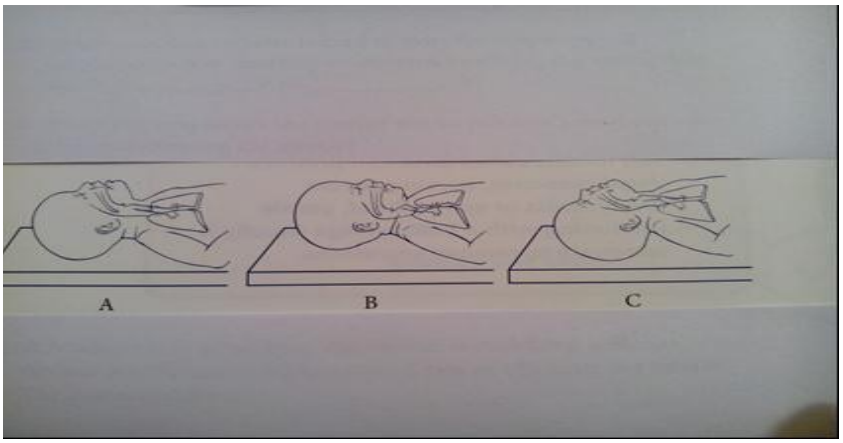
Part B: Assessment of Knowledge (Circle the correct option)

1. The best way to determine if a newborn needs resuscitation is to
   a) Dry the baby and observe the response to this stimulation
   b) Wait until one minute after birth and assign the Apgar score
   c) Listen to the baby's heart rate
   d) Perform resuscitation only if central cyanosis is present.
   e) Check for meconium staining for baby's skin

2. Immediate care for a normal newborn includes:
    a) Skin to skin contact followed by placing of the baby in warm incubator
    b) drying the baby, removing the wet cloth and covering with clean dry cloth
    c) stimulating the baby by slapping the soles of foot
    d) deep suctioning to remove the mucus .
    e) squeezing the chest to remove secretions from the airway .

3. The correct way to stimulate a new-born
    a) Slap the back
    b) Rub the back 2-3 times
    c) Slap the sole of foot.
    d) Squeeze the rib cage

4. The steps of neonatal resuscitation are as follows
    a) Provide warmth→ Dry and stimulate→ Position head and clear airway→ provide positive pressure ventilation →Chest compression →Administer epinephrine
    b) Provide positive pressure ventilation →Chest compression →Administer adrenaline →Position head and clear airway→ Provide warmth
    c) Administer adrenaline→ Chest compression→ Positive pressure compression→ Position head and clear airway→ Provide warmth
5. Which baby is positioned properly for positive pressure ventilation?



6. When ventilating a new-born, you should provide positive pressure ventilation at a rate of ---------to---------beats per minute

    a) 40-60
    b) 20-40
    c) 60-80

7. In newborn babies, the cord should not be clamped earlier than one minute after birth if they do not require positive-pressure ventilation

    True False

8. When new born babies require positive-pressure ventilation, the cord should be clamped and cut to allow effective ventilation to be performed.

    True False

9. Which of the following is the most essential equipment for basic neonatal resuscitation?

    a) Oxygen cylinder

b) Laryngoscope

c) Adrenaline and sodium bicarbonate

d) Self-inflating bag- valve mask device

10. In newly-born babies who do not start breathing despite thorough drying and additional stimulation, positive-pressure ventilation should be initiated within one minute after birth.

True False

11. In newly-born babies requiring positive-pressure ventilation, ventilation should be provided using a self-inflating bag and mask.

True False

12. In neonates born through clear amniotic fluid who start breathing on their own after birth, suctioning of the mouth and nose should not be performed.

True False

13. In neonates born through clear amniotic fluid who do not start breathing after thorough drying and rubbing the back 2-3 times, suctioning of the mouth and nose should not be done routinely before initiating positive pressure ventilation. Suctioning should be done only if the mouth or nose is full of secretions.

