A RESEARCH PROPOSAL FOR DISSERTATION IN PART OF FULFILLMENT OF MASTERS OF MEDICINE (MMED) DEGREE IN PAEDIATRICS AND CHILD HEALTH,UNIVERSITY OF NAIROBI

DETERMINATION OF THE ADHERENCE OF NURSES TO NATIONAL NEONATAL RESUSCITATION GUIDELINES AT PUMWANI MATERNITY HOSPITAL

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Registration number: H58/68448/ 2011

DECLARATION:

This dissertation is my original work, and has not been presented for a degree in any university nor published anywhere.

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ACKNOWLEDGMENTS:

I would like to extend my sincere gratitude and appreciation to the following for making it possible for me to reach this far:

1. My supervisors: Prof Rachel Musoke and Prof Dalton Wamalwa for their constant support and constructive input

2. Mr Phillip Ayieko and Millicent for their valuable assistance in data entry and analysis

3. The Department of Paediatrics and Child Health for their support and constructive criticism

4. Funding is from the Linked-Strengthening Maternal, Newborn and Child Health Research Training in Kenya. The grant is linked to Partnership for Innovative Medical Education in Kenya (PRIME-K). The project described was supported by Award Number 5R24TW008907 from the US National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the US National Institutes of Health

5. The administration and staff at Pumwani Maternity Hospital with emphasis on my research assistants: Serah Kilei , Bilha W. Kinyanjui and Diana Mwikali Kinywa who made the collection of research data possible

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Definition of Important Terms:

Neonate: An infant from birth to 28days or one month of age

Infant: a child up to 1 year of age

Neonatal mortality rate: the probability of dying within the first one month of life expressed per 1000 live births

Infant mortality rate: the probability of dying before the first birthday per 1000 live births

Under 5 mortality rate: the probability of dying between birth and the fifth birthday, expressed per 1000 live births

Neonatal Resuscitation: set of interventions at the time of birth to support the establishment of breathing and circulation

Preterm: a neonate born at less than 37 completed weeks or 259 days of gestation

Birth Asphyxia: failure to establish breathing at birth

LIST OF ABBREVIATIONS:

BMV: Bag Mask Valve

BScN: Bachelor of Science in Nursing

ECN: Enrolled Community Nurse

ENC: Essential Newborn Care

EPLS: European Paediatric Life Support

ETAT: Emergency Triage Assessment and Treatment

HCWs: Health Care Workers

ILCOR: International Liaison Committee on Resuscitation

KDHS: Kenya Demographic and Health Survey

KNH: Kenyatta National Hospital

KRCHN: Kenya Registered Community Health Nurse

MDG: Millennium Development Goal

MNCH: Maternal Newborn and Child Health

MoH: Ministry of Health

Ms Excel: Microsoft Excel

PALS: Paediatric Advanced Life Support

PMH: Pumwani Maternity Hospital

PRIME-K: Partnerships in Innovative Medical Education for Kenya

PRONOTO: Programe de Rescate Obstetrico y Neonatal:Tratamiento Otimo y Oportuno

RR: Respiratory rate

SPSS: Statistical Package for Social Science

U5MR: Under 5 years Mortality Rate

UNICEF: United Nations Children's Fund

UoN: University of Nairobi

WHO: World Health Organisation

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ABSTRACT:

Background and significance:

MDG4 targets a reduction in the Under 5 year Mortality Rate (U5MR) by two thirds between 1990 and 2015 and it has been noted that neonatal deaths are becoming a greater portion of the total under 5 mortalities. Globally, 3-6% of neonates require basic resuscitation and it has been demonstrated that basic resuscitation of new-born babies can lead to a 6-42% decrease in neonatal deaths. Kenya as a country has developed guidelines on neonatal resuscitation in an attempt to save as many neonates as possible. Our aim was to assess if these protocols were indeed correctly being put into practise at Pumwani Maternity Hospital (PMH).

Objectives:

Our primary objective was to determine the level of adherence of nurses to the National neonatal resuscitation guidelines at PMH.

Methodology:

We carried out a cross sectional survey at PMH over a period of three months. This involved determining the availability of basic equipment required for neonatal resuscitation at PMH as well as an analysis of the knowledge and practices of the nurses of neonatal resuscitation.

Results:

Of the 140 resuscitations observed in three locations at PMH (labour ward, maternity theatre and newborn unit), the National guidelines were only adhered to in 39%. Three quarter of the resuscitations were observed during the day while the remainder were observed at night.

When analysed according to the different steps of resuscitation, the guidelines were adhered to in 71.4% of the resuscitations in preparation, drying and warming, 63.6% in airway and 39.3% in breathing.

The most poorly performed steps were correct suctioning in the presence of meconium (52.5%), calling for help (67.1%), giving the correct number of inflation breaths (56.4%) and achieving adequate chest rise during ventilation (73.5%).

Adherence to guidelines was better in the new born unit (OR 3.75, p=<0.001), when all resuscitation equipment was available (OR 2.74, p=0.004), in cases of resuscitation of preterm neonates (OR 0.18, p=<0.001) and neonates less than 2500 grams (OR 0.37, p=0.008).

Resuscitation equipment was fully available in 57% of the resuscitations with the shortage of two dry towels for each resuscitation being the major gap.

Only 57.1% of the 35 nurses attained ≥50% on the knowledge assessment. Knowledge was poorest in the following areas: identifying preparation as the most important step in resuscitation, correct number of inflation and ventilation breaths, knowing when to initiate chest compressions, use of oxygen in resuscitation and the frequency of assessing the neonate during resuscitation.

Conclusion:

Of the 35 nurses observed, 5.7% adhered to the National guidelines with 39% of the 140 resuscitations being carried out well.

1.0: INTRODUCTION /BACKGROUND:

Millennium Development Goal 4 (MDG4) targets a reduction in the under 5year mortality rate (U5MR) by two thirds between 1990 and 2015. Globally, the U5MR has dropped by 35% from 88 deaths per 1000 live births in 1990 to 57 in 2010. These deaths are predominantly concentrated in Sub Saharan Africa and Southern Asia. While the U5MR has been declining, the rate of decline of neonatal mortality has been much slower than the decline in U5MR. In statistical terms, the neonatal mortality has declined by 28% globally from 32 deaths per 1000 live births in 1990 to 23 in 2010, an average decline of 1.7% per year compared to an average decline of 2.2% per year in the U5MR. This leads to the observation that the proportion of under 5 deaths that occur within the neonatal period has increased from 10% in 1990 to more than 40% in 2010. Sub Saharan Africa bears the largest burden of these neonatal deaths and having an average annual rate of 1.8% reduction in U5MR, is currently making insufficient progress towards achieving MDG4 [1].

Of these increasing neonatal deaths, 99% occur in developing countries [2] with 30-50% occurring on the first day of life[3] and 82% occurring in the first week of life [4]. The major direct causes of neonatal deaths at the global level are infections (35%), preterm birth (28%) and birth asphyxia (23%) [5].

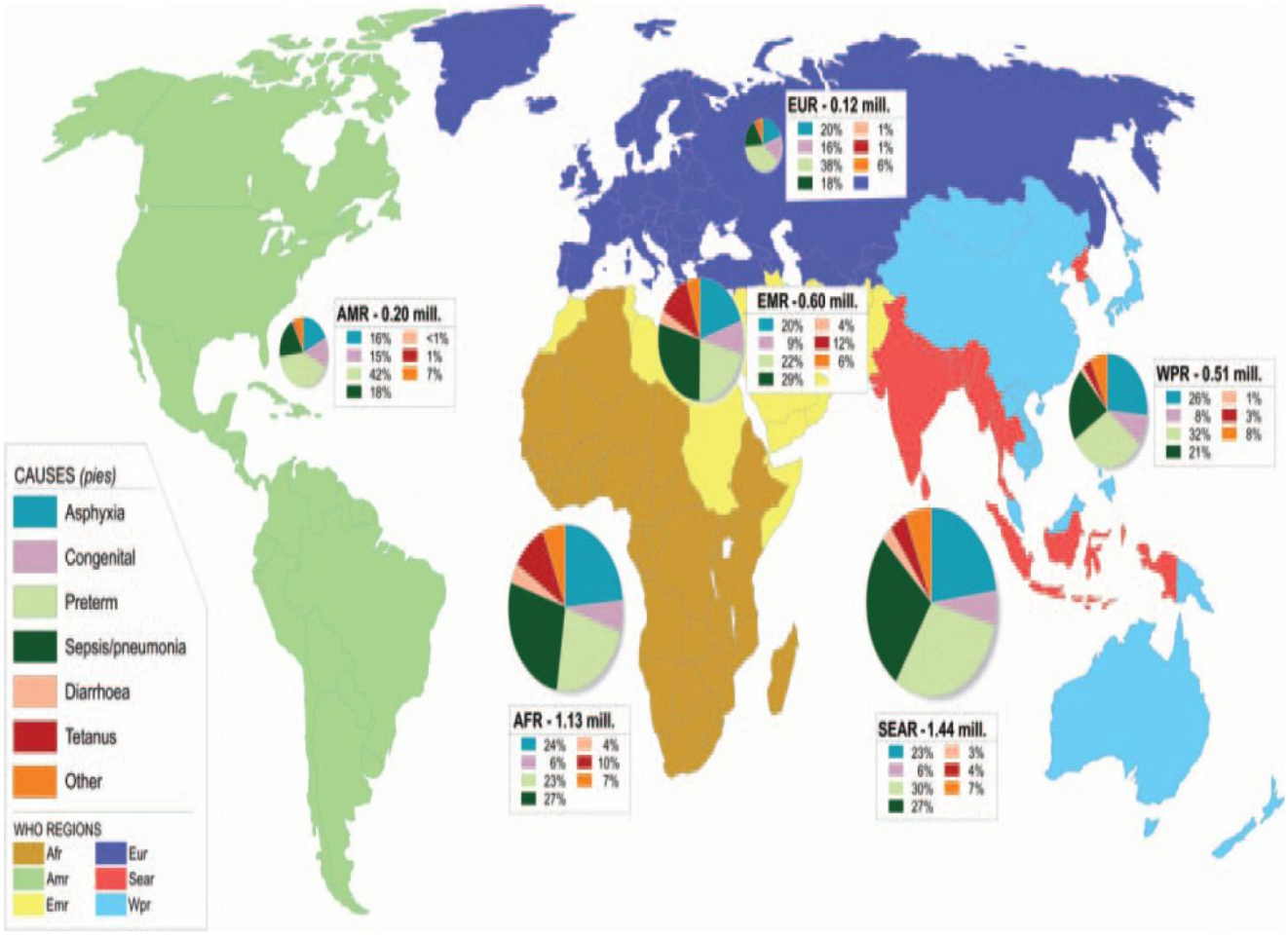

Figure 1: Contribution of different causes towards neonatal deaths in different geographical areas. (*Adapted from Int. J. Epidemiol. June 2006 35 (3): 714)* [5]

Afr= Africa, Amr= Americas, Emr= Eastern Mediterranean, Eur= Europe, Sear= Southeast Asia and Wpr= Western Pacific

In Africa, sepsis prematurity and asphyxia share the greatest burden of neonatal deaths. Of the neonatal deaths, 99% of the intra-partum related deaths occur in low-middle income countries.

A majority of the deaths due to asphyxia can be prevented by adequate resuscitation practices which would then lead to a decline in the overall neonatal mortality.

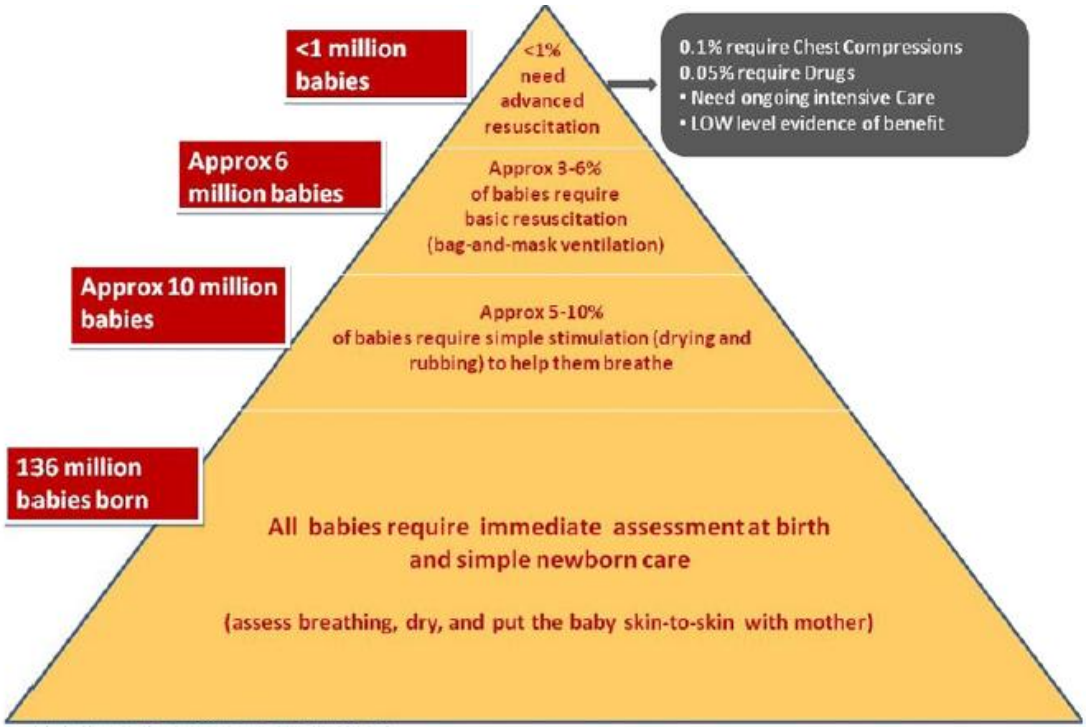

Figure 2: The Global Need for Resuscitation *(Adapted from Wall S et al, IJGO 2009;107: S47 – S64)* [6]

Globally, 3 – 6% of neonates require basic resuscitation on delivery consisting of stimulation and assisted ventilation. Less than 1% of the neonates require advanced resuscitation (figure 2).Therefore, Kenya as a developing country should be able to save a majority of the neonates requiring resuscitation even with minimal resources[6].

In Kenya 43% of mothers deliver in a health care facility while only 44% deliver under supervision of a skilled birth attendant [4]. In low resource countries where the burden of intra-partum events is the greatest, the capacity to provide adequate neonatal resuscitation is lacking. As demonstrated in figure 3, based on data collected between the years 2000 and 2007, only 7% of all babies were delivered by

staff trained in neonatal resuscitation and only 22% of all babies were born in facilities with equipment for new-born respiratory support in Kenya [7].

