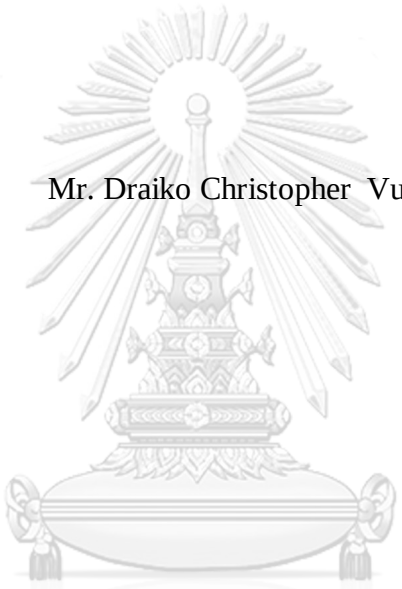
ACTIONS TO HELP BABIES BREATHE AT BIRTH: TRAINING INTERVENTIONS TO IMPROVE HEALTH WORKERS KNOWLEDGE, PRACTICES AND COMPETENCY ON HELPING BABIES BREATHE IN TERTIARY HOSPITAL IN THE REPUBLIC OF SOUTH SUDAN

Mr. Draiko Christopher Vunni



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บทคัดย่อและแฟ้มข้อมูลฉบับเต็มของวิทยานิพนธ์ตั้งแต่ปีการศึกษา 2554 ที่ให้บริการในคลังปัญญาจุฬาฯ (CUIR)
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"ปฏิบัติการเพื่อช่วยเหลือทารกหายใจเมื่อแรกเกิด: โครงการฝึกอบรมเพื่อพัฒนาศักยภาพและการปฏิบัติของเจ้าหน้าที่ทางการแพทย์ในการช่วยให้ทารกหายใจ ในโรงพยาบาลตติยภูมิ สาธารณรัฐเซาท์ซูดาน"

นายไดรโก คริสโตเฟอร์ วันนี่

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรดุษฎีบัณฑิต
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ความเป็นมา:การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาผลของโครงการช่วยทารกที่มีภาวะขาดออกซิเจนในครรภ์ให้หายใจเมื่อแรกคลอดโดยการให้ความรู้และฝึกทักษะในการปฏิบัติงานของเจ้าหน้าที่ทางการแพทย์ในการจัดการภาวะไม่หายใจและลดการเสียชีวิตของทารกแรกเกิดใน24ชั่วโมงหลังคลอดวิธีการศึกษา:ารศึกษานี้เป็นการทดสอบก่อนและหลังการทดลองใช้การสุ่มตัวอย่างโรงพยาบาลแบบเจาะจงและใช้คอมพิวเตอร์สุ่มเลือกผู้เข้าร่วมการวิจัยโรงพยาบาลจูบาได้รับเลือกเป็นโรงพยาบาลทดลองและโรงพยาบาลวูเป็นโรงพยาบาลควบคุมเจ้าหน้าที่ได้รับการประเมินผลก่อนและหลังการอบรมช่วงเดือนกุมภาพันธ์ถึงเดือมิถุนายน2560ซึ่งการประเมินหลังการทดลองได้กระทำทันทีที่เสร็จสิ้นการอบรมและอีกครั้งภายหลังการทดลองสิ้นสุดเดือนโดยใช้การจาลองสถานการณ์ทารกแรกเกิดผลการศึกษา:ผู้มีส่วนร่วมการวิจัยรวม70คนแบ่งเป็นกลุ่มทดลอง40คนและกลุ่มควบคุม30คนในกลุ่มทดลองพบว่าคะแนนเฉลี่ยของความรู้ของเจ้าหน้าที่ทางการแพทย์เพิ่มขึ้นจาก 42.5%เป็น 97.8%(p<0.05)เมื่อสิ้นสุดการทดลองละมีคะแนนลดลงเป็น84.7%(p<0.05)หลังการทดลอง เดือนผลของคะแนนทักษะเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติทั้งหลักการอบรมและภายหลัง3 เดือน คือ 94.4% อสิ้นสุดการทดลองและเพิ่มขึ้นหลังการทดลอง 3เดือนเป็น 95.4%(-0.3-0.8),(p<0.05) ส่วนทักษะการปฏิบัติเพื่อช่วยทารกหายใจอย่างง่ายมีคะแนนเพิ่มขึ้นจาก27%เป็น88.9%เมื่อสิ้นสุดการทดลองและคะแนนยังคงเป็น89.2%(p<0.05)เมื่อการทดลองสิ้นสุด3เดือนหรับทักษะที่ซับซ้อนนั้นกลุ่มทดลองมีคะแนนการช่วยเหลือทารกสูงขึ้นอย่างมีนัยสำคัญทางสถิติเมื่อเปรียบเทียบระหว่างคะแนนก่อนการทดลอง (p<0.05)อย่างไรก็ตามคะแนนหลังการอบรม 3เดือนได้ลดลงแต่ไม่มีนัยสำคัญทางสถิติ [CI2.74(-6.71.22)]ป:ารศึกษานี้พิสูจน์ว่าการทดลองหรือการฝึกอบรมนี้มีประสิทธิผลในการเพิ่มความรู้และทักษะในการปฏิบัติงานของเจ้าหน้าที่ทางการแพทย์ในการลดการตายของทารกที่เกี่ยวข้องกับการหายใจเมื่อแรกเกิดใน 24 ชั่วโมงแรก

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สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต .....
ปีการศึกษา 2560 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....
ลายมือชื่อ อ.ที่ปรึกษาร่วม .....

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DRAIKO CHRISTOPHER VUNNI: ACTIONS TO HELP BABIES BREATHE AT BIRTH:TRAINING INTERVENTIONSTO IMPROVE HEALTH WORKERS KNOWLEDGE, PRACTICESAND COMPETENCY ON HELPING BABIES BREATHE INTERTIARY HOSPITAL IN THE REPUBLIC OF SOUTH SUDAN. ADVISOR: ASSOC. PROF. KHEMIKA YAMARAT, Ph.D., CO-ADVISOR: ALESSIO PANZA, MD, 184 pp.

Background: This study aimed to examine the effects of the Helping Babies Breathe (HBB) training interventions program on the knowledge and practical skills of health workers in managing birth asphyxia and reducing mortality within 24 hours. Methods: This study was pre- posttest design. Participants were purposively selected to participate in the study. Juba Hospital was selected as intervention and Wau Hospital as control. Health workers were evaluated before and after training from February to June 2017. Post training evaluation was done immediately and three months using NeoNatalie newborn stimulator. Result: 70 health workers were enrolled; 40 were in the intervention and 30 in the control group. In the intervention group, knowledge increased from 42.5 % to 97.8% post-test ($p<0.05$) but declined to 84.7% ($p<0.05$) at 3 months. The practical skills among the intervention group increased significantly both at immediate posttest (94.4%) ($p<0.05$)]. This further increased to 95.4% at 3 months 0.1 (-0.3-0.8). Practical skills for simple resuscitation increased from 27.0% at baseline to 88.9% at immediate post intervention and remained at 89.2%, 3 months follow up ($p<0.05$).Meanwhile intervention group had significant increase in complex neonatal resuscitation between baseline and immediate post intervention ($p<0.05$) However, it decreased at 3 months [CI 2.74(-6.71-1.22)] but the changes was insignificant ($p>0.05$). Conclusion: This study has proven that training was effective in improving the knowledge and practical skill of the health workers and reduction of deaths related to birth asphyxia within 24 hours

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Abbreviations, Acronyms

AAP: American Academy of Pediatrics

ACLS: Advanced Cardiovascular Life Support

AHA: American Heart Association

ANC: Ante natal Care

ANOVA: Analysis of variance

ASMR: Asphyxia Specific mortality rate

BMV: Bag mask Ventilation

CBIP: Community Based Intervention Program

CEmONC: Emergency Obstetric and newborn Care

CF: Case fatality

CHD: County Health Department

CIA: Central intelligence Agency

CPR: Cardiopulmonary Resuscitation

CTG: Continuous Cardiotocography

ECEB: Essential Newborn Care

ENBM: Essential Newborn Mortality

FSB: Fresh Still Birth

GDP: Gross Domestic product

GDP: Gross Domestic Product

HBB: Helping Babies Breathe

HBB: Helping Babies Breathe

HIE Ischemic Encephalopathy

ICHD: Institute of Child Health Development

ICPD: International Conference on Population and Development

ILOCOR: Internal Liaison Committee on Resuscitation

IMC International Medical Corps

IMNCI: Integrated Management of Newborn and Childhood Illnesses

JTH: Juba Teaching Hospital

LIC: Low Income Countries

MCQ: Multiple Choice Questions

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MOH: Ministry of Health

NER: Net Enrollment Rate

NICU: Neonatal intensive Care Unit

NNPD: National perinatal Database

NNR: Neonatal resuscitation

NRP: Neonatal Resuscitation Program

NSL: Newborn Life Support

OSCE: Objective structural clinical evaluation

OT: Operating Theater

PALS: Pediatrics Advanced Life Support

PHCC: Primary Health Care Center

PMR: Perinatal mortality rate

QIC: Quality Improvement Cycle

RCT: Randomized Control trial

RMF: Real Medicine Foundation

SDG: Sustainable Development Goal

SSHS: South Sudan House Hold survey

TREND: Transparent Reporting of Evaluation with Non Randomized Design

UN: United Nations

UNESCO: The United Nations Educational, Scientific and Cultural Organization

UNFPA: United Nation Population Fund

UNICEF: United Nations Children Fund

USAID: United States Agency for International Development

VHW: Village health workers

WFP: World Food Program

WHO: World Health Organization

WTH: Wau teaching Hospital

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Chapter One

Introduction

1.1 Background information and Rationale for the study

Health is fundamental right and every community must enjoy. The health of communities in the world is judged by the overall health of the children and the mother. In a population, the health of women and children among the communities are considered vulnerable(1).Recently the health of mother and newborn has drawn attention of the public as part of working toward achieving sustainable development goal 3 targets 3. 2 &2 (SDG 3) signifying the commitment shown by the international community to end preventable newborn and under five mortality between 2015 to 2030.(2)

South Sudan has been ranked among the world countries with high number of under-five mortality with worst indices for maternal and newborn and Mortality rate at 105 per 1,000 live births. According to count down statistics, (2014) South Sudan has newborn mortality estimated at 35/1,000 and the infant mortality was 67/ 1,000 live birth(3)

Globally, about 3.6 million newborn deaths accounts for higher proportion of 41% of deaths in under-five children than previously reported. insignificant progress has been made in reducing the number of deaths due to pre maturity and it is well known that prematurity contribute significantly to newborn and under-five mortality worldwide.(4)

In 2015, 4.5 million (75% of all under-five deaths) occurred within the first year of life. the risk of a child dying before completing the first year of age was highest in the African region (55 per 1000 live births), over five times higher than that in the developed region (10 per 1000 live births). Globally, the infant mortality rate has decreased from an estimated rate of 63 deaths per 1000 live births in 1990 to 32 deaths per 1000 live births in 2015. At the same time it was reported that the global annual newborn deaths have declined from 8.9 million in 1990 to 4.5 million in 2015.

Majority of the deaths reported occurred in low setting and poor countries where women and children lack access to quality maternal and newborn health care as well as poor health seeking behavior among the communities(5)The most common cause of neonatal mortality are attributed to pre-term birth complications(12%) birth asphyxia (9%), sepsis (6%) and pneumonia (4%). Neonatal mortality rate are significantly influenced by the quality of existing health care facilities for newborns.(6)

The main causes of newborn deaths have remained unchanged for the last one decade and causes are due to complication of infections (26%), intrapartum complications (24%) including birth asphyxia and preterm delivery (34%) with breathing problem contributing to mortality and morbidity as well as congenital abnormalities (9%).[8]The real cause of newborn deaths is difficult and most challenging to determine for the health professionals. It is important that nurses, midwives, Clinical officer, medical officers, Maternal health workers and community Health workers (CHWs) attending births to have the essential knowledge and skills to assess neonates ' breathing status and effectively respond as needed

The real cause of newborn deaths is difficult and most challenging to determine for the health professionals. A newborn exhibits few symptoms in reactions to any illness and their manifestations of various diseases tend to overlap.(7)However, most of the newborn deaths and still births happened at home, remained unobserved and mostly unaccounted for by Ministry of Health in most of the poor and developing countries.(8) The uncertain figure of newborn deaths could be attributed to lack of vital registration system in these high burden countries(9)

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A clear strategy is required to reduce newborn mortality within the first 28 days of life in order to achieve the sustainable development goal. According to world health organization(10). an estimated 136 million infants are born each year and this figure is expected to rise globally to nearly 137 million births yearly by 2016. In the entire human life, the most risky part of life is the day of birth.(11) It was reported that of the 136 million newborn births, one million of newborn will not survive each year during their first day of life.[14] Based on one million deaths each year globally, effort must be aimed at interventions to reduce the high number of deaths in newborns. Birth being a natural process has potential high risk with consequences.