True False

14. All the following are indications of chest compressions except

a) No cardiac activity

b) Heart rate less than 60 pbm

c) Need for ventilation

15. Regarding chest compression in newborn all are true except

a) Ratio of Chest compressions: Ventilation is 15:2

b) place thumbs just below the imaginary line connecting the nipples on the sternum

c) Compress one third the anterior–posterior diameter of the chest

d) Stop chest compressions if HR > 60pbm and reassess.

16. In newly-born babies with no detectable heart rate after 10 minutes of effective ventilation, resuscitation should be stopped.

True False

Appendix IV: Practices (Observer check list)

Instructions please tick in box next to the choice that applied to resuscitation being observed .

Study code _____ Number of observations _____

Shift : Day / Night Station :

Parameter Researcher notes	Observation	Yes (done)	No (not done, or wrong action done	Not applicable) NA
	NR step performance			
A- Preparation for newborn resuscitation	1- prepares area for resuscitation			
	2- check availability of resuscitation equipment			
	3- check equipment			
	4- identify helper			
Remarks				
	immediately after birth for the newborn			
B- drying \ stimulation	Was the baby dried thoroughly by gently rubbing the back?			
	Was Wet cloth removed?			

Child status: (Researcher notes here)	Was the baby kept warm?			
Remarks				
C- Airway clearance	Were the airways checked and cleared?			
Child status	Was meconium suctioned before stimulation			
	Was suction done by direct vision?			
	Was baby's head put in neutral position?			
Remarks				
D- Bag and mask ventilation for breathing Child status:	Was BMV initiated all the newborns who didn't initiate breathing or gasping? at 40-60 breath/min?			
	Was started at the golden time?			
	Was the mask size fit for the newborn? size1-normal weight Size 0 for small infants (<2.5kg)			
	Was chest moving adequately each ventilation?			
	Was resuscitator shouted for help?			
Remarks				

E- Circulation Child status	Was the baby's heart rate checked at 1minute?			
	Was CPR started when HR is below 60bpm after 30-60 seconds of ventilation (3chest compressions: one breath for 1minute)			
	Was supplemental oxygen provided?			
	Was thumb put in correct position?			
	Reassessment?			
Remarks (medications, other ventilatory support)				
Neonatal outcome (State the time frame, 20 minutes?)		Apgar scores 1 minute __ __ 5 minute __ __. 10 minute __ __ Newborn status at 20 minutes Survived and well. _____ Survived and sick _____ Succumbed _____		

Appendix V: Basic neonatal resuscitation equipment checklist

To be filled in at the start of each resuscitation by the principal researcher or research assistant)

STATION: LABOR WARD ___ MATERNITY THEATRE____NEWBORN UNIT____

Permanent items	Absent	Present	Function	Non function	Additional comment / observation
Warmer/ resuscitaires					
Oxygen source – concentrator, cylinder, pipeline					
Suction machine					
Ambu bag (250, 500mls)					
Clock					
Stethoscope					

Temporary items	Specify (circle items seen)	Absent	Present	Specify / Remarks
Suction tube	6F, 8F 10F			

Bulb suction device	(penguin device, coloured bulb sucker)			
Face mask	preterm: size 0; term: size 1			
Mode of oxygen delivery	(nasal catheter, nasal prongs, face mask)			
Clean dry towels (2)	Specify Number of towels.			
Oxygen tubing				
Gloves				
Weighing scale (specify max weight)	0 - 10kg 0 - 20kg Other …… kg			
Others …..				

Appendix VI- Consent form

Study Title: Neonatal resuscitation: Knowledge and practices of Nurses and Midwives in two hospitals in Mogadishu, Somalia

Name of researcher: Dr Ahmed Mohamed Adan

Supervisors: Prof Elizabeth Maleche Obimbo, Dr Paul Laigong

I am a postgraduate student at the University of Nairobi pursuing a Master of Medicine degree in Paediatrics and Child Health. I am conducting a study on the Neonatal resuscitation: Knowledge and practices of Nurses and Midwives in two hospitals in Mogadishu, Somalia.