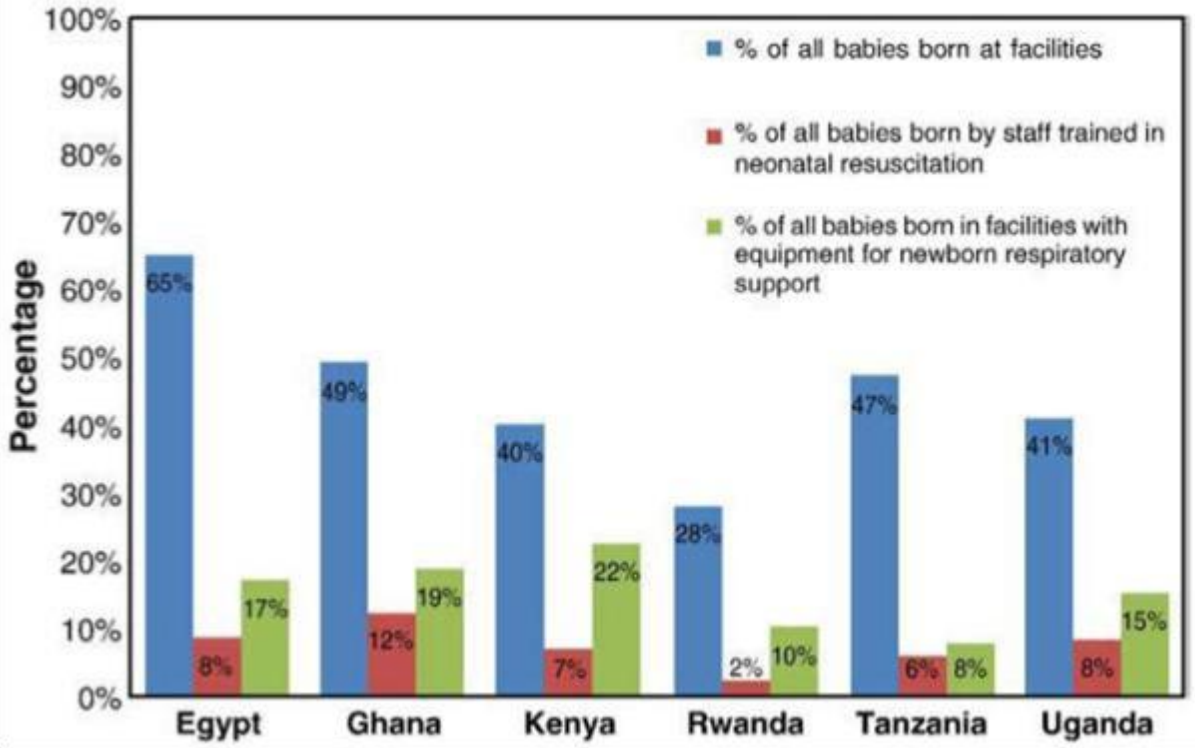

Figure 3: Estimates from 6 countries for the percentage of babies born in facilities, and the percentage of facilities with staff trained in neonatal resuscitation and with bag-and-mask (*Adapted from: International Journal of Gynecology and Obstetrics 107 (2009) S48)*[8]

In order to reduce neonatal mortality, good knowledge and practices in neonatal resuscitation are mandatory backed up by the necessary equipment. Kenya has developed protocols on neonatal resuscitation so as create uniformity and promote better neonatal resuscitation practices so as to reduce the number of neonatal deaths. These protocols were developed to target all health care workers involved in the care of neonates and children in Kenya.

2.0: LITERATURE REVIEW:

2.1:Impact of neonatal resuscitation:

Neonatal resuscitation is an essential skill in which every health care worker involved in deliveries should be proficient. Although only a small percentage of neonates require resuscitation on delivery as demonstrated in figure 2, several studies have shown that skilled resuscitation can significantly decrease neonatal mortality rates. Lawn *et al* showed that neonatal resuscitation in facilities could reduce mortality of term intra-partum related neonatal deaths by 30% and also reduce deaths for preterm babies[9] .Basic neonatal resuscitation alone could save 192 000 birth asphyxia related deaths and 10,000 preterm deaths [10].

2.2: Knowledge and practices of health care workers in neonatal resuscitation:

Several studies have been done to assess the knowledge and practices of health care workers in neonatal resuscitation. Douglas *et al* demonstrated that 54% of the resuscitations recorded had deviations from the neonatal resuscitation guidelines[11]. Ogunlesi *et al* showed that 95.5% of participants had adequate knowledge of evaluation of neonates while 49.7% had adequate knowledge of appropriate decisions and actions[12]. Murila *et al* demonstrated that 85.4% of medical providers had heard of neonatal resuscitation but more than 70% considered their knowledge to be inadequate[13]. Alwar *et al* also found that 39.0% of health care workers had adequate knowledge while 47.2% had appropriate practises in neonatal resuscitation[14].

In addition to the several studies above that demonstrate a significant gap in the knowledge and appropriate practices of health care workers in neonatal resuscitation, Leone *et al* also demonstrated that substantial variations existed in neonatal resuscitation practices[15].

2.3: Impact of neonatal resuscitation training programs:

It has been demonstrated that neonatal resuscitation trainings can lead to a significant decline in neonatal mortality rates[2,7,9,10,16,17,18]. A study done in Pumwani Maternity Hospital in 2006 showed that implementation of a one day new-born resuscitation training can be followed by an immediate significant improvement in health care workers practices[17]. Results from the study showed that trained providers demonstrated a higher proportion of adequate initial resuscitation steps compared to the control group as well as a statistically significant reduction in inappropriate and potentially harmful practices. At the time of this study when there were clearly evident gaps in the practises of health care workers at PMH, the Kenyan guidelines on neonatal resuscitation had not yet been developed in the form of job aides.

Of interest are the results of the Lancet series done on neonatal survival which demonstrated that at 90% coverage, intra-partum and postnatal packages have a two to three fold greater reduction in neonatal mortality than antenatal care. In addition, it also demonstrated that resuscitation of new-born babies alone can lead to a 6 – 42% decrease in all causes of neonatal mortality[19].

2.4: Development of and adherence to guidelines:

Guidelines are generally designed to create uniformity in correct practises founded on evidence based recommendations. However several studies done in adult medicine have shown poor adherence levels. A study by Mc Glynn *et al* showed that practitioners follow evidence based guidelines inconsistently in many diseases with an adherence rate as low as 55% [20]. A study done in Malawi showed that midwives did not adhere to 9 out of the 21 resuscitation guideline steps and generally there was substandard adherence to guidelines on identification of warning signs of birth asphyxia and neonatal resuscitation [21].

2.5: Barriers identified as contributing to poor adherence to guidelines*:*

The barriers identified in several studies are variable and unique for each recommendation. The most commonly perceived barriers in a study done among Dutch general practitioners were lack of agreement with recommendations due to lack of applicability or lack of evidence, environmental factors such as organisational constraints, lack of knowledge regarding guideline recommendations and guideline factors such as unclear or ambiguous guideline recommendations [22].

2.6: Steps in basic neonatal resuscitation (According to the 2012 WHO guidelines on newborn resuscitation [23]):

2.6.1: Who to resuscitate:

According to the WHO recommendations, all babies who do not cry, do not breathe at all or who are gasping 30 seconds after birth should be resuscitated with bag mask ventilation.

2.6.2: Suctioning:

Routine naso-pharyngeal suctioning and routine intrapartum suctioning for intra-partum meconium stained amniotic fluid is not recommended. There is no benefit and this may lead to potential adverse effects. The WHO recommends suctioning only in cases where meconium is present and the baby does not cry.

2.6.3: Management of meconium staining of liquor:

Routine intra partum perineal suctioning for meconium stained amniotic fluid is not recommended any more after review of four studies (Carson *et al.,* 1976; Falciglia,1988; Falciglia *et al.,* 1992; Vain *et al.,*2004) did not show any significant benefits in mortality, meconium aspiration syndrome, perinatal asphyxia or air leaks following intrapartum suctioning in infants born through meconium [23]. This data is however collected from developed countries where the cases of meconium staining are rare. In low income settings, the risk of meconium aspiration is much higher. In places with adequate facilities for endotracheal intubation, endotracheal suctioning should be done for a non-vigorous baby with meconium stained liquor. In facilities without capabilities for endotracheal intubation, the guidelines are not too clear.

However, according to the Ministry of Health (MoH) Paediatric protocols, oro-pharyngeal suctioning should be done for non-vigorous babies with meconium stained liquor [24].

2.6.4: Ventilation:

Studies have demonstrated that the majority of babies who do not breath at birth do well on initial ventilation with a self-inflating bag and mask. There is little difference in time to first breath whether using ventilation by Bag Mask Valve (BMV) or endotracheal intubation with an experienced provider.

Recommendations are an initial 5 slow inflation breaths followed by continued ventilation at a rate of 30 – 50 breaths per minute. [23]

2.6.5: Chest compressions:

The WHO does not advocate for chest compressions in basic resuscitation unless there are 2 health care workers and there is an accurately assessed persistent bradycardia despite adequate ventilation. There are 4 main arguments proposed to support omission of chest compressions at lower level facilities:

- Chest compressions are not needed for most babies who survive
- Often a second person to assist in compressions is not available
- In most cases, the assessment of heart rate is inaccurate
- Once babies require chest compressions, they often need intensive care that is not available at lower level facilities.

In the rare instance that chest compressions are given, they are given 1 finger breath below the nipple line using both thumbs (encircling technique) or two fingers at a ratio of 3 chest compressions to one breath aiming at depressing the chest to two thirds of its anterior posterior diameter.

2.6.6: Use of oxygen:

A meta-analysis showed that there is a significant decline in mortality for new-borns who were resuscitated with room air versus 100% oxygen [23]. Babies resuscitated with room air also had shorter time to first breath and sustained respirations as well as higher Apgar scores. Therefore, oxygen is not compulsory for effective resuscitation of new-borns.

2.6.7: Equipment needed for neonatal resuscitation:

The equipment required for basic neonatal resuscitation is simple and easy to procure. Two warm towels, a source of heat, a suction device and a BMV device (preferably 500mls) with different sizes of face masks available.

3.0: JUSTIFICATION/ RATIONALE:

Neonatal resuscitation is a vital skill that every health care worker involved in handling deliveries should be proficient in. The Ministry of Health together with other partners, developed national neonatal resuscitation guidelines in the form of a working aide in 2008 that was updated in 2010(Appendix 1) [24]. These guidelines are readily available but health care workers do not seem to make use of them.

Knowledge and practice change over time as new evidence arises and thus there is need for regular refresher courses on neonatal resuscitation. In most institutions, including PMH, this does not happen. PMH depends mainly on donors to provide trainings and refresher courses. The last well- structured neonatal resuscitation training took place two years prior to this study.

In Kenya, Nairobi has the highest neonatal mortality rate. PMH is centrally located in Nairobi and mainly caters for the lower income population amongst whom the neonatal mortality is highest [4]. This makes PMH an ideal location to assess adherence to guidelines as it is a place where there is a high demand for neonatal resuscitation and thus need for updated and evidence based knowledge and practices amongst health care workers.

Although guidelines may be available, several barriers have been identified both at an institutional and individual level that hinder their implementation thereby reducing their effectiveness in achieving their target [25]. Opiyo *et al* demonstrated this fact in their study at PMH in 2006 where they noted that the availability, accessibility and correct functioning of basic resuscitation equipment was a missing necessity for successful resuscitation[17].

4.0: STUDY QUESTION:

What is the level of adherence of nurses to the National neonatal resuscitation guidelines at PMH?

4.1: OBJECTIVES:

4.1.1: Primary Objective:

1. To determine the level of adherence to the National guidelines during resuscitation of neonates at PMH

4.1.2: Secondary Objectives:

1. To assess if the hospital is adequately equipped for basic neonatal resuscitation
2. To determine the proportion of nurses who have adequate knowledge of the National neonatal resuscitation guidelines

5.0: METHODOL0GY:

5.1: Study design:

This was a hospital based cross sectional survey.

The selected sample of nurses was followed over a period of 3months until the required number of resuscitations had been observed per nurse.

5.2: Study location:

PMH is centrally located and mainly caters for the low income population. It has a bed capacity of approximately 350 (maternal beds and neonatal cots) with an average of 1500 deliveries per month and a neonatal mortality rate of approximately 20 per 1000 births. Our study was carried out in PMH labour ward, maternity theatre and the newborn unit. The newborn unit was included as most neonates requiring resuscitation were quickly transferred from labour ward and theatre to the newborn unit where most resuscitations were carried out.

5.3:Study population:

Nurses who were involved in receiving neonates after delivery at PMH formed the primary study population. PMH has approximately 123 nurses of which 40 are stationed in the maternity theatre, 57 in labour ward and 26 in the newborn unit. A minimum of 13 of these nurses are on annual leave at any given time. As a result, the actual number of nurses involved in deliveries was variable.

The nurses operated in three main shifts: morning (7:30am to 4:30pm), afternoon (12:30pm to 6pm) and night shift (6pm to 8am).

5.3.1: Eligibility criteria:

Inclusion criteria:

i. Nurses involved in receiving babies who had given voluntary consent to be observed while carrying out resuscitations

ii. Nurses who had worked at PMH for a minimum of 1 month

Exclusion criteria:

i. Nurses employed on a locum basis

ii. Student nurses

5.4: Study period: 3 months (September to December 2013)

5.5: Sample size:

Sample size was determined using formulae for cluster sample surveys proposed by Bennett et al (1991)

$$c = \frac{p(1-p)D}{s^2 b}$$

Where:

c = number of clusters (nurses) to be studied

p = proportion of resuscitations done appropriately (assumed to be 0.5)

1-p = 1-0.5 = 0.5

D = design effect, estimated at 1.3 based on ICC of 0.15 (Opiyo *et al*) [17]

ICC= Intra-class Correlation Coefficient. It reflects the homogeneity of the sample

b = number of resuscitations observed per nurse (4 events)

$$c = \frac{0.5\ (1 - 0.5) \times 1.3}{0.1^{\,2} \times 4}$$

C = 33 nurses performing 4 resuscitations each yielding a total of 132 resuscitations

We managed to observe 34 nurses and there were no drop outs.

At the end of 3months all the data collected was analysed.

5.6: Sampling procedure:

The participants were selected consecutively. All nurses who met the inclusion criteria and were involved in resuscitating a neonate were included. The research assistant in each of the three different areas was instructed to recruit a minimum of 11 nurses.

5.7: Consent procedure:

Written consent was obtained at the beginning when recruiting nurses after making them aware of the study.

5.8: STUDY PROCEDURE:

5.8.1:PREPARATION STAGE:

This laid down the foundation for carrying out the study.

Once ethical approval had been obtained the staff at PMH was invited to an early morning meeting in the labour ward to sensitize them on the study and its benefits with emphasis that participation was entirely voluntary. The audience was allowed to ask any questions that they had. All the nurses could not be made aware of the study at the same time due to the different work shifts and thus most of the nurses had to be approached on an individual basis by the research assistants in the three different study areas.

Once a nurse agreed to participate in the study, he or she was issued with a study code and given a consent and bio-data form to fill in. The nurse's name did not appear on the bio-data form and instead the study code was written. This was to protect the identity of the participating nurses. Only the research assistants knew the study code that was assigned to each of the participants.

The research assistants were recruited from within the PMH nurses in each unit to minimize the Hawthorne effect. We made the assumption that the nurses were less likely to change their practices when being observed by another nurse in the same unit as opposed to an observer from outside PMH. The research assistants were not given any formal neonatal resuscitation training but they were instructed on how to observe resuscitations against a pre prepared checklist and two practical observations were done with the

primary investigator to ensure that all the research assistants used the checklist in a similar manner.