Although little emphasis was placed on the newborn health, progress has been made by the global communities in reducing infant and child deaths and there has been some decline in the mortality rate(12)Despite decrease in under-five mortality at the same period, the numbers of deaths among the infants in the first months of life remain significantly high and the rate is reducing at much lower rate. About 3.6 million newborn deaths accounts for higher proportion of 41% of deaths in under-five children than previously reported globally. insignificant progress has been made in reducing the number of deaths due to pre maturity and it is well known that prematurity contribute significantly to newborn and under-five mortality worldwide.(4)

Majority of the health workers/ staff often failed to recognize breathing difficulty early, and most of times could not assess and take immediate action to resuscitate non-breathing babies at the time of delivery. Priority has often been given to the mother's needs. The neonates often remained unattended to for several minutes with little attention. This problem could be partly attributed to not having a staff member present dedicated to the newborns. Despite the burden of newborn death being high in the low and poor countries, coverage of skilled birth attendance is very scarce in these countries.[16] similarly, more than one million preterm neonates die from complications of preterm delivery of respiratory distress syndrome, while majority of the preterm newborn requires assistance to initiate breathing at birth.(13) Having known that prematurity and intrapartum hypoxic are the main cause of early neonates mortality in majority of the neonates, training of health workers in basic neonatal resuscitation globally, regional and locally will help to improve the newborn survival and will save hundreds of thousands of newborn infants lives yearly.

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To address newborn health care, there is need to orient public health care intervention to include pregnancy through child birth and the newborn period and one year of life.(14)The most significant contribution that will help in child survival is to train health professional in basic resuscitation and care within ninety minutes focusing on those health professionals in community and hospital settings as most of the birth occur at home in Control to the facility births.(15)Wall indicated that about one million newborn who requires some degree of resuscitation at birth and such simple interventions are airway clearing, tactile stimulation and position. All newborn babies experience some degree of hypoxia during the intervals of contractions of the uterus.

Literature review on neonatal resuscitation training in health care facilities indicated that training of health workers who attend to birth and neonates could avert 30% of intrapartum related newborn deaths.(16) Despite benefits of training of health workers on neonatal resuscitation in averting newborn deaths, the coverage of neonatal resuscitation remain very low in settings with high burden of neonatal deaths. Currently, various neonatal resuscitation training course are being promoted and implemented in many countries in order to build the capacity and competence of the health workers to become better qualified in managing sick newborns or children in emergency setting.

A number of guidelines and algorithms exist and most of this can be found online. However, most of the guidelines and algorithms are reported to been based on the consensus of the pediatricians experts than evidence based training module. The courses use to teach on neonatal resuscitation are the newborn life support (NLS), the neonatal resuscitation program (NRP), WHO essential Newborn care Course and Pediatric life support courses. A review found out that there seems to be inadequate evidence pointing at improvement of skill and performance of the health workers through in-service training in neonatal resuscitation in caring for critical ill newborn baby. However, there is still some evidence to show benefit of training of health workers in newborn resuscitation(17).

Among the most effective strategies available for low resource setting is Helping Babies Breathe (HBB) program, a neonatal resuscitation training program aimed to increase the knowledge and skills of skilled Birth Attendant (SBA).(18) HBB is a life support program developed by the American Academy of Pediatrics in collaboration with other organizations.(19) With the objective of achieving Sustainable Development Goal (SDG) of ending preventable deaths of neonatal and under-five children “through increasing the coverage of skilled birth attendants and improving the quality of maternal and newborn care, the training intervention on Helping Babies Breath in hospital and health center is essential. ‘HBB-plus’ training intervention is believed to increase knowledge, skill and competency of the health workers on newborn resuscitation that will contribute to reducing asphyxia related newborn mortality in South Sudan.

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1.2 Statement of the Problem

In republic of South Sudan, attempts have been made to address maternal and newborn challenges through developing national policies and roadmaps. The developed health policy focused on interventions and strategies to address the existing disparity in planned activities and situation strategically to improve coordination of the interventions and delivery of services across the continuum of care including maternal and newborn health services.(20)The current existing newborn and child initiative are Integrated Management of Newborn, childhood Illness (IMNCI), Essential newborn Care, care of low birth weight and preterm babies (Kangaroo Care) and Lifesaving skills training for health workers providing antenatal, peri-natal and postnatal women. Majority of support for the roll out and implementation of the strategies was derived from the donor support and international nongovernmental organization and UN agencies (UNICEF, UNFPA and WHO). Ministry of Health (MOH) significantly considers asphyxia related mortality and morbidity as major priority as the main drivers of newborn deaths.[26]

Although, MOH developed several programs aimed at newborn resuscitation and care, it is clear from the World Health Organization Countdown 2015[3]report that asphyxia related deaths remain unchanged for the past five (5) years and worse still the number of skill attendant and skilled delivery was estimated at 19.4% and the hospitals and the primary health care units and centers have dismal lack of basic resuscitation equipment's and qualified skill attendant (midwives).

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In the situation analysis, the magnitude and reason for the high newborn mortality was clearly described including the existing health resources available to address the challenges in the country.[26, 27]the neonatal mortality in South Sudan stands at 35/1,000. Undocumented report from Juba Teaching Hospital indicated that some of the fresh still birth could be wrongly classified and recorded as still birth due to lack of skills for identifying still birth (non- breathing newborns with heart activity at delivery). It is optimistic that implementation of Helping Babies Breathe and ECEB training program will address the challenges of having high newborn mortality in South Sudan.

1.3 System Gap

There is need to integrate Helping Babies Breath training with other existing newborn program already emphasized by Ministry of Health. Imperatively, HBB have not been introduced in South Sudan although some low resourced countries are implementing the program.(21).This could be the reason for the unchanged newborn morality due to asphyxia over the last five years.

Currently Ministry of Health (MOH) of South Sudan strategy focused on improving the skills of health workers on newborn care and resuscitation. Helping Babies Breathe (HBB) has not been introduced in Republic of South Sudan. Its Implementation remained limited. The benefit of training health workers on HBB is not yet known among the health workers and the policy makers. Helping Babies Breath is new approach developed by the American Academy of Pediatrics (AAP) as simplified version for neonatal resuscitation guideline and protocols.

The protocol of helping Babies Breath is program developed to train health workers in limited resources setting to help prepare and build their competency and change their attitudes and practices to care well at birth for those babies who are not breathing. In every birth, there should be a killed health workers who is knowledgeable to provide quality care for both mothers and the newborn and infants. Helping Babies Breath is first minute interventions usual referred to as golden minute that saves newborn lives with asphyxia.

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1.4 Research Gap

Neonatal resuscitation is not new in South Sudan; however, the simplified version of resuscitation packaged as Helping Babies Breathe is new idea which has not been explored and implemented on large scale in the public health facilities in South Sudan. The training was adapted from Helping Babies Breathe developed by American Academy of Pediatricians for low resourced countries. The aim of this study was to evaluate the immediate and long- term effect of HBB training on neonatal resuscitation knowledge and skills and reduction of neonatal mortality due to asphyxia.

Although, studies to test intervention on the effect of training health workers on their skills and knowledge were carried out in other low resourced countries, Helping Babies Breathe (HBB) and Essential Care for Every Newborn (ECEB) has not been introduced in Republic of South Sudan on large scale using organized interventions. To reduce neonatal mortality from asphyxia, there is need for the MOH to adapt, introduce and scale up implementation of HBB and ECEB in the facilities and integrated in it into new strategies at different level with other newborn and maternal health care. Besides, there was no record on training health workers and implementation of helping babies Breathe in South Sudan.

The effectiveness of the HBB training has not been tested in South Sudan among the health workers in improving their competencies and practices as well reducing newborn mortality. Therefore, the study is concerned with establishing the effect of training health workers on HBB on their practices and competency Helping Babies Breath –plus intervention was carried in Juba Teaching hospitals in South Sudan and health workers were trained to recognize the need for breathing problem at birth. The training was adapted from helping Babies Breathe and ECEB developed by American Academy of Pediatricians for low resourced countries.

1.5 Research Question

- Is training on Helping Babies Breath –plus intervention effective in improving the knowledge, psychomotor skills and competency of health workers?
- Does training of health workers in HBB-plus lead to reduction of newborn mortality within the first 24 hours of life?

1.5.1 Specific research questions

- Do health workers in intervention group demonstrate increased HBB plus knowledge about newborn resuscitation when compared to control group participants at 1 and 3 months?
- Do health workers in intervention group achieve increased rate of psychomotor skills compared to Control at 1 and 3 months?

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- Do health workers in intervention group demonstrate increased competency compared Control group at 1 and 3 months
- Do newborn mortality reduced in intervention group compared to Control group at 1 and 3 months?

1.6 Research Objective

To evaluate the effect of HBB-plus training of health care workers on neonatal resuscitation knowledge skills competency and reduction of neonatal mortality due to asphyxia.

1.6.1 Specific Objectives

- To assess change in health worker knowledge, on neonatal resuscitation before and after the training in intervention and control group
- To assess change in psychomotor skills of trained health workers regarding neonatal resuscitation before and after the training in intervention and control group
- To assess change the competency of the health workers regarding managing neonates with birth asphyxia before and after training in intervention and control group
- To assess change in reduction in the ratio of perinatal mortality due to asphyxia of hospital admission within 24 hours of birth before and after training in intervention and control group

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1.7 Research Hypothesis

1.7.1 Null Hypothesis

- The change in knowledge , psychomotor skills, competency of the health workers and reduction in the ratio of perinatal mortality due to asphyxia of hospital admission within 24 hours of birth will not be different between pre and post-training of the Helping Babies Breathe Training Intervention

1.7.2 Alternative Hypothesis

- The change in the level of knowledge, psychomotor skills, competency and reduction in the ratio of perinatal mortality due to asphyxia of hospital admission within 24 hours will be different between the pre –test and post – training of helping Babies Breathe Training intervention

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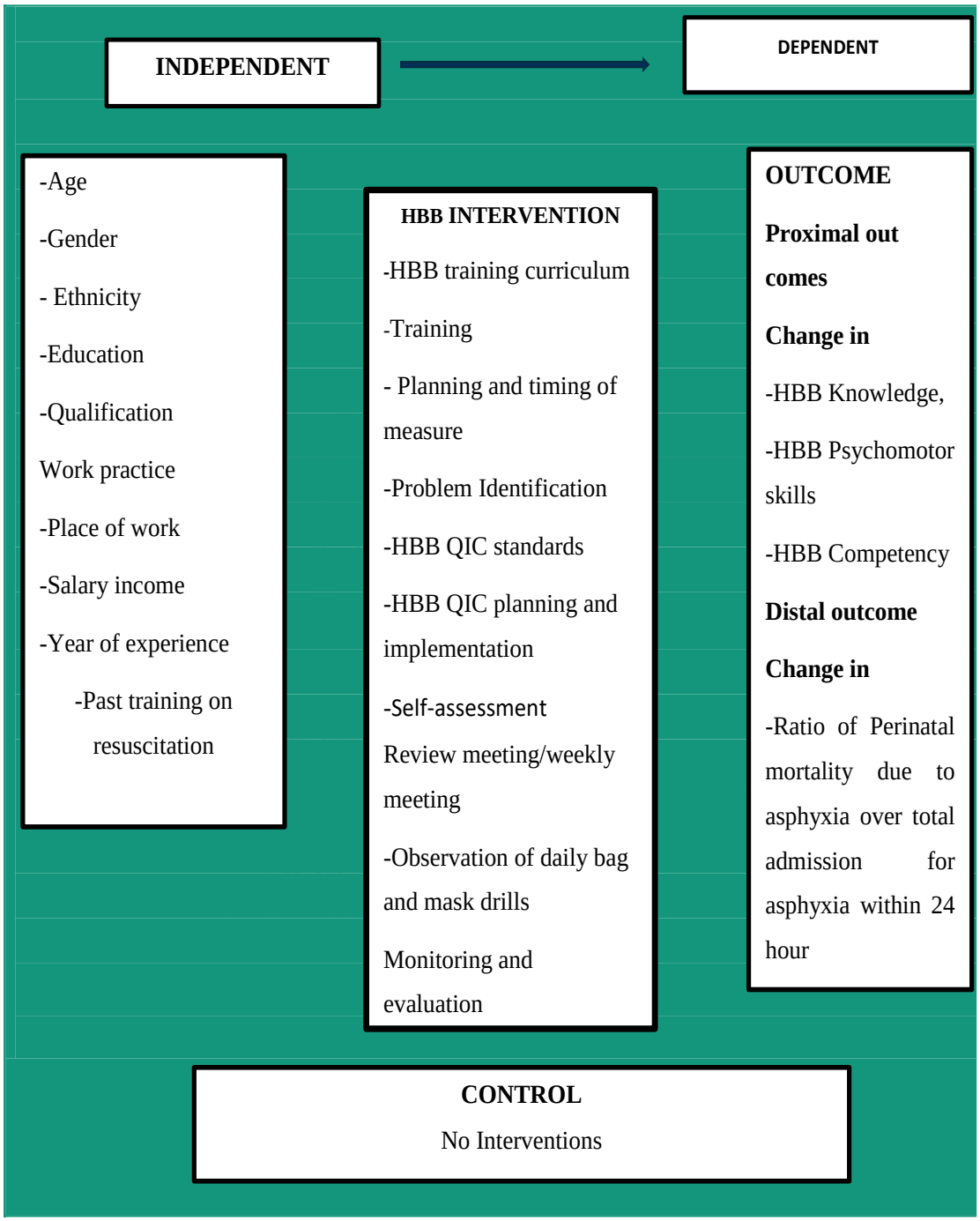
1.8 Conceptual Frame Work for HBB Intervention



