

**ASSESSMENT OF HEALTH CARE WORKERS' COMPETENCE
IN BASIC NEWBORN RESUSCITATION AT SUB COUNTY
HOSPITALS IN UASIN GISHU, KENYA**

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DECLARATION

Declaration by candidate:

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DEDICATION

This thesis is dedicated to my parents; Mr Gabriel Kamau Muhanda and Mrs (late) Margaret Ng`endo Kamau.

God bless you for the sacrifices you have made to educate me.

ABSTRACT

Background: The neonatal period presents the highest risk of death among the under-fives. Uasin Gishu County has a neonatal mortality rate of 52/1000 live births, much higher than the national mortality rate of 22/1000 live births. One of the major causes of neonatal deaths is birth asphyxia. Up to a third of neonatal deaths can be averted by performing facility based basic neonatal resuscitation which entails stimulation at birth and assisted ventilation with bag and a mask. Delay in establishing ventilation for non-breathing infant leads to hypoxia events that contribute to neonatal mortality and morbidity. The success of new-born resuscitation depends on knowledge, skills of the health care workers and the availability of the equipment.

Objective: To assess the health care workers' competence in basic new-born resuscitation at Sub County Hospitals in Uasin Gishu County

Study Methods: This was a cross sectional study conducted in the six Sub County Hospitals in Uasin Gishu County between January and June 2016. A census was done of all the health care workers in the labour wards. Data on socio-demographic characteristics were collected using a structured questionnaire. Knowledge on basic new born resuscitation was assessed using questions adapted from Neonatal Textbook of Resuscitation 6th Edition (2015). Skills assessment was based on clinical simulations adapted from Emergency Triage Assessment and Treatment plus admission care (ETAT+) course. Factors associated with skills and knowledge were also determined. Equipment was marked against a checklist. Data were analysed using STATA Software Version 14. Descriptive statistics were used for continuous variables and categorical variables were presented in tables and graphs. Chi square test and Fishers Exact test were used to test for association between categorical variables. A p-value of <0.05 was considered significant.

Results: A total of 46 out of 57(80.7%) health care workers from the six sub county hospitals were assessed. Majority were registered nurses 38(82.6%) and 15(39%) had worked in the labour ward for more than five years. Twenty one (45.7%) health care workers had received in-service training on new-born resuscitation, with 18(85.7%) trained on Basic Emergency Obstetric and Neonatal Care (BEmONC). On their knowledge performance, 21(46%) health care workers passed while the rest failed. The following steps of resuscitation were achieved by the number of health care workers indicated; Dry baby 30(71.4%), Assess Airway 24(57.1%) Assess Breathing 14(33.3%), Call for Help 4(9.6%), Effective ventilation 2(4.8%). None of them achieved all the mentioned steps of basic new-born resuscitation hence comparative statistical analysis was not done. There was no significant association between knowledge and years of experience, cadre and in service training (P value, 0.519, 0.411, 0.979) respectively. The following equipment was available in all the hospitals; self-inflating bag, face mask size 1, bulb sucker and radiant warmer.

Conclusion: Health care workers do not have skills on basic new-born resuscitation in as much half of them have the minimum competency level of knowledge. The sub-county hospitals are well equipped for basic new-born resuscitation.

Recommendation: There is need to improve the health care workers resuscitation competency in Uasin Gishu County to acceptable levels.

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ABBREVIATIONS AND ACRONYMS

ALARM	Advanced Labour and Risk Management
AMPATH	Academic Model Providing Access to Health Care
BEmONC	Basic Emergency Obstetric and Neonatal Care
CEmONC	Comprehensive Emergency Obstetric and Neonatal care.
ETAT+	Emergency Triage Assessment and Treatment plus Admission Care
NRP	Neonatal Resuscitation Program
HBB	Helping Babies Breath
HIE	Hypoxic Ischaemic Encephalopathy
ILCOR	International Liaison Committee on Resuscitation
KEMRI	Kenya Medical Research Institute
KPA	Kenya Paediatric Association
LSTM	Liverpool School of Tropical Medicine
MDG	Millennium Development Goal
MTRH	Moi Teaching and Referral Hospital
NBU	New Born Unit
NMR	Neonatal Mortality Rate
NRCK	National Resuscitation Council of Kenya
TOTs	Trainer of Trainers
UNICEF	United Nations International Children`s Emergency Fund
WHO	World Health Organisation

OPERATIONAL DEFINITION OF TERMS

- Advanced resuscitation:** Resuscitation that extends to chest compressions, intubation, or medications
- Basic equipment:** Warmer, two towels, blanket, mucus extractor, self-inflating Bag valve and mask, face masks (2 sizes) i.e. size 0 for pre-term babies, size 1 for term babies and a clock.
- Basic new-born resuscitation:** Provision of warmth, airway clearing (sucking), head positioning, and positive pressure ventilation via bag valve and mask.
- Birth asphyxia:** Failure of a new-born to initiate and sustain breathing at birth.
- County hospital:** Hospital in the capacity of receiving all referral patients from Sub county hospitals and there is one in each County.
- Sub County hospital:** Hospital receiving patients referred from primary care services facilities such as dispensaries. Previously referred as level III hospital.
- Health care workers:** Birth attendants namely, nurse midwives, clinical officers and medical officers.
- Competence:** Skills and knowledge sufficient to comply with predefined clinical standards in ETAT+ and NRP guidelines respectively.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Globally, the neonatal mortality rate fell from 33 per 1,000 live births in 1990 to 20 per 1,000 in 2013. Sub-Saharan Africa has lagged behind other regions with the highest neonatal mortality rate of 31 deaths per 1,000 live births (WHO, 2014). In as much as the neonatal mortality has declined, its proportion in Under Five mortality is rising (WHO, 2014). The neonatal mortality rate in Kenya is now 22 per 1000 live births (*Kenya Demographic and Health Survey 2014*) which is a major decrease from the previous figure of 31 per 1000 (*Kenya Demographic and Health Survey 2009*). The current neonatal mortality rate in Uasin Gishu County is 52 per 1000 live births (*Uasin Gishu County Health Sector and Strategic plan 2013-2018*). According to the Kenya District Health Information system (<https://hiskenya.org/>), 4531 babies were delivered in 2016 in the six sub county hospitals.

One of the basic needs of a new-born is the ability to breathe normally. Upon delivery the transition from intra uterine life to extra uterine is not always straightforward for all babies. Normally, new-borns inhale air into their lungs upon making vigorous efforts. As a result oxygen enters the blood and baby turns from blue to pink. At least 90 % of newly born babies make the transition from intrauterine to extra uterine life without difficulty (AHA/AAP, 2016)). A new-born experiencing difficulty in this transition requires timely and effective resuscitation measures. This may involve positive pressure ventilation with bag and mask, chest compressions and rarely medications (AAP, 2011). On average, the amount of pressure required in a term baby is 30cm water for 2-3 sec in order to aerate the lungs. Pre-term babies may require less pressure of about 20-25 cm water (Resuscitation Council, 2010). Some of the respiratory changes

occurring as a result of successful transition into extra uterine life include patent alveoli with establishment of spontaneous breathing.

The airway, breathing and circulation (ABC) approach is applied in new-born resuscitation. Airway is assessed for secretions or meconium and cleared if any. Once the airway is clear the baby is dried and stimulated by rubbing the back once or twice or flicking the soles of the feet and then placed in neutral position. The step on Breathing includes assessing if it is absent, poor or checking for gasping respirations. If any of these is present, the birth attendant should call for help and initiate ventilation with bag and mask at a rate of 30 breaths per minute. Breathing should be started within 60sec upon birth also called the Golden minute. With effective ventilation the heart rate increases to more than 100 beats per minute. Circulation is supported by starting chest compressions if the heart rate is below 60 beats per minute. For every one effective breath ,three chest compressions are administered for a duration of one minute .The ABC is reassessed every 1-2 minutes until heart rate is above 60 beats per minute and the breathing is adequate (*Textbook of Neonatal Resuscitation (NRP), 7th Ed, 2016*).The algorithm showing the steps of new-born resuscitation is as shown in Appendix VII.

Some new-borns may develop failure to initiate and sustain spontaneous breathing referred to as birth asphyxia. Consequently they become oxygen deprived. There are circulatory and non-circulatory adaptive mechanisms that exist allowing the foetus to cope with asphyxia and preserve vital organ function of the adrenal gland, heart, and brain. These compensatory mechanisms fail in severe and/or prolonged insults, resulting in hypoxic ischemic injury, leading to cell death via necrosis and apoptosis (Rainaldi & Perlman 2016). A major complication in the brain includes hypoxic ischaemic encephalopathy .Other affected organs include gut, kidneys, skin and severe

hypoxic ischaemic injury can result in multi organ failure and consequently death (Polglase, Ong, & Hillman 2016).

In severe cases of birth asphyxia, other long term complications have been noted such as neurodegenerative diseases, mental retardation and epilepsy. Mild insults are characterised by minimal brain damage disorders such as attention deficit and hyperactivity (Golubnitschaja, Yeghiazaryan, Cebioglu, Morelli, & Herrera-Marschitz, 2011). The main goal of resuscitation is therefore to prevent morbidity and mortality associated with hypoxic-ischaemic encephalopathy.

In one of the studies done to assess the intervention that can be undertaken to reduce deaths from birth asphyxia, neonatal resuscitation was found to be a highly effective intervention (J. E. Lawn, A. Manandhar, R. A. Haws, & G. L. Darmstadt, 2007). It is taught in the pre-service and in service training of health care workers. The necessary equipment and skilled birth attendant should be available at the time of delivery to facilitate a rapid transition especially for babies delivered and have no spontaneous breathing or/and have a reduced heart rate of less than 100 beats per minute (*Textbook of Neonatal Resuscitation (NRP), 7th Ed*, 2016). The equipment needs to be in working condition and clean.

Some of the common courses offered on new-born resuscitation include Emergency Triage Assessment and Treatment plus Admission Care (ETAT+) (<http://www.idoc-africa.org/index.php/en/etat/>) and Emergency Obstetric care and Neonatal care (EmONC) (http://reprolineplus.org/system/files/resources/Guidelines_for_Basic_and_Comprensive_InService_Final.pdf). Other courses that target resource constrained settings include Advances In Labour and Risk Management (ALARM), Helping Babies Breathe (HBB) program and Neonatal Resuscitation Program (NRP). ALARM is an International Program backed by Society of Obstetricians and Gynaecologists of

Canada (SOGC) (<https://sogc.org/alarm/>) and targets several African countries including Kenya.

EmONC course was developed by the Liverpool School of Tropical Medicine (LSTM) and Royal College of Obstetrician and Gynaecologists (RCOG) in partnership with the Department of Making Pregnancy Safer, World Health Organisation (WHO), Geneva. The EmONC course is offered as Basic Emergency Obstetric care and Neonatal care (BEmONC) or Comprehensive Emergency Obstetric care and Neonatal care (CEmONC) depending on the facility level. The BEmONC targets health care workers in facilities offering primary care whereas (CEmONC) targets health care workers in facilities performing Caesarean Sections. New-born care is one of the signal functions of both curriculum and new-born resuscitation is taught comprehensively (http://reprolineplus.org/system/files/resources/Guidelines_for_Basic_and_Comprehensive_InService_Final.pdf)

HBB is a neonatal resuscitation curriculum that also targets health care workers in low resource setting. It was developed by American Academy of Paediatrics (AAP) in 2010 and included by World Health Organisation (WHO) in 2011 among the recommended trainings ("American Academy of Pediatrics. Guide for implementation of Helping Babies Breathe. 2011, https://www.aap.org/enus/Documents/hbs_implementationguide_english.pdf#page=1"). It has been rolled out in various countries in Africa. An evaluation done of the educational impact of the course in Kenya and Ethiopia has reported gains in knowledge and skills in neonatal resuscitation (Hoban et al., 2013a; Singhal et al., 2012). Tanzania has had a reduction in neonatal mortality attributable to the introduction of the program since 2009 (Msemo et al., 2013).