5.8.2: DATA COLLECTION:

This was done in two main stages. The first stage involved collecting information about resuscitation practices and availability of essential resuscitation equipment. We had three observers, one stationed in each of the three study areas. Most observations were done when the research assistant was on duty and this included both day and night resuscitations. Thus observations were only done when the research assistant was on duty and if there were two resuscitations at the same time in one unit, the observer would go to the delivery that began first.

Once a neonate was delivered, the research assistant included the resuscitation only if two criteria were fulfilled. First, the nurse receiving the neonate had consented to participate in the study and the neonate delivered required resuscitation. In our study, a neonate requiring resuscitation was defined as one who did not cry immediately, was not breathing or was floppy. On fulfilment of these two criteria, the observer graded the performance of the nurse against a pre prepared checklist that assessed the availability of neonatal resuscitation equipment as well as the skills of the nurse under observation.

The assessment of resuscitation skills focused on three main areas:

a) Preparation, drying and warming:

This focused on determining if the participant checked that essential resuscitation equipment was available and tested it to ensure that it was in good working order before receiving the neonate at the beginning of the resuscitation. In addition, the observer also checked which equipment was available at the beginning of the resuscitation.

The next step was to assess if the nurse put the neonate under a heater and dried him/ her thoroughly with disposal of the initial wet towel. In the newborn unit, as long as the nurse was noted to remove the wet towel and replace it with a dry towel, it was checked that she had achieved this step. If the neonate was already received from labour ward in a dry towel, the nurse resuscitating the neonate in the newborn unit was assumed to have achieved this step. This was a modified criterion in the newborn unit.

b) Airway:

The aim here was to assess inspection of the airway, suctioning if required and correct positioning of the head into the neutral position. Suctioning is often indicated in a baby with significant secretions leading to respiratory distress or in a neonate with meconium stained liquor before the first cry.

c) Breathing:

We evaluated the participant's ability to assess for breathing effort and to make a correct decision on the need for assisted ventilation. The participant was required to assess breathing in three aspects, looking listening and

feeling for breathing effort. If there was no spontaneous respiratory effort, the neonate was gasping or breathing at a rate below 20 breaths per minute assisted ventilation should have been initiated after calling out for help.

In cases that required assisted ventilation, we evaluated the process including calling for help, giving the correct number of inflation and ventilation breaths, using an appropriately sized mask and ensuring adequate chest rise. Inflation breaths should have been given with the chest rising adequately at least twice.

We did not include chest compressions assessment as the decision to initiate chest compressions depends on variables not easily determined by the observer and very few resuscitations require chest compressions as shown in figure 2.

The research assistants then recorded any inappropriate or harmful practices observed. They were briefed on these during the preparation stage and the main practices they were advised to watch out for included:

- Holding the neonate upside down
- Shaking the neonate vigorously
- Hard patting of neonate on back
- Flicking foot of the neonate
- Vigorously wiping neonate
- Squeezing chest of neonate

If any of these practices were seen to be harmful or compromising resuscitation, the observer would intervene and correct the nurse so as to ensure that the neonate would be given the greatest chance of survival.

At the end of each week, the research assistants handed over the checklists to the primary investigator who entered the data into a Microsoft Access database for later analysis. Any missing data was sought for and if not available, the observation was disregarded but this only occurred in the case of one observation.

Quality assurance was attempted through random visits by primary investigator to ensure that observations were being carried out as instructed and questionnaires were being filled in on site. It was difficult to physically observe the resuscitations with the research assistants as this made the nurses alter their practices. However, the research assistants were encouraged to clarify any areas of concern or uncertainty and in cases where the primary investigator noted any errors in terms of collecting data, the error was brought to the attention of the research assistants and corrected immediately.

This procedure was repeated daily until the 35 nurses who had given consent had been observed 4 times each.

Once the observations were over, all the nurses participating were individually issued with a questionnaire to assess their knowledge. They immediately filled it in and handed it back to the research assistant. The knowledge questionnaire was given at the end to avoid pre-empting the nurses on what

we aimed to assess in the resuscitations thus causing them to change their practices.

The above steps are summarised in figure 4.

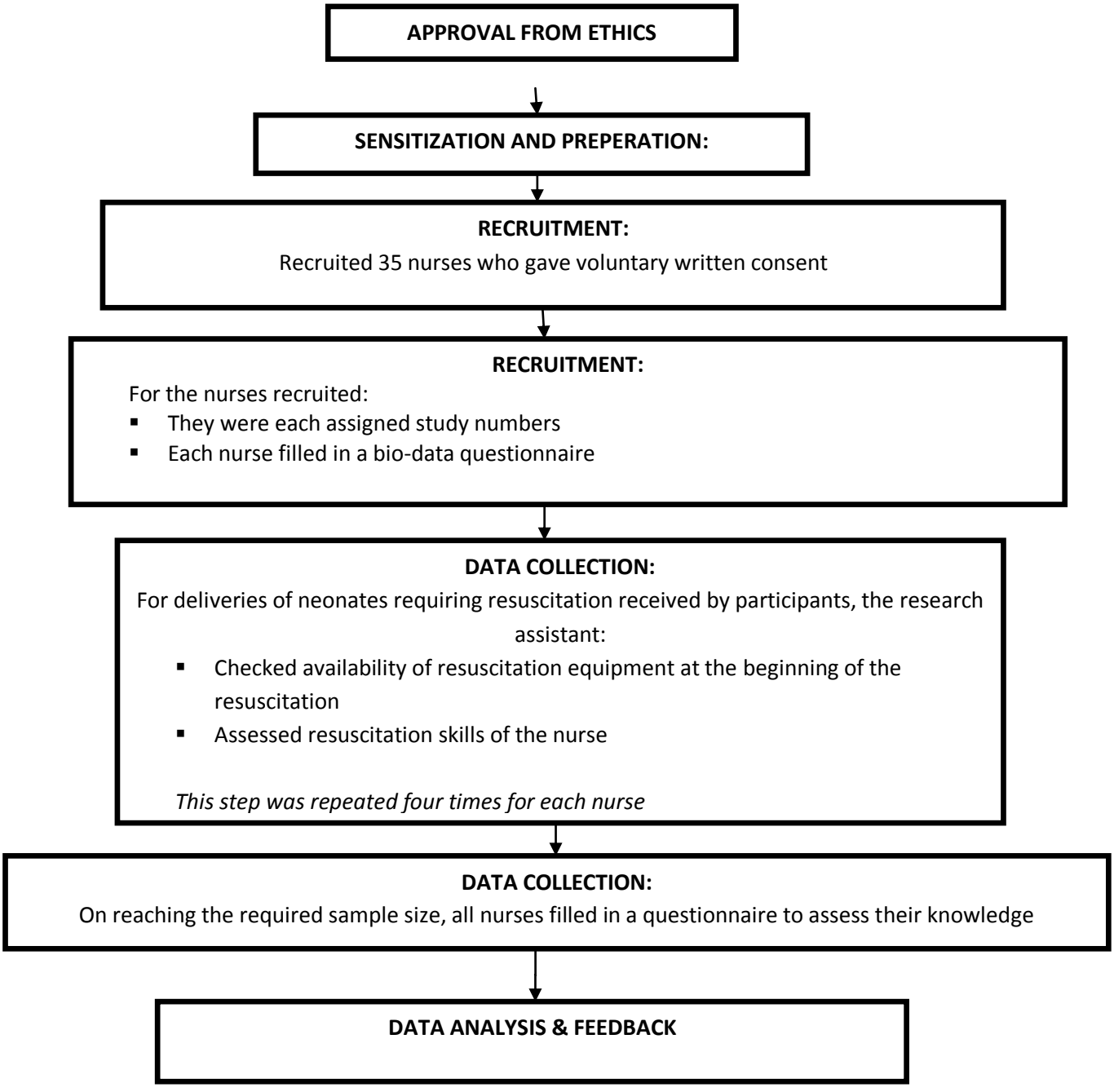

Figure 4: Summary flowchart on methodology

5.9: STUDY TOOLS:

Three main study tools were employed. A bio-data form to collect information about the participants (Appendix 2).A questionnaire to assess the knowledge of the participants on neonatal resuscitation guidelines (appendix 3) and checklists to assess resuscitation equipment availability and skills of healthcare workers during resuscitations (appendices 4 &5)

5.10: DATA MANAGEMENT:

The data collected were entered into a pass word protected Microsoft access database by the primary investigator and cleaned by a data analyst. The cleaned data was then analysed using SPSS version XVII. Categorical data collected included gender, qualifications and whether or not trained in resuscitation.

Quantitative or continuous data included age and years of experience in maternity practice. Statistical testing was done using Chi square test for categorical variables. Tests of associations were performed using Chi-square test for categorical variables and the results were presented in form of tables. The tests of association were performed for the following variables:

1. The nurses baseline characteristics and their knowledge on neonatal resuscitation
2. The adherence to guidelines during resuscitation and the nurses' knowledge, availability of equipment, neonatal characteristics and nurses' baseline characteristics

6.0: ETHICAL CONSIDERATIONS:

There was anxiety on the side of nurses on repercussions in case of identification of incorrect practices or poor knowledge. This was counteracted by keeping the identities of nurses observed confidential by recording information using a study code for each nurse. This code was only known by primary investigator and research assistants. There was strict observation of confidentiality at all levels of the study.

However, since the interests of the neonates also had to be protected, nurses noted to have poor skills were given confidential individual feedback at the end of the study.

The research assistant or observer's primary responsibility was collecting data but if required to assist in resuscitation, he/ she was obliged to provide help first. However such a situation did not arise.

Any harmful resuscitation practices were immediately interrupted. Once the investigator observed a harmful practice, he/ she intervened and recorded only the observations up to the point of intervention and noted clearly the reason for intervention and the type of intervention. It is important to note that the observer intervened but did not educate the nurse under observation on what should have been done until it was time for feedback at the end of the study so as to avoid change in practices and alteration of results. The most harmful practices we came across were outdated methods of stimulating the neonate such as vigorous shaking and as such we did not intervene but gave feedback to the nurses at the end of the 4 observations.

7.0: RESULTS

7.1: Study profile:

Thirty-five (n = 35) nurses working at Pumwani Maternity Hospital were recruited in the study between September and December 2013. These 35 participating nurses conducted a total of 140 neonatal resuscitations which were observed and assessed for adherence to National clinical guideline recommendations. This is summarized in figure 5.

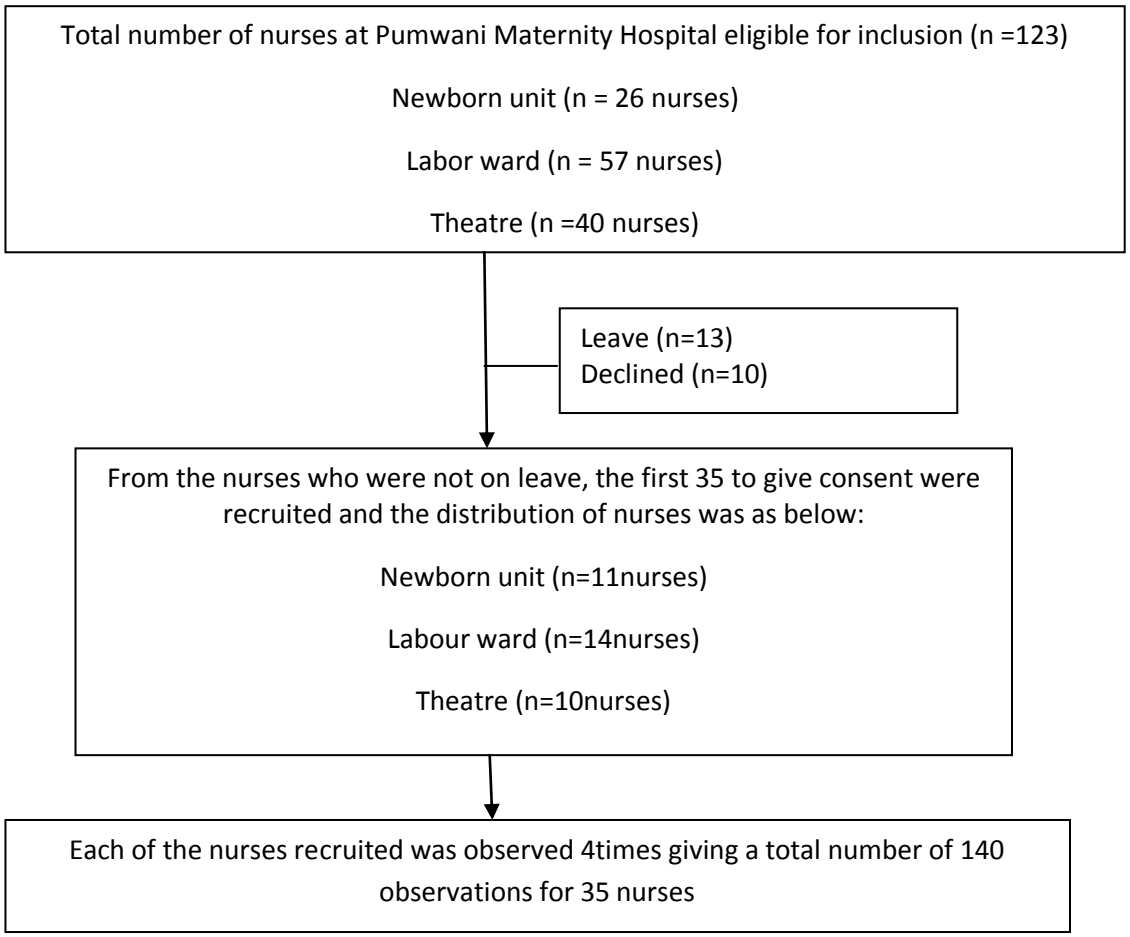

Figure 5: Study profile and recruitment of nurses

Most nurses were willing to participate in the study. The few who declined to give consent were worried about being exposed as having poor knowledge and skills and facing penalties from the hospital. Despite several attempts at reassurance that their

identity would remain confidential, some nurses (n=10) still did not feel comfortable and refused to give consent.

7.2: Participating nurses' characteristics:

The mean age of nurses was 39 years (SD = 5.1) and 32 (91.4%) nurses were aged >25 to 50 years (Table 1). Female nurses comprised 29 (82.9%) participants giving a ratio of male-to-female nurses of 1:5. Registered nurses accounted for 71.4% of nurses providing newborn resuscitation care and most of the nurses had provided maternity care for periods ranging from 5 to 10 years (48.6%) or >10 years (34.3%).

Table 1: **Characteristics of nurses providing neonatal resuscitation**

	Frequency (n = 35)	**Percentage (%)**
Age (in years)		
>25 to 50 years	32	91.4
>50 to 60 years	3	8.6
Sex		
Male	6	17.1
Female	29	82.9
Nursing qualifications		
KRCHN	25	71.4
ECN	10	28.6
Years of maternity nursing practice		
<5 Years	6	17.1
5 to 10 years	17	48.6
> 10 years	12	34.3
Attended neonatal resuscitation training		
Yes	21	60
No	14	40
Area of practice		
Newborn	11	31.4
Maternity theatre	10	28.6
Labour ward	14	40

Twenty-one (60%) nurses reported ever attending neonatal resuscitation training. Figure 6 shows the different neonatal resuscitation courses that these participants had attended. Of the nurses who had attended neonatal resuscitation trainings, most had attended the European Paediatric Life Support (EPLS) training (n = 9, 42.8 %). None of the nurses recorded having attended more than one type of neonatal resuscitation training course.