1.9 Operational Definition

Term	Definition
Age:	Age is defined as self-reported completed year of life at the latest birth day
Gender	Refer to male and female health workers
Ethnicity	Refers to ethnic group (ethnicity) of where the health workers belongs defined by their spoken mother tongue and association
Education	Refer to the level of education obtained by the health worker, primary (8 years) secondary (3 years) and college 3- 4 years
Qualification	For the purpose of this research ,it refer to the health workers ability to perform some task in nursing , midwifery and clinical medicine
Work practice	Refers to the task performed by the health workers regardless of their obtained qualifications
Place of work	refers to the wards and unit where participants health workers do their work in the hospital setting
Salary Income	Refers to the total amount of salary income per month combined with other benefits received by the health workers.
Year of experience	The self-reported number of years the health worker has practiced in the health care facility since her/his qualification as Nurse, midwife medical doctor , clinical officer and Community health workers
Past Training on newborn resuscitation	refers to knowledge and skills received by health worker on neonatal resuscitation to improve newborn survival within the past three months prior to the study
HBB Intervention	Refers to action taken to improve newborn survival using quality improvement cycle of planning, training, mentoring, problem identification, self-assessment and monitoring and evaluation
HBB Training curriculum	refers to the lessons and content of the helping babies breathe taught for the participants during the training program in a school and training workshops

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Training	Refers to the knowledge and skills received by the health workers on HBB neonatal resuscitation protocols on birth preparation during each child birth on preparation for birth, drying the baby, checking for breathing , keeping the baby warm, clamping and cutting the cord , clearing the airway, initiating ventilation for babies who are not breathing, check the heart rate , calling for help for advanced care and transporting mother and baby measured by MCQ questionnaires (Appendix 3), Observation Check list (Appendix 4)
Planning and timing measure	This is process of how the simplified HBB training intervention will be implemented based on the problem identified by the birth attendants and the observer .using the continuous quality improvement cycle measured by presences of training schedule (Appendix 8,) and observation check list (Appendix 4)
Problem Identification	Is the process of reviewing and comparing the performance on the helping babies Breathe against the baseline data, post training and self-assessment by the health worker and researcher observation and carrying out discussion on the problems with the help of the HBB facilitators
HBB QIC standards	Refers to the process of developing goal and objectives on how participants implement HBB
HBB Planning and timing measure	This is process of how the simplified HBB training intervention will be implemented based on the problem identified by the birth attendants and the observer .using the continuous quality improvement cycle measured by presences of training schedule (Appendix 8,) and observation check list (Appendix 4)
Self-assessment	refers to the process of health workers reviewing and checking for the correct steps taken during each child birth on preparation for birth, drying the baby, checking for breathing , keeping the baby warm, clamping and cutting the cord , clearing the airway, initiating ventilation for babies who are not breathing, check the heart rate , calling for help for advanced care and transporting mother and baby together using the 25 Multiple Choice questions (Appendix 7).

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Review /Weekly meeting and Mentoring	refers to any professional discussion between the health workers and the researcher to enhance knowledge skills and performance at workplace through problem identification, action plan and improvement in the performance of the health workers knowledge and psychomotor skills during the period of the HBB intervention measure by observation checklist (Appendix 8)
Observation	Refers to regular observation of the health workers conducting regular drill and performing neonatal resuscitation on newborn baby by the researcher assistant in ward and unit measured by the observation checklist (Appendix 9)
Monitoring and evaluation	refers to regular checks on the implementation of the HBB training intervention on the health workers to determine if the activities to be implemented are on track to achieve the objectives and make corrections where necessary according to HBB guideline for improving newborn survival measured by Bag and mask Checklist (Appendix 4, 5,&6)
HBB Knowledge	refers to ability of the health workers to answer the helping Babies Breathe steps on birth preparations , provision of routine care ,drying the baby thoroughly, keeping the baby warm, clamping and cutting the cord clearing and stimulating the baby ,breathing and ventilation , checking for heart rate ,keeping the baby clean when to call for help and transporting the mother and baby together measured by MCQ on HBB knowledge (Appendix 3)
HBB Psychomotor skills	refers to health workers ability to check and select for HBB equipment's, application of the mask on the face of the baby firmly identification of breathing problem and ventilate the baby at 40 breathe per minutes, looking for chest movement and improving ventilation if the chest of the baby does not move during the newborn resuscitation measured by Helping Babies Breathe Bag and Mask ventilation Psychomotor Skill Check (Appendix 4).

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HBB Competency	Refers to the steps taken by the health workers to care for the newborn from birth to the time of baby breathing normally using the HBB protocols measured by Objective Structured Clinical Examination (OSCE) checklist in appendix 5 and 6
Ratio of Perinatal mortality	Refers to the number of perinatal death due to asphyxia over total admission for asphyxia within 24 hour during HBB intervention measured by routine hospital data collection
Birth asphyxia	Refers to the clinical status of a newborn who "fails to initiate or maintain regular breathing at birth" caused before delivery due to prematurity, meconium aspiration, intracranial, neuromuscular causes.

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Chapter Two

Review of the Literature

2.1 Introduction

This review of the literature examines empiric studies focused on effectiveness of training interventions on Helping Babies Breathe interventions in general and their associated theoretical frameworks. The review also includes an additional focus on educational interventions related to resuscitation, it retention, and early newborn care that are congruent to the design and execution of training of health workers on helping Babies breathe in low cost income countries, high income countries and developing countries.

2.2 Background Information

According to literature, the need for assistance during the critical transition to extra-uterine life has been well documented .(19) It was estimated that somewhere between three to five percent of all births, approximately ten million infants yearly, do not breathe spontaneously and will require some resuscitation, typically in the form of assistance with initiation or establishment of effective breathing, at the time of birth .Furthermore, many of the deaths attributed to infant mortality, happen either in the immediate newborn period, or in the first week of life. Programs focused on essential newborn care during this period could play a significant role in decreasing infant mortality rates(22) . The intrapartum period is an extremely hazardous time period for infants born in resource limited settings of developing countries of Africa and South East Asia. The universal challenge in improving outcomes is designing a system of care that assures safe passage for every newborn, with critical linkages between home, community, and facility services(23).

One of the greatest essential element that can contribute to improvement of perinatal outcome is the availability of at least one health care provider knowledgeable with skills on newborn resuscitation(10). In low income countries especially in

developing countries, more than 60% of delivery take place outside the health care facilities and when delivery occur at home, skilled health workers or birth attendant may not be available. In this kind of situation and environment, the challenges of accessing effective resuscitation is increased and magnified. Besides, evidence has shown that providing structured universal follow up of the newborn for the first seven days improves the newborn outcome. Interestingly, this follow up does not happened in most regions in the developing countries as follow up care may not be available.

2.3 Sustainable Development Goals (SDGs)

In 2015, the United Nations set post Millennium Development Goal (MDG) with number of goals to be attained by 2030 with Sustainable Development Goal 3 of ensuring healthy lives and promoting well-being for all at all ages. The goal's focus on ensuring healthy lives rather than preventing diseases or infirmity is highly welcome, but the level of ambition is likely unrealistic, given the current operationalization of the goal.

SDG 3 is among the most specific SDGs with a number of clear, measurable targets. It is a direct result of the fact that SDG 3 can build on experience with the MDGs, which had a very strong focus on health (MDGs 4, 5 and 6). Particularly in this regard, it is unfortunate that some of the main lessons learnt from the MDGs have not been accounted for. Clear examples are Targets 3.1, 3.4 and 3.6, which focus on global reductions only.

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Global targets not only risk masking significant variations in the starting conditions of countries but also risk being adopted at the national level, as experience with the MDGs has demonstrated. A positive feature of the goal is that the majority of targets apply to developing and developed countries alike, despite the goal's history with the MDGs. The importance of targets such as maternal, infant and child mortality justifies their inclusion, despite their greater relevance for developing countries.

SDG 3 is complementary to a number of other goals. First, the implementation of social protection schemes required in SDG 1 includes health protection. Second, health is crucial for the ability to get educated (SDG 4). Third, safe drinking water and adequate sanitation and hygiene (SDG 6) contribute to limiting the spread of diseases. Fourth, employment and economic well-being (SDG 8) strengthen the possibilities for

purchasing health care where it is not publicly provided. Fifth, SDGs 13, 14 and 15 – with their focus on ecosystem services and environmental well-being – complement SDG 3, at least indirectly.

The SDG goal 3 is operationalized through nine targets and four suggestions for means of implementation. Most of the targets deal with health issues that are relevant for developing and developed countries alike. Most of the targets are very precise; the level of ambition, however, varies considerably between the targets. The Sustainable Development Goal 3 Target 3.1& 3.2

The target 3.1 requires by 2030 to "*reduce the global maternal mortality ratio to less than 70 per 100,000 live births*". This is a welcome continuation of an important MDG target, yet two of the main lessons learnt from the MDGs have been disregarded. First, the global focus of the target will not prevent its translation into a goal adopted at the national level, as the suggestions of the SDSN for the disaggregation of the target plainly demonstrate. But the simple adoption at the national level is highly unfair to those countries with challenging starting conditions. This weakness could easily be removed by adding "by reducing national maternal mortality ratios to less than 20% per 100,000 live births"; each country would then specify the target value, given the different starting conditions. Second, data on maternal mortality rates are highly unreliable.

The SDSN mentions the problem that many developing countries lack a death (and often also birth) registration system, which makes it virtually impossible to derive a reliable number of maternal deaths. The implementation of death and birth registration systems is an important part of the data revolution.

The SDG Target *3.2*: The target requires by 2030 to "*end preventable deaths of newborns and under-five children*". The great importance of the target justifies its high level of ambition; however, it will be crucial to ensure that poor countries are not left alone with their limited resources to deal with this task. Target 3.2 is closely linked with target 2.2 on ending all forms of malnutrition, as malnutrition is a frequent cause of death for newborns and under-five children

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2.4 Global Burden of Perinatal Mortality and Morbidity

Perinatal Mortality is defined as intrapartum stillbirths and early (one week) neonatal deaths per 1000 live births. Perinatal health globally has received increasing international attention over the past 15-20 years. However, almost 99% of all deaths still occurred in resource-poor settings, (24)and stillborn babies are not even included in SDG 3 Target 1&2 goals. Each year, intrapartum-related hypoxia (often equated with birth asphyxia) is estimated to account for about two million perinatal deaths worldwide including intrapartum stillbirths and early neonatal deaths(25).The intrapartum stillbirth rate is estimated to around 10 per 1000 births.(26)

The vast majority of intrapartum-related neonatal deaths occur within the first week of life and the risk for intrapartum-related death on the first day of life is estimated to about 11 per 1000 births(34). An additional one million of the surviving infants develop neurocognitive problems such as cerebral palsy and learning difficulties.(10) Official figures probably underestimate perinatal mortality and morbidity rates because of considerable under-reporting. The psychological and sociological burdens are impossible to measure (27).

There are several causes contributing to perinatal mortality and morbidity. Adverse perinatal outcome secondary to intrapartum fetal organ damage due to poor oxygenation may be difficult to distinguish from other conditions including infections and trauma. However, these conditions often co-occur, and intrapartum fetal hypoxia and ischemia is probably the final common pathway for many intrapartum-related fresh stillbirths (FSB) and early neonatal deaths, whether the event is obstructed labour, hemorrhage, cord prolapsed, pre or eclampsia, or maternal infection/sepsis. Depending on the severity and duration of intrapartum hypoxia the baby may die during labour and present as a FSB, or be delivered with variable degree of hypoxic-ischemic injury. Strategies for prevention of intrapartum-related adverse outcome can be divided into three phases:

1) Primary prevention of the insult by adequate fetal monitoring and correct use of the partograph coupled with timely obstetric interventions. That should have an important impact on reducing both maternal and perinatal mortality and morbidity.

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2) Secondary prevention after the insult by immediate resuscitation of the non-breathing baby.

3) Tertiary prevention of complications in the baby by adequate postnatal treatment.

A consequence of improved obstetric care may result in decrease in neonatal mortality because babies that previously would have died during labour (FSB) might be born alive with hypoxic-ischemic insults. Similarly, improved resuscitation may hinder or delay neonatal deaths, but increase neonatal morbidity

2.5 Birth Asphyxia" And Intrapartum-Related Deaths

Intrapartum hypoxia and the consequences of intrapartum fetal organ damage due to poor oxygenation are often equated with "birth asphyxia". "Asphyxia" is based on the Greek word meaning "pulses less" and applies to a syndrome that combines hypoxia and metabolic acidosis. World Health Organization broadly defined "birth asphyxia" as the clinical status of a newborn who "fails to initiate or maintain regular breathing at birth". This definition does not imply a particular cause (e.g. intrapartum hypoxia); the baby may not breathe because of prematurity, meconium aspiration, intracranial, thoracic or neuromuscular diseases. Therefore, additional makers (e.g. Apgar score and fetal distress) have been used to indicate possible intrapartum hypoxia and acidosis. The most commonly used indicator to identify birth asphyxia in resource limited settings is 5 minute Apgar score < 7. The scoring is often done by the same person who has delivered the baby, and the total score includes several subjectively assessed variables (Table 1). Thus, Apgar scores may be an inaccurate and unreliable indicator of birth asphyxia. Furthermore, many babies with intrapartum hypoxic-ischemic injury are likely not reported or misclassified as FSB(9). Therefore, considerable uncertainty surrounds the "true" proportion of birth asphyxia related mortality.