The Neonatal Resuscitation Program (NRP) is an educational program jointly sponsored by the American Heart Association (AHA) and American Academy of

Paediatrics (AAP).It mainly applies simulation methodology in teaching. This course also targets hospital workers caring for the new-born at the time of delivery (*NRP Neonatal Resuscitation Textbook 6th Edition (English version)*, 2011)

All the above courses utilise simulation based teaching using manikins. Whereas they are taught in the in service period across the hospitals, ETAT+ in addition is taught to medical undergraduates during their clinical rotation in Paediatrics at the University of Nairobi(M. English, Wamae, A., Nyamai, R., Bevins, B., & Irimu, G. , 2011).

In Uasin Gishu County, a total of 160 out of 814 health care workers in primary health care facilities have been trained in Basic Emergency Obstetric and Neonatal Care (BEmONC) between October 2014 and March 2015 through the initiative of Academic Model for Providing Access to Health Care (AMPATH)(Ministry Of Health, 2015).The workers were drawn from tier 2 and 3 health facilities across the county. The aim was to equip health workers with knowledge and skills on addressing common and unpredictable causes of maternal and neonatal mortality. Eighty four health care workers have also been trained on ETAT+ at the Moi Teaching and Referral Hospital between 2015-2017 (*ETAT+ Summary Report 2010-2017*, 2018).

Essentially all the workers should be competent in performing basic new-born resuscitation (Wall et al., 2009).

1.2 Problem Statement

Birth asphyxia is one of the three leading causes of neonatal death, accounting for 14% of the total deaths in under-fives worldwide(WHO, 2014) yet it can largely be prevented by effective basic new-born resuscitation. According to the Global Burden of Disease 2010 (GBD 2010), intrapartum-related conditions comprised 50.2 million disability adjusted life years (DALYs) and 6.1 million years of life with disability(YLDs) (Lee et al., 2013).

At Moi Teaching Referral Hospital(MTRH), Kenya which receives asphyxiated babies from the sub county hospitals, birth asphyxia accounts for 14% of the neonatal mortality(MTRH, 2017). Neonatal mortality has been reported to be as high as 51.6% among low birth weight infants in the same facility (Njuguna et al., 2014). In 2014 a total of 39,529 babies were delivered in health facilities in Uasin Gishu County and 643(1.6%) neonatal deaths were reported in the same year(<https://hiskenya.org/>) There were 34,326 neonatal deaths in the country and Uasin Gishu County accounted for 1.8% of the total neonatal deaths(<https://hiskenya.org/>).The number of new-borns delivered with a low APGAR score in 2016 was 234 (<https://hiskenya.org/>).However there were no records for the previous years to compare with . Skilled health care workers who are competent in neonatal resuscitation and proper equipment are fundamental in reducing these mortalities and improve survival of new-borns with a low APGAR score.

1.3 Justification

Effective resuscitation is crucial to reduce mortalities and morbidities attributable to birth asphyxia. Basic new-born resuscitation can be performed with basic equipment and minimal skills(M. English et al., 2004).Training of health care workers is one of the intervention that has directly been linked with improvement of neonatal outcomes.

Uasin Gishu County has the second largest referral hospital in Kenya, the Moi Teaching and Referral Hospital (MTRH) which receives patients referred from hospitals within Uasin Gishu County, Western and Northern Kenya (Yego et al., 2013).Whereas MTRH serves as the main referral hospital located in an urban area, the sub county hospitals are a place of referral for the primary health care facilities such as health centres and dispensaries found in the rural areas. In 2014, a total of 39,529 babies were born in the county and close to 600 died over the neonatal period(<https://hiskenya.org/>).The major

causes of neonatal deaths remain similar to the ones in other rural settings in Kenya i.e. birth asphyxia, preterm births and infections (M. English et al., 2003).

This study offers an opportunity to assess the availability of basic equipment, skills and knowledge of health care workers on basic new-born resuscitation and factors associated with skills and knowledge. The results will give concrete evidence on the competence of health care workers on new-born resuscitation and inform further intervention on the same.

1.4 Research Question

Are health care workers at the sub-county hospitals in Uasin Gishu competent in conducting basic new-born resuscitation in consistence with Emergency Triage Assessment and Treatment plus Admission case (ETAT+) guidelines?

1.5 Objectives:

1.5.1 Broad Objective

To assess the health care workers competence on basic new-born resuscitation at Sub county Hospitals in Uasin Gishu County in consistence with Emergency Triage Assessment and Treatment plus Admission case ETAT+ guidelines.

1.5.2 Specific Objectives

- i. To describe the health care workers` knowledge on basic new-born resuscitation.
- ii. To evaluate the health care workers skills on basic new-born resuscitation using selected new-born resuscitation simulations.
- iii. To determine factors associated with skills and knowledge of health care workers on basic new-born resuscitation.
- iv. To assess the availability and working condition of basic new-born resuscitation equipment in the sub-county hospitals.

CHAPTER TWO: LITERATURE REVIEW

2.1 Birth Asphyxia

Birth asphyxia leads to great burden in relation to neurological disability and impairment besides accounting for 23% of the neonatal deaths (WHO, 2009).

In the 16th and 17th Century birth asphyxia was associated with apparent death of the new-born due to impaired respiratory function of the placenta. In 1791, it was defined as a lack of oxygen and therefore preventable (Obladen, 2017).

Several studies have been done to try and find out the best way to prevent birth asphyxia. Recent efforts include India where several randomised home based studies have shown that neonatal resuscitation at home can reduce mortality by 65% in a rural set up (Bang, Bang, Baitule, Reddy, & Deshmukh, 2005). Delaying ventilation for every 30sec up to 6 minutes has been associated with a risk of death or prolonged admission (Ersdal, Mduma, Svensen, & Perlman, 2012). In effort to further save these neonates, advanced countries use of systemic hypothermia in neonates with moderate/severe encephalopathy has led to a significant decrease in mortality and disability (Seetha Shankran 2017). A replication of this study is being attempted in low income country. Interestingly enough, some studies in East, Central and South Africa indicate inappropriate resuscitation is being done even within hospital set up (Kinoti, 1993). Hence the need to have a well trained workforce.

2.2 Knowledge on new-born resuscitation

Knowledge is acquired in formal training and/ or during years of service. The average duration of formal training on new-born resuscitation is 3 hrs and includes practical exposure (Murila, Obimbo, & Musoke, 2012). The knowledge and skills to be acquired during in-service training include recognition/anticipation of a new-born who requires

resuscitation and structured approach to neonatal resuscitation (MoH). This is fostered in practical sessions using manikins.

Various studies have been carried out on assessment of health care providers knowledge in new-born resuscitation. A group of paediatric residents were assessed using an 80 item questionnaire in a cross sectional done in Pennsylvania prior to undergoing Neonatal Resuscitation Program (NRP) course and a performance mean of 37.6% was noted. Despite a high performance mean score of 94.1% immediately after training, there was partial retention of knowledge 6 months after, with the mean score dropping to 62.7% (D. Trevisanuto et al., 2005). Among final medical students evaluated for knowledge using a 21 multiple-choice questions covering evaluation, practical actions and theory domains, knowledge was below expectation, and evaluation appeared to be their weakest domain (Lai, Ngim, & Fullerton., 2012). This was a retrospective study carried out in Malaysia after a training in new-born resuscitation.

In Zambia, pre-training knowledge scores were also found to be relatively low despite advanced formal education and experience of the nurse midwives (Carlo et al., 2009). The questions were adapted from Neonatal textbook of Resuscitation and focused on principles of resuscitation, initial steps, ventilation, and chest compressions. Knowledge decay was reported early as 6 months after training whereas in Rwanda knowledge retention has been noted up to 9 months after training (Tuyisenge et al., 2014). Of note is that in Rwanda, study population was medical students who were writing an exam around the time of reassessment and may have spent time revising prior the assessment. In as much as training alleviates the gap in knowledge it is vital to find ways on enhancing knowledge retention such as refresher courses (Murila et al., 2012).

In Ghana, midwives were assessed on baseline knowledge before neonatal resuscitation training and after training. There was a significant improvement in performance and this was sustained over 9 month duration(Bookman et al., 2010).In Kenya very few health care workers attained the minimum competency level upon evaluation of their knowledge with written questions despite having 9 years average of experience (Murila et al., 2012). Failure to attain the pass mark i.e. minimum competency level indicates a major knowledge gap in neonatal care.

Despite a wide magnitude of experience, birth attendants have been noted to be deficient in basic knowledge on new-born resuscitation as noted in a cross sectional study done across hospitals in Kenya (Murila et al., 2012). This has been attributed to either lack of formal training, disinterest in the subject or lack of apprenticeship an important avenue of impacting knowledge. Formal training programs are important in offsetting this gap as they improve knowledge among health care personnel in the delivery room (Patel, Piotrowski, Nelson, & Sabich, 2001).

2.3 Skills on New-born Resuscitation

A combination of theoretical knowledge and hands on skills is required for competent neonatal resuscitation to occur. Initial steps on resuscitation include provision of warmth by placing the new-born under a radiant heater, positioning the head to open the airway and drying the skin. In preterm babies, especially those with gestation age < 28 weeks, drying and wrapping may not be sufficient to conserve heat. They should be wrapped in a plastic wrapping without drying and placed under a radiant heater(*Textbook of Neonatal Resuscitation (NRP), 7th Ed, 2016*). New-borns who are likely to require resuscitation at birth include preterm, one not breathing at birth or gasping or one with poor muscle tone. The sequence of resuscitation includes assessing

Airway, Breathing and Circulation(ABC)(*Textbook of Neonatal Resuscitation (NRP), 7th Ed, 2016*).There are various critical steps of new-born resuscitation in different ETAT+ simulation scenarios that are considered mandatory for a candidate to achieve in order for one to qualify as a provider of the emergency care .They include drying baby, Assessing Airway and Breathing, Call for help, Giving 30 ventilation for one minute.

In a randomised controlled trial, residents who continually had manikin practice erred less than those who did not have any booster sessions after they were all trained in resuscitation using NRP guidelines .Fifteen out 59 residents dropped out after baseline assessment of skills, however there was no significant differences in their baseline scores (Kaczorowski et al., 1998).

In Afghanistan, in a cross sectional study, health care workers were assessed using clinical simulations on an anatomical model (Young Mi Kim et al., 2013) .The assessment tools used in this study were adapted by the Ministry of Public Health's Reproductive Health Task Force and then reviewed, revised, in collaboration with national EmONC trainers, UNICEF, WHO, and experts from non-governmental organizations (NGOs).The percent of providers who completed specific tasks during simulation of new-born resuscitation was reported with both doctors and midwives having demonstrated similar level of skills. Therefore clinical simulations can be used as a practical way to assess skills.

In Pakistan, competency of health care providers has been evaluated by demonstration of resuscitation steps on a mannequin(Shabina Ariff et al., 2010). A uniform scenario was simulated by an experienced paediatrician who was also certified in new-born resuscitation skills and a standard check list adapted from NRP guidelines used. Across all the cadres assessed there was overall poor performance and major lapses were noted

on maintain airway, assessing breathing and heart rate. In Cameroon, health care workers were observed conducting resuscitation on new-borns who did not breath at birth and it was found that they had less than 10% completion of tasks such as, positioning of the airway and mask and ventilation (Monebenimp, Tenefopa, Koh, & Kago, 2012).The conclusion that health care workers in the Level one facility were not competent in conducting new-born resuscitation showed the need for strengthening skills in area of new-born resuscitation in a bid to improve maternal health as per Millennium Development Goals. There was no predefined level of competence and 24% score on all neonatal resuscitation tasks completed among the health care workers was equated as lack of competence with no scientific basis.

An assessment of health care workers practices on new-born resuscitation has been done using an observation check list adopted from the New-born Life Support training, in a randomised controlled trial in Pumwani Maternity Hospital , Kenya (Opiyo et al., 2008).The initial steps of resuscitation including the practices of suction, restricted only to babies born through meconium yet to take a breath, drying (stimulating), airway examination (A) and positioning and assessment of breathing (B) were assessed among trained and untrained health workers. The results showed a higher proportion of adequate/perfect initial steps of resuscitation among trained health care workers as compared to untrained health workers. There were also significant reductions in the frequency of inappropriate and potentially harmful practices. In assessment of skills, health care worker may not only demonstrate the appropriate steps but also harmful practices and thus form a basis for intervention. The observations were done on live birth resuscitations and hence results depict actual performance of health care workers unlike in a simulation assessment.