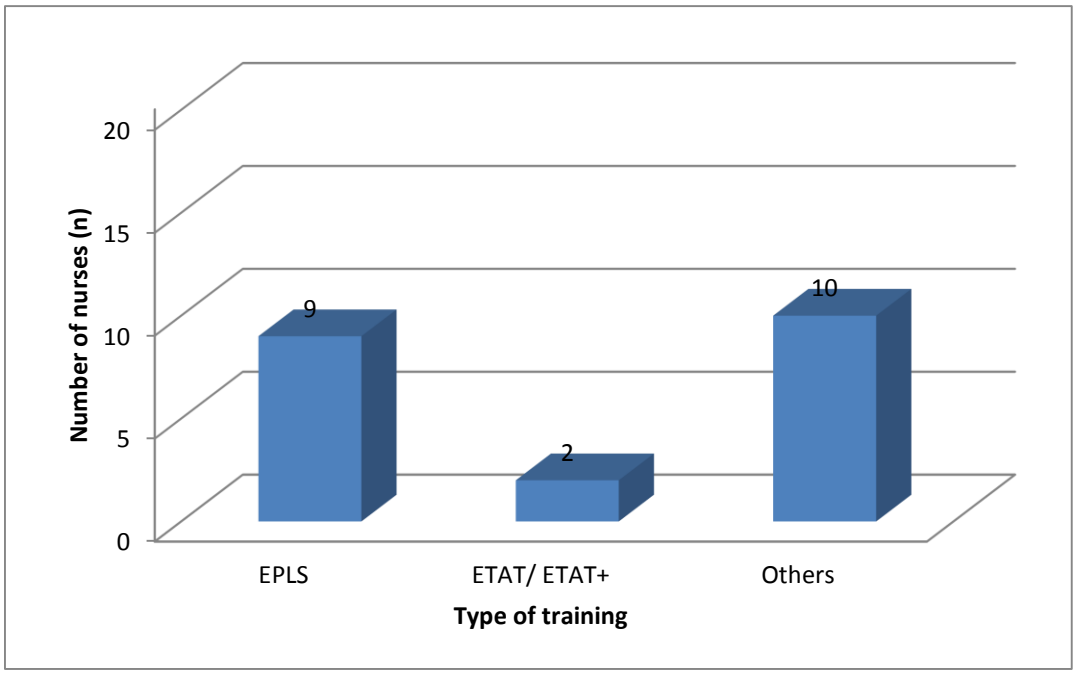

Figure 6: Types of neonatal resuscitation courses attended by nurses [Others included Essential Newborn Care (ENC), Programe de Rescate Obstetrico y Neonatal:Tratamiento Otimo y Oportuno(PRONTO), non-specific neonatal resuscitation courses]

The EPLS curriculum provides training on immediate emergency care to all health care workers involved in caring for children. It is mainly designed for the developed countries. The ETAT+ course targets all the health care workers involved in the

immediate care of sick children in a typical African setting and has a section specifically dedicated to the immediate resuscitation of a newborn at delivery.

Of the nurses who had attended neonatal resuscitation training, 51.4% (n=18) had attended the training more than a year prior to the study and only 2.9% (n=1) had attended the training less than 6months before study. In addition, of the nurses who had attended neonatal resuscitation training, only 14.2% (n=3) had ever attended a refresher course and the main reason identified for not having gone for a refresher course was lack of finances (n=12, 66.7%)

7.3: General characteristics of resuscitations observed:

In total 140 neonatal resuscitations performed by 35 nurses were observed. One-hundred and two (72.9%) resuscitations were conducted during day shifts and 38 (27.1%) during night shifts .Fifty six (40%) of resuscitations were done in the labor ward, 40 (28.6%) in the maternity theatre and 44 (31.4%) in the newborn unit. The characteristics of the 140 neonates who were resuscitated are summarized in Table 2. Eighty-eight (62.9%) neonates were delivered through SVD. The average birth weight was 2673.2 grams (SD = 824.5) and 45 (32.1%) newborns were low birth weight (< 2500 grams). Fifty-seven (40.7%) deliveries were preterm births with gestational ages < 37 weeks.

Table 2: **Characteristics of neonates requiring resuscitation**

	n (%)
Mode of delivery	
SVD	88 (62.9)
Breech	4 (2.9)
Elective C/S	3 (2.1)
Emergency C/S	44 (31.4)
Not stated	1 (0.7)
Birth weight	
< 2500 grams	45 (32.1)
2500 grams and above	95 (67.9)
Gestational age	
< 37 weeks	57 (40.7)
37 weeks and above	83 (59.3)
Ante/ intra- partum complications	
Preeclampsia	18 (12.9)
Antepartum hemorrhage	29 (20.7)
Prolonged labour	23 (16.4)
Meconium stained liquor	34 (24.3)
Others	36 (25.7)

*(*Other ante/intra partum complications: *obstructed labour, fetal distress, undiagnosed twins, retained second twin, cord prolapse, prolonged rupture of membranes PROM)*

The frequencies of maternal complications during pregnancy ranged from 12.9% for preeclampsia to 24.3% for meconium stained liquor.

7.4: Overall Adherence to Guidelines:

Overall, adherence to guidelines was observed in 55 (39%) out of the 140 neonatal resuscitation episodes observed during the study (Figure 7).

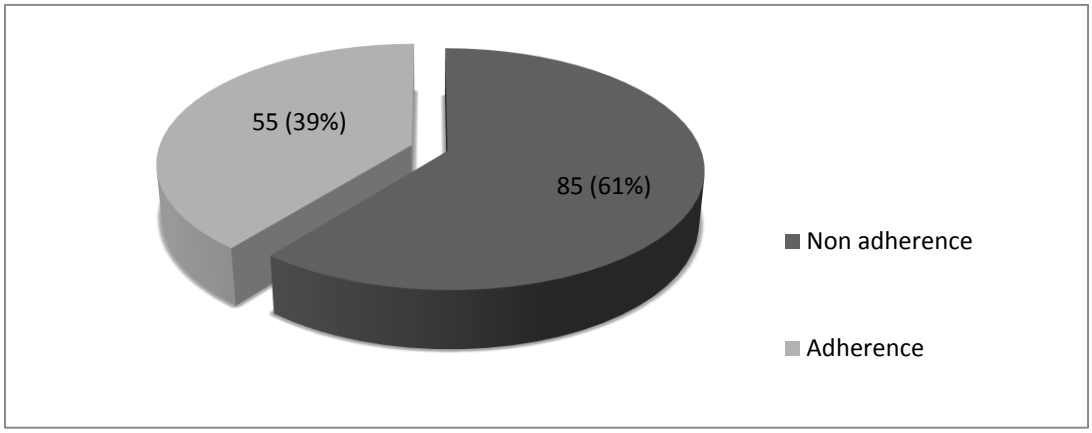

Figure 7: Percentage of resuscitations in which guidelines were adhered to

Table 3 shows that 5.7% of the nurses always adhered to national resuscitations guidelines while 14.3% of the participating nurses never adhered to guidelines during resuscitation. Most nurses either rarely (37.1%) adhered to guidelines or adhered to guidelines sometime (31.4%) or most of the times (11.4%).

Table 3: **Adherence to neonatal resuscitation guidelines by nurses**

	National Guideline Adherence	
	Number of nurses n (%)	Number of resuscitations n (%)
Always (4 out of 4 observations)	2 (5.7)	8 (5.7)
Most of the time (3 out of 4 observations)	4 (11.4)	12 (8.6)
Sometimes (2 out of 4 observations)	11 (31.4)	22 (15.7)
Rarely (1 out of 4 observations)	13 (13.7)	13 (9.3)
Never (0 out of 4 observation)	5 (14.3)	0 (0)
Total	35	55

This score of complete adherence to guidelines was calculated taking into account that all the following steps were carried out correctly as directed by the national resuscitation guidelines:

- Checked availability of equipment and tested it
- Placed neonate on warmer/ resuscitaire
- Dried neonate thoroughly and removed wet blanket
- Looked into airway
- Suctioned airway in the presence of meconium only if the neonate had not taken first breath
- Assessed for breathing
- Made correct decision to ventilate and used correct mask
- Called for help
- Gave the correct number of inflation breaths and achieved adequate chest rise at least twice

7.5: Adherence to guidelines at each step of neonatal resuscitation:

We looked at adherence to guidelines in greater detail by analysing performance at each of the main steps of resuscitation: preparation, drying and warming; airway and breathing.

Preparation, drying and warming:

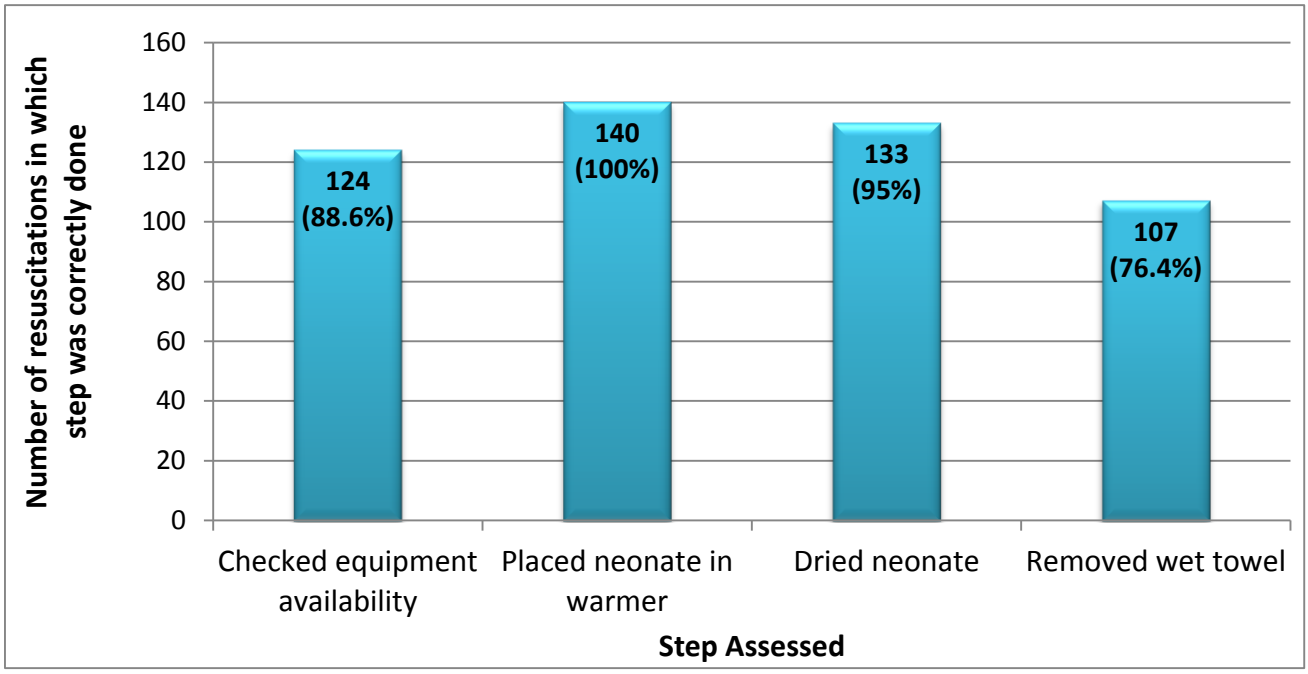

Figure 8: Number of resuscitations in which various steps on preparation, drying and warming were correctly done

As demonstrated in figure 8, the adherence to guidelines in the first few steps of preparation, drying and warming was generally good. Overall, all steps in this category were correctly adhered to in 71.4% of the cases. Nearly all (95%) of the neonates were correctly dried but the wet towel was removed in only 76.4% of resuscitations.

Airway:

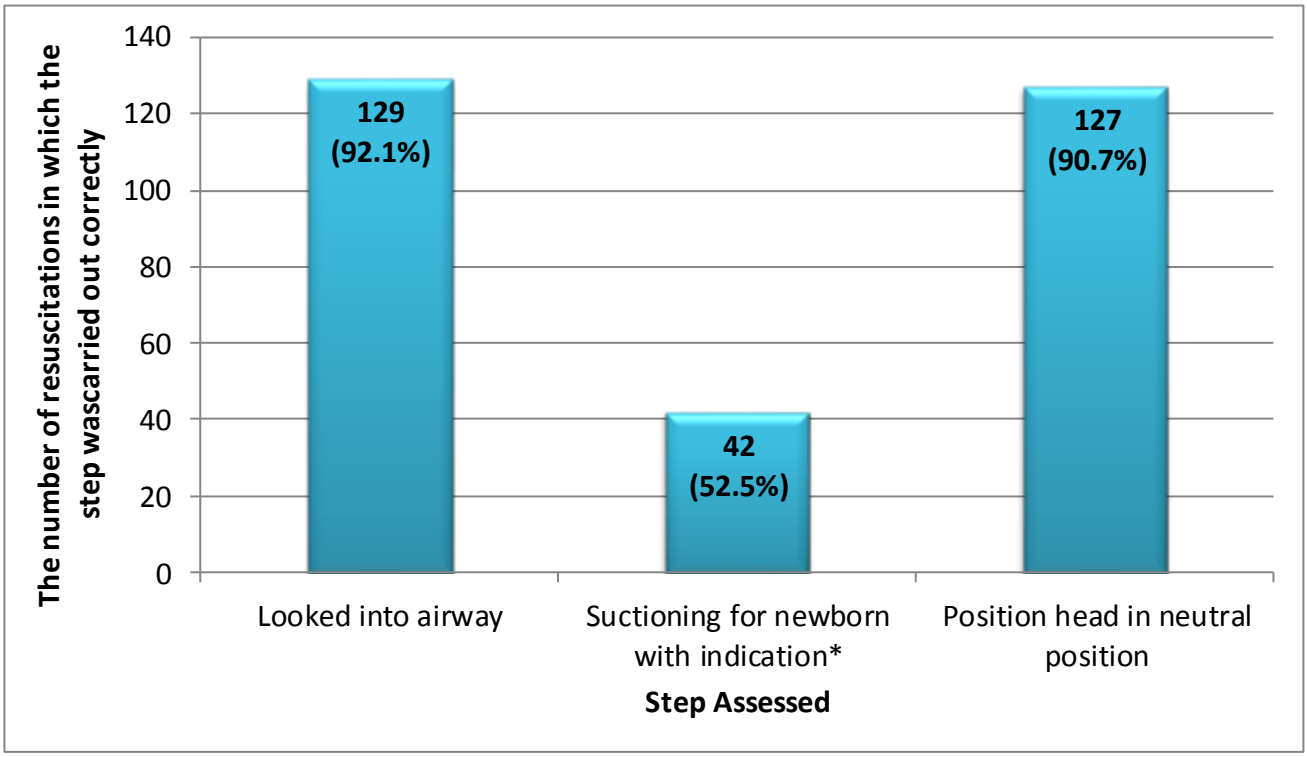

Figure 9: Number of resuscitations in which steps in the airway component were correctly done

*Suctioning was correctly carried out in 42 of the 80 resuscitations in which meconium was present.