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Table 1: Apgar score

Sign	Score 0	Score1	Score 2
Heart rate	Absent	<100/min	>100/min
Respiration	Absent	Weak	Good
Muscle tone	Flaccid	Some	Good
Reflexes	No response	Grimace	Good
Color	Pale/Blue	Blue extremities	Pink

Understanding the correct distribution and presumed causes of death, in settings with the highest burden, is critical before effective preventative strategies can be implemented. Many of the intrapartum-related deaths and the huge burden of ill-health are thought preventable with appropriate low-tech interventions, and simple learning programs. High-tech, hospital-based, specialist–driven neonatal care should not be required to meet much of the present challenge. Contrary, it is necessary to definite appropriate low-tech interventions, and learning programs that can be implemented with high coverage and quality in urban and community settings where most of the deliveries take place.

2.6 Fetal Heart Rate Assessment and Intrapartum-Related Hypoxia

Clearly efforts to meet Sustainable Development Goal (SDG) 2 by 2015 focused on reducing perinatal deaths, in particular deaths occurring at the day of birth. The most important aspect is the primary prevention of any insult that will have likely impact on the intrapartum adverse result. Health workers ability to detect fetus at risk of developing hypoxia during labour process is significant and critical catalyst for subsequent intervention to reduce deaths and improve child health in low income countries.

The actions taken to detect hypoxia during labour process will result in improvement of the outcome of the mother as well. Date from developed high income countries indicated that fetal monitoring emergency obstetric care and targeted intervention led to significant reduction of perinatal deaths.(28) The gold standard recommended for the monitoring the fetal heart rate of the fetus is the Continuous electronic Fetal Heart monitoring that can easily identify fetus with high risk and this

is commonly used in the developed countries.(29), (30) However, these devices are neither available nor visible in low income countries where the burden of perinatal death is highest.(31)

The use of Fetal heart monitoring combined with the fetal acoustic stethoscope is the most used mean of monitoring fetal heart in low income countries. Although frequently used, there is no evidence on the efficacy and reliability of the instrument is not tested on detecting fetus with high risk during intrapartum period and virtually nonexistent.(32), (33) it was reported that only one randomized control trial study to determine the effectiveness of different fetal heart monitoring in low resourced country. The result showed out that the use Pinard's stethoscope was related to poor of perinatal outcome compared to the use of continuous Cardiotocography (CTG) or intermittent hand held Doppler ultrasound monitoring.(34)

In a recent series on stillbirths the presence of skilled care at birth linked with emergency obstetric care was identified as two major components to reduce the number of stillbirths. Interestingly, the necessity or importance of FHR monitoring to detect the babies at highest risk for either intrapartum stillbirths or intrapartum-related neonatal death was not addressed.(35), (36)additionally, there are several studies indicating that only a small proportion of birth attendants use the partograph effectively, and even fewer monitor the FHR adequately.(37), (38)

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2.7 Neonatal Mortality

Neonatal mortality is defined as death before one month of age and recent global estimates range from 2.9 to 3.6 million deaths per year. (9). Of these, 50-70 percent occurs within the first day of life.,(39) The presumed causes of neonatal deaths have remained unchanged over the past decade and include infections (~ 30%), preterm birth (~ 30%), and birth asphyxia (~ 25%).(40), However, uncertainty surrounds these estimates due to an almost complete lack of reliable vital registration systems from settings where mortality is highest.(41)Thus analyses are based on retrospective household surveys, and most cause specific data rely on verbal autopsy without consistent definitions and algorithms. Intrapartum-related deaths within the first 24 hours are likely under-reported or misclassified as stillbirths. (13)Nevertheless, early

neonatal mortality, especially within the first day of life, is thought to contribute substantially to the overall neonatal mortality rates.(54)

2.7.1Neonatal Mortality on the Day of Birth

Asphyxia is defined as the state in which either placental or pulmonary gas exchange are compromised or absent. Asphyxia is often associated with end-organ ischemia (i.e. decreased or cessation of blood flow). Infants affected by birth asphyxia have an altered respiratory pattern at birth. The infant's initial response is a rapid respiratory rate; however, with continued asphyxia (either in utero or at birth) the infant develops primary apnea. Infants with primary apnea will often begin breathing in response to tactile stimulation. However, if the insult is not resolved expediently, the infant begins to gasp irregularly. If the asphyxia persists the frequency of the gasps slows and the infant proceeds to secondary apnea. Secondary apnea is more difficult to treat – the infant will not respond to tactile or noxious stimulation – and some form of positive pressure ventilation is required to rescue the infant. Longer durations of fetal distress or asphyxia, result in longer delays in spontaneous respirations. If prolonged or unmitigated, asphyxia at the time of birth may result in hypoxic ischemic encephalopathy, death and/or survival with disability. Historically birth asphyxia has been estimate to account for 25% of neonatal morality. These estimates are imprecise, and likely under estimate the magnitude of the problem, given challenges with recording births and deaths in the developing world. Evaluation report from Tanzania indicated that 60% of the neonatal death was due to asphyxia which occurs within the first 24 hours of life.(42)

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Although intrapartum risk assessments to identify high-risk deliveries and prompt rapid sequence triage to more advanced care settings are recommended, the reality in the developing world is that these options are limited. The quality of the roads, limited transportation options (i.e., bicycle ambulance), and the distance to more advanced care settings often make this triage impossible or lead to prolonged delays in seeking or receiving care. (13) A report conducted in Nigeria focused on material resources in the developing world context, revealed that 60% of the primary health facilities and 50% of the secondary facilities did not have a functioning ambulance and were, therefore, unable to refer and transfer newborns from primary care to secondary

care. Any facilities did not have a functioning communication at their facility. Healthcare workers reported using their personal funds and cell phones in order to organize care within facilities and to refer patients for increased levels of care outside of the facility.(43)

2.8. Basic Neonatal Resuscitation

Each year approximately 136 million babies are born globally. It is estimated that about ninety percent make the transition from intrauterine to extra-uterine life without any intervention.,(44),(45) This successful transition depends on several factors (e.g. the health of the mother, the pregnancy, and the labour process), and healthy fetuses are likely to tolerate some intrapartum hypoxia remarkably well. However, with severe or sustained lack of oxygen during labour progression to hypoxic-ischemic injury will occur and a non-breathing baby is born.

Approximately, ten percent or 13.6 million newborns are delivered with absent or poor respiratory effort and need some degree of support to achieve cardiopulmonary stability. It is estimated that between three to six percent need assisted positive pressure ventilation and less than one percent require advanced resuscitation including intubation, chest compressions, and medications(59) However, these estimates are based on five reports,(46), and none of which reflect Sub-Sahara Africa where the burden of perinatal deaths and morbidity is considered to be highest. Therefore, recently published global estimates on immediate postpartum neonatal needs and interventions are uncertain due to a paucity of data from low-and middle-income countries and almost a complete lack of reliable data from rural community-based settings(46),.

2.9 The History and Evolution of the Neonatal Resuscitation Program

In the developed countries like United States of America, Neonatal Resuscitations (NRP) is taught using the trainer model universally standard care accepted for the neonatal resuscitation since its initial development by the American Academy of Pediatrics (AAP) and the American Heart Association (AHA) in 1987.(47) This course which was standard and optimize to hospital resuscitation is mainly taught to nurses, physicians, trainee and other inter-disciplinary health care workers.

Successful completion of the training by the health workers after taking written test, performance checklist and mega code scenarios attract certification. After the initial training, a mandatory two years recertification is required for all those trained but this is not based on any evidence of practice.

Since the beginning, NRP has been widely adopted and implemented across United States of America. Estimate indicate that about 26,000 newborn resuscitation instructors and over four million certified health care workers comprising of 80% of the nurses were available in US alone.(47) Attitude and resource changes were demonstrated after NPRTM training programs.(48) There was an urgent need for health care providers with knowledge and skills of newborn resuscitation both in community and health facility. The high demand for NRP was created due to the expansion of the perinatal care unit and centers. However, due to the clinical urgencies for the resuscitation program, little or no comprehensive prospective evaluation was conducted to assess the impact of the educational program on knowledge and skills of before and after training and dissemination of NRP as with many educational endeavors, competency is an elusive concept. The NRP™ course materials contain the following disclaimer:

"Completion of the program does not imply that an individual has the competence to perform neonatal resuscitation. Each hospital is responsible for determining the level of competence and qualifications required for someone to assume clinical responsibility for neonatal resuscitation.[66] According to study, NRP involves development, and validation of a checklist to assess newborn resuscitation mega codes skill which was tested and currently integrated into NRPM updates(49). Besides, there were challenges and difficulties of establishing initial competencies from the resuscitation training program such as NRPTM, and up to date not so much is known about the stability of newborn resuscitation knowledge and skills over time. Even the bi- annual recertification of the skilled health workers was found to provide less ground. Report provided highlighted some of the limitation and lack of evidences for the stability/durability of resuscitation skills that exist. Most of the studies cited were carried out for past 20 years which might fail to reflect the actual complexity surrounding the current practice(50).

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Over the past 20 years, after the wide national dissemination of the NRPM, guidelines were developed based on the accepted practices and expat opinions to an increasingly sophisticated focus on integrating of the evolving sciences of newborn resuscitation and more theoretical science based education. More paradigm shift in training of the health workers on neonatal resuscitations was observed when human factors and simulation was introduced in newborn training program.(51), (52)there has been small number of focused evaluation on the impact of NRP training supported by NRP research award program that supported basic clinical educational and epidemiological studies to larger areas of newborn resuscitations.

The curriculum use in the United States become wide spread and later was translated into more than twenty four languages which was disseminated international in more than 130 low and high income countries with an estimated 500,000 health care providers trained globally.(53)While there was wider dissemination globally, again the urgent needs for the newborn resuscitations in the low income countries culminated into the generalization of the program curriculum to the developing countries without robust testing of the educational, clinical outcome and its cost effectiveness. There was also belief that the adaptations of American and European resuscitations council programs such as the American Heart Association cardiopulmonary Resuscitation program have hinder the development of model specific for their context for their training programs.

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Furthermore, the costs associated with royalties for AHA and European Resuscitation Council accreditation, teaching materials, and copyright represent a tremendous proportional cost for many of the countries that need it most. These disincentives serve to further limit access to uniform, high-quality training in developing countries; the net result may be a small, elite group of health professionals who can pay for such courses and many in the frontlines of care who cannot.(54) Such disincentives could also preclude nurses, who are the largest cadre of frontline healthcare providers, from being trained in the numbers needed. Additionally, these costs represent ongoing barriers to sustainability of the resuscitation programs over time.

The evolution of NRPTM has focused on building and integrating the science behind the clinical recommendations. The methodology behind the reviews of the

evidence is now a transparent process with a consistent level of evidence model.(55) It is important to note that the AAP, AHA, and the 1997 creation of the International Liaison Committee on Resuscitation (ILCOR) have also led efforts to infuse evidence into the design and delivery of the structured curriculum. Also, efforts have been made to design courses that more simply and effectively translate this science of resuscitation into clinical practice. In concert with the Utstein Symposium recommendations, the NRP™ curriculum continues to evolve, and the 2010 guidelines have placed increased emphasis on the use of simulation and imbedded, active, adult learning in efforts to enhance the effectiveness of the program.

2.10 Consensus on Neonatal Resuscitation Science

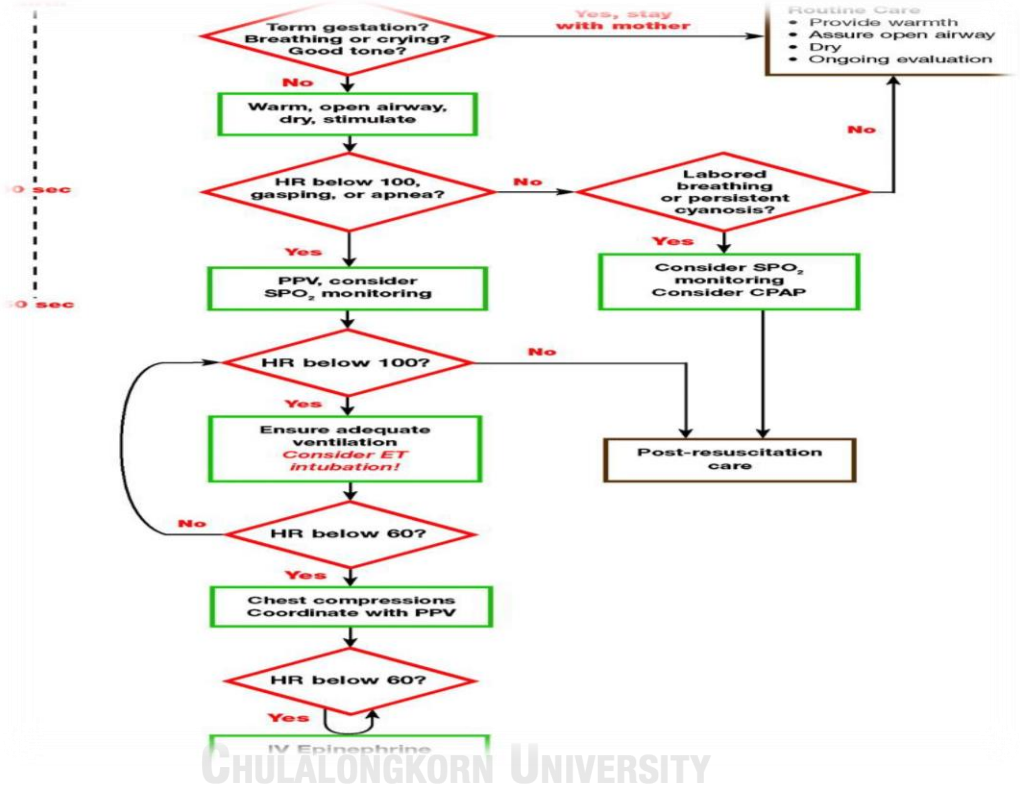
The International Liaison Committee on Resuscitation (ILCOR) is committed to develop and publish consensus on resuscitation science every five years. The most recent Consensus on Science and Treatment Recommendations (CoSTR) statement was published in 2010(56), (57) The CoSTR document is used as a basis for developing specific resuscitation guidelines appropriate for implementation in respective countries. Current CoSTR Neonatal Resuscitation Guideline suggests about 30–60 seconds of time following delivery should be allocated to assess spontaneous respiratory and heart activity before initiating intermittent positive-pressure ventilation if indicated. (Figure 1). Failure to initiate spontaneous respirations at birth in most cases is believed to be secondary to intrapartum hypoxia and the state of primary apnea (heart rate > 60 beats/minute with compensated blood pressure) (58) These infants invariably respond fairly promptly to early interventions like drying, stimulation, clearing the airways as indicated, as well as face mask ventilation (FMV) applied within the first minute (Figure 2).