2.4 Factors associated with Health Care Workers competence in new-born resuscitation

Several factors affect knowledge and skills on resuscitation whether related to the health care worker or facility characteristics. Some of the health care worker related factors include cadre, years of offering emergency obstetric and neonatal care, confidence in performing new-born resuscitation and training.

Health care workers have been assessed on knowledge of resuscitation across hospitals in Kenya in a cross sectional study. The scores of clinicians who included medical officers and clinical officers were found to be significantly higher than that of the nurses (Murila et al., 2012). In a different setting, when the performance on knowledge was compared among primary health care providers namely midwives, doctors, lay health visitors and lady health workers (equivalent to enrolled community nurse), doctors performed poorest whereas on resuscitation skills assessment, all cadres performed poorly (Young Mi Kim et al., 2013).

In a cross sectional study in Afghanistan, health care worker who had experience of 5.9-6.5 years were more knowledgeable on resuscitation (Young Mi Kim et al., 2013). In addition health care workers who previously worked in delivery unit and special care baby units within 5 years had better knowledge than those who had not, as shown in a study done in Nigeria (T Ogunlesi., 2008). Experience has also been strongly related with confidence as providers who practice longer become more confident in their skills. Health care providers who felt more confident about performing resuscitation performed better on knowledge and skills.

In the same study, preservice and in-service training on new-born resuscitation had an impact on both skills and knowledge. The midwives received competency based

preservice training which is mandatory prior to their graduation from mid-wifery school. However not all mid wives receive competency based training as noted in a cross sectional study across different hospitals in Kenya (Murila et al., 2012). Almost half of the health care workers who had received formal training missed practical exposure on neonatal resuscitation and this complicated their lack of competency. Similarly, in a cross sectional survey done in Nigeria to assess knowledge among nurses, a significantly higher number of those who had adequate knowledge had attended neonatal resuscitation training (T Ogunlesi., 2008). However, the type of training and duration after training was not mentioned.

Facilities have an impact on knowledge of health care workers. Larger hospitals with specialist physicians and medical students have more opportunities for learning e.g. grand rounds compared to smaller facilities like district hospitals .Therefore working in larger hospitals has been positively associated with providers' knowledge in Afghanistan(Young Mi Kim et al., 2013) .

2.5 Availability and condition of Resuscitation Equipment

Some of the essential equipment required for resuscitation includes heat source, ambu-bag, warm dry linen, face masks size 0 and 1 (Newton & English, 2006) .Equipment is an important structural component for providing quality new-born care. According to the Donabedian framework of assessing quality of care, three measures namely structure, process and outcome are included (Donabedian, 1988). Improving the knowledge and skills of health care workers will be largely irrelevant if inadequate structure limits the possibility of improving outcomes of care(Opondo et al., 2009).

In availability of resuscitation equipment is a great hindrance to effective resuscitation as noted in Migori County, Kenya (Matthew Carwara., 2013).A study across district hospitals in Kenya indicated that vital equipment such as resuscitaires and bag-valve-mask devices were often unavailable(Opondo et al., 2009) and yet some of these equipment such as self-inflating bag are affordable(Wall et al., 2009).In Europe some centres have noted a decline in neonatal mortality rate associated with perinatal and intrapartum asphyxia. This has been attributed to provision of the resuscitation equipment and improving the skills of personnel in the delivery room (Vakrilova, Elleau, & Slüncheva, 2005).Some settings are still faced with the challenge of missing functioning equipment ,a major prerequisite for success of training and resuscitation itself ((Newton & English 2006). Not only is having the bag and mask necessary but also increased practice and regular retraining to maintain effective skills of resuscitation (Patricia Coffey et al., 2012).

This study will be useful in finding out if the same hindrance is experienced in these sub county hospitals, as effective use of a bag and mask during resuscitation can greatly improve neonatal outcome in our resource limited setting (Newton & English, 2006).

2.6 New born resuscitation guidelines on skills and knowledge

With up to 0.92 Million deaths resulting from birth asphyxia, experts and policy makers have identified several key research and implementation priorities to address birth asphyxia such as competency based training in neonatal resuscitation(Joy E. Lawn, Ananta Manandhar, Rachel A. Haws, & Gary L. Darmstadt, 2007).

Some guidelines have been developed on new-born resuscitation by the International Liaison Committee on Resuscitation (ILCOR,2005).The guidelines are revised every 5 years and adapted in various countries across the globe.

In Kenya the clinical practice guidelines on new-born resuscitation are adapted from Resuscitation Council, UK and WHO guidelines. They are adopted nationwide and put down in a booklet on Basic Paediatric Protocol under initiative of the Ministry of Health, Kenya (MoH, November 2013). Another type of clinical practice guidelines have been developed for emergency and hospital care for children in Kenya contained in the ETAT+ course. ETAT+ a paediatric life support course was developed in Kenya in 2006 to aid in caring for acutely ill children by the health workers (Irimu et al., 2008). Over the past years it has gained regional identity through a partnership program involving Kenya, Uganda and Rwanda supported by the Royal College of Paediatrics and Child Health in the UK. Over 600 participants were trained between September 2010-2011 in the mentioned regions (*ETAT+ Summary Report 2010-2017*, 2018; Tuyisenge et al., 2014). It is a full 5 day training on recognition and initial management of the 10 commonest medical causes of paediatric hospital admission in East Africa and includes emergency life support care for new-born, infant and children. It is supported by the KEMRI / Wellcome Trust Research Programme and WHO-Kenya working with Ministry of Health, Kenya ("ETAT+ (Emergency Triage Assessment and Treatment plus Admission Care)"). New-born resuscitation is taught in theory and practical i.e. through skills practice on manikins ("ETAT+ (Emergency Triage Assessment and Treatment plus Admission Care)," ; Irimu et al., 2008)

There are various studies that have been done in developing countries to evaluate health care performance on knowledge in relation to the ETAT+ course. In Rwanda health care workers were assessed using multiple choice questions and skills as demonstrated on a manikin (Hategekimana et al., 2016). One of the components of knowledge assessment was on new-born resuscitation and 6 MCQs were administered pre and post course.

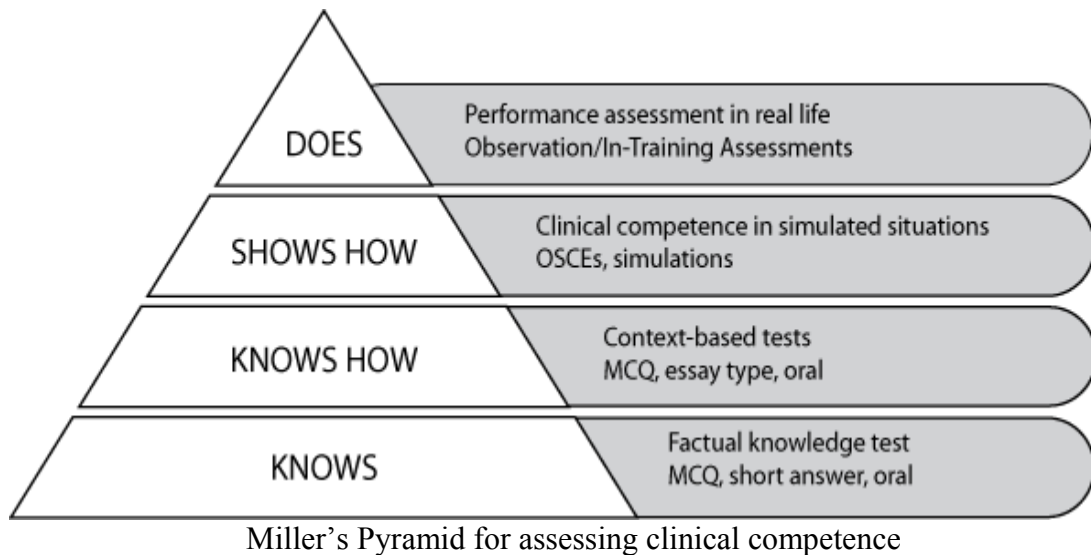
The outcome reported was as an overall improvement in the score. The health care worker skills on neonatal resuscitation were assessed using a standardised scenario and the failure rate was noted for each step with the most missed steps being calling for help and observing tone and colour.

While assessing medical students knowledge and skills retention after training on ETAT+ course, in longitudinal cohort study, Tuyisenge showed that whereas knowledge was retained ,skills declined after 3-9 months (Tuyisenge et al., 2014). The knowledge score was reported as the percentage of the correct responses given in the test comprising of 50 MCQs. There were two scenarios used for skills assessment one being on neonatal resuscitation and 67% students passed. The management steps in the scenario that were omitted or done inadequately by students who failed were indicated.

It is therefore paramount to also evaluate the skills of workers who are not previously trained in order to identify any gaps in new-born resuscitation competency.

2.7 Competence Assessment

Webster dictionary defines competence as sufficient knowledge, judgment, skill, or experience for some purpose. This definition can, however, not function as a thorough framework for clinical competence. A clear and concise definition of clinical competence seems most pressing for assessment purposes. George E. Miller distinguished several hierarchical layers of competence to function as a framework for within which assessment might occur as shown in the figure below (Miller, 1990).



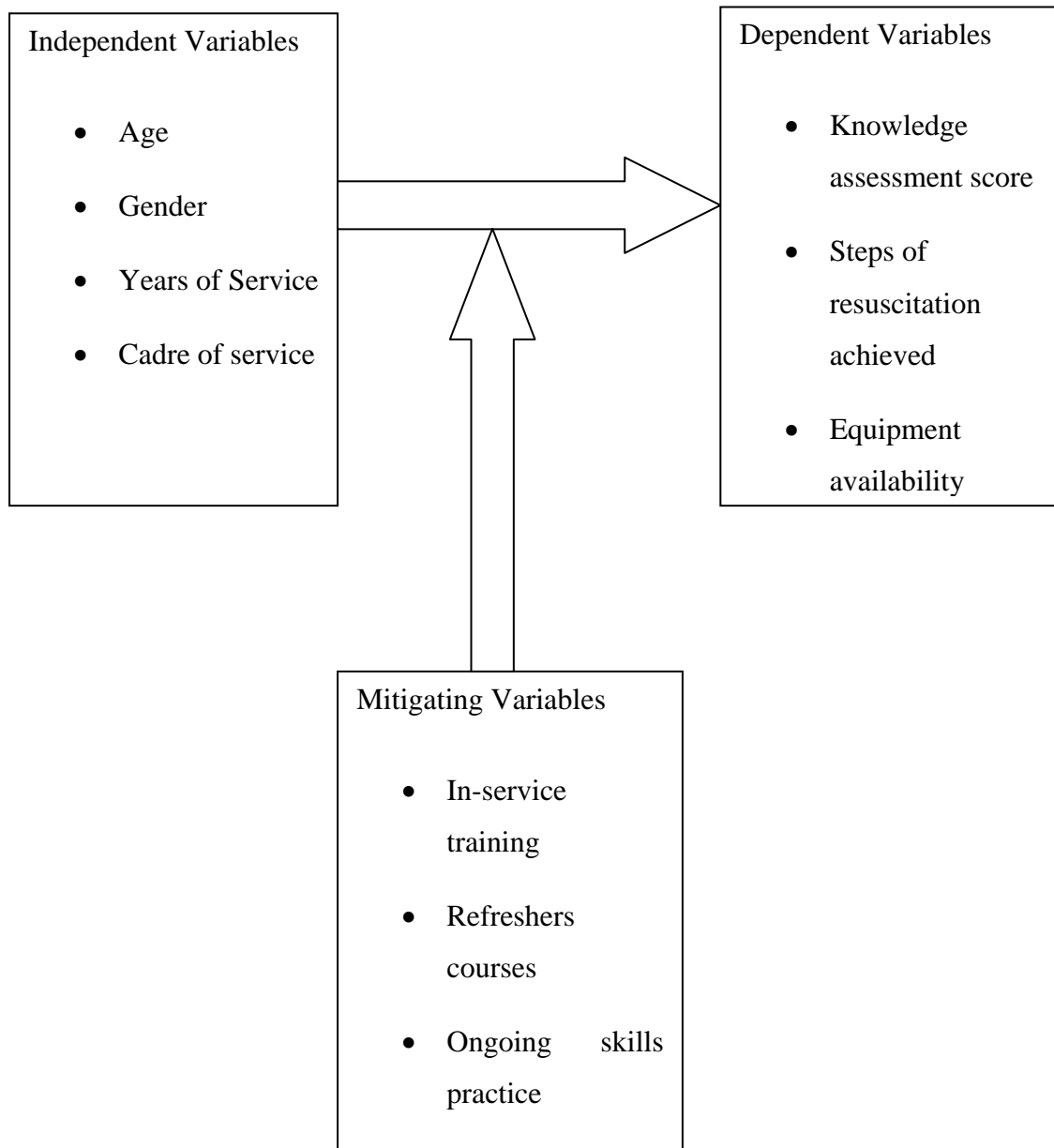
Competence assessment of higher levels i.e. 3 and 4 has more validity and when applied in specialist trainees it entails skills, knowledge, and clinical judgement, attitudes and behaviour.