We are requesting you to kindly participate this research study. The purpose of this consent form is to provide you with the information you will need to help you decide whether to participate in the study. This process is called 'Informed Consent'. Please read this consent information carefully and ask any questions or seek clarification on any matter concerning the study with which you are uncertain.

Introduction:

Neonatal resuscitation has previously been defined as the set of interventions at the time of birth to support the establishment of breathing and circulation in a new born, Globally, of 136 million babies born annually, around 10 million require assistance to breathe. Despite slight improvements in other maternal and child health indicators, neonatal mortality rate in Somalia has remained stubbornly high at 39 per 1000 live births. Interestingly, birth asphyxia as a cause of neonatal deaths can be effectively treated to a very large extent with timely resuscitation of newborns by healthcare providers who are skilled in and knowledgeable about neonatal resuscitation.

Benefits:

The results of the study will be shared with you and the facility. You will also receive education and training on newborn resuscitation skills. The results of the research will also be used to make a policy and training on midwives and nurses toward neonatal resuscitation guideline.

Risks:

There will be no risks to you during the study. There will be no invasive procedures carried out in the study that may harm you. Refusal to participate will in no way lead to victimization or discrimination.

Voluntariness:

The study will be fully voluntary. There will be no financial rewards to you for participating in the study. One is free to participate or withdraw from the study at any point. Refusal to participate will not victimization or discrimination in any way.

Confidentiality:

The information obtained about you will be kept in strict confidence. No specific information regarding you will be released to any person without your written permission. We will, however, discuss general overall findings regarding all babies assessed but nothing specific will be discussed regarding you. We will also, not reveal your identity.

Problems or Questions:

If you ever have any questions about the study or about the use of the results you can contact the principal investigator, Dr Mohamed Adan Ahmed by calling +252615430408 or 0716662891.

For more information about your rights as a research participant, you may contact the secretary/ chairperson, Kenyatta National Hospital-University of Nairobi Ethics and Research committee, Telephone No. 2726300 Ext 44102

Email. Uonknh_erc@uonbi.ac.ke

Consent Form: Participant's Statement:

I _____having received adequate information regarding the study research, risks, benefits hereby AGREE / DISAGREE (Cross out as appropriate) to participate in the study. I understand that my participation is fully voluntary and that I am free to withdraw at any time. I have been given adequate opportunity to ask questions and seek clarification on the study and these have been addressed satisfactorily.

Health Worker's Signature: _____ Date

I _____ declare that I have adequately explained to the above participant, the study procedure, risks, benefits and given him /her time to ask questions and seek clarification regarding the study. I have answered all the questions raised to the best of my ability.

Interviewer's Signature _____ Date

Name:……. Designation:……

Appendix VII: Research Budget

Category	Remarks	Units	Unit Cost (KShs)	Total (KShs)
Proposal Development	Printing drafts	500 pages	5	2500
			600	6,000
ERC fee	Proposal Copies	10 copies	2000	2000 2000
Data Collection	Stationery			5,000
	Research assistant	2	15,000	30,000
Transportation				45,000
Data Analysis	Statistician	1		30,000
Thesis Write Up	Computer Services			5,000
	Printing drafts	1000 pages	5	5,000
	Printing Thesis	10 copies	600	6,000

Contingency funds				50,000
Total				193,500

Appendix VIII: Timeline of proposed study

	Activity	Sept-Nov 2020	Dec 2020	Jan 2021	Sep – Nov 2021	Feb-2022
1	Proposal development					
2	Submission of proposal to the department					
3	Final proposal development					
4	ERC Approval					
5	Data collection and entry					
6	Data analysis					
7	Data presentation					
8	Thesis Defense					

Appendix IX: Correct responses for assessment of knowledge

Question number	Correct answer
Q1	A
Q2	B
Q3	B
Q4	A
Q5	C
Q6	A
Q7	T
Q8	T
Q9	D
Q10	T
Q11	T
Q12	T
Q13	T
Q14	C
Q15	A
Q16	T