Delaying basic resuscitation in apneic infants is thought to result in a progressive decrease in heart rate and blood pressure (secondary apnea) and eventual death and/or brain injury in those who start gasping and/or breathing. If a baby is born in the state of secondary apnea or if it evolves after birth, it is more difficult to resuscitate and restore cardio-respiratory status (severe birth asphyxia).

These assumptions are based on the experimental cardio-respiratory responses described in asphyxiated newborn monkeys(76). Scientific evidence from human

beings is almost non-existing. The guidelines for resuscitation of newborns are based on limited research with few cases with several knowledge gaps(59) Therefore, defining the transitional changes at birth in the newborn is critical towards a better understanding of the problem of intrapartum-related hypoxia and the importance of basic interventions in the first minutes after birth.(60)

Figure 1: Pathway to understanding Birth Asphyxia



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2.11 The "Helping Babies Breathe" Training Program

Helping Babies Breathe (HBB) is an evidence-based curriculum in basic neonatal care and resuscitation for use in resource limited areas.(79) It is developed by the Global Implementation Task Force of the American Academy of Pediatrics in response to the need for an evidence-based, appropriate, and feasible training program in neonatal resuscitation to meet the challenges of MDG 4.(18) The scientific basis is the neonatal evidence evaluation of ILCOR.

The simulation-based educational program was developed to train large numbers of health workers who attends to birth of newborn babies in low-income

countries using a cascade model. The objective of the helping the baby breathe is “to ensure that all babies are born with a skilled birth attendant present and in the HBB a skilled birth attendant is a person who has the knowledge, skills, and competency to care for a newborn baby. The global curriculum is designed to be used by birth attendants who are responsible for the care of both the woman and the newborn infant at delivery, and who may not have assistance from a second trained helper. HBB is an intervention tool to ensure immediate assessment of the baby, temperature support, stimulation to breathe, and assisted ventilation as needed, all within "The Golden Minute®" after birth. These basic tenets of newborn resuscitation coupled with appropriate available equipment should reduce Fresh Still Birth rates, neonatal mortality, and improve intact survival.

The educational kit includes an action plan, a culturally adopted flip-over facilitator guide, and a student workbook. The HBB plus course material is largely pictorial with simple text. Though aimed at midwives, the curriculum can also be adapted for community health workers and even traditional birth attendants with limited literacy. The Action Plan is a pictorial guide with very few words to the evaluations, decisions, and actions that should be taken to help every baby. Different colors are allotted for different level of care and action and also the colors signify the level of care that is green for Routine Care needed by all babies. Yellow signifies the key concept of "The Golden Minute®" – the first minute after birth, when prompt action to stimulate breathing or begin ventilation is thought vital to prevent deaths and disability. Finally, the red zone indicates the need for more prolonged or advanced resuscitation. Supplemental oxygen, intubation, chest compressions, and medications do not enter the algorithm – these interventions or actions are not relevant in most resource-limited settings.

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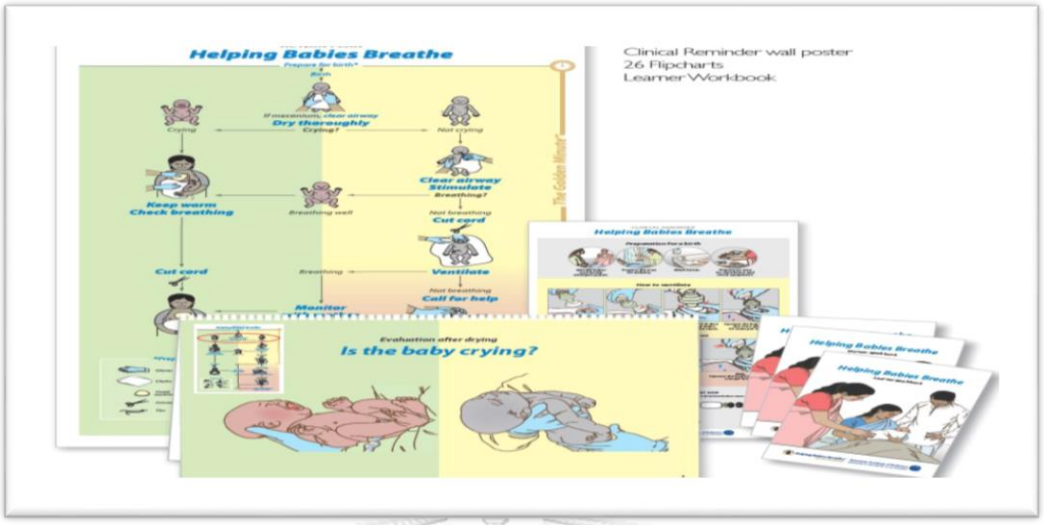
Figure 2: Helping Babies Breathe Course Material



The helping Babies Breathe program was augmented by Laerdal Medical who developed a low-tech, low-cost neonatal simulator (NeoNatalie), for low resource areas(developing countries) and an affordable manual resuscitator and a bulb suction (that can be easily cleaned for reuse) to meet the training and clinical equipment needs. The advantage of neonatal enables the instructor to simulate the presence or absence of crying, breathing, and pulse by squeezing bulbs. No electricity or computers are needed. The mannequin is shipped collapsed, but filled with 2.5 liters of warm water it provide realistic weight, temperature, and tone that mimics a lifeless baby.

Skills training and simulations using the simulator is the foundation of the course. During training, all the way through participants work in pairs or teams using the simulator - together to help one another learn the skills and recognizing that they learn best when they are teaching. “The Golden Minute®" highlights the importance of immediate action and every participant has to practice and simulate until he/she masters every scenario in the course. The HBB material and equipment is expected to be left behind after a course. The majority of birth attendants do not manage non-breathing babies frequently. Therefore, it is believed that they need to re-train regularly using the simulator and the student workbook to retain knowledge, skills, and competency, although, studies on transfer of performance from a simulated setting to a similar clinical situation are almost non-existing.

2.12 Preparation of trained health workers for Basic Newborn Resuscitation

Use of intrapartum to assess the newborn risk alone do not reliably predict which infants will require newborn resuscitation, and options to refer mothers to a higher level of care are limited, all delivery personnel must be ready to provide resuscitation at every birth, irrespective of the site at which the birth takes place (19).Every newborn requires care immediately after birth to assess their health and wellbeing. It was estimated that somewhere between three to five percent of all births, approximately ten million infants yearly, do not breathe spontaneously and will require some form of breathing assistance at the time of birth(19). Infants with perinatal depression and birth asphyxia may be born with poor respiratory effort and have a sometimes imperceptible, slow, or absent heart rate.

When initiated promptly in the first minute of life, simple measures, including careful drying to limit evaporative heat loss, warming the infant using skin-to-skin maternal care and/or other measures to preserve body heat, as well as opening and clearing of the airway and breathing passages, are often all that are required to effectively resuscitate most infants(61). A group of infants, estimated to include another three to six percent of births, approximately six million infants born globally annually may require more aggressive assistance at birth, often in the form of artificial respiration, which must be provided until spontaneous breathing is well established by the infant[19]. While training of health workers on Helping Babies Breathe, the process and steps and the frequency of newborn resuscitation support required by the newborn infant is always highlighted with importance. Additionally, the basic training and practice, health workers are expected to provide artificial respiration using simple self-inflating bag and resuscitation mask devices. In high income countries, a usually high dose as high as 100% concentrated oxygen is provided. However, evidence shown from the review of Cochrane meta-analysis alluded to the fact that bag mask ventilation of room air is safer, highly effective, and may in fact be preferable to the use of highly concentrated inspired oxygen.(62)

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2.13: Gaps in the Skill Level of "Skilled Health workers who attend delivery in the Hospital and community in developing countries

There is clear difference that exists in the education and the skilled level of the health workers (Skilled Birth Attendants) (63). Study conducted on the level of HBB knowledge and skills found out that the literacy level among the skilled birth attendant was very low estimated at <50% while 80% of the skilled birth attendants were found to have one month or less formal training. This was reported to be compounded by the lack of basic equipment such as blood pressure measuring machine, stethoscopes, infant bag and manual resuscitators.

Further study conducted in Zambia by the midwifery team found out that traditional birth attendants (TBAs) who were culturally better placed to advise women pertaining to child birth practice lacked knowledge about birth related complications. The qualitative study indicated that the TBAs rely much on traditional beliefs and witchcrafts to explain complications and sometimes placed their blamed on infidelity as the cause for the poor maternal and newborn outcome or complications. On the knowledge of the newborn resuscitation and essential newborn care, the study found out that TBAs do not recalled or failed to describe clearing of airway, skin to skin care as mechanism of temperature regulation or early breastfeeding(64).

A National Service Provision Assessment, which included estimates of newborn resuscitation capacity in six African countries, revealed that even when births occur in health facilities only 2 to 12% of personnel conducting these births had been trained in neonatal resuscitation techniques. The availability of basic equipment for newborn resuscitation was also inconsistent. Of the facilities surveyed, only 8 to 22% of facilities reported that they had equipment to provide newborn respiratory support. (19). A recent cross sectional survey of 124 birth centers in Africa and Asia evaluated access to the "WHO child-birth related essential technologies," critical equipment that supports birth and infant resuscitation. The survey revealed significant gaps in access to basic equipment for newborn resuscitation (BMV devices and warming devices) with wide variations in access to critical equipment that were most notable in small centers with < 100 deliveries per year.(65)

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There is report of variation of number and availability of trained skilled birth attendant or health workers in regions even in the developed high income countries of the world. Data obtained from the rural United States of America (USA) demonstrated suboptimal and inconsistent skill in the newborn resuscitations at birth(66), (67).However, there was report that there was increase in the newborn mortality rate among the Inuit population in Canada(68). Therefore the gap observed in the newborn resuscitation and the need for the availability of health workers with simple resuscitation skills, knowledge and having basic equipment's at the place of birth is most urgent in the developing countries with low resources.(69) Despite developing the best practices of newborn resuscitation for low income and developing countries, there guidelines and the protocols have not yet systematically been disseminated or adopted to many countries in the developing countries or low resources setting. Further evidence suggest that simple, inexpensive but highly effective resuscitation measures could be provided in the many birthing places including home and facility deliveries(76)

2.14: Impact of Delayed or Suboptimal Resuscitation of newborn babies

Delays in initiating newborn resuscitation or suboptimal resuscitation may result in death. Besides, a proportion of newborn infants who are compromised and survive birth asphyxia will suffer from the long-term impact of hypoxic ischemic encephalopathy, which may result in development of complications such as cerebral palsy, learning disabilities, cognitive disabilities and ongoing seizure disorders. Potentially preventable morbidities affect over one million children globally. Of those infants who suffered serious intrapartum events and survive beyond one year of age, 18% will have a major disability.(35).

In low-resource settings, newborns who initially survive birth asphyxia have high mortality rates in the first year of life; 45% will die by one year of age. The actual prevalence of birth-related disabilities world-wide is unknown; however, in Katmandu, Nepal, a representative developing setting, the estimated prevalence of neurological impairment attributable to birth asphyxia was measured at 1 per 1000 live births.(70)

The 2004 Global Burden of Disease assessment estimated 41,683,855 disability-adjusted life years due to birth asphyxia. (35) Resuscitation training is a very cost-effective strategy with direct costs of approximately US $208 per life saved and

approximately US $5.24 per disability-adjusted life year. This cost indicates that neonatal resuscitation is among the most cost-effective perinatal care strategies available, and among the most cost-effective of all child health interventions.(71).

2.15: Invisible Mortality: An Evolving Understanding of Stillbirths

Newborn babies are clearly at risk of deaths in the early perinatal period. The most unfortunate part on the newborn is that their birth are not officially documented or certificated in most part of the developing countries. Non documentation of the infant birth that died will be problematic to know. Lack of accurate account for the live birth and death of the newborn infant and the contributing factors for all the neonatal deaths are extremely difficult discern. (17).

However, newborn mortality rate even accurately reported failed to tell the whole true story. Some of the newborn deaths remained invisible in the traditional reports of the death statistics because newborn do not survive labor or sometimes they are severely depressed at birth that they are misclassified as still birth or more specifically fresh still births" in defining stills birth, it is a baby more than 1000gram born with no signs of life after 12week of gestation or pregnancy or after 28 weeks of gestations. (17). Recent data suggest that about 3.9 million still births occurs globally with the highest rate almost 98% in the low income and developing countries.(72) Of the reported 3.9 million still births that occur yearly, an estimated 1.2 million happened during the intrapartum period. This is in addition to the 904, 000 staggering number of newborn deaths that has been reported.