Several studies have been carried out to assess competence of health care workers in relation to knowledge and skills in new-born resuscitation. In Pakistan an assessment of health workers knowledge and skills have shown a competency level of less than 50% (S. Ariff et al., 2010). Knowledge was assessed by means of a semi-structured, close-ended questions (MCQs) whose components were adopted from evidence published in Lancet series on Maternal and New-born Child Survival Series (Darmstadt et al.; Knippenberg et al., 2006; Lawn, Cousens, & Zupan 2005). Resuscitation skills were assessed using a standardized checklist adapted from Neonatal Resuscitation Program (NRP) guidelines by American Heart Association (AHA) and American Academy of Paediatrics (AAP) upon demonstration of resuscitation steps on a mannequin. The minimum competency level of 70% defined in this study was arbitrary and was based on knowledge and skills against the predefined clinical standards for the study. The author acknowledged this as a study limitation as there was no national benchmark and even internationally there has not been one (Sara & Diane 2016).

In Australia, when assessing nurse competence in resuscitation, focus was on theoretical knowledge and practical assessments of skills using American Heart Association's (AHA), the European Resuscitation Council's (ERC) and the Immediate Life Support exams. The pass level for each of these guidelines was used to determine the competency level (Allen, Currey, & Considine, 2013).

The importance of stating competency level is to define the assessment outcome conclusively. The measure of competency in resuscitation skills used in our study is per ETAT+ guidelines where a study participant has to achieve all the critical steps on new-born resuscitation. The pass level set by Neonatal Resuscitation Program (NRP) guidelines has been used to define the minimum competency level in knowledge of new-born resuscitation. In our extensive literature search we did not find a tool that has a composite index measure of competence in new-born resuscitation.

2.8 Conceptual Framework



CHAPTER THREE: METHODOLOGY

3.1 Study design

This was a descriptive cross sectional study conducted in the six Sub county hospitals namely Huruma, Ziwa, Kesses, Burnt Forest, Uasin Gishu and Kapteldon. Uasin Gishu County Hospital was considered a sub county hospital as it serves as the referral centre for primary care facilities in Moiben sub-County.

3.2 Study site

Uasin Gishu County is situated in the mid-west of the Rift Valley covering an area of 3,345.2 square kilometres and lies between longitude 34 degrees 50' east and 35 degrees 37' west and latitude 0 degrees 03' south and 0 degrees 55' north (). It is a cosmopolitan county with population estimate of 894 179 in 2009 and with intercensal population growth rate of 3.8%, the total population was projected to grow to 1,211,853 by 2017("County ICT roadmap 2015 -2020,") (KNBS, 2009). It is one of the 47 counties of Kenya and covers former Rift Valley Province.

The county is divided into six smaller administrative units called sub counties as shown in Appendix VIII and each has a public sub county hospital. The sub counties are diverse in terms of size, population coverage, and proximity to the capital town, Eldoret. The Sub County with the highest population is Soy, and has Ziwa sub county Hospital. Ainabkoi Sub County has the least population of 77,290 and has Burnt Forest Hospital. The population size does not march the volume of the sub county hospitals as some regions have many primary level facilities such as dispensaries. Even so the sub county hospital may be quite far for patients to access them during deliveries.

The sub county hospitals serve as the referral centres for the primary care health facilities within the sub county.

The study was conducted in all the six Sub county hospitals namely Uasin Gishu Hospital, Ziwa Hospital, Huruma Hospital, Burnt Forest Hospital, Kapteldon Hospital and Kesses Hospital. These facilities are mainly in the rural areas of the county except for Uasin Gishu Hospital and Huruma Hospital which are in the urban part of the County. The volume of deliveries per year varies in these hospitals. In 2014, Ziwa sub county Hospital had the highest number of deliveries at 895, Huruma Hospital-889, Uasin Gishu Hospital-425, Burnt Forest Hospital-325, Kesses Hospital 84 and lastly Kapteldon Hospital the least at 19. In these hospitals the nurses are ones who resuscitate new-borns. In case of complicated cases of resuscitation they call on clinical officers and medical officers.

3.3 Study population

This consisted of health care workers based in the labour wards of the six Sub county Hospitals namely Medical officers, clinical officers and nurses.

3.4 Eligibility Criteria

3.4.1 Inclusion criteria

- a) Health care workers namely nurses, midwives, clinical officers and medical officers working in the labour ward during the study period irrespective of their duration of experience.

3.5 Sampling technique

The sampling frame consisted of 57 health care workers based in the labour wards of the six sub county hospitals. During the study period, four were away on study leave and eleven did not consent for the study and therefore 46 workers were recruited as study participants by census. The distribution of the workers across the hospitals varied

from high as thirteen to low as five and the volume by deliveries of the health facilities was also heterogeneous. A sample from these facilities would not have given a precise representation of the study population due to the heterogeneity of these facilities and therefore a census was done.

The health workers were approached in their monthly meetings and weekly Continued Medical Sessions (CMEs). Others were assessed at the end or beginning of the working shifts upon liaising with the hospital in charges. This involved making at least two visits in each facility in order to capture all of them. The interval of visits between hospitals varied between two weeks and a month and this was greatly influenced by availability of participants due to the varying work schedules.

The table below shows the total number of health care workers in each facility

Name of Facility	Number of staff
Ziwa Sub county Hospital	10
Huruma Sub County Hospital	11
Uasin Gishu Sub County Hospital	11
Kapteldon Sub County Hospital	5
Kesses Sub County Hospital	5
Burnt Forest Sub County Hospital	15
Total	57

3.6 Study Period

The study period was between January 2016 and July 2016.

3.7 Study Procedure

The study was conducted by the Principal Investigator (PI) assisted by a Research Assistant (RA) over the duration of study. Both are residents in Paediatrics and Child Health trained in ETAT+ and Generic Instructor Course (GIC). In addition the RA has conducted trainings on ETAT+ to medical students and was considered more experienced than the PI.

3.7.1 Standardization Process

Prior to execution of this study, they both underwent a standardisation process on assessment using the resuscitation simulations used for the study under the supervision of a full instructor in ETAT+. During the standardisation process, two clinicians and a nurse were assessed on the two simulations, one of a baby delivered in meconium stained liquor and new-born delivered without immediate cry. The PI and RA assessed independently each of the steps carried out. In the case where there was disparity in the step marked, the full instructor repeated the scenario and explained the correct assessment. This was done until there was congruency in the marking of the steps of resuscitation.

3.7.2 Written test procedure

The PI sought permission from the County to conduct the study and then liaised with the various hospitals in charges in sensitising the health care workers about the study. The Labour ward in charges pooled the nurses in their monthly meetings and or Continued Medical Education (CME) sessions. The PI was given a chance after the meetings to elaborate further about the study, allayed all the concerns and requested the health care workers to participate.

The participants were then each given the questionnaire on the bio data to fill (Appendix III). Upon filling it, the six multiple choice question test was administered under supervision by the PI and Research Assistant (Appendix IV). This took five minutes. The sheets were collected and kept in a sealed envelope to be marked later. A mark of 80% and above was considered a pass mark and below that was a fail as per NRP guidelines ("Revised Neonatal Resuscitation Guidelines,").

The multiple choice questions were derived from Neonatal Textbook of Resuscitation 7th Edition (AHA;AAP, 2011). The questions covered basic new-born resuscitation steps on ventilation techniques, appropriate action on stimulation and airway clearance. Every response earned one mark while an incorrect response earned no mark.

3.7.3 Skills assessment procedure

Upon collection of the questionnaires, the PI and RA set up the equipment for skills assessment in the same room. Four participants dropped out at the point of skills assessment. The remaining 42 participants were assessed individually on simulations (Appendix VI). The PI and RA took turns in reading out the scenarios and would request the participant to first verbalise the scenarios given to ensure that it was well understood. The participant then demonstrated the steps of resuscitation on the manikin. In cases where the respondents did not verbalise their actions they were prompted with questions. The PI and RA gave the appropriate responses at the various stages and marked on scoring sheet whether each step was achieved or not achieved. The marking was done independently. In the case where a step was marked differently by the two assessors, the more experienced assessor's (RA) mark was taken as the final mark. The participants were commended for the steps achieved and corrected on the steps that were not achieved. This was done after assessment of the second scenario. The two scenarios were adopted from ETAT+ and modified to suit the objectives of the study. This tool is used often in training and assessment of trainees after undertaking ETAT+ course.

The PI assessed the equipment availability and function status with the labour ward in charge. The PI ascertained if the equipment was present and or functional and ticked the checklist appropriately (Appendix V).

3.8 Data collection and Analysis

3.8.1 Data Collection

Each participant was given a unique code to identify their questionnaire then filled the biodata form upon signing the consent form.

Basic new-born resuscitation knowledge was assessed using a multiple choice written test administered by RA and PI and the correct answer was circled. However in some of the facilities it was not possible to have all the health care workers in one sitting due to the emergencies in the labour ward. In that case the health care worker would fill the questionnaire after attending to their duty and were not allowed to carry them away.

The assessment of skills was done as per the ETAT+ guidelines where for each step; a candidate must demonstrate certain skills("ETAT+ (Emergency Triage Assessment and Treatment plus Admission Care),")On the first step of warming and drying the baby, the respondents were expected to say that were placing the baby under a warmer and demonstrate drying of the baby. On assessment of airway, they were expected to check for secretions in the nose and mouth and if any to suck using the equipment provided. For the scenario on term baby delivered in meconium stained liquor, the respondents were expected to suck first then dry and stimulate the baby. Anyone who dried and stimulated the baby before sucking the meconium was marked as not achieved and were allowed to continue with the following steps. On assessment of breathing, the health care worker was expected to look, listen and feel for breathing. In both scenarios the babies were not breathing and in the step thereafter the respondents were expected to call for help and initiate ventilation using bag and mask at a rate of 30 breaths per minute. If one did not position the airway but ventilated well, this step was considered not achieved. The number of HCWs who achieved each step were noted.

The resuscitation equipment was assessed against checklist. A tick was put appropriately on each column marked as present (P), absent (A), functional (F) and not functional (NF). Equipment kept in the store were considered absent (Appendix V).

3.8.2 Data Storage

Data were checked by the principal investigator for completeness and accuracy, then keyed into Microsoft Excel after data cleaning. Confidentiality was maintained by excluding any personally identifiable information from the keyed dataset. The database was password protected to prevent un-authorized access and backed up in a remote hard disk and flash drive to safeguard against data loss

3.8.3 Data analysis and presentation

Data were analyzed using STATA version 14 at 95% confidence interval. P value of less than 0.05 was considered statistically significant. Frequency listings and percentages were used for categorical data. Association between categorical variables was tested using Chi Square test and Fishers exact test depending on the cells numbers. Results are presented in form of graphs, tables and text.

3.9 Ethical considerations

Ethical approval to conduct the study was sought and given by Institutional Research and Ethics Committee (IREC) of Moi University/MTRH and permission sought from the Uasin Gishu County Ministry of Health.

The health care workers gave a written consent. There was no coercion or payment given to the study participants. Confidentiality was upheld throughout the study.