In the category of airway, looking into the airway and positioning the head were carried out correctly in a large percentage of resuscitations (92.1% and 90.7% respectively as shown in figure 9).However, suctioning was only correctly carried out in the presence of meconium as per our guidelines in about half the resuscitations (52.5%). This was because once nurses noted meconium, the tendency was to suction the airway irrespective of whether the newborn had taken their first breath or was crying. We did not record cases in which the airway was suctioned in the absence of meconium. The overall adherence to all steps in this category was 63.6%.

Breathing:

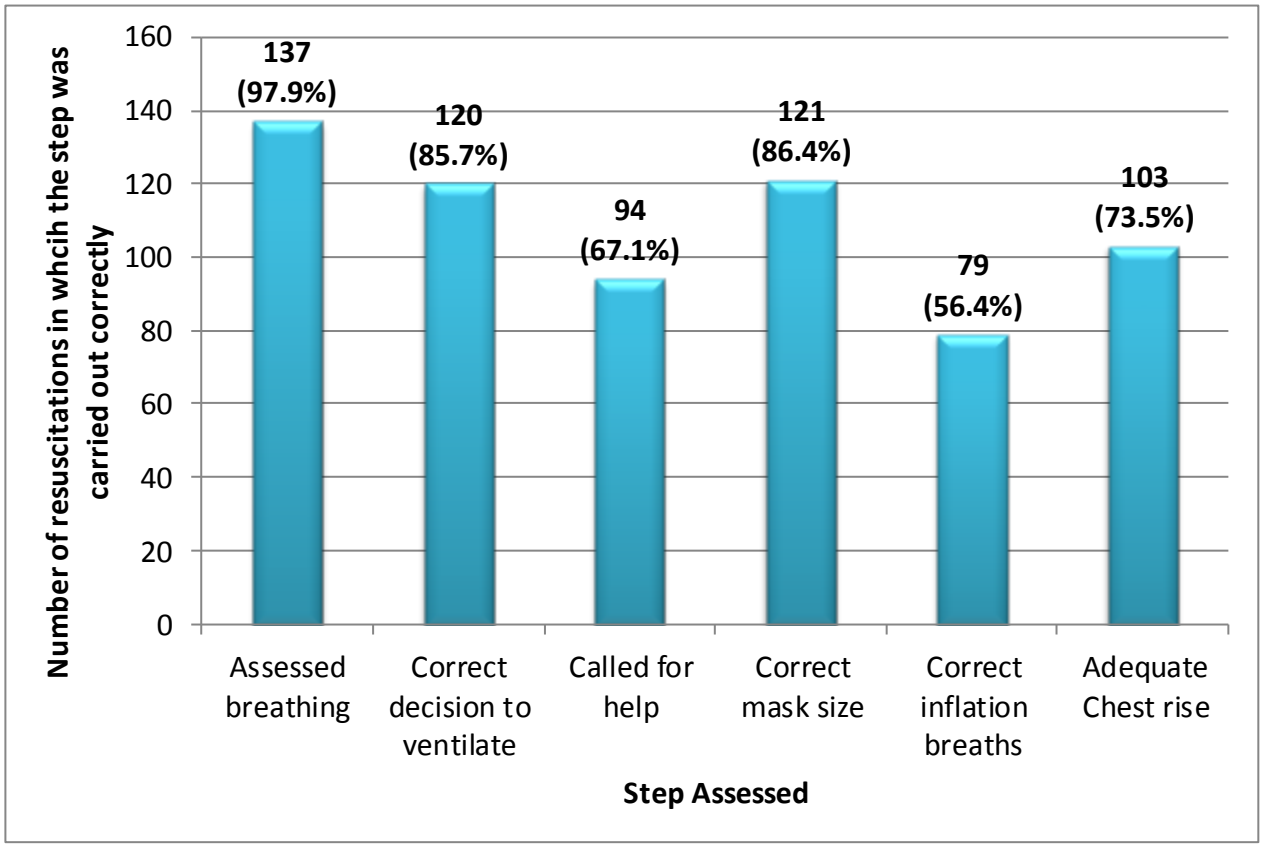

Figure 10: Number of resuscitations in which various steps of breathing were correctly done

The most poorly performed steps in the breathing component were giving the correct number of inflation breaths (56.4%), calling for help (67.1%), and achieving adequate chest rise during ventilation (73.5%) as shown in figure 10. Overall, the guidelines were followed in only 39.3% of the resuscitations in the breathing category. This category of resuscitation was identified as the key area in which guidelines were inadequately followed.

Table 4: **Adherence to guidelines according to different components of neonatal resuscitation**

Component of resuscitation observed	Number of resuscitations n (%)
Preparation	100 (71.4)
Airway	89 (63.6)
Breathing	55 (39.3)

The inappropriate practices were observed in only 22 (15.7%)of the resuscitations with vigorous shaking of the neonate and flicking of the neonate's foot being the most common, each being observed in 10 resuscitations (7.1%).

7.6: Availability of Hospital equipment for neonatal resuscitation:

Scores were calculated for resuscitation equipment availability and ranged from 40% to 100%. Figure 11 shows that in 80 (57.1%) out of the 140 resuscitations observed all the essential equipment required to conduct resuscitation were available. This score was calculated from the availability and assessment of the working condition of essential resuscitation equipment: suction machine, warmer, oxygen source, ambu-bag and clock.

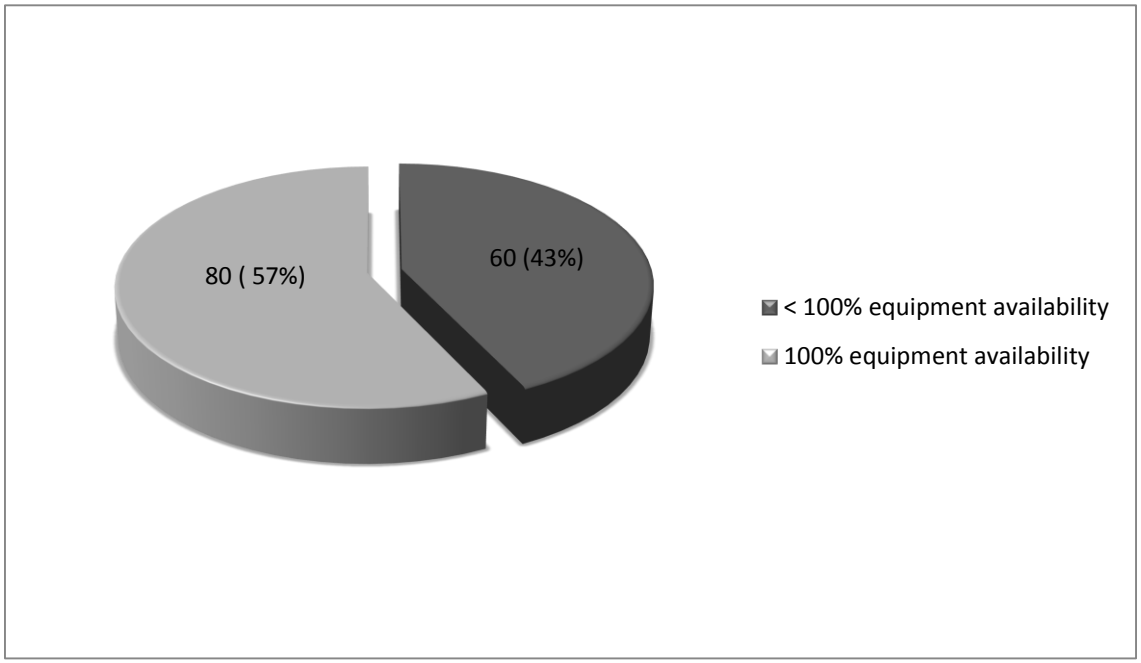

Figure 11: Percentage of resuscitations in which all equipment was available

Figure 12 shows the availability of individual equipment used to generate the overall score of equipment availability. A working suction machine, ambu-bag and oxygen source were available on all the 140 observed resuscitations. A clock was available on 127 observations and the clock was noted to be functional in 119 cases. The largest problem with equipment availability for neonatal resuscitation was related to availability of clean, dry resuscitation towels which were available in only 83 (59.3%) of the resuscitations.

Although a functional suction machine was always available, suction tubing was absent on 6 (4.3%) occasions. A face mask was missing on 3 (2.1%) occasions despite the presence of a functional ambu-bag at all times. Similarly oxygen tubing was absent in 4 (2.9%) occasions.

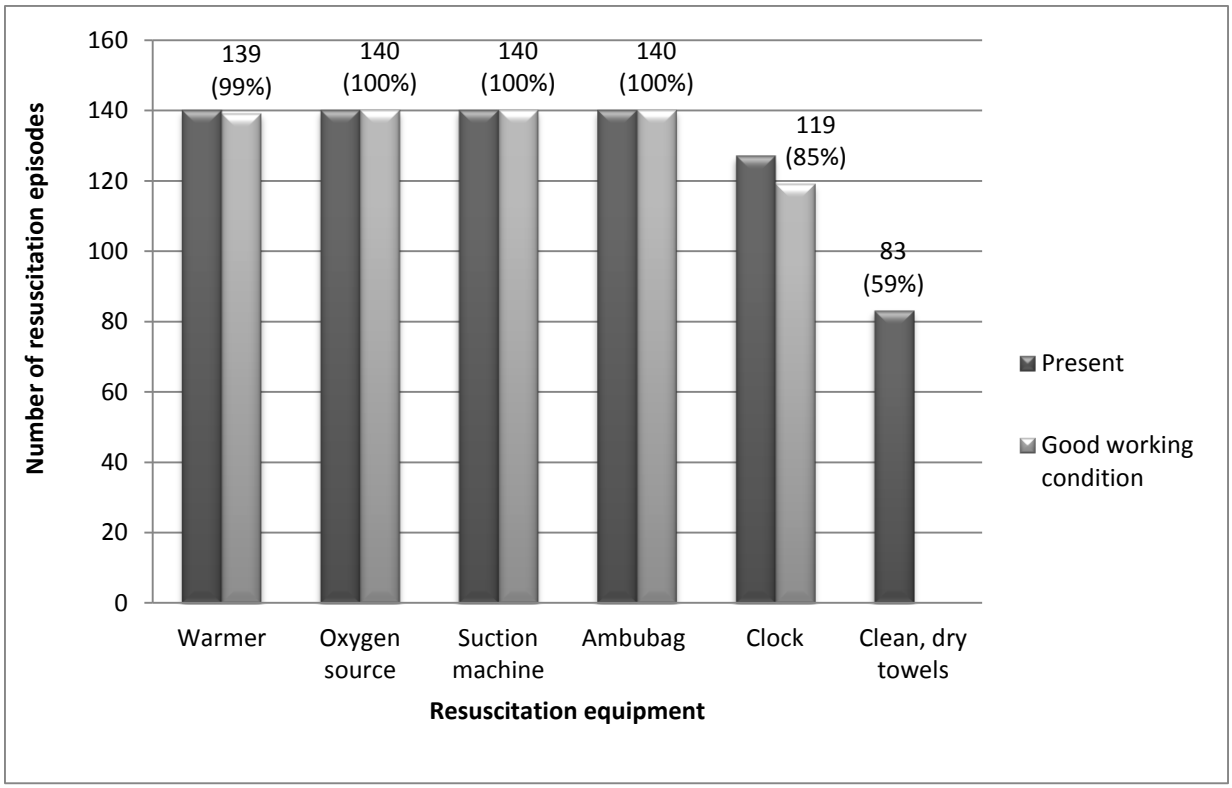

Figure 12: Presence and working condition of essential resuscitation equipment

7.7: Neonatal resuscitation Knowledge:

Thirty-one (88.6%) nurses reported that they were aware of the existence of the national guidelines on neonatal resuscitation and only 20 nurses (57.1%) claimed that they used job aides while carrying out resuscitations. In order to assess the knowledge of guideline recommendations a 15-item test was administered to participants. The average score on this test was 7.5 (SD = 17) out of 15 with a range between 3 and 13. Twenty (57.1%) of the nurses attained at least 50% or more (≥7.5 out of 15) on the knowledge assessment.

The responses to each of the 15-items of neonatal resuscitation are analyzed below to identify areas in which the nurses' knowledge was deficient. Over one-half of nurses knew two out of the four initial resuscitation steps (Figure 6), and a similar percentage responded correctly to three out of the seven items assessing knowledge of suctioning and BVM ventilation (Figure 7). With regard to neonatal reassessment

and oxygen use, at least 50% of nurses knew the preferred airway position on airway opening and indications for ventilation.

Initial resuscitation (receiving, drying and warming the neonate):

Figure 13 shows that of the 35 participating nurses 8 (22.9%) correctly knew that being prepared was the first and most important step during resuscitation and 14(40%) that the chest is the only part of the neonate left exposed after drying and warming.

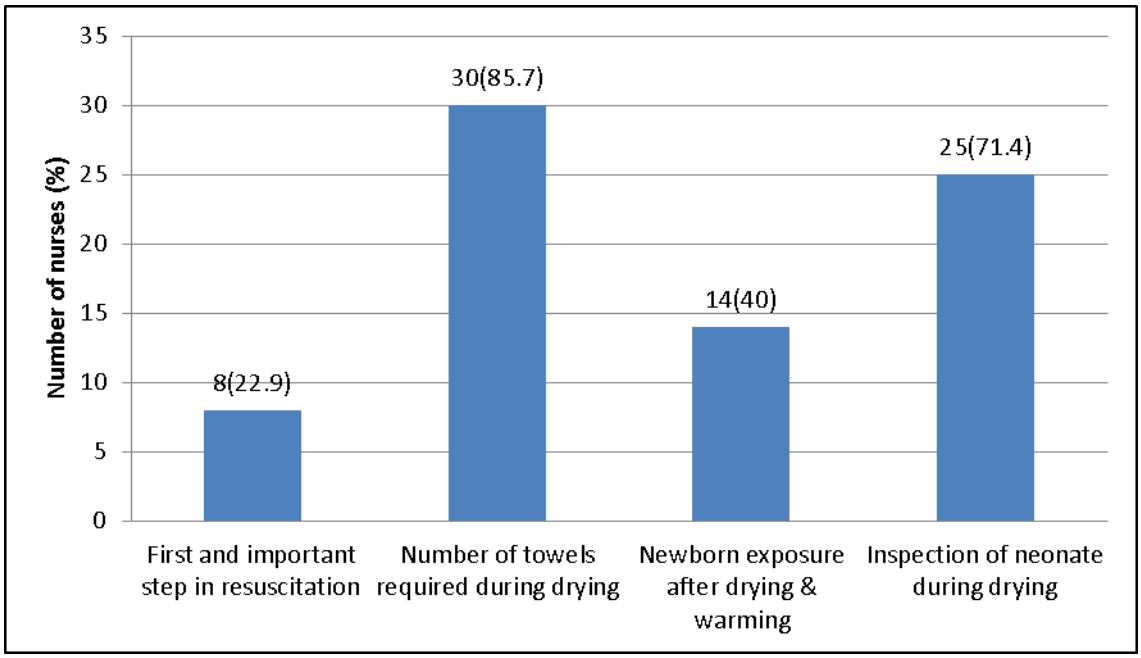

Figure 13: Percentage of nurses with correct knowledge of initial steps in neonatal resuscitation

Airway, breathing and circulation:

The nurses' responses reflected inadequate knowledge in the following areas of neonatal resuscitation (Figure 14): number of inflation breaths for neonates failing to breathe spontaneously (22.9%), BVM breaths per min (22.9%), number of chest compression (8.6%), and indications for chest compressions (45.7%).