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Where a baby is born matters, as illustrated by intrapartum-related neonatal mortality rates that are 25-fold higher in the lowest income countries stillbirth rates that are up to 50-fold higher than in higher resource settings. (17). Despite the magnitude of the burden of stillbirths in the developing world, until recently these deaths have been largely invisible in global health indicator reports. There is a clear mismatch between the mortality burden, and evolving international policies and programmatic responses. The stillbirth data further amplify the challenges in providing newborn resuscitation. It is postulated that many births that are misclassified as "stillbirths" may actually be full-term infants, who are suffering from perinatal depression, many of whom would likely respond to simple resuscitation measures initiated in the first minute or minutes of life.

2.16. Structured Educational Curriculum of Helping Babies Breathe Designed for Low Resource Settings

In response to the urgent need for effective newborn resuscitation, irrespective of the site of birth, a new evidence-based neonatal resuscitation curriculum for use in low resources settings, titled Helping Babies Breathe (HBB plus, has been developed. (79) This skills-based curriculum is the concerted work of a team of neonatal and perinatal experts, which was undertaken as an initiative of the American Academy of Pediatrics with input from the World Health Organization and developed in association with a number of key partners. The work was partially funded by Laerdal Foundation for Acute Medicine, Stavanger, Norway. The Latter-Day Saints Charities, Salt Lake City, Utah provided support for evaluation of the program materials. Implementation and evaluation of the curriculum was also supported by the US Agency for International Development (USAID).

The HBB program represents a unique collaboration between clinicians from the United States and the developing world. The training reemphasizes the importance of the presence of a skilled birth attendant at birth. In addition, the HBB training provides a structured training curriculum that integrates the International Liaison Committee on Resuscitation (ILCOR) evidence-based neonatal resuscitation strategies that have been pragmatically adapted for use in low-resource settings.

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The emphasis of HBB is on the early recognition of newborns in distress. This is followed by the prompt initiation of simple but effective low-technology resuscitation efforts that can be initiated in the first minute of life, regardless of the birth setting. The focus of the interventions, aptly titled “The Golden Minute,” is a carefully structured care sequence that can be taught to and provided by a wide range of skilled birth attendants wherever babies are born.

The Helping Babies Breath® Resuscitation Program(79) includes a scripted structured curriculum, standardized educational materials, and low technology resuscitation training simulator. The program uses low technology educational tools and visuals including a flip chart, a handheld pocket-sized resource manual, along with culturally sensitive flowcharts as structured teaching aides and a consistent script for the trainers. The educational model uses the train-the-trainer methodology, with a

combination of didactic teaching, and an emphasis on small group learning facilitated by a master trainer who works with two to three trainee learning dyads.

Psychomotor and clinical decision-making skills are evaluated using both baselines and post-tests to identify knowledge and practice gaps and to quantify and reinforce learning. The testing uses a plastic inflatable mannequin, NeoNatalie.(12) that is the size and shape of a newly born infant and serves as an effective low-technology simulator. NeoNatalie can be filled with warm water, emulating the average birth-weight in the developing world (2 kilograms) a dimension that further enhances the fidelity of the simulations. The tactile dimension and fidelity of the simulation are enhanced by the doll's inherent laxity; this replicates the "feel" of an infant with significant hypotonia from perinatal birth depression.

This structured educational curriculum and unique educational modality has an emphasis on the following: dyad peer-to-peer teaching and learning, expert faculty facilitation with a six to one faculty to student ratio, ongoing practice and return demonstrations, and integration of both formative and summative objective structured clinical evaluations / examinations (OSCEs). The HBB plus program was developed primarily by expert consensus by members of the Global Implementation Task Force of the AAP. Content validity testing included two rounds of review by a panel with expertise in global health and neonatal resuscitation, using the Delphi technique. An additional review was conducted by a regional technical expert at the World Health Organization (23)

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The HBB plus program underwent preliminary field testing in low resource settings in Bangladesh, India, Kenya, Pakistan, and Tanzania, during which participants demonstrated, improved skill acquisition on specific critical resuscitation competencies. The first published formative evaluation of the HBB plus program published in the peer reviewed literature focused on the development and formative evaluation. It was conducted independently at two international field-testing sites (Kenya and Pakistan) with learners who had not been formally trained in neonatal resuscitation at baseline. (23)

The "dose" of the field-testing educational intervention included 1.5 days (10 hours) in training, with 6 hours of instruction and 4 hours spent on baseline and post-test evaluations. The evaluation team focused on a 7-stage hierarchal evaluation model

including: participant numbers, satisfaction, learning, competence and performance. Secondarily, evaluation on whether participants achieved acceptable levels of knowledge and/or performance of skills. It was noted that higher levels of evidence for the efficacy of such training might include patient and community health outcomes, which were not performed in the initial assessments.

The research team evaluated facilitator and learner perceptions of the course structure and learning materials using a five point Likert scale and structured focus groups. The empiric evaluation of the utility and performance of the assessment tools (HBB plus Knowledge Multiple Choice Question Test and the HBB plus BMV Checklist) were not well described in this publication. Results from a study suggested that even after the intensive training the majority of participants still did not demonstrate mastery of bag and mask ventilation(23). The study noted that achievement of competence for HBB can be challenging and imperatively none of the participant demonstrated any signs of competence from the training, however, it was noted that there was high level of satisfaction, efficacy, and gins in knowledge and skills.

The main challenges observed from the training was the difficulty of achieving mystery skills and integrating the skills to the case management could not be achievable during the classroom but continuous teaching and additional practice, continued learning and mentoring at workplace will help to improve the skill and knowledge of the participants.

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Modification was made to the HBB training curriculum after international field testing before making the program available in 2010. Based on the modifications, two complementary curriculums were developed. One of this was the helping the babies survive which mainly focused on the essential newborn health care beyond the first hour of life and helping the mother survive which is concern with the reducing maternal mortality.

2.17. Considerations in the Scale-Up and Dissemination of Helping Babies Breathe in low resourced countries

Tanzania was one of the countries in Africa where country wide implementation of helping babies breathe was supported. The total population of forty two million

people, with 1.4 million births yearly and the rate of newborn death were estimated at 32 per 1000 live births. 50% of the newborn deaths occur around the time of birth which is less or within 24 hours which 75% in the first week of life. In Tanzania 30% of this newborn mortality were attributed to birth asphyxia. It was acknowledged that despite the effort to meet the MDG 4, the rate of newborn and infant mortality remained stagnated in the region. In 2009, ministry of health adopted holistic strategy with goal of training trainers and service providers with set time line which included a research arm.

This was implemented in the four hospitals with date and information collected and relayed to the central team. The implementation was scaled up aimed at reducing newborn mortality by 50% by the end of 2015.(73) . Report from the scaled up implementation showed significant improvement in the competency and performance of the skilled health workers. The study and wide implementation used videotaped and independently rated assessments evaluation of the training program on helping Babies breathe. During the study implementation, the number and percentage of care givers who passed the simulated scenarios increased drastically to 74% from 41%. Although, the simulated performance improved, it persisted for at least seven months. However, the use of resuscitation skills did not lead to improvement of the real practice world of the clinical practice of resuscitations. This in particular to the number of newborns being suctioned and/or ventilated at birth did not change and the use of simulation in the delivery room decrease after the training on HBB.(74)

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As part of the second study, an evaluation was conducted on national dissemination of HBB in Tanzania that involved systematic training for health workers from major referral, regional and district hospitals. However, the study did not examine the outcome of training and implementation but instead focused main stream indicators such as fresh still births and early neonates within the first 24 hours of life. The study reported significant reduction in the newborn mortality.(73)

Away from Tanzania, a third study on the structured educational helping Babies breathe using before and after evaluation to test the effectiveness of training to improve health workers knowledge and skills aimed on how it impact on newborn mortality in India.(75) The study evaluated the impact of training through conducting, pre and post written evaluation of the trainee knowledge, post training skills assessment and

performance, still birth rates, pre discharges mortality, and neonatal death rates before and after Helping Babies Breathe Training was assessed. The study was confounded by grouping first time HBB plus trainees, with those who were receiving a "refresher course." The content, dose, and duration of the refresher course were not clear from the published report. Knowledge scores, as measured by the HBB plus MCQ, had a 46% pass rate on the baseline and 88.6% pass rate on the post-test for those being trained for the first time; HBB plus MCQ scores began at 69% and increased to 90.4% for those in the refresher course. Unfortunately, no baseline measures of BMV skills or competency were obtained in this study. The post-test level of BMV competency was 58% for first-time attendees and 68% for those attending the refresher course, suggesting ongoing low rates of competency of this skill despite two educational interventions.

Similarly, when HBB® trained providers were observed in clinical practice, actual resuscitation rates went down (similar to the reports from Tanzania) with a mean of 28% of infants receiving resuscitation in the pre-training period versus 11.9% in the post-training period). Actual use of BMV remained low. The report postulated that the emphasis on drying and vigorous stimulation may have decreased the actual need for BMV in infants this cohort, although this was speculative as drying efforts were not tracked in the study. When BMV was required, it was primarily provided by physicians; nurses and midwives only initiated BMV in 3% of the baseline cases and 7.5% of the posttest cases. This is an intriguing finding, given the fact that physicians do not attend most births in the developing world. (97).

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2.18 Systematic Reviews of Helping Babies Breathe Training Programs

In reviewing international educational structuring programs, a clear guidance must be followed. This has been published in the recent reviews of literature which is related to helping the Babies Breathe. Cochrane systematic review that examined the effect of in-service training of skilled birth attendants to improve care of sick newborns in low income setting in developing and developed countries. The systematic review found limited effect of training of the skilled birth attendant in reducing newborn mortality. The review also found out that the review was limited in the focus with two Randomized Controlled Trial (RCT) was published before the review that met the

rigorous inclusion criteria. However, during the review, it was found that the recent Randomized Controlled Trail was not included.(76)

The second systematic review, conducted was not restricted to RCTs only but had broader overall patient inclusion criteria including studies in adults (primarily focused on trauma triage training), studies in pediatric patients, as well as some studies dealing with the population of interest – newborns(89). The aim of the systematic review was to evaluate the published evidence on the impact of non-specific, resuscitation training programs on the short-term outcomes of cognitive knowledge, psychomotor skills, self-efficacy, and simulated team behavior. The review also attempted to examine the more difficult to assess outcomes including operational performance, clinical patient outcomes, cost-effectiveness and sustainability. The systematic review cited 44 relevant papers, of which 38 empiric studies met their inclusion criteria and are included in their review.

Fifteen of the cited papers measured Outcome variables of self-efficacy and eight of the papers reviewed or cited were on student satisfaction which consistently reported improvement; notably, high self-efficacy was inversely related to performance at six months. However, the studies included in the systematic review were found to be fraught with inconsistent, inadequate, and with untested methods to test both educational outcomes as well as measure relevant patient outcomes. The evaluation of psychomotor skills, such as bag-mask ventilation – a skill critical to newborn resuscitation – was particularly weak across all of the studies. Inconsistent reporting of baseline skills and failure to use validated scoring systems were prevalent in the studies included in this systematic review specifically, and in the literature at large.

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Additionally, the weakness of the systematic were found not to have included studies examining the acquisition of psychomotor skills, nor did they test whether the classroom-skill acquisition translated into performance in a real-world setting(89). More importantly, the question of whether or not resuscitation and/or other educational programs make a difference on patient mortality and/or morbidity was incompletely answered in the studies reviewed. Although the review did attempt to include studies evaluating team training, these studies were conducted in the trauma or adult settings. In the final analysis, although the goal was to evaluate the cost-effectiveness of

resuscitation training, none of the 38 studies evaluated was designed to measure the true value proposition, that is, costs per lives saved, of the training interventions.

Both systematic reviews were silent on important issues related to the stability and/or retention of knowledge and skills over time; this clearly reflects the paucity of literature in this area. Both reviews focused heavily on training of healthcare providers; notably absent were studies that evaluated the impact of community-based, educational interventions on neonatal mortality and morbidity. Furthermore, neither systematic review comprehensively addressed the impact of combined interventions (i.e., impact of both the Essentials of Newborn Care and NRPTM training program). In summary, despite the fact that two systematic reviews have recently been published, notable gaps exist in the literature. An additional Cochrane Review, titled "Formal resuscitation training courses for reducing mortality and morbidity in newborn infants," is at the protocol stage, and when published should provide additional information on both the acquisition and retention of knowledge and skills.

The most recent, relevant systematic review published in December 2010, focused primarily on community-based intervention packages, combining and integrating antepartum, intrapartum, and postnatal educational and care packages into the existing healthcare system in an attempt to improve perinatal health in the developing world(29). This paper analyzed ten, large-scale, controlled studies conducted in rural, developing settings. These studies included rural sites in Bangladesh, Pakistan and Southeast Asia; notably absent are similar trials in urban settings or on the continent of Africa. Although some overlap exists, many of the studies included in the review were published after the systematic reviews. The review of the community based intervention on the helping babies breathe will be presented separately in the literature review(22). (89).