A written report shall be submitted to Uasin Gishu County Executive officer of Health.

CHAPTER FOUR: RESULTS

4.1 Enrolment Flow chart.

Out of the 57 health care workers (HCWs) based in the labour wards of the six sub county hospitals, 46 were enrolled based on the eligibility criteria. The sub counties are geographical regions subdividing the county and have a varied population catchment for the hospitals within. The diagram below illustrates the process of enrolment.

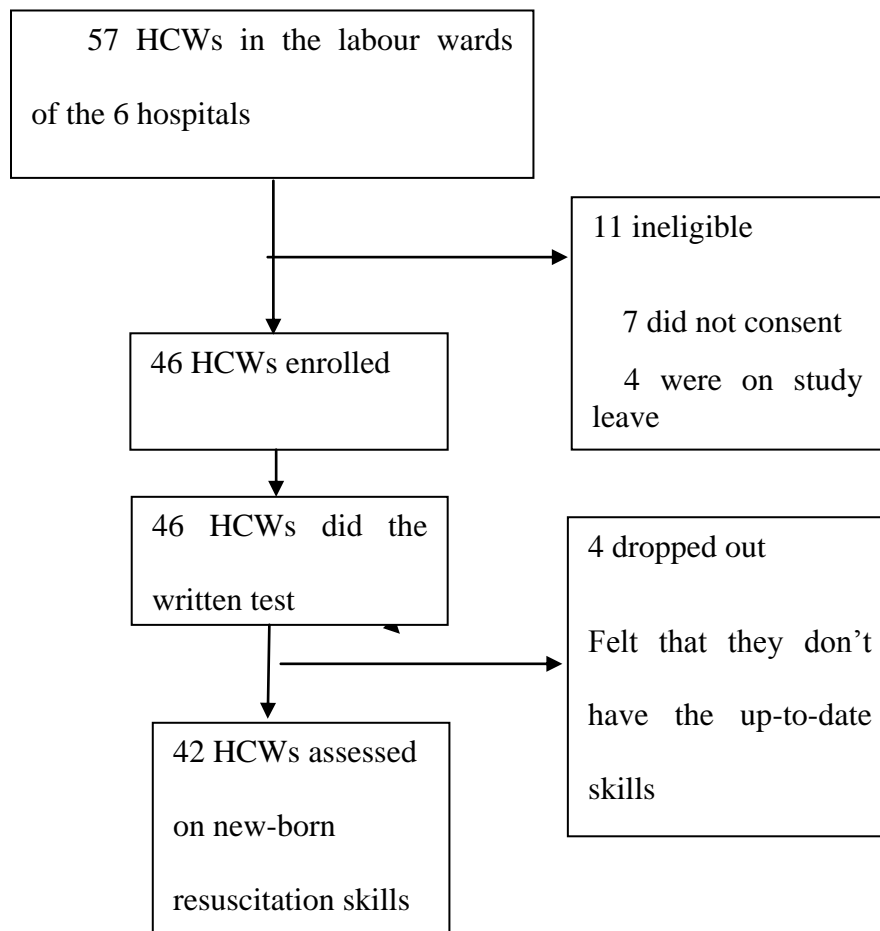


Figure 1: Flow Diagram of the Participants enrolment

The four participants who dropped out after the written test were from two different facilities, were all female and half of them passed. Two of them had received in service training on resuscitation, an equal number had worked for 2-5 years in the labour ward. Their details are as shown in the table below.

Table 1. Characteristics of four health care workers who dropped out after written test.

Health care worker	Gender	Age (years)	Designation	Years of experience (years)	In service training	Type of training	Knowledge score
1.	Female	>35	Registered nurse	2-5	Yes	BEmONC	Pass
2.	Female	25-35	Registered nurse	2-5	No	-	Pass
3.	Female	<25	Registered nurse	<2	No	-	Fail
4.	Female	>35	Enrolled nurse	>5	Yes	BEmONC	Fail

The distribution of the 46 health care workers varied across the hospitals as shown in the table below. Burnt Forest Sub County Hospital had the highest number of participants whereas Kapteldon and Kesses sub county hospitals equally had the least number of participants.

Table 2: Distribution of the Health Care Workers

Name of Facility	HCWs based in the labour ward who participated
Kesses Sub County Hospital	5
Kapteldon Sub County Hospital	5
Uasin Gishu Sub County Hospital	7
Huruma Sub County Hospital	8
Ziwa Sub County Hospital	8
Burnt Forest Sub County Hospital	13
Total	46

4.2 Health care Workers Characteristics

Of the forty six health care workers, 36(78.3%) were female and 38(82.6%) were registered nurses who had undergone a 3.5-year diploma course. Half of them, 23(50%) were between the age group of 25 to 35 years followed by 22(47.8) % above 35 years and one (2.2%) aged below 25 years. The years of experience in labour ward varied among the participants with 14(30.4%) having worked under 2 years , equal to those who had worked for 2years to 5 years while 18(39.1%) had worked more than 5 years. Approximately half of the health care workers 21 (47.8%) had received in service training on new-born resuscitation mainly the Basic Emergency Obstetric and New-born Care (BEmONC) course.

Table 3: Health Care Worker Characteristics

Variable	Frequency n=46	Col %
Designation		
Medical Officer	2	4.40%
Clinical Officer	5	10.90%
Registered nurse	38	82.60%
Enrolled nurse	1	2.20%
Age(years)		
Under 25	1	2.20%
25 to 35	23	50.00%
>35	22	47.80%
Gender		
Female	36	78.30%
Male	10	21.70%
Years of Experience		
Under 2	14	30.40%
2 to 5	14	30.40%
>5	18	39.10%
Trained in New-born Resuscitation		
No	25	54.30%
Yes	21	45.70%
Type of Training		
None	25	52.20%
ETAT+	1	2.20%
BEMONC	18	39.10%
Essential New-born care	2	4.40%

For those who were not trained in neonatal resuscitation the main reason was that they had never heard about the new-born resuscitation courses 16 (72.7%). All of those who had not been trained reported that they would wish to be trained in new-born resuscitation. Majority of the respondents 39 (84.78%) reported to have performed new-born resuscitation in the past 3 months for less than 5 times.

4.3 Knowledge on new born resuscitation based on written test

The health workers were given a written test which consisted of 6 questions on basic new born resuscitation (see Appendix VI). One was considered to pass if they scored 80% and above, the standard level as per NRP guidelines. Any mark below 80% was considered a fail. The graph below shows the scores of the 46 health workers with 25(54.3%) having failed.

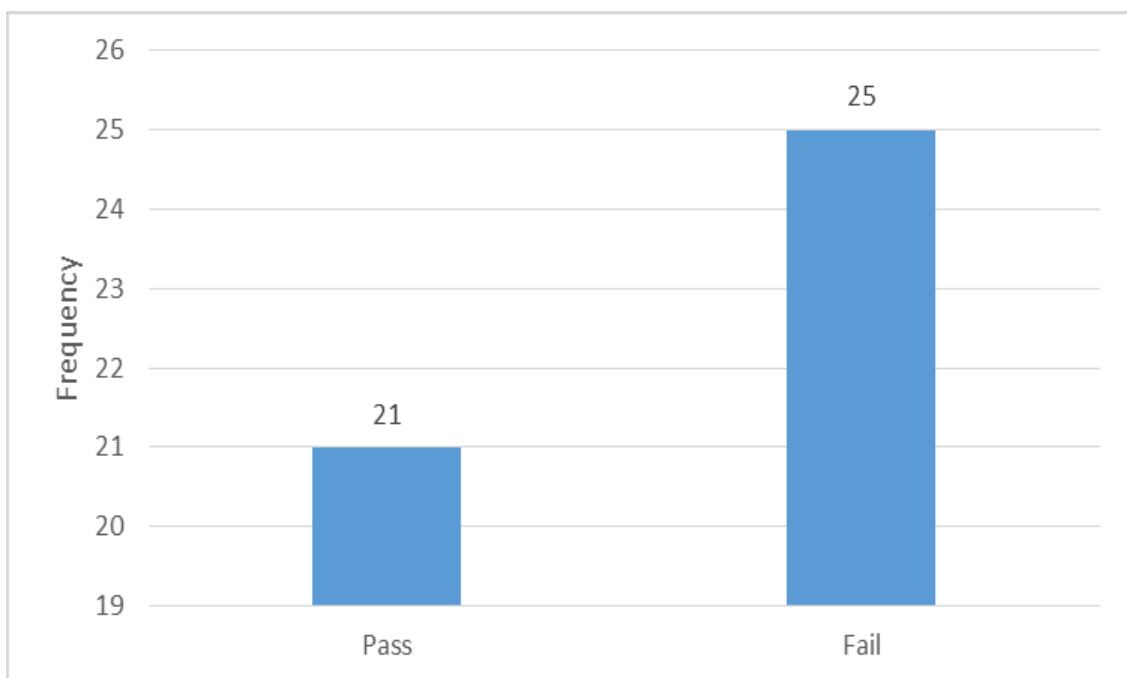


Figure 2: Score on new born resuscitation knowledge based on written test

The responses to each of the 6 questions of neonatal resuscitation were analyzed as shown below to identify areas in which the HCWs knowledge was deficient

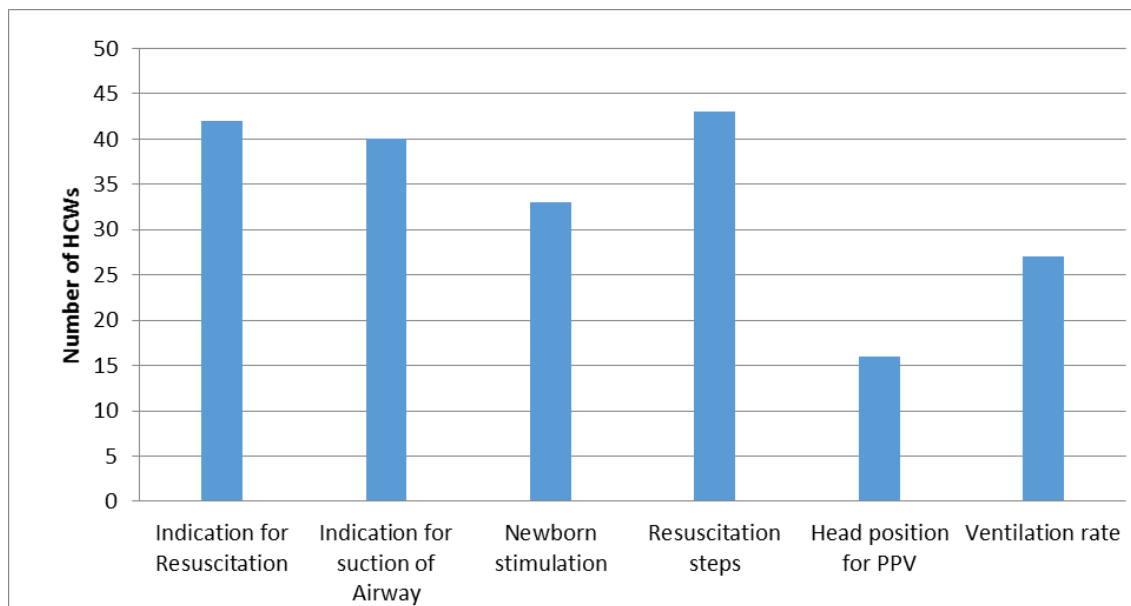


Figure 3: Number of HCWs with correct knowledge of basic knowledge of basic resuscitation.

Majority of the HCWs knew the steps of resuscitation, indication for resuscitation and suction of airway i.e. 43(93.5%), 42(91.3%), 40(87%) respectively. Few 16 (34.8%) knew the correct head positioning for PPV.