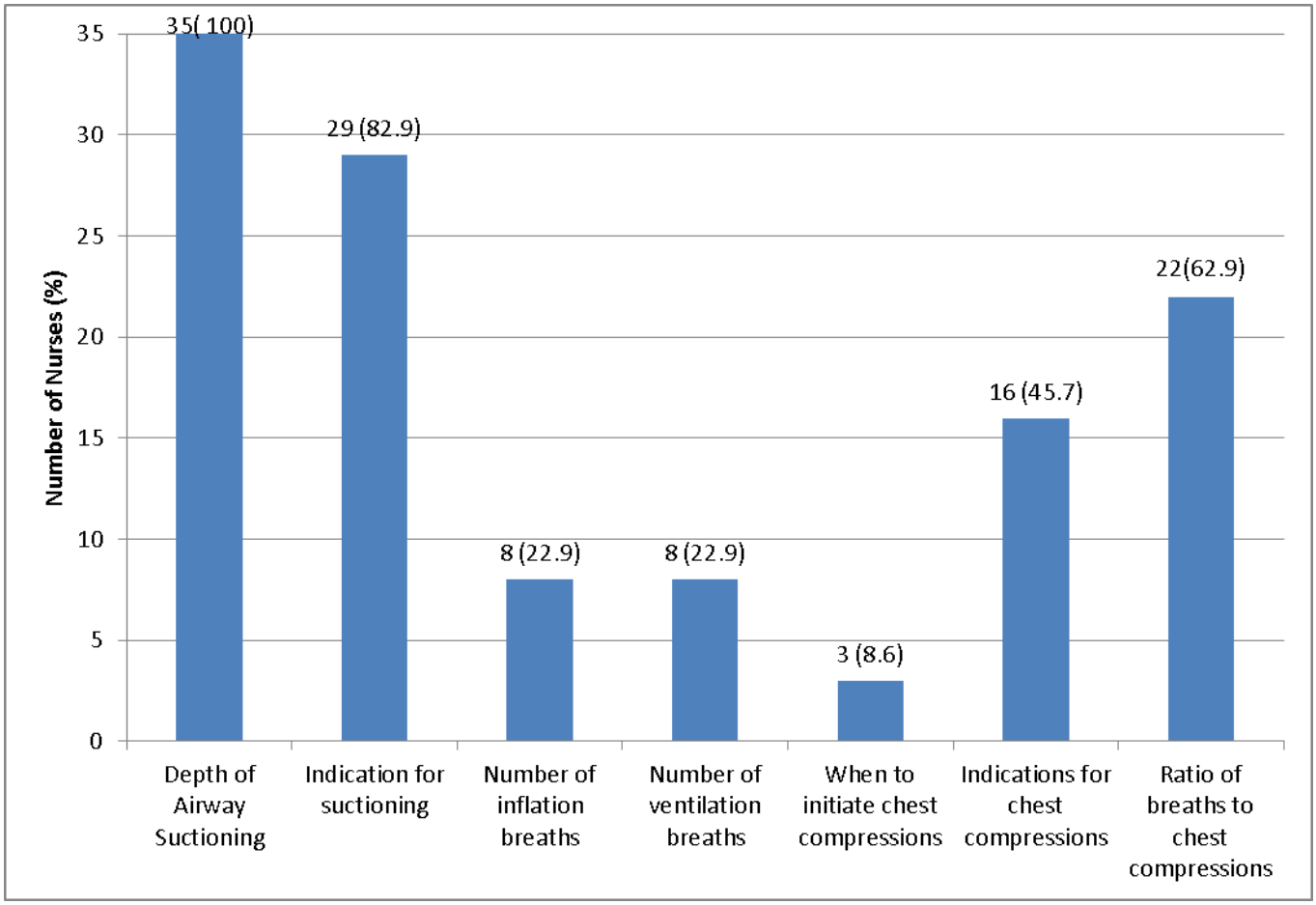

Figure 14: Percentage of nurses with correct knowledge on suctioning and neonatal BVM resuscitation

Neonatal reassessment and oxygen use:

Out of the four items assessing neonatal reassessment and oxygen use inadequate knowledge were noted in the following two areas (Figure 15): frequency of neonate reassessment (11.4%) and use of oxygen in resuscitation (14.3%).

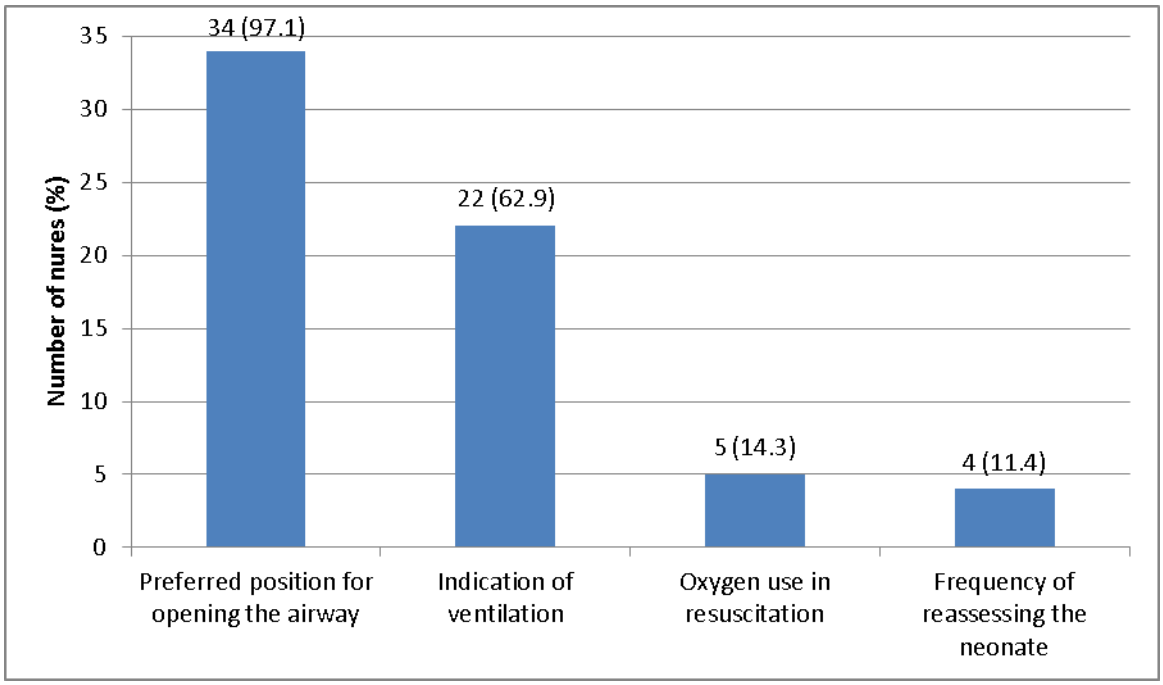

Figure 15: Percentage of nurses with correct knowledge of neonatal reassessment and oxygen use

7.8: Associations between Adherence to guidelines and baseline characteristics of nurses and neonates:

Table 5: **Adherence to guidelines according to nurses' characteristics and availability of equipment**

	Guideline adherence*		**Unadjusted OR** (95% CI)**	**P value**
	Yes	No		
Nursing qualification				
ECN	16	24	1.0	
KRCHN	39	61	1.04(0.47-2.33)	0.92
Years of practice in maternity				
<5 years	11	13	1.0	
5-10 years	28	40	0.83(0.31-2.24)	0.71
>10 years	16	32	0.59(0.20-1.72)	0.33
Area of practice				
Labour ward	18	38	1.0	
Maternity theatre	11	29	0.84(0.39-1.82)	0.66
Newborn unit	27	17	3.75(1.80-7.80)	<0.001
Neonatal resuscitation training				
Yes	29	55	1.0	
No	26	30	1.64(0.80-3.39)	0.18
Resuscitation knowledge				
Inadequate (Scored < 50%)	24	36	1.0	
Adequate (scored ≥ 50%)	31	49	0.95(0.45-1.98)	0.89
Equipment availability				
< 100% availability	16	44	1.0	
100% availability	39	41	2.74 (1.37-5.48)	0.004

* Resuscitation episodes (n = 140) conducted by 35 nurses

** Cluster adjusted analysis using GEE logistic regression models

Availability of essential resuscitation equipment showed a statistically significant association with adherence to guidelines recommendations. The odds of providing guideline recommended care was approximately three- fold higher (OR = 2.74, 95%CI 1.37-5.48, p value 0.004) in resuscitation episodes where all essential equipment were available compared to cases where at least a single essential equipment was missing.

In addition there was a positive correlation between the area of practice and adherence to guidelines. Resuscitations carried out in the newborn unit were almost 4 times more likely to adhere to guidelines than those carried out in labour ward or maternity theatre (OR=3,75, 95% CI 1.80-7.80, p value of <0.001). There was no significant difference in adherence to guidelines in resuscitations carried out for the labour ward versus the maternity theatre.

Characteristics of nurses' conducting resuscitation including qualification (p=0.92), experience in maternity care (p=0.71,0.33), attendance of neonatal resuscitation training(p=0.18) and knowledge of the guideline recommendations (p=0.89) were not significantly associated with observed neonatal resuscitation practices (Table 5).

***Table 6*: Adherence to guidelines according to the neonate's characteristics**

	Guideline adherence*		Unadjusted OR** (95% CI)	P value
	Yes	No		
Delivery mode				
SVD	39	49	1.0	
C/S or assisted delivery	16	35	0.58(0.28-1.23)	0.16
Meconium stained liquor				
Yes	14	20	1.0	
No	41	65	0.91(0.41-1.99)	0.81
Birth weight				
<2500 grams	25	20	1.0	
≥2500 grams	30	65	0.37(0.18-0.78)	0.008
Gestational age				
< 37 weeks	36	21	1.0	
≥ 37 weeks	19	64	0.18 (0.08-0.37)	<0.001

* Resuscitation episodes (n = 140) conducted by 35 nurses

** Cluster adjusted analysis using GEE logistic regression models

There was no association between the mode of delivery (p=0.16) or presence of meconium (p=0.81) to the adherence to guidelines. However, there was a significant association between the newborn's gestational age (p<0.001) and birth weight (0.008) with adherence to guidelines in their resuscitation. The probability of adherence to guidelines was higher when resuscitating newborns born at <37 weeks gestation (OR=0.37, 95% CI 0.18-0.78) and at a birth weight of <2500g (0R 0.18, 95% CI 0.08 – 0.37).

8.0: DISCUSSION:

We expect the knowledge and skills of nurses who are often the first health care providers in contact with newly delivered neonates to be close to perfect. Contrary to our expectations however, the results of our data demonstrate a great paucity in both the knowledge and skills of the nurses in neonatal resuscitation as per the National guidelines. Of the resuscitations observed, the National guidelines were adhered to in a mere 39% which translated to only 5.7% of nurses adhering to neonatal resuscitation guidelines. It must be noted however that although these figures are low, only a few incorrectly performed steps contributed to these low figures.

Of the nurses observed, 28% were working in maternity theatre, 32% in the new born unit and 40% in labour ward. This gave us a fair representation of the nurses' practices in all possible areas where neonates are commonly resuscitated.

Of all the resuscitations observed, three quarters were conducted during the day and a quarter at night. This gave us a good overall picture of resuscitation practices. During the day we expected nurses to be more alert and relaxed and thus expected better practices. The night time observations were targeted to get a greater number of emergency cases that we believed would most probably have had a greater need for resuscitation.

When analysing the results categorically, the guidelines were adhered to in 71% of the resuscitations for the steps of preparation warming and drying, 64% for airway and 39% for breathing. This showed that as the steps became more complicated and less likely to be required as per the pyramid of neonatal resuscitation, the adherence to guidelines declined. Thus, neonates who often are in the greatest need of

resuscitation are less likely to receive the correct measures thereby decreasing the likelihood of survival.

It is commendable to note that the neonate was placed under a warmer in all resuscitations observed and dried in 95% of the resuscitations. However, the wet towel was removed in only about three quarters of the resuscitations and this could partially be explained by the shortage of the presence of two towels at each delivery as will be elaborated later.

It was also very encouraging to note that the neonate's head was correctly positioned in 90% of the resuscitations observed. This is a key step in resuscitation as it enables suctioning of meconium to be carried out effectively, if necessary, and ensures that adequate chest rise is achieved in cases where BMV may be required to initiate breathing. This is a simple but very critical step in the sequence of neonatal resuscitation.

The most poorly performed steps were suctioning appropriately in the presence of meconium, giving the correct number of inflation breaths and calling for help. The indications for suctioning in the presence of meconium have recently been updated in 2012 and this may explain the poor performance due to absence of regular updates[23]. In terms of calling for help, most resuscitations carried out at PMH were performed by one nurse due to the large workload and thus most nurses did not give priority to calling for help as in most cases they would not have received any assistance.

The correct number of inflation breaths were given in only about half the resuscitations observed and adequate chest rise was only achieved in about three

quarters of all the resuscitations observed. In most cases it was noted that the nurses did not give inflation breaths but went straight to ventilation breaths till they noted initiation of spontaneous breathing by the neonate. We contributed this to the probability that the nurses did not fully understand the physiology of inflation breaths versus ventilation breaths and thus incorrectly perceived that either could be used to initiate spontaneous breathing effort in the neonates.

These findings can be compared to those of Alwar and Otido where correct practices were observed in 47% and 26% of the resuscitations at Kenyatta National Hospital (KNH) in 2010 and Garissa Provincial General Hospital (GPGH) in 2012 respectively [14, 26]. Alwar looked at the practices of nurses while Otido looked at the practices of all health care workers. We would expect the practices to be better in hospitals dealing with a higher number of resuscitations. KNH has more cases than either PMH or GPGH and this is reflected in the results of the studies quoted whereby the greatest percentage of correct practices were observed in KNH. This could further be explained by the fact that KNH has in house training and regular exposure to trained personnel while PMH and GPGH have fewer opportunities for training and exposure to regularly trained personnel. These reasons could partly explain the differences in percentages of correct practices in the three hospitals.

Similar to our observations, the practices of appropriate suctioning of the airway and correct ventilation were the poorest performed in the two studies mentioned above. It was commendable to note that the airway was correctly positioned in the neutral position in 90% of the resuscitations observed at PMH compared to 76% at KNH and 64% at GPGH. We would have expected the percentage to be higher in KNH as their overall percentage of correct practices was much higher. However, this was not the

case. This may just indicate that correct positioning of the airway is an important step of resuscitation that the nurses in PMH seem to be well versed with.

Of the nurses who had attended neonatal resuscitation trainings, most had attended EPLS or general neonatal resuscitation trainings. We would have expected that with the increase in awareness in ETAT/ ETAT+ that is cheaper and applicable in low resource settings with back up from the government protocols, a higher number of the trained nurses would have been exposed to this training, but this was not the case as demonstrated by our results. It is important to note, however, that we did not enquire as to whether neonatal resuscitation was a component of their basic training. This finding is similar to Otido's study at GPGH where he found that 60% of the health care workers had attended neonatal resuscitation trainings specifically ETAT+ [26]. These percentages were higher than that seen in Alwar's study at KNH whereby only 7% of the nurses had attended neonatal resuscitation training[14]. This may demonstrate an increase in the awareness and attendance of neonatal resuscitation trainings over the last 3 years.