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2.19 Teaching Resuscitation in Low-Resource International Settings

The problem in the real world of the neonatal resuscitation training program is the failure to understand the level of educational training in the primary health care givers for the mother and their newborn babies. Most of these care givers are the nurses and understanding their roles in the society and their position in the health care system may lead to assumptions about the baseline level of knowledge and skill in particular

health care setting. Study conducted to assess the knowledge of the nurses in Bahrain showed that only 7% passed the general knowledge test although 75% described or indicated that they were confident or extremely confident to perform CPR. The study concluded that nurse's knowledge and ability to respond were concern as they had false impression and confidence regarding their competence to perform CPR(77).

A more real issues and challenges emerged when study was sanctioned to evaluate effectiveness of resuscitation and other training program adapted from the developed countries to low resource setting in the developing countries. In the rural setting of the low income countries, care givers shared the challenges of preparing for low volume and infrequent event leading to newborn resuscitation or other cases. However, in the urban setting health care facilities or tertiary care settings, the need for the services overwhelmed the health care systems

The concern on the demand and the use of health system birth in rural and urban setting in the low resourced setting and response to the high neonatal resuscitations in the first twenty four hours of births, AAP developed and launched new program focused on newborn resuscitation titled helping the Babies Breathe (HBB). The preliminary testing of the new program has been conducted in some countries. However, considerable work remained to be conducted to established the effectiveness of the program and maximize the potential impact of the international imitative of reducing newborn mortality.(79)

2.20 Evaluations of Real-World Resuscitation Practices Compared to NRPTM Standards

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A newborn resuscitation application skill in the practical clinical practices was evaluated using prospective real time analysis using videotaped systematic assessment and scoring of resuscitations. The evaluation was conducted on the busy tertiary intensive care unit hospital and high risk birthing places in the United States of America where newborn resuscitation occurs frequently provided or leads by the certified NRPTM providers. The finding of the evaluation indicated that there was deviation from the standard NRPTM training guidelines with considerable percentage of 54 %.(78).The study further revealed that the more complicated the case was, the more deviations observed from the standard NRPTM guidelines and protocols indicating that translation of the training program into clinical practice can be challenging even in the

high income countries with well-placed equipment's and sufficient and proficient NRPTM trained health workers. Similarly report on the prospective systematic evaluation study conducted in various levels of health care by the regional team shows that there was clear differences between the NRPTM training guideline and protocols and the actual clinical practice.(79)

The study further found out that use of deliver room medication and chest compression were mostly employed by the certified health workers. The study also indicated that there was high rate of post resuscitation hyperthermia which was a concern. Maintaining normal body temperature is a basic concept that applies to every newly born infant, and thermal management skills are emphasized in the NRPTM curriculum. Based on the key finding from the evaluation, it was concluded that the premise that NRPTM certification, "does not assure competency, nor does it ensure compliance with established standards of care

A descriptive study using new developed scales of neonatal Resuscitations Index which was the measure of knowledge of critical element of NRPTM and Neonatal resuscitation experience to measure comfort with the recent performance of the trained health workers on neonatal resuscitation was conducted in thirty six hospitals in the Midwest United States.(79).The study evaluated physicians and nurses in the rural health care facilities who were responsible for newborn resuscitations in the delivery room or centers. The result showed that wide variations in the range of score on the knowledge related to frequent but highly high stakes event such as newborn resuscitations. In the study, there were attempt to evaluate the psychomotor skills and integrations or higher order of complex decision making skills.

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2.21: Effectiveness of Training Interventions Focused On Resuscitation And Care Of the Newborn Infant in Low-Resource Settings

2.21.1: Single-Intervention Studies: Essentials of Newborn Care

One of the evaluation conducted to determine the impact of low cost, evidence based training program of newborn resuscitation was pre and post intervention clinical audit technique(80). This involved ninety minutes teaching sessions for the hospital

nurses, physicians and the community based nurses on newborn practices at tertiary hospital in Tansepalpa District of Nepal. The pre and post intervention assessment was conducted using structured checklist for chart reviews which was done six weeks after training.

The knowledge acquisition by the health worker evaluation was done using multiple choice questions , and skill competences was tested using objective , structured , clinical evaluation(OSCE). In addition, a post – intervention evaluation of participant's satisfaction yielded high result with 80% of the participants rating the program as good, very good and excellent. Using Wilcoxon signed Ranked Test, using pre and post intervention test multiple choice tests showed improvement in all the groups of health workers. The finding from pre and post intervention evaluation found overall junior medical officers scored 87%, hospital nurses 65% and the community based nurses score 80%. The evaluation based on the chart review indicated high improvement (100%) in history taking, examination and measurements, administration of vitamin K increased from 24.5% to 95.8%. Hypoglycemia risk assessment also drastically increased to 95% while the measurement of at risk infants increased from 9% to 59% respectively.

However, it was reported that the short period of study did not allowed for testing of the stability of the knowledge and skills beyond the six weeks and also the sustainability of the intervention could not as well be evaluated. Although faced with limitations, the training program or interventions to a review of care practices in resourced limited setting represents a unique model to test knowledge translation into real-world clinical practice and performance

A second pre and post evaluation study was carried out to test the effect of structural training program interventions. During the study, a 15 module training program taken form World Health Organization (WHO) essentials of newborn was provided for the maternity care staff (nurses and medical officers) for four days. The impact of the four day training was examined after completion of the training interventions for newborn practices after discharge in two hospitals in north western province of Sri Lanka(76).Before the intervention, information was collected from 144 mother- newborn pairs who were later followed up, interviewed in the home 28 to 35 days postpartum.

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It was found out that maternal satisfaction improved tremendously from 56% to 92% and the opportunity for the mother to ask questions and clarify their doubts with the care increased from 47.9% before the intervention to 84.7% post interventions. Other improvement were observed in the unwanted cord care practices which was negatively increased, covering of the cord with nappy went from 31 down to 14%, while exclusive breastfeeding was maintained according to the study findings. Limitations of the study included the following: the failure to evaluate neonatal resuscitation practices or outcomes; the lack of a control group; and the large loss to follow-up, given that 35% of the sample could not be followed due to geographic constraints.

The same research team conducted a carefully designed, more comprehensive, multi-site study. This pre and post-intervention study with a control group was designed to evaluate the effect of the educational program (ENBC, provided over a four day training period, with 32 hours total training), administered to maternity ward healthcare providers (midwives, nurses, and doctors) and examined the impact on improving newborn care practices in inpatient hospital obstetrical units.

The study was conducted in the District of Puttalam in the North Western province of Sri Lanka from 2003 to 2004, a region where there are high newborn births per year. Five hospitals were randomly assigned to one of two groups. The hospitals were drawn using a stratified random sampling method proportionate to the number of deliveries in the hospital, and included 892 mother/newborn pairs (pre-intervention baseline data collected on mother-newborn pairs. Outcome measures included direct observation of care practices related to the Essential Newborn Care (ENBC) curriculum.

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Approximately 10% were selected for direct labor room observation pre- and post-intervention; structured maternal interviews were also conducted, and data were extracted from the chart regarding undesirable health events. Hand washing, a skill emphasized in the hygiene portion of ENBC, improved in the intervention group from 62.5% to 100% compared to the control (66.7% to 87.5%). Significant improvements were also noted in preparation for resuscitation: readiness of bag-mask equipment increased from 25% to 95.8%; emergency tray preparation increased from 20.8% to 87.5%; and newborn breathing assessments increased from 25% to 95.8%. The stability of this intervention was assessed, and found that four out of five practices remained

improved three months post-intervention. Undesirable events decreased from 32 to 21 per 223 newborns; however, this decrease was not statistically significant.

The study's ability to evaluate resuscitation practices was limited by the small numbers of infants who required active resuscitation; however, the authors were able to demonstrate improvements in preparation for resuscitation. The presence of an observer at delivery may have led to "best practice" rather than "usual practice." This study was also confined to low-risk newborns; therefore, more data are needed regarding the impact of ENBC on higher-risk scenarios.

Strengths of this study include an attempt to perform a formal power analysis; however, this was difficult as there were no other studies in similar settings on which to base the sample size. The research team estimated that care practices were happening approximately 50% of the time; in order to detect a 15% increase in care practices with a power of 90 and an alpha error of 0.05, it was estimated that 223 mother/infant pairs were needed. The fact that the educational intervention was based upon a baseline needs assessment survey with high priority given to self-identify high needs areas is an additional strength. Furthermore, there was a three-month lag between the educational intervention and measurement of the outcome variables and this design allowed the team to evaluate the stability of information and sustainability of the effort.

The study also employed the complementary use of direct observation and maternal interviews. A third research study, structured as a before and after intervention study, tested the WHO ENBC curriculum. It was delivered using a train-the-trainer model and measured differences in the knowledge and skills of 114 college educated nurse midwives employed in first-level delivery clinics in Lusaka and Ndola, Zambia.(82) Knowledge was tested using a 22-item MCQ examination and performance was evaluated using an 18-item, instructor observed, performance measure. The course participants were evaluated for written and performance). Knowledge scores improved for 78% of the participants, and performance scores improved for 81% of the participants; average improvements in the written scores were 12% and average improvements in performance were 29%. A small convenience sub-sample of the study was used to test the stability and durability of this knowledge six (6) months after the intervention. Strengths of the study included careful psychometric evaluation and factor analysis of the test questions, as well as the subscale development.

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Another evaluation conducted to compare the effectiveness of two training strategies, comparing group one given the conventional five day WHO ENBC training course and group two given the same course and manual(83). It was organized as a self-directed learning program over five weeks, in a cluster trial design, in Pernambuco, Brazil. Researchers used multiple regressions and two-way ANOVA to compare tests scores between tests and groups and found that knowledge improved with both teaching methods; however, they found essentially no difference between the two training strategies. Self-directed learning was estimated to be 20 to 25% less expensive.

It is important to note that unlike the previous studies of the WHO ENBC interventions, in this study, overall practice improved marginally between the two groups. Neither strategy brought about the expected improvements in the quality of care. This study must be interpreted in light of some notable limitations. The lack of random assignment to the cluster or group made it is impossible to discern whether the measured effects are hospital effect or intervention effects.

Although the intent was to enroll both nurses and physicians, only 14 to 22% of the trainees were nurses in each group. Because physicians in this healthcare system contract with multiple hospitals, and move among and between institutions, the study results may have been confounded by this crossover effect, Furthermore, testing was not conducted on all enrollees; and post-training testing was not done due to unspecified "administrative problems" at two of the research sites. Furthermore, it was postulated that "correspondence" or self-directed cooperative learning course, comprised of locally developed, perinatal educational manuals and cooperative learning led by a site coordinator(84). They then tested the cognitive knowledge of 114 midwives from primary, secondary, and tertiary settings situated in nine regions of South Africa who volunteered to participate in this study. This research demonstrated mean baseline and posttest cognitive knowledge scores related to maternal and newborn care improved significantly. The study did not attempt to measure psychomotor skills and/or what, if any, impact this increased knowledge had on patient outcomes over time. It does suggest the possibility that structured content can be taught locally in a disseminated learning model.

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2.21.2 Single Intervention Studies: Neonatal Resuscitation Program (NRPTM)

The impact of NRPTM training interventions on the knowledge and performance was conducted in Zambia[98]. The first training intervention was conducted for experienced college educated midwives who were in practice ranging from three to thirty years of practice. This college experienced midwives were working in the low risk clinics in Zambia and who previously trained in newborn resuscitations but were not exposed to the NRPTM training interventions. Training interventions was divided into phase one and phase two. The first training for the group was conducted by the core team of the study and the second phase training was conducted by train the trainer's midwives trained during the interventions. Three scales were used to detected any changes or outcome from the training interventions from baseline and post interventions. In the evaluation, knowledge assessment was based on the written NRPTM evaluation which was divided into sub scales related items.

Performance evaluation was based upon the 29 items in NRPTM lessons 1 to 4 relevant to low-resource settings and performance (judged by a trained, unmasked observer using a structured checklist); and self-efficacy was measured based upon a newly developed 14-item, 5-point Likert scale. These three items were measured with a baseline to measure baseline knowledge and two posttests; one conducted immediately after the initial training and another follow-up testing six months later. The internal consistency of all three evaluation scales was demonstrated using Cranach's alphas. Interestingly, the initial testing showed low written scores of 57%; however, post-intervention scores increased to 80%. Similar patterns were observed with low baseline performance scores (43% pre-intervention) that rose to 88% post-intervention.

The increase in performance scores was higher than the knowledge scores, perhaps reflecting the very low initial psychomotor skills scores and/or the NRPTM program's emphasis on psychomotor skills. In sharp contrast to the pre-intervention knowledge and performance scores, the pre-intervention self-efficacy scores were 3.7, indicating that the nurse midwives rated their knowledge and skills higher than the actual pre intervention testing of knowledge and skills indicated. Those with high self-efficacy had the largest decline in performance scores compared to those with low pre-intervention self-efficacy scores, whose performance scores remained higher.

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At the six month testing, there was an overall decline or degradation in written performance from 86% to 62%, which was statistically and, likely, clinically significant given that they regressed almost to their pre-intervention levels of 59%. Performance scores declined less, from 90% to 80% which was also statistically significant. Self-efficacy scores stayed stable, from 4.3 to 4.2. Those with initial high self-efficacy had the largest decline in performance scores; those with low self-efficacy pre-training had performance scores that remained high.