Table 4: Characteristics of HCWs who passed vs Failed

The characteristics of those who failed or passed are as indicated in the figure below. Both medical officers failed, whereas more clinical officers failed than passed. The number of those who passed or failed was equal among the nurses

Variable	Fail (%)	Pass (%)	P value (X²)
Designation			0.411
Medical Officer	2 (100)	0 (0)	
Clinical Officer	3 (60)	2 (40)	
Registered nurse	19 (50)	19 (50)	
Enrolled nurse	1 (100)	0 (0)	
Age (years)			0.591
Under 25	1 (100)	0 (0)	
25-35	13(56.5)	10 (43.5)	
>35	11 (50)	11 (50)	
Gender			0.261
Female	18 (50)	18 (50)	
Male	7 (70)	3 (30)	
Years of Experience			0.519
Under 2	9 (64.3)	5 (35.7)	
2-5	6 (42.9)	8 (57.1)	
>5	10 (55.6)	8 (44.4)	
Trained in New-born Resuscitation			0.979
No	16 (54.2)	9 (45.8)	
Yes	12 (54.5)	9 (45.5)	

4.4 Performance on skills on new-born resuscitation

A total of 42 health care workers were assessed using the clinical simulations after 4 of them dropped. Each step was marked either as achieved or not achieved by two different people. The Cohen`s Kappa coefficient was 0.42 translating to moderate agreement. The table below shows each step with the number of respondents who achieved it. The bolded steps are considered as key steps that must be achieved

Table 5: Number of HCWs who achieved the Steps of Resuscitation

Skill	Frequency (%)
Warm baby	34 (81%)
Dry baby	30 (71.4%)
Observe tone, color and respiratory effort	2 (4.8%)
Assess Airway	24 (57.1%)
Assess Breathing	14 (33.3%)
Call help	4 (9.5%)
Give 30 ventilation for 1 min	2 (4.8%)

The step that was best performed was warming the baby with 34(81%) health care workers achieving it followed by drying the baby at 30(71.4%).The poorest performance was on giving the ventilation with only 2 (4.8%) people achieving it. Only 4(9.5%) respondents called for help upon assessing that the baby was not breathing. More than half 24(57.1%) of the respondents were able to assess the airway and a third 14(33.3%) achieved the step on assessing breathing. Majority of the HCWs (95.2%) did not give 30 ventilations per minute nor observe the tone, colour and respiratory effort. They faltered on checking for chest rise and rate of administering the ventilations. The various steps that were faltered are as shown below.

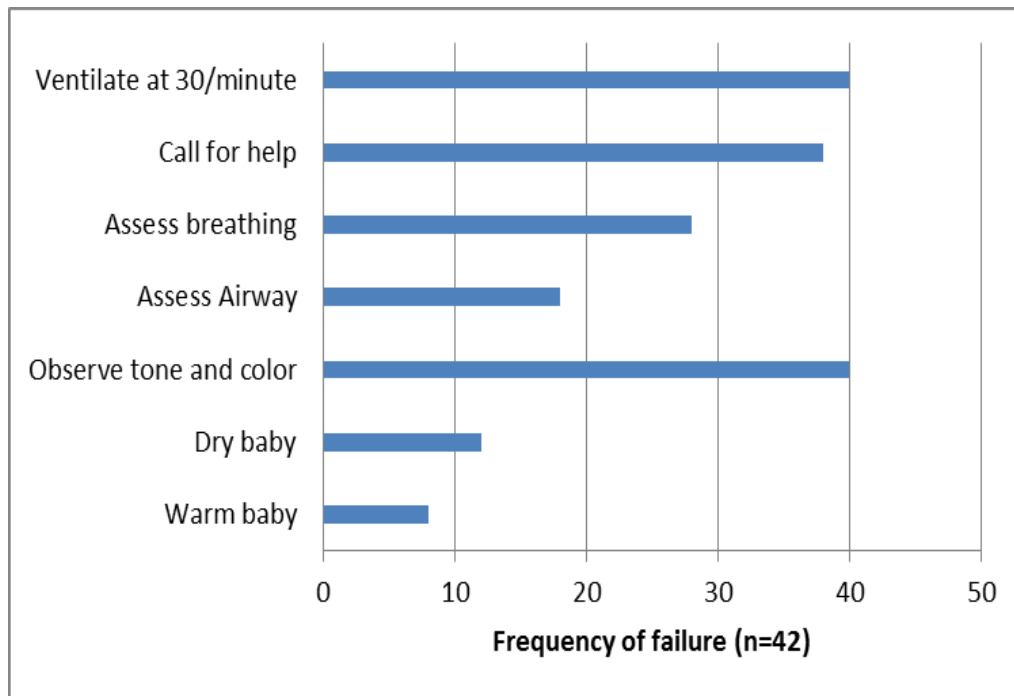


Figure 4: Reasons for failure of new-born resuscitation

The figure below shows the steps of resuscitation and frequency of failure among the HCWs. Majority of participants 40 (95.2%) did not perform ventilation and observe for tone, colour and respiratory effort. Thirty eight (90.4%) did not call for help, 18(42.9%), 28(66.7%) checked the airway and breathing respectively.

The critical steps of resuscitation that are considered mandatory for a HCW to achieve in this simulation include **Dry baby, Assess Airway, Assess Breathing, Call for help, give 30 ventilations per minute**. The steps were summated not in particular order to identify if any HCW achieved all of them. The table below shows the proportion of steps and number of the HCWs who achieved.

Table 6: Performance on 5 critical steps of resuscitation among HCWs

Number of Steps achieved	Frequency (%)
0	6 (14.29%)
1	12 (28.57%)
2	13 (30.95%)
3	8 (19.05%)
4	3(7.14%)
5	0

Six health care workers did not achieve any steps of resuscitation whereas none of them achieved all the 5 critical steps. As per the ETAT+ guidelines none of them is skilled in basic newborn resuscitation since failure to achieve a critical step is regarded a fail.

4.5 Factors associated with knowledge and skills performance

Several factors namely designation, years of experience, training in resuscitation were tested for association with knowledge performance and none was significant. Fishers Exact test was used for small cells whereas Chi square test for cells with expected value of more than 5. P value of less than 0.05 at 95% Confidence Interval was considered significant.

Table 7: Knowledge performance and associated factors

Variable	Fail (%)	Pass (%)	P value (X²)
Designation			0.411
Medical Officer	2 (100)	0 (0)	
Clinical Officer	3 (60)	2 (40)	
Registered nurse	19 (50)	19 (50)	
Enrolled nurse	1 (100)	0 (0)	
Age (years)			0.591
Under 25	1 (100)	0 (0)	
25-35	13(56.5)	10 (43.5)	
>35	11 (50)	11 (50)	
Gender			0.261
Female	18 (50)	18 (50)	
Male	7 (70)	3 (30)	
Years of Experience			0.519
Under 2	9 (64.3)	5 (35.7)	
2-5	6 (42.9)	8 (57.1)	
>5	10 (55.6)	8 (44.4)	
Trained in New-born Resuscitation			0.979
No	16 (54.2)	9 (45.8)	
Yes	12 (54.5)	9 (45.5)	

Skills performance and associated factors

All the health workers failed the new-born scenario irrespective of cadre, age, years of experience and training in new-born resuscitation despite half of them having passed the written test. Since none of them passed we did not have a basis for comparison in attempt to measure association. However their characteristics are as illustrated in Table 3 and Table 7.

CHAPTER FIVE: DISCUSSION OF FINDINGS

We assessed the knowledge, skills of the health care workers in basic new-born resuscitation, associated factors with skills and knowledge and availability of the equipment in all the sub county hospitals in Uasin Gishu County.

5.1 Knowledge on new-born resuscitation

Neonatal resuscitation is effective only when health professionals have sufficient knowledge and skills (Gebreegziabher, 2014). The knowledge is acquired during formal training of the nurses, midwives and doctors and through neonatal resuscitation training programmes such as ETAT+, HBB, Essential New-born Care. According to NRP guidelines the minimum competency level is defined by a score of 80% and above.

We assessed the health care workers knowledge on new-born resuscitation using a written test that had multiple choices. Almost half of the health care workers passed the written test. These results were different from what Murila et al noted in a study done to assess knowledge where only 35.4% health workers passed (Murila, Obimbo, & Musoke, 2012). Whereas the basic new-born resuscitation steps were assessed, other advanced steps such as endotracheal intubation and administration of drugs were included in that study. In our study we focused only on basic new-born resuscitation because we were dealing with primary health care facilities that do not carry out advanced resuscitation.

In overall only about half of the health care workers attained a pass and would be considered to have minimal competency level for knowledge on basic new-born resuscitation. This however does not translate to hands on skills.

5.2 New-born Resuscitation Skills

The new born resuscitation skills are acquired during preservice training and or in service training. Some of the in service training courses proposed for implementation in low income countries include Essential New-born Care and ETAT+ among others (Opiyo & English, 2010). The ETAT+ training was rolled out in Kenya in 2006 and has been used to provide standard, appropriate knowledge and skills to health providers with limited experience or prior training (M. English, Wamae, A., Nyamai, R., Bevins, B., & Irimu, G., 2011). The steps bolded in the skills assessment tool (see appendix VI) are considered critical and a trainee has to achieve them so as to be considered as having passed this course. We looked at the proportion of the workers who achieved these steps and also noted that none of them achieved all the critical steps.

Majority of the health care workers did not achieve the step on administering effective positive pressure ventilation upon being given the clinical simulation of a new-born who did not cry at birth. They faltered on checking for chest rise during ventilation and on the correct rate of administering the positive pressure ventilation. Some of the outdated practices observed included administering of five slow inflation breaths instead of continuous breaths at a rate of 40-60 breaths per minute. When compared with a study done in Afghanistan a much greater number of doctors and midwives, 87.5% and 81% respectively were able to ventilate at 40 breaths per minute. We acknowledge that this is the most important and difficult step in new-born resuscitation (Oddie, Wyllie, & Scally 2005). However there is an urgent need to improve the skills of the health care workers if we are to save thousands of new-born who require resuscitation by positive pressure ventilation at birth.

Looking at the assessment of breathing, a third of the health care workers were able to achieve that. Those who did not achieve this step faltered on checking for signs for

breathing and only two of them remembered to call for help when they noted that the baby was not breathing of which is a critical step. Similar findings have been noted in a study in Pakistan by Ariff et al, where there was a major lapse in checking of new-born respiration (S. Ariff et al., 2010). We did not find previous studies that mentioned on the step of calling for help however, in these primary care facilities deliveries are conducted by a single health worker. It is likely that health care workers have not acquired that practice because of conducting deliveries single handedly. There is a crucial need for the health care workers to identify a baby that requires assistance with breathing and act accordingly by calling for help and initiating ventilation.

Another critical step of resuscitation is assessing the airway and more than half of the workers checked the nose and mouth for secretions. A relatively higher number demonstrated the step on drying baby and giving warmth during the simulation unlike in the study done in Pakistan where most of the participants failed to provide adequate thermal protection (S. Ariff et al., 2010). All the facilities we visited had a warmer at the resuscitation corner hence health care workers may have gotten used to the practice of placing a new-born in a warm place. Of note, in the study conducted in Pakistan, facilities were lacking equipment such as warmers. Thermal protection is very crucial especially for the preterm babies and this is a positive step towards improving survival of preterm babies.

The overall poor performance on critical steps of resuscitation indicates a big lapse in the skills of the health care workers. There has been similar findings also in Cameron with the competence of health care providers being rated poor at 24% (Monebenimp et al., 2012). With these findings there is a clear need demonstrated that health care workers are not proficient in new-born resuscitation and this could one of the hindrances towards improving new-born survival.

5.3 Factors associated with Knowledge and skills

We found no association between knowledge and cadre of service, years of experience and training. None of the workers demonstrated competency in resuscitation skills as per ETAT+ guidelines hence no comparable statistics could be done. We however can state that medical officers, clinical officers and nurses do not have skills of resuscitation irrespective of their years of experience in labour wards or previous in training in resuscitation.

5.3.1 Training in Basic New-born Resuscitation

In low and middle income countries, training of birth attendants in new-born care has resulted in reduction in early neonatal mortality (Pammi, Dempsey, Ryan, & Barrington, 2016) . Close to 1400 health workers have received full training in ETAT+ between 2006 and 2010(M. English, Wamae, A., Nyamai, R., Bevins, B., & Irimu, G. , 2011).