It is important to note that of the nurses who had attended a training course, half had done so more than a year before and only 14% had attended refresher courses. The main reason identified for the delay in attending refresher courses was lack of finances in about a half of the nurses. This is significant in explaining the low levels of adherence of nurses to knowledge and skills in neonatal resuscitation as explained below.

The p values of the association between neonatal resuscitation training and correct practices in the three hospitals were 0.18 at PMH, 0.64 at KNH and 0.229 at GPGH. All these figures showed no statistically significant association between neonatal

resuscitation training and correct practices. It has however been demonstrated that training courses in neonatal resuscitation can effectively increase the competency of health careworkers in conducting neonatal resuscitation and reduce potentially harmful practices. However in order for these courses to be effective, maintenance of these skills is crucial and requires regular refresher courses and supervision as has been demonstrated in several studies. A study done by Opiyo *et al* at the same hospital (PMH) evaluating the effect of a single day of resuscitation training showed that there was a significant immediate improvement in practices but it did not evaluate the long term effect and most studies show that there is a rapid and linear decay in cardiopulmonary resuscitation (CPR) skills from as early as two weeks after training with skills deteriorating to pre training levels by one year [17]. This may partially explain why all the three studies quoted demonstrated no statistically significant association between newborn resuscitation training and appropriate resuscitation practices or adherence to guidelines. It is also important to remember that completion of resuscitation training does not imply that an individual is competent to perform neonatal resuscitation as stated by the American Heart Association (AHA) neonatal resuscitation programme (NRP) [27].

The level of adherence was higher among nurses who had practised for 5-10 years and were registered but this was not shown to be statistically significant. As the years of practice in maternity increased to more than 10 years the adherence dropped even more though ,again, not statistically significant. This could be explained by the fact that with longer periods of practice, the nurses take up more administrative roles and thus practice less clinically leading to deterioration in knowledge and skills especially without regular refresher courses. It should be noted

however, that we dealt with a small number of nurses that were not adequate to enable us to make general inferences.

Factors that showed a positive association with adherence to guidelines included: the location of resuscitation, gestational age and birth weight of the neonate. Nurses in the new born unit were more likely to adhere to guidelines than those in labour ward and maternity theatre (OR 3.75, p=<0.001) as they carried out resuscitations more regularly and were in constant contact with paediatricians who had been exposed to updates in resuscitation practices. The practices in theatre were not significantly better that those in labour ward. This was in contrast to findings in Otido and Alwar's studies. Otido and Alwar did not look at the newborn unit but they did demonstrate that the resuscitation practices in theatre were greater than those in labour ward (OR 3.2, p=0.021 in Otido's study and OR 2.07, p=0.04 in Alwar's study) [26,14].

The probability of adherence was three fold higher (OR 2.74, 95% CI 1.37 – 5.48) when all the essential equipment for neonatal resuscitation was available. This could be explained from two different angles. First, the availability of equipment partly depends on the nurse's preparedness. The more prepared she is the more likely it is that all equipment will be available assuming it is in stock, although we did not look into the stock of PMH. Secondly, if some equipment is missing during the resuscitation and the nurse realizes this after receiving the neonate, she may leave the neonate to get that piece of equipment and in the process compromise the resuscitation.

In terms of gestational age and birth weight, the adherence to guidelines was greater in newborns born at less than 37 weeks gestation and at a birth weight of less than

2500 grams. This is probably due to the fact that nurses expect preterm and low birth weight babies to have a greater risk of complications and need for resuscitation and thus tend to be more prepared and attempt to do each step as correctly as possible so as to increase the chances of survival. This is supported by the publication entitled Born Too Soon, The Global Action Report on Preterm Birth, 2012 by WHO. Here they emphasize that a greater percentage of premature babies require assistance to begin breathing at birth (Wall *et al*., 2009) and that basic resuscitation for preterm births reduces preterm mortality by about 10% in addition to immediate assessment and stimulation (Lee *et al*.,2011) [28].

The most commonly identified ante-partum and intra-partum complications were antepartum haemorrhage in 20% of cases and meconium stained liquor in 24% of cases. These conditions have been shown to increase the risk of neonatal deaths by 2-6 and 12 times respectively thus emphasizing the need for preparedness for neonatal resuscitation in their presence[29]. However, in our study the adherence to guidelines was not higher in the presence of meconium than in the other resuscitations (p=0.16). We would have expected the adherence to be higher due to greater anticipation of complications and thus better preparedness but this was not so. This is similar to the finding of Otido's study where there was no statistically significant association between meconium staining and resuscitation practices (p=0.75) [26].

Inappropriate practices were observed in a fifth of the resuscitations observed and the most common were shaking the neonate and wiping the neonate vigorously. Again this demonstrated older practices that have been updated where current recommendations advocate for milder forms of stimulation. As most nurses have

been practicing for long and without refreshing their knowledge, their practices are outdated and may even be harmful.

Despite 88% of the nurses claiming to be aware of the existence of the National guidelines on neonatal resuscitation, this awareness was not reflected in the percentage of nurses who passed the test for knowledge and the checklist for skills in neonatal resuscitation. This may be explained by the fact that even if they were aware of these guidelines, only about half of the nurses used job aides and as per observations in the unit most of these job aides were from international manufacturers of resuscitation equipment or international guidelines and were not an entirely true picture of our national recommendations which are in the form of a small protocol booklet that can be carried to work by each nurse. No job aides from the Kenyan guidelines were visible or used in PMH. As stated in the 2012 WHO guidelines on basic newborn resuscitation, most resuscitation guidelines are based on the ILCOR consensus and these are not appropriate for low resource settings as they rely on the presence of more than one health care worker and the availability of advanced resuscitation equipment [23].

A mere 57% of the nurses attained a score of 50% or more on the knowledge questionnaire and the main areas of weakness were in breathing and chest compressions. It is vital to mention that only 22% of the nurses correctly identified preparedness as being the first and most important step in neonatal resuscitation. This is a key critical step that has to be emphasized. Anticipating which infants may require neonatal resuscitation could aid in emergency preparedness but 20 – 76% of infants needing neonatal resuscitation have no risk factors, thus the importance of

being prepared to carry out resuscitation when receiving any neonate despite the absence of antepartum or intra-partum risk factors [30].

Of the nurses questioned, 85% knew that two dry towels were required during resuscitation but despite having this knowledge, two dry towels were available in only 59% of the resuscitations observed. This may be due to inadequate preparation by the nurses but the nurses identified inadequate procurement of towels as the main problem and this was supported by the fact that they sometimes improvised by using sterile theatre cloths as substitutes for the towels. This is a procurement problem that can readily be rectified by the hospital administration.

Another important finding to emphasise on is that only 14% correctly knew that oxygen is not an absolute requirement in neonatal resuscitation. Current meta-analysis of pooled data found a significant reduction in mortality for new-borns who were resuscitated with room air versus 100% oxygen as highlighted in our literature review[23]. Again, most of our nurses were older and had many years of experience and despite having had training it was more than a year before the study. This finding is relatively new and has been incorporated into our protocols but due to inadequate updates this information may not have reached the nurses and thus has not been put into practise. This is critical as in cases where nurses do not have oxygen they may tend to give priority to sourcing for oxygen instead of starting ventilation with room air and may cause loss of critical seconds in the golden hour. This may not have been a big problem in our setting as an oxygen outlet was always available and the oxygen tubing was only absent in 3% of the cases.

Findings from the assessment of the nurses' knowledge on neonatal resuscitation showed that the level of knowledge was not significantly associated with previous

training on neonatal resuscitation (p = 0.51), nursing qualifications (p = 0.71) or years of practice in maternity (p = 0.53). The number of nurses used was however too small for these associations to be used to make general inferences.

The percentage of nurses with adequate knowledge in newborn resuscitation was higher at PMH than in KNH as demonstrated by a similar study done by Alwar in 2010 whereby only 39% of the nurses had adequate knowledge [14]. This may partly be explained by the higher proportion of nurses who had attended newborn resuscitation training in PMH versus KNH.

Just as the performance in skills got worse as we went up the pyramid of resuscitation, the performance in knowledge scores also deteriorated as we ascended up the pyramid from drying and warming to breathing and circulation.

Overall, our results confirm what has been demonstrated in other studies done on neonatal resuscitation such as that done by Alwar in KNH that also showed poor performance with 39% of health care workers having adequate knowledge and 47% having appropriate practice [14]. Murila *et al* demonstrated that despite 85% of medical providers having heard of neonatal resuscitation, more than 70% considered their knowledge inadequate [13]. Similarly in our study, 88% of nurses were aware of national neonatal resuscitation protocols but only 57% had adequate knowledge and only 5.7% demonstrated correct practises.

9.0: STUDY LIMITATIONS:

Observations were predominantly done during the day when nurses were more alert and under greater level of supervision, this may have created a bias in observations and may have caused us to miss most of the emergencies that occurred at night. This however was minimised as much as possible by having at least a few observations at night..

There may have been a bias in practice of nurses due to the pressure imposed on them by the research observer. Maximum effort was made to limit this bias by recruiting research assistants from staff at PMH and by entering in data away from resuscitation site and as discretely as possible

All health cadres were not assessed as most resuscitations in this facility are carried out by the nurses

Assessment of appropriate practices focused on certain areas and thus not all aspects of neonatal resuscitation. Our study focused on those areas of resuscitation that are considered more critical and that can be practised in any facility even with minimal resources. Research assistants were drawn from within the study population but over time staff were aware of their involvement in the study and this may have led to alteration of practices. Masking was done but may not have been fully effective and this could have led to the Hawthorne effect that was taken into consideration when analysing data.

For the resuscitations observed in the newborn unit, the drying and warming step had to be modified if the neonate had already been dried and put in a dry towel. We assumed they had done it correctly if neonate was eventually out in a dry cloth.

10.0: CONCLUSION:

Adherence to the National neonatal resuscitation guidelines was seen in 39% of the resuscitations observed with only 5.7% of the nurses always adhering to the guidelines.

PMH is well equipped for neonatal resuscitation but there is paucity of dry towels.

Only 57.1% of the nurses passed the test on knowledge on neonatal resuscitation.

11.0: RECOMMENDATIONS:

All nurses working in PMH should be trained in neonatal resuscitation with regular refresher courses and updates on changes in guidelines.

Further studies should be carried out to determine the impact of National neonatal resuscitation guideline job aides in form of charts and protocol booklets posted on the wall or carried by each nurse for quick reference.

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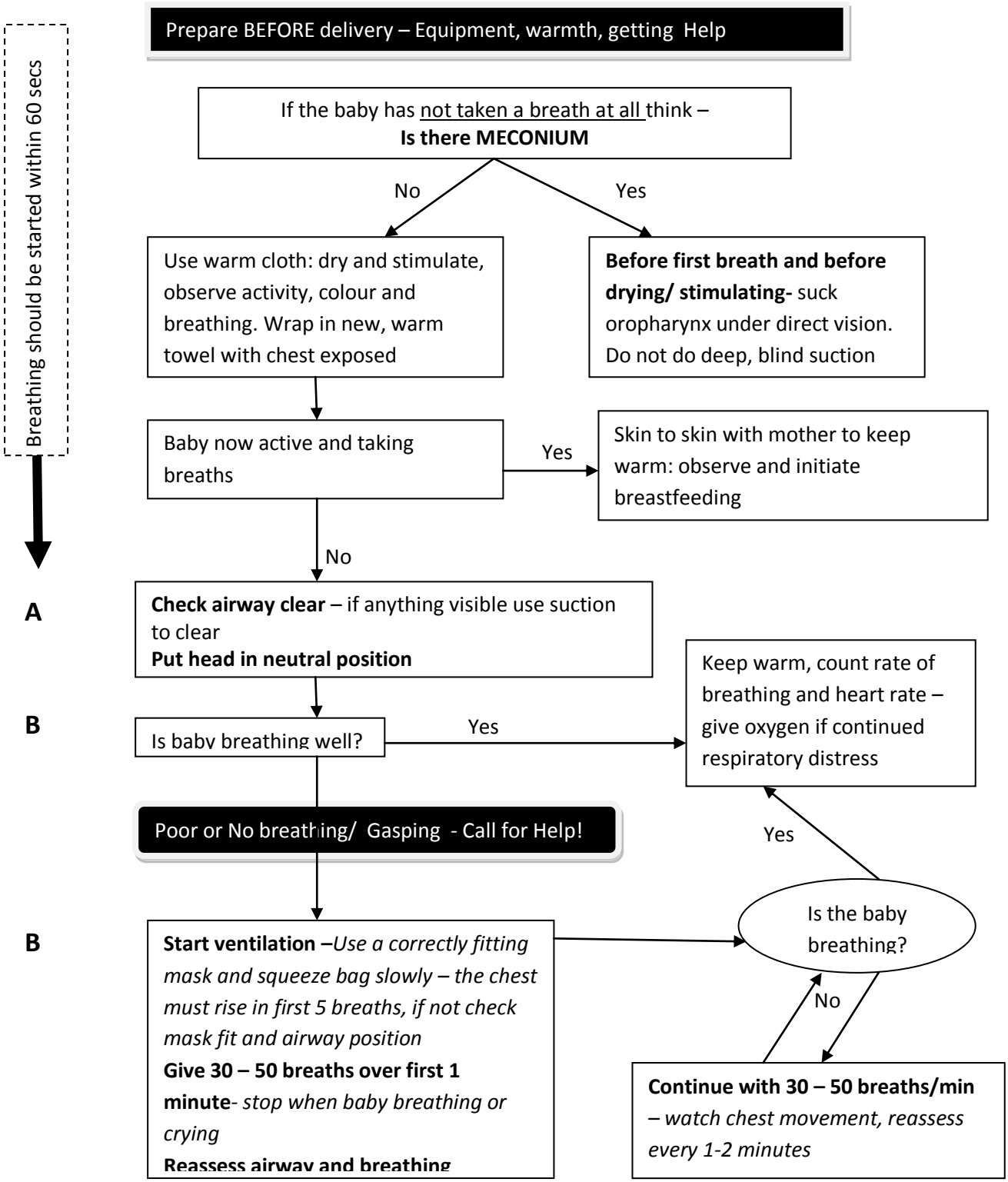
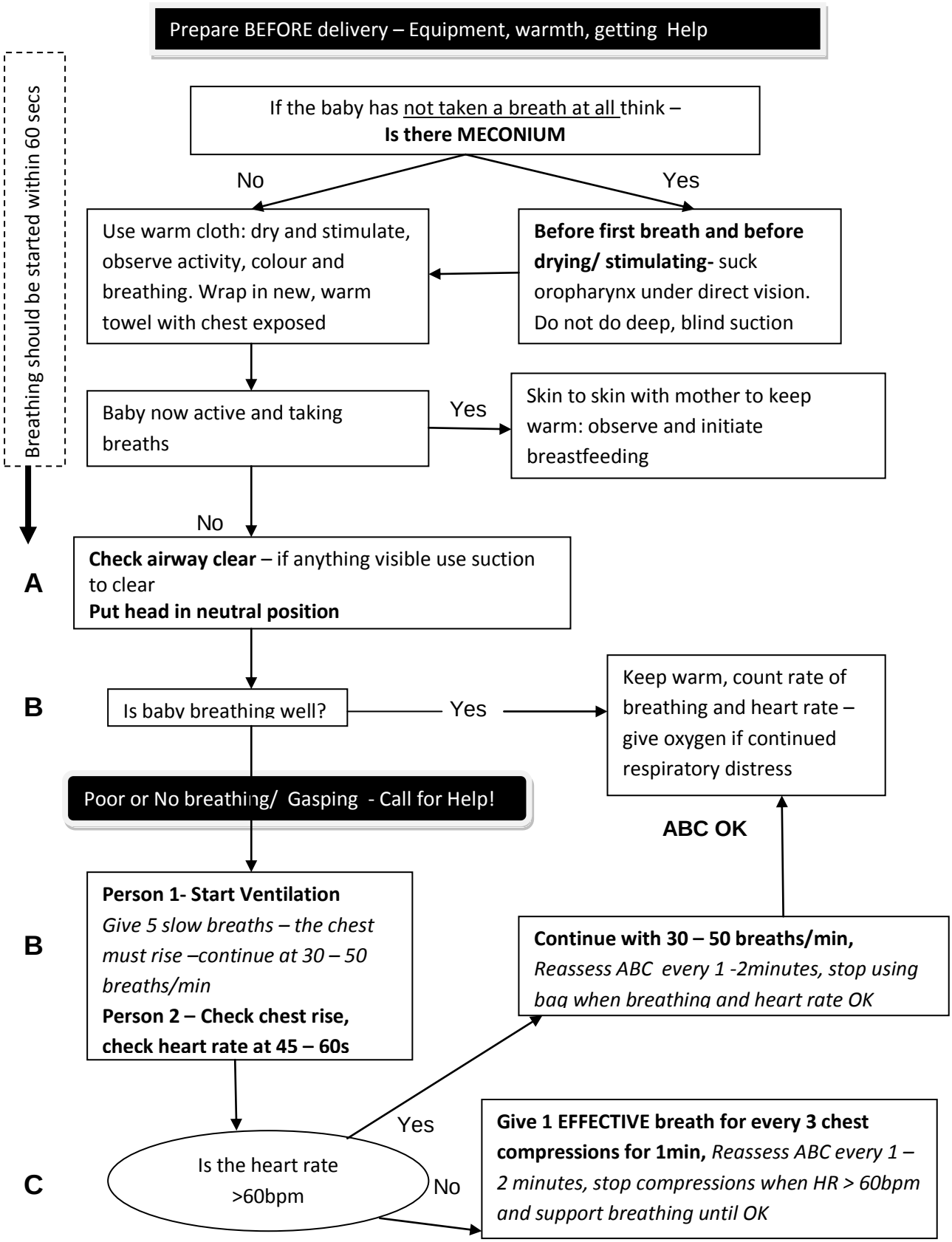
13.0: APPENDICES:

13.1. BASIC NEONATAL RESUSCITATION PROTOCOLS (Adapted from Basic Paediatric Protocols- Revised, September 2010 Edition, Ministry of Health, Republic of Kenya [24])

Neonatal Resuscitation: For a single health care worker – be prepared!



Neonatal Resuscitation: For two trained health care workers – be prepared!



13.2. BIO-DATA FORM

Please respond by ticking in the box next to the answer most suitable for you

Study code:

BIODATA:

1. Gender
   - ☐ Male
   - ☐ Female
2. Age
   - ☐ 20 - 25years
   - ☐ >25 to 50 years
   - ☐ >50 - 60 years

TRAINING & QUALIFICATIONS:

3. Highest qualification achieved
   - ☐ BScN
   - ☐ KRCHN
   - ☐ ECN
   - ☐ Other
4. Year of qualification as a nurse……
5. Years of practice in maternity
   - ☐ <5years
   - ☐ 5 to 10years
   - ☐ > 10years
6. Have you ever attended neonatal resuscitation training?
   - ☐ Yes (proceed to question 7)
   - ☐ No (proceed to question 10)
7. Which training?
   - ☐ ETAT/ ETAT+
   - ☐ EPLS
   - ☐ PALS
   - ☐ Other (please specify)……

8. How long ago did you attend your last course on neonatal resuscitation?
    - ☐ <6months ago
    - ☐ ≥6months to 1year ago
    - ☐ >1 year ago
9. Have you gone for refresher courses after your initial training on neonatal resuscitation?
    - ☐ Yes (proceed to question 11)
    - ☐ No (proceed to question 10)
10. Why not? (why have you not attended a training or a refresher course on neonatal resuscitation)
    - ☐ I feel I have adequate knowledge
    - ☐ No time
    - ☐ No finances
    - ☐ Other (please specify)……
      ……..
11. Do you use any job aides at work?
    - ☐ Yes (please specify which ones)……
      ……
      …….
    - ☐ No

Thank you very much for taking time to fill in this form

13.3. KNOWLEDGE ON NEONATAL RESUSCITATION

Instructions: Please circle the most correct answer. In case of cancellation, please completely cross out initial incorrect answer circled

Study code :

1. Which is the first and most important step in neonatal resuscitation?
    a) Securing the Airway
    b) Giving assisted ventilation
    c) Drying
    d) Chest compressions
    e) Being prepared
2. When drying a baby, how many towels are required?
    a) 1
    b) 2
    c) 3
    d) 4
    e) 5
3. Which part of the neonate is left exposed after drying and warming?
    a) Head
    b) Chest
    c) Legs
    d) Arms
    e) None
4. The following are things you check in neonate while drying EXCEPT:
    a) Colour
    b) Activity
    c) Breathing
    d) Tone
    e) Umbilical stump pulsation
5. How deep do you suction the neonate's airway?
    a) As far as you can go
    b) As far as you can see

6. When is suctioning of the airway indicated?
    a) Meconium after baby has been stimulated, dried& cried
    b) Meconium, before first cry
    c) In all cases of meconium
    d) In all neonates
    e) Immediately after delivery before clamping the umbilical cord
7. In a baby who does not begin spontaneous breathing, how many inflation breaths are given?
    a) 2
    b) 3
    c) 4
    d) 5
    e) As many as one wants
8. When ventilating a neonate using BMV, how many breaths are given per minute?
    a) <10
    b) 10 - 30
    c) 30 – 50
    d) 50 – 70
    e) No clearly defined rate
9. In the presence of only one health care worker, when do you proceed to give chest compressions?
    a) When heart rate< 60bpm
    b) After giving inflation breaths
    c) No cardiac activity
    d) On arrival of help if heart rate <60bpm
    e) Never
10. All the following are indications for chest compressions except..
    a) No cardiac activity
    b) Heart rate < 60bpm
    c) Need for ventilation

11. What is the ratio of breaths: cardiac compressions in a neonate?
    a) 1:3
    b) 1:5
    c) 2:15
    d) 2:30
    e) No established ratio
12. How often should the neonate be reassessed?
    a) Every 1-2 minutes
    b) Every 5 – 10mins
    c) Every 20 – 30mins
    d) After each intervention
    e) Never
13. All the following are indications for ventilation except…
    a) Floppy cyanotic neonate
    b) No spontaneous cry/ breathing effort
    c) No cardiac activity
    d) Respiratory rate of 15/minute
    e) Respiratory rate of 30/minute
14. On opening the airway in a neonate, the preferred position is….
    a) Neutral position
    b) Sniffing position
    c) Any position
15. Is oxygen necessary for resuscitation?
    a) Yes
    b) No
16. Are you aware of any national guidelines on neonatal resuscitation?
    a) Yes
    b) No

13.4. BASIC NEONATAL RESUSCITATION EQUIPMENT CHECKLIST:

(To be filled in at the start of each resuscitation)

Instructions: Please tick in appropriate column to indicate if equipment is present or absent. The percentages will be calculated later.

Date: Venue:

PERMANENT ITEM	PRESENT	IN WORKING CONDITION
Warmer/ resuscitaire		
Oxygen source		
Suction machine		
Ambu bag (500mls)		
Clock		
% of equipment present		
% of equipment present and in good working condition		

TEMPORARY ITEM	PRESENT	ABSENT
Suction tube (6F,8F and 10F)		
Face mask (preterm: sixe 0; term: sixe 1)		
Mode of oxygen delivery (nasal catheter, nasal prongs ,face mask)		
Oxygen tubing		
Clean dry towels (2)		
% of items available		

13.5. CHECKLIST ON SKILLS AND PRACTICES

Instructions: *Please tick in box next to the choice that applies to resuscitation being observed*

Study code: ☐ **Number of observations**: ……. /4

Shift:

- ☐ Day
- ☐ Night

Location:

- ☐ Labour ward
- ☐ Maternity theatre
- ☐ New born unit

Maternal complications during pregnancy:

- ☐ Preeclampsia/ eclampsia
- ☐ Antepartum haemorrhage
- ☐ Prolonged active stage of labour
- ☐ Meconium stained liquor
- ☐ Other (please specify)…….
  ……

Details of neonate:

Birth weight (grams):……..

Apgar score: …….1, ……5,……10 minutes

Gestational Age: ……..

Mode of delivery:

- ☐ SVD
- ☐ Assisted delivery
- ☐ Elective C/S
- ☐ Emergency C/S
- ☐ Other (please specify)……
  ……

RESUSCITATION PROCEDURE: (*please tick yes/ no depending on observation made during resuscitation)*

PREPARATION, DRYING AND WARMING:

Observation:	YES	NO
Checked availability of equipment		
Tested equipment		
Placed neonate under warmer/ resuscitaire		
Dried neonate thoroughly		
Removed wet blanket		

AIRWAY:

	YES	NO
Looked into airway		
Meconium present	Suctioned	
	Not suctioned	
Child was breathing before suctioning		
Positioned head in neutral position		

BREATHING:

	YES	NO
Assessed for breathing (looked, listened and felt) ***Document which aspect not done if all three actions not completed***		
Correct decision made to ventilate: ▪ No spontaneous breathing effort ▪ RR< 20/min ▪ Gasping		
Called for help		
Correct mask size used (covers nose and mouth and forms a tight seal)		

How many inflation breaths were given? ▪ 2 ▪ 5 ▪ >5		
How many times did the chest rise during the inflation breaths? ▪ <2 ▪ ≥2		

NEONATAL OUTCOME:

- ☐ SURVIVED
- ☐ SUCCUMBED

Please tick any of the following practices if observed:

- ☐ Held the neonate upside down
- ☐ Shook neonate vigorously
- ☐ patted neonate on back with excessive force
- ☐ Flicked foot of the neonate
- ☐ Vigorously wiped neonate
- ☐ Squeezed chest of neonate

Please note down any harmful or inappropriate practices noted other than those in list above and any interventions required from you, as the observer

……

……

……

……

……

Date:

Name of observer:

13.6: CONSENT FORM

Introduction:

I am currently a resident in Paediatrics at University of Nairobi. As per the requirements of my course, I am carrying out a study at your facility, Pumwani Maternity Hospital (PMH) to assess how well we carry out neonatal resuscitation in our maternity wards and theatres in relation to our national guidelines.

Objectives of the study:

My aim is to determine how adequate the knowledge of neonatal resuscitation is in nurses who handle deliveries and to see whether their practice is in accordance with the guidelines. I also intend to determine how well the hospital is equipped to enable nurses to resuscitate neonates.

What do I require of you as a participant?

In order to determine how well we adhere to neonatal resuscitation guidelines, I will require 3main things from you as a participant:

- Background details of your education, training and work experience
- Allow me to observe you as you receive a neonate after delivery so as to observe your resuscitation skills
- Participate in a theoretical test to determine your level of knowledge on neonatal resuscitation

Confidentiality:

You as a participant will be given a study number so that your name does not appear in any of the data collection instruments and your identity remains confidential. Only the team of observers will know the number given to you. This is to avoid adverse consequences in case of identification of harmful practices or poor performance in either of the areas assessed.

Feedback will be given confidentially to you as the participant on your performance and to PMH as an organisation about the knowledge and performance of participants as a group, not as individuals.

Benefits:

The study will help identify how well we adhere to national neonatal resuscitation guidelines as well as identify the gaps in knowledge and practise in neonatal resuscitation. By identifying the gaps and possible barriers to poor adherence to guidelines, recommendations will be made to promote better practice and improve neonatal outcomes. This will aid you as an individual by providing means of improving your skills and knowledge in your daily practice.

Risks:

None identified to you as the participant. Please note that if observer notices any wrong practices, you will be given feedback confidentially at the end of the study and this information will not be forwarded to the hospital with your name and thus you do not have to worry about any harsh repercussions in case of identification of any incorrect practices.

Recruitment, compensation and withdrawal:

Participation in the study is entirely on a voluntary basis and there is no compensation offered. You are allowed to withdraw from the study at any point and your records will be disposed of. If you decide to leave study, you need to let to the primary investigator know and the observers on the ground will be alerted not to observe any resuscitations you are involved in and all your records up to that point will be disposed of confidentially without any repercussions to you the participant.

Contact information of researchers:

In case of any queries, please reach me via contacts below

Primary Investigator: Dr Jaspreet Kaur Bhurji

Cell number: 0720 108 268

Email address: doc_jazk@yahoo.com

Contacts of supervisors:

Prof Musoke: 0721 307 160; rachelnamu@africaonline.co.ke

Prof Wamalwa: 0721 239 493; dalton@africaonline.co.ke

I agree to participate in the above mentioned study. I understand the requirements and accept to participate without any compensation. I maintain the right to withdraw from the study at any point and at such a time all my records will be destroyed.

Participant's name:…… Witnesses' name:……

Participant's signature:…… Witnesses' signature:…….

Date:…… Date:……

Participant's contact details:……..

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Ref: KNH-ERC/A/267

2nd September, 2013

Dr. Jaspreet Kaur Bhurji
Dept.of Paediatrics & Child Health
School of Medicine
University of Nairobi

Dear Dr. Kaur

RESEARCH PROPOSAL: DETERMINATION OF THE ADHERENCE OF NURSES TO NATIONAL GUIDELINES DURING RESUSCITATION OF NEONATES BORN AT PUMWANI MATERNITY HOSPITAL (P154/04/2013)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 2nd September, 2013 to 1st September 2014.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study
This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website **www.uonbi.ac.ke/activities/KNHUoN.**

Yours sincerely

PROF. A.N. GUANTAI
CHAIRPERSON, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The Principal, College of Health Sciences, UoN
The Dean, School of Medicine, UoN
The Chairman, Dept.of Paediatrics & Child Health, UoN
Supervisors: Prof. Rachel Musoke, Dr. Dalton Wamalwa

PUMWANI MATERNITY HOSPITAL

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QUALITY MATERNAL CARE

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PMH/DMOH/12/1052/2013

13TH SEPTEMBER 2013

Dr. Jaspreet Kaur Bhurji
Dept. of Paediatrics & Child Health
College of Health Sciences
University of Nairobi.

RE: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that your research proposal entitled "**Determination of the adherence of Nurses to National Guidelines During Resuscitation of Neonates Born at Pumwani Maternity Hospital**" has been approved.

You are hereby allowed to collect data. We look forward to receiving a summary of the research findings upon completion of the study.

Yours sincerely

DR. L.O. KUMBA
MEDICAL SUPERINTENDENT