The health care workers in this study were asked if they had received prior in service training. Half of them had received in service training with a majority being trained in BEmONC and a few trained in ETAT+ and Essential New Born Care. However Murila and Ogunlesi found that a much lesser number(12%-14%) of health workers had received formal training on new-born resuscitation (Murila et al., 2012; T Ogunlesi 2008). Majority of those that were not trained stated that they had not heard about the new born resuscitation courses and they were all willing to be trained in new-born resuscitation.

Competence based training has been shown to exert a great influence on knowledge and skills(Young Mi Kim et al., 2013).For those trained in new-born resuscitation, the average duration after training was 4.4 years with an range of 1 -9 years. We compared

the performance on the knowledge test between those previously trained and those that were not. There was no statistical difference in the scores of the two groups. This shows a clear decline in the knowledge in spite of the previous training. There has been similar findings in Zambia where a decline in both written and performance scores was noted early as 6 months after training (Carlo et al., 2010). This clearly indicates that there is a need to focus on knowledge and skills retention beyond the in service training. One of the standards of WHO in improving quality maternal and new-born care is to have health care staff in child birth areas receive in service training or regular refresher sessions once in every year. Secondly is to have monthly drills or simulation exercises in basic new-born resuscitation (WHO, 2016). Other suggested ways on retention of skills and knowledge include Ongoing skills practice and monitoring and more frequent retesting (Hoban et al., 2013).

5.3.2 Cadre of Service

The sub county hospitals are considered as primary care facilities and the main birth attendants are the nurses and nurse midwives. In this study, we found the majority of the birth attendants were nurse midwives and this is in line with WHO recommendation that every birth should be conducted by a skilled birth attendant namely doctor, nurse, and nurse midwives (WHO, 2016).

Some of the facilities in addition had clinical officers and medical officers and they were called upon to assist in difficult resuscitation cases. They also acted as point of referral for cases that needed advanced management. The medical officers failed the written test whereas the number of clinical officers who passed was almost equal to those who failed. The number were too small to for statistical analysis but having most of them not showing minimum competency level is of concern as the nurses look up to

them when resuscitation are difficult. Elsewhere, Kim et al showed that nurses displayed similar level of knowledge as the doctors whereas we found half of the nurses passed, a proportion higher than doctor and clinical officers combined (Young Mi Kim et al., 2013). The poorer performance of doctors and clinical officers in this study could result from less exposure to resuscitation of neonates as they were mainly consulted when there was complicated cases of resuscitation.

In relation to skills health care workers in Nigeria mainly nurses were also found not to be competent in resuscitating new-borns after delivery. The reason attributed to their failure in resuscitation was lack of previous training, unlike in our study where half of them were trained. It is possible that their skills also had decayed over time due to the long duration between their training and time of assessment in this study. In contrast midwives have been reported to have better skills than medical officers in Pakistan with reason attributed to greater exposure to child births (Shabina Ariff et al., 2010). In as much as the midwives conduct most of the deliveries in our setting as compared to the medical officers and clinical officers, they equally performed poorly still as a result of skills decay as some of them had been previously trained.

5.3.3 Years of Experience

In the Maternity Unit, at least a third of the health care workers had worked for a minimum of five years. The years of experience have varied in other studies with a range of 5.9 years in Afghanistan to 9 years in Kenya (Murila et al., 2012);(Y. M. Kim et al., 2013).The long duration of experience may not necessarily imply that health workers were adequately knowledgeable on new-born resuscitation as there was no significant association between years of experience and knowledge performance.

However in Afghanistan, workers who had worked for an average of 5.9-6.5 years were significantly more knowledgeable. In that study, the content and duration of midwifery programs were reported to be intensive as compared to minimal hours of training of nurses on new-born resuscitation noted in a study in various hospitals across Kenya (Murila et al., 2012).

5.4 New-born Resuscitation Equipment

Basic new-born resuscitation requires a bag and mask for ventilation, a mucus extractor for suctioning, a source of warmth for thermal protection, and a clock ("WHO | Basic newborn resuscitation: a practical guide

http://www.who.int/maternal_child_adolescent/documents/who_rht_msm_981/en/,").

The key equipment is a self-inflating bag-and-mask and is used in lung inflation, the most important and difficult step in new-born resuscitation (Oddie et al., 2005).

In this study, each of the six hospitals had a self-inflating 500ml bag, face mask size 1, suction device i.e. bulb sucker and mechanical suction device and radiant warmer. They were all functional. The self-inflating bags and bulb suckers were soaked in cleaning detergents at the time of data collection. However it was not within the scope of this study to evaluate the cleaning and disinfection practice. In a study done in Afghanistan, it was found that a few facilities missed a bag and mask or simple suction apparatus (Young Mi Kim et al., 2013). The hospitals we studied had received donations of new-born resuscitation equipment a few weeks prior the beginning of the study perhaps explaining they were well equipped. It is unfortunate that all facilities lacked face mask size for preterm new-borns.

Half of the facilities did not have towels for drying the babies and wall clocks and this was similar to a national survey done in Vietnam where half of the facilities were

also noted not to have a clock in the delivery room (Trevisanuto et al., 2016). The WHO requires that a large wall-clock with hands indicating both minutes and seconds should be easily visible in the delivery room and this was the case in the other three facilities. A common practice was the use of a wrist watch or mobile phone in timing of resuscitation. This may affect the accurate timing of the resuscitation events. With the lack of towels, the health care workers resorted to using the mother's clothes as an alternative. In a setting where a mother does not carry extra cloth for the baby, the baby may not get optimum resuscitation care and hence an intervention is still needed to always ensure all supplies are in place.

It was commendable to see that each of the facilities had a modified resuscitation table in the corner of the labour ward with a mattress on the concrete working surface placed next to the radiant warmer. The sub county hospitals in Uasin Gishu County are generally well equipped for new-born resuscitation and this is a positive step towards improving new-born survival.

5.5 Study Limitations

- i. Some of the well performed steps during simulation could be explained by the fact that research assistant and principal investigator were closely observing and health care workers were therefore careful to perform rightly i.e. Hawthorn effect.
- ii. The health care workers were assessed irrespective of their duration of work in the labour ward. The results may therefore not represent a homogenous group as nurses rotated for different duration across the hospitals.
- iii. Attitude a component of competence was not assessed among the health care workers.

- iv. Qualitative aspect was not included in this study to explain the level of knowledge, skills and reasons why four health care workers declined skills assessment.
- v. The written test was administered at different times across all the hospitals and it is possible that some health care workers had a leakage of the questions prior writing the exam.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- a) Half of the health care workers have adequate knowledge on new-born resuscitation.
- b) The health care workers are not skilled in basic new-born resuscitation.
- c) The sub county hospitals are well equipped for basic new-born resuscitation

6.2 Recommendations

- a) There is need to improve health care workers resuscitation competency in Uasin Gishu County to acceptable levels.

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APPENDICES

APPENDIX 1: CONSENT FORM

Consent to participate in New-born Resuscitation Assessment Study

SERIAL NUMBER

Background

You are being asked to participate in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Read the following information carefully and ask us if there is anything that is not clear or if you would like more information. Please take time to decide whether you want to take part in this study.

This study aims at assessing the capacity of the Sub county hospitals in Uasin Gishu County to conduct basic new-born resuscitation. The keys areas that will be looked into include resuscitation equipment, health care worker knowledge and skills and the staffing in the maternity wards.

The information gained during this research will be used for the sole purpose of addressing the challenges that hinder affective new-born resuscitation in the county.

Study Procedure

The questionnaire that you shall fill shall capture your professional background, new-born resuscitation training if previously attended, and an assessment on basic new-born resuscitation steps. Each questionnaire shall have a serial number and not a name so as to maintain confidentiality. The findings cannot therefore be linked to an individual health care worker.

Person to Contact

If you have questions, complaints or concerns about this study, you can contact the Principal investigator from Moi University, School of Medicine, department of Child Health and Paediatrics, Postgraduate programme; Dr. Pauline Thirimu Kamau 0720326954,

Email address: thirimup@gmail.com

Institutional Review Board

This study has been approved by the Institutional Research and Ethics Committee (IREC) of Moi University/Moi Teaching and Referral Hospital. Contact IREC if you have questions or complaints or concerns which you do not feel you can discuss with the investigator using the address;

The Chairman IREC, Moi Teaching and Referral Hospital, P.O BOX 3, Eldoret, Kenya.
Tel. 33471/2/

Voluntary Participation

It is up to you to decide if to participate in this study. Refusal to participate will not result in any penalty or loss of any benefits. The relationship with the investigator will not be affected.

Right of investigator to withdraw

The investigator can withdraw you from the research without your approval.

Costs and Compensation to participants

There is neither cost nor compensation for participation in this study.

Thank you for your participation in this research.

CONSENT

By signing this consent form, I confirm I have read the information in this consent form and have had the opportunity to ask questions. I will be given a signed copy of this consent form. I voluntarily agree to take part in this study.

Name of Health Care workerSignature.....Date.....

Name of InvestigatorSignature..... Date.....

APPENDIX II: HEALTH STAFFING QUESTIONNAIRE FORM

1. How many deliveries have been conducted in this facility in the past one year?

2. How many new-born resuscitation cases have been conducted in the past 3 months?

3. How many nurse/mid wives work during the day shift-----night shift-----

4. What was the total number of nurse/mid wives based in labour ward for the past one year?

5. How many clinical officers/medical officers are allocated the labour ward?(specify)

APPENDIX III: HEALTH CARE WORKER QUESTIONNAIRE FORM

Encircle one answer and specify where indicated.

Section A: Demographic Data

1. Serial No..... Designation.....

2. Age a) Under 25 years b) 25-35 years c) Over 35 years

3. Sex a) Male b) Female

4. Years of Service in the Unit. a) Under 2 years b) 2-5 years c) Over 5 years

5. What is your formal training level? a) Clinical Officer b) Medical Officer

c) Enrolled nurse d) Registered nurse

Other (specify) -----

6. Have you been trained on new-born resuscitation after your formal training?

a) Yes b) No

7. If yes, which of these training courses a) EPLS b) PALS c) ETAT+ d)

BEmONC e) Essential New-born Care Others (specify) -----

8. If no, why

a) Cost of the course is expensive

b) Have never heard of any course

c) No time off work to attend the course

d) Not Interested

9. Which year did you attend the course-----

10. Would you wish to be trained in new-born resuscitation if you have not been trained previously?

a) Yes b) No

11. How many times have you performed new-born resuscitation in the past 3 months?

a. Less than 5 times

b. 5-10 times

c. More than 10 times.

APPENDIX IV: NEW-BORN RESUSCITATION WRITTEN TEST

Encircle the correct response.

1. A new-born who is born at term, has no meconium in the amniotic fluid or on the skin, is breathing well and has good muscle tone

- a. Does not need resuscitation
- b. Does need resuscitation.

2. A new-born with meconium in the amniotic fluid who is not vigorous

- a. Will not need suctioning of the airway.
- b. Will need suctioning of the airway.

3. The correct way to stimulate a new-born

- a. Slap the back
- b. Rub the back
- c. Slap the sole of foot.
- d. Squeeze the rib cage

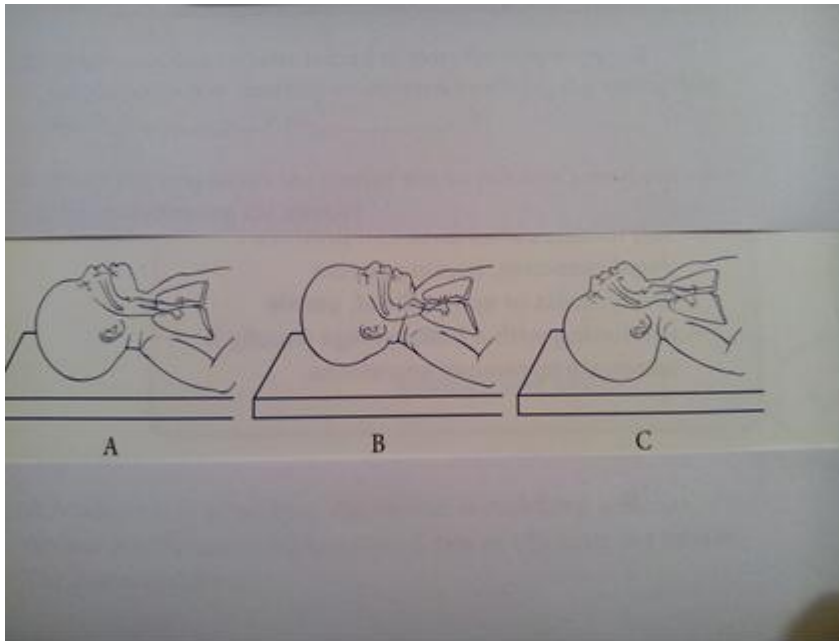
4. The steps of neonatal resuscitation are as follows

1. Provide warmth→ Dry and stimulate→ Position head and clear airway→ provide positive pressure ventilation →Chest compression →Administer epinephrine

2. Provide positive pressure ventilation →Chest compression →Administer adrenaline →Position head and clear airway→Provide warmth

3. 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

Appendix V: Basic Newborn Resuscitation Equipment Checklist

HOSPITAL SERIAL NUMBER..... Service station: Labour Ward

Mark as appropriate *F* for present, *A* for absent, condition: *F*-Functional or *NF*-

Non functional

ITEM	PRESENT	ABSENT	FUNCTIONAL	NON FUNCTIONAL ¹
Resuscitation table				
Radiant warmer				
Towels minimum of 2				
Mucus Extractor/Vacuum Suction Machine				
Bulb sucker/Penguin syringe				
Self-inflating bag and masks (250/500mls)				
Face mask size 0				
Face mask size 1				
Clock/Watch				

Appendix VI: Basic New-Born Resuscitation Scenarios

Participant Serial Number:

Designation:

Scores: 0-Not achieved 1-Achieved

Tick as appropriate.

Scenario 1

A term baby is delivered after a Caesarean Section for prolonged second stage and low foetal heart rate. The baby makes no immediate cry as the cord is being cut. There is no meconium. What do you do?

Action required	Information	SCORE	
		0	1
Place the baby on resuscitation where it can be warmed			
Dry the baby , remove wet cloth and wrap in a dry cloth	There is no cry to this stimulation The baby is floppy and pale		
Observe Cry/respiratory effort Tone Colour			
Assess airway -Look in the mouth	There is nothing in the mouth		
Assess breathing -look, listen and feel for breathing Call for help	There is no breathing		

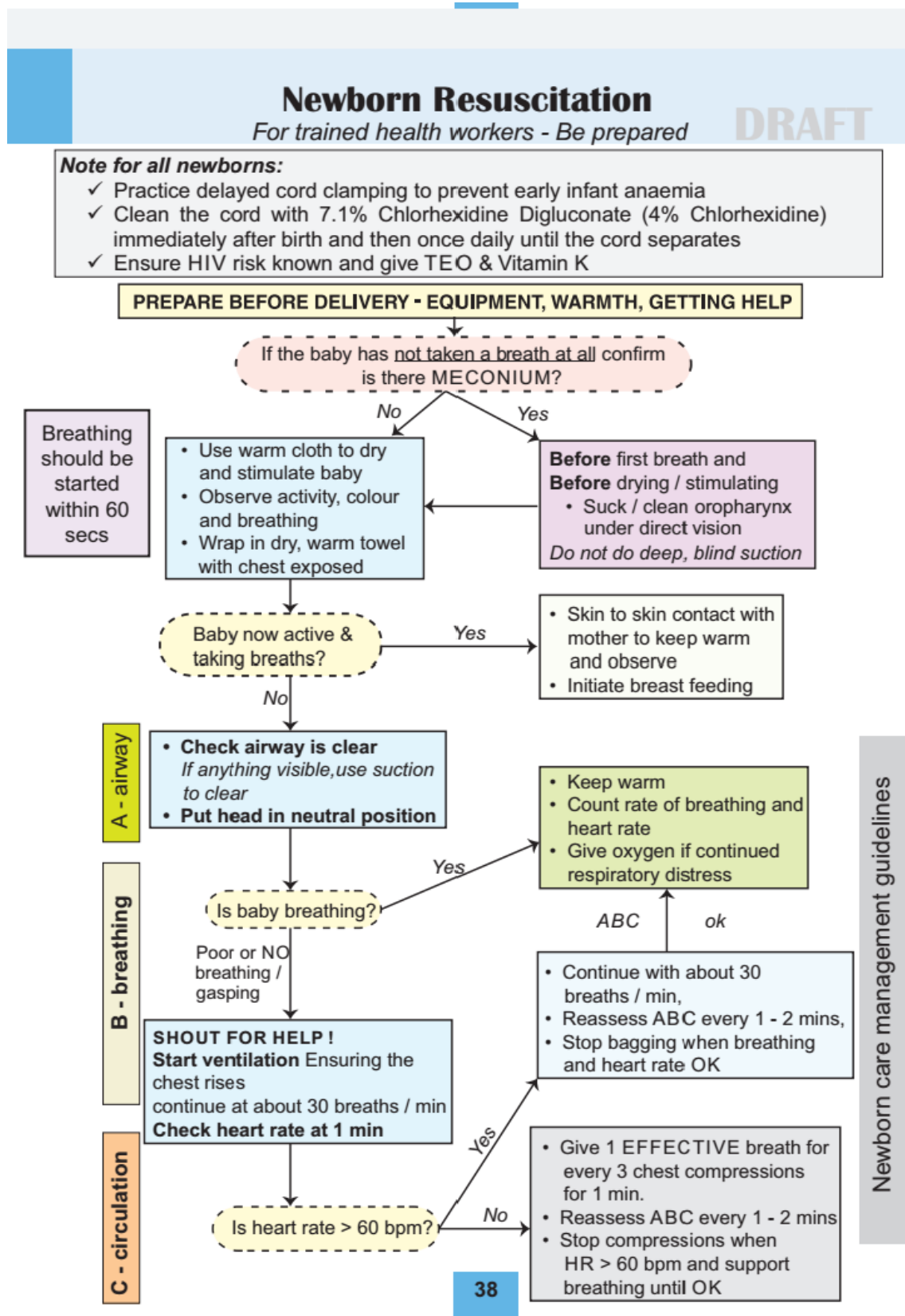
Give 30 ventilation for 1 minute			
Assess large pulse umbilicus or listen	There is a pulse 90 bpm		
Total score			

Scenario 2.

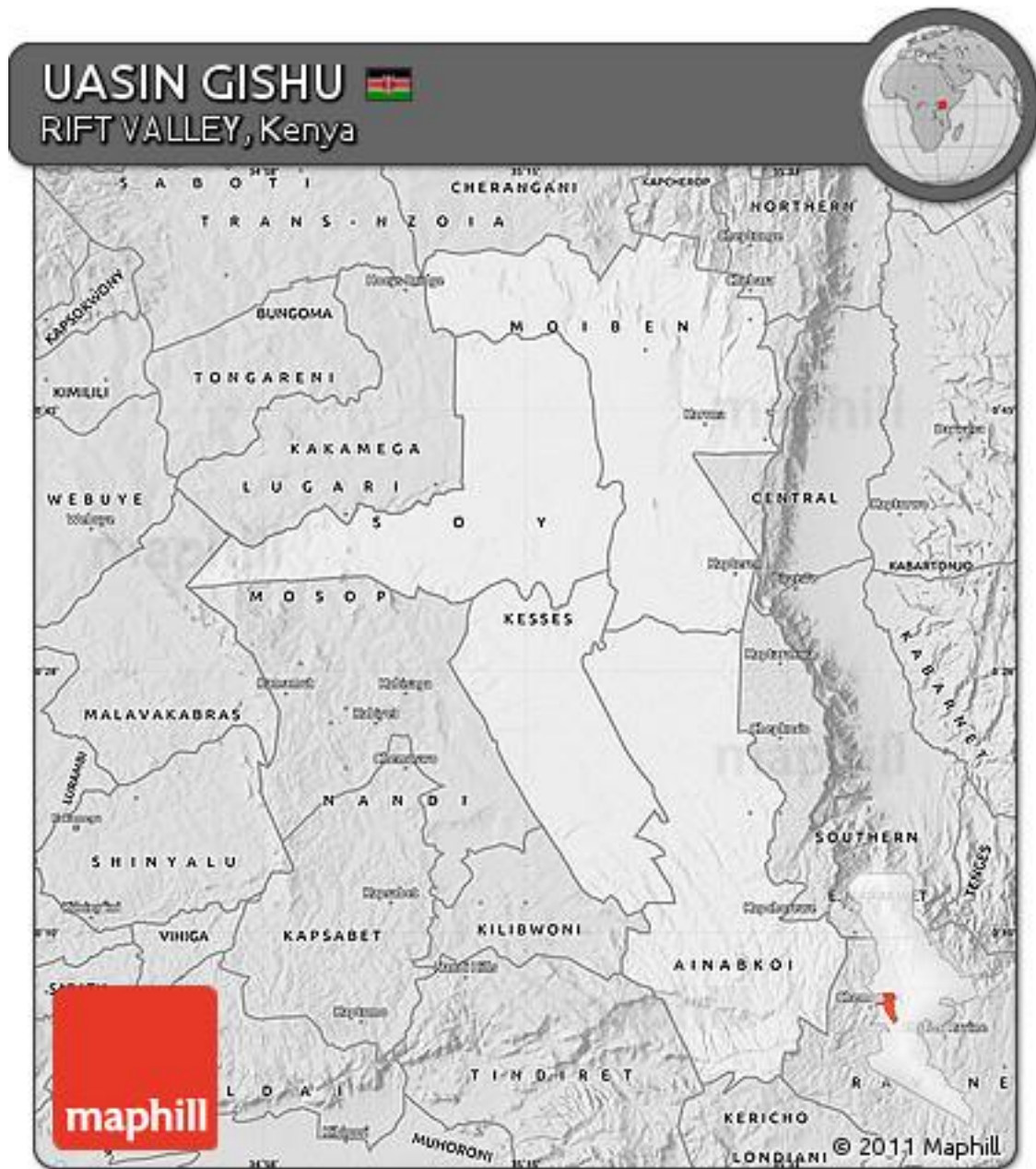
A term baby is delivered through meconium stained liquor. The baby is floppy. What do you do?

Action required	Information	SCORE	
		0	1
Place the baby on resuscitation where it can be warmed			
Look in the mouth	There is meconium		
Suction the mouth	No more meconium		
Dry the baby , remove wet cloth and wrap in a dry cloth	There is no cry to this stimulation The baby is floppy and pale		
Observe Cry/respiratory effort Tone Colour			
Assess airway -Look in the mouth	There is nothing in the mouth		
Assess breathing -look, listen and feel for breathing Call for help	There is no breathing		
Give 30 ventilation for 1 minute			
Assess large pulse umbilicus or listen	There is a pulse 90 bpm		
Total score			

APPENDIX VII: BASIC PAEDIATRIC PROTOCOLS, ETAT+ ALGORITHM FOR NEW-BORN RESUSCITATION



APPENDIX VIII: MAP OF UASIN GISHU COUNTY



Source: Maphill 2013

APPENDIX IX: BUDGET

ITEM	QUANTITY	UNIT COST [Kshs]	TOTAL [Kshs]
Box files	5	1,000	5,000
USB/Flash disc	1	1,000	1,000
Printing cartridges	2	10,000	20,000
Printing paper	30	500	15,000
Folders	100	50	5,000
Printer	1	20,000	20,000
Hiring a set of manikin and equipment	1 month	25000	150,000
Training expenses	2 day	6,000	12,000
Transport	-	50000	50000
Contingencies (10% of Total Cost)			23,600
Total			Kshs 301,600

APPENDIX X: TIME FRAME

ACTIVITY	START	END
Proposal Writing	January 2015	May 2015
Presentation of Proposal to the department of Child Health and Paediatrics	March 2015	End of March 2015
IREC Review	June 2015	August 2015
Pilot study	October 2015	November 2015
Definitive study Collection of Data	January 2016	March 2016
Data Analysis	October 2016	December 2016
Thesis writing and presentation to the department of Child Health and Paediatrics	January 2017	May 2017
Presentation of Thesis to the School of Medicine for Examination purposes and Defence	June 2017	January 2018