The study was consistent with others in demonstrating that NRPTM can significantly increase neonatal resuscitation knowledge and performance in a group of well-educated midwives with extensive clinical experience[98]. The study was limited by the instruments and outcome measures, which were newly developed and incompletely tested for reliability. Furthermore, failure to blind, and the potential for inter-rater differences between those scoring the performance measures was not evaluated and could have impacted performance scores. Additionally, the wide range of midwife years of practice (ranging from 3 to 30 years) may have been a confounding variable.

2.21.3 Single Intervention: Neonatal Resuscitation using United Kingdom ABC Model

Evaluation of Neonatal Resuscitations using United Kingdom ABC model training interventions was conducted for simple one day training. The evaluation employed Randomized Controlled Trial (RCT) that provided knowledge using lectures and mannequin training to impact psychomotor skills. The main focus of evaluation was to determine the impact of training of the health care providers on neonatal resuscitation practices in maternity hospital in Kenya with high number of newborn births each year. The methodology used random assignment of the ward and the operating wards nurses and midwives to receive training in the initial phase or in the late phase.(85)

The study evaluation was said to be unique because it has used the real time resuscitation events where the health workers activities were recorded by trained observers. The observers who were nursing students received training for three (3) days. In order to capture the information, the observer remained in the ward twenty four hours following the shift pattern of the hospital and besides, they were blinded to the training

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of the health workers. Their records were reviewed with another blinded resuscitation instructors for scores and other documentations on the resuscitations. The main intended primary outcome of the interventions was to measure the proportions of newborn resuscitations with appropriate step taken by the health workers while the secondary outcome of the intervention was to determine and analyze the harmful or inappropriate practices exhibited by the health worker.

The inappropriate practices was classified based on the health workers not implementing the right procedure such as not giving the right breathing support or giving oxygen, health worker administering oxygen directly into the nostril, exhaling oxygen directly on the infant face, in appropriate stimulation performed before drying , shaking the whole baby, slapping baby's back and squeezing the chest. The finding indicated poor baseline knowledge and skills present in the health workers who routinely encounter neonatal resuscitations. The Controls were made on the case fatality differences before and after interventions of the training education.

2.21.4 Single Intervention Studies: NRPTM and Birth Asphyxia

A study to evaluate the single educational intervention carried out in Trakya region in Turkey with the annual birth rate of 12, 000 live birth focused on retrospective chart review targeting critical outcome such as birth related morbidity and mortality and pre and post NRRTM training. In the study infants with Ischemic encephalopathy defined from the standard definition were referred to higher tertiary neonatal units were also included in the study(86).The training course was provided into two phase comprising of 50% of the staff received training in 2003 and 45% received training course in 2004 and data was collected over three years period. The result of the study indicated that there was drastic increase in the number of patient with birth asphyxia during the transition and post implementation period. Furthermore, the newborns with no resuscitations drastically reduced within the three year a sign that more active resuscitation measures were undertaken by the health workers with one minute Apgar score improved while there was no significant improvement in the five minutes Apgar score.

The effect of the training was also felt in the newborns with stage one and two where the number of Ischemic encephalopathy (HIE) reduced. Despite the study

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seemingly pointing at improvement of morbidity and mortality related birth asphyxia, the overall newborn survival of the referred infants seems to have not declined or change in time. However, the study has limitations due to its small sample size drawn from single regional referral region. There was no evidence that the change in the referral pattern could have led to the changes in the number and type of infant reoffered. Unfortunately, this was only the referral facility in the region thus making it less likely.

This was also compounded by lack of data on the number of infant not referred in any of the time sequences and there was not attempt to determine the quality of NRPTM guided resuscitations(46). A second study as follow up was conducted to evaluate the impact of regional NRPTM education on the incidence, management and outcome of birth asphyxia conducted both pre and post intervention. Participants were selected from the region of India and at least two faculty members from institution were selected, trained and certified who subsequently train their hospital staff.

The outcome measure was the review of monthly data review of the birth asphyxiated related morbidity and mortality with detail of resuscitation. The data was collected for a period of three months before the intervention and 12 months post interventions and this was analyzed and compared. The effect of the study indicated that there was increased documentation of asphyxia cases measured by the Apgar scores following the introduction of NRPTM and at five minutes with marked changes in newborn resuscitation practices such as the use of mask bag for ventilation and co currently use of medication and chest compression decreased. Overall, the study documented that despite increased reports of compromised newborn, in the NRPTM training period indicated that newborn were effectively resuscitated with bag – mask ventilation. However, the newborn mortality did not decrease but asphyxia death related causes slightly decreased. The limitation of the study was that there was no details information on the number of providers, roles and whether 24-hour attendance at deliveries was achieved). They also did not attempt to evaluate the knowledge or skills of those trained at baseline and after training, nor were the study designed to test the stability of knowledge or sustainability of outcomes over time.

Furthermore, the nature of the study (prospective/retrospective Controls) does not allow establishment of causality. However, the strength of the association, and the findings in concert with other studies, lends credence to the hypothesis that NRPTM

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training could be an effective tool to decrease morbidity from birth asphyxia in the developing world.

Stronger evidence for the impact of national implementation of NRPTM was reported by Boo in 2009. This was a prospective, observational before-and after measure evaluating the nationwide impact of implementation of a single educational intervention (NRPTM), which was championed by the Malaysian Perinatal Society in collaboration with the Ministry of Health. Data were collected from 1996 to 2004. The NRPTM materials were translated into the Malay language. Initially 37 core instructors were trained to support the train-the-trainer rollout. Thereafter, NRPTM training and certification was provided to 14,575 healthcare providers (95% were doctors and nurses) by the original train-the-trainer instructors. All doctors working in Labor and Delivery (L/D) or the NICU received "full certificates." Only 80% of nurses in these areas received "full certificates." The report provided a ratio of annual live births per certified NRPTM instructor. Before NRPTM, the perinatal mortality rate (PMR), neonatal mortality rate (NMR) and stillbirth rates were already decreasing. After NRPTM implementation, the NMR decreased significantly from 6 to 3.8. Stillbirth rates remained unchanged and the PMR decreased from 9.1 to 6.8. This study demonstrated the feasibility of a well-orchestrated, nationwide implementation of NRPTM. The magnitude of the effect of NRPTM training is unclear given the pre-existing decrease in mortality that was observed.

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2.21.5. Educational and Implementation of a Nurse-Led Resuscitation Team

One unique study reported a pilot test of a single innovative intervention. The authors sought to determine if a team dedicated to basic neonatal resuscitation situated in an extremely busy delivery ward (22,000 deliveries per year) at Mulago Hospital, in Kampala, Uganda, a resource-limited setting, would reduce mortality and/or morbidity.(87) Basic resuscitation training was provided to five members of the nursing staff. The educational program consisted of a five day classroom course (didactic and hands-on), followed by five days of supervised training in the delivery unit. However, there was no information on pre-existing, structured, educational curriculum that was used, nor did they report any educational outcomes from the study. The pilot test also established 24:7 coverage of the delivery unit with a five member team of specially

trained resuscitation nurses. During the study period, this team attended 1,046 deliveries over a 31-day period.

The overall number of stillbirths was unchanged. The program reduced the incidence of infant mortality from 16.8% to 6.4% for infants > 2 kg. Given the volume of births in this setting, logistically, not all births requiring resuscitation could be attended. The report noted that very few hospitals in low resource settings would have the volume to warrant this level of resuscitation team staffing. They also reported anecdotally that the success of the program has led to enduring funding that has allowed the model to continue successfully beyond the confines of the study

2.21.6 Single Intervention Studies of Helping Babies Breathe Program (HBB Plus)

Based on theoretic perspective, the HBB® skills-based neonatal resuscitation program, incorporating the ILCOR evidence-based resuscitation science, a program which has been designed specifically for teaching resuscitation in low resource settings, may have an advantage over other resuscitation programs like NRPTM. The educational field testing of HBB reports the results of the Kenyan facilitators and learners who tested the curriculum, program design, and instructional tools including flip charts, print materials, and the low-technology infant simulator.

Structured questionnaires designed for formative evaluation were used to critique the course organization, teaching efficacy, and materials. Multiple-choice questions (MCQs) evaluated knowledge of birth asphyxia and neonatal resuscitation. Performance of specific resuscitation skills, such as mechanical ventilation using a self-inflating bag-mask ventilator and room air, was evaluated using OSCEs, while both knowledge and performance were measured before and immediately after the educational intervention.

After completing training, 100% of the facilitators felt that they had enough information to lead the HBB course (they agreed or strongly agreed). Of the learners, 97.8% agreed or strongly agreed that they could provide bag-mask ventilation (BMV). One very important finding of this study was that at baseline, none (0%) of the participants had adequate BMV skills. Post HBB intervention, 96.9% (62 of 64) demonstrated competency in bag-mask ventilation, suggesting that the hands-on teaching strategies and mannequin were effective.

The result concluded that Kenyan birth attendants had good baseline knowledge of birth asphyxia and neonatal resuscitation; however, they demonstrated profound deficits related to critical psychomotor skills such as BMV. Given the large gap between "knowing" and "doing," the report suggested that OSCEs should be used as both formative and summative evaluations in teaching neonatal resuscitation.

Many participants expressed gratitude and excitement at learning bag mask ventilation, compared and contrasted "old" and "new" neonatal resuscitation skills, and expressed an eagerness to disseminate and teach the program. Primary concerns focused on the need for more time for training and to practice skills and role-playing. The authors concluded that "HBB is an overwhelmingly acceptable curriculum for neonatal resuscitation training. It was met with universal enthusiasm by Kenyan birth providers, who expressed confidence that the curriculum, materials, and equipment were feasible at both health facility and community levels". These two preliminary reports focused on the field-testing of HBB® providing early and limited data about this program. The results are limited by the methods (qualitative methods) and measures that are not yet fully tested and without normative data. The stability of the participants' knowledge and skills were not tested in these studies. The findings can best be generalized to other settings in Kenya.

The investigators did not report the proportion of each type of healthcare provider that was present, their level of education, years of experience, English proficiency or other relevant demographics that may have influenced both the acceptance of, as well as the performance of, these resuscitation skills. The HBB development team recently published more detailed program results. (23)

Knowledge and skill assessments included pre- and post-scores from multiple choice questions (MCQ) and post-training assessment of bag-mask skills, as well as two objective structured clinical evaluations (OSCE) in two geographic settings of Kenya and Pakistan. Assessment of participant knowledge and skills pre and post-program demonstrated significant gains, however, the majority of participants could not demonstrate mastery of bag mask ventilation on the post training assessment without additional practice. Despite demonstrated high satisfaction, high self-efficacy and gains in knowledge and skills, mastery of ventilation skills and integration of skills into case

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management may not be achievable in the classroom setting without additional practice, continued learning, and active mentoring in the workplace. (23)

A second publication from a HBB implementation team reported that although birth attendants in a rural hospital in Tanzania performed significantly better in simulated neonatal care and resuscitation seven months after one day of HBB training, this improvement did not transfer into clinical practice. (95) Conversely, a more global evaluation of HBB, evaluated a strategy for national dissemination of HBB in Tanzania that included systematic training for healthcare providers from three major referral hospitals, four associated regional hospitals and one district hospital(96).

This large scale before and after study examined important downstream indicators of fresh stillbirth rates and neonatal deaths during the first 24 hours of life and the reported a significant reduction in neonatal deaths: RR with training also reported a significant reduction in the rates of fresh stillbirth. To date the effectiveness of this educational program has not been well tested in other areas of the developing world, and furthermore, the stability of knowledge and psychomotor skills has not been demonstrated. More research will be needed to better understand the educational strategies, clinical outcomes, and impact on mortality, morbidity, and cost-per-lives saved of this educational intervention.

2.21.7: Studies That Evaluated Combined Interventions (ENBC and NRPTM)

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One of the most powerful studies in the developing world was a recently published, large, controlled, population-based, multi-center study using a pre-post intervention model that combined two structured educational interventions, the WHO ENBC and NRPTM (98) The research team tested the hypothesis that the two training programs, ENBC and NRPTM, would incrementally reduce seven day neonatal mortality rates for low-risk institutional deliveries that occur at eight low-risk, first-level, urban community, public-sector, delivery clinics/health centers in Lusaka and Ndola, Zambia. This sample accounted for 98% of institutional, low-risk deliveries in the region. Using a train the- trainer model, certified research midwives trained local midwives, allocating one research midwife per clinic. The midwife trainees were practicing midwives who performed deliveries in low-risk, first-level, urban, community health clinics in two cities in Zambia.

Data collected in the post-intervention phase, revealed that the all-cause, seven day neonatal mortality rate decrease from 11.5 deaths per 1000 live births to 6.8 deaths per 1000 live births. This was primarily attributable to decreases in the post-discharge mortality rate. The decrease in mortality rate after ENBC training was attributable to decreases in the rates of deaths from birth asphyxia. The perinatal mortality rate decreased from 18.3 deaths per 1000 live births to 12.9 deaths per 1000 live births. The rate of stillbirths did not change significantly.

After implementation of the NRPTM training, the seven day neonatal mortality rate increased. The increase in mortality rate was attributable to unknown or other causes of death, escalating from 1 to 2.5 deaths per 100 live births. This was presumed to be a function of changes in the follow-up data and disappears with statistical "correction. "This study was unique given its size, scope, and population-based data, as well as measurement of the relevant clinical outcomes (infant mortality in the first seven days of life). Furthermore, the exclusive use of local midwives in a train-the-trainer model lends credibility to the potential for larger scale implementation and sustainability. A clear limitation of this study lies in the differences in the follow-up rates throughout the study that had the potential to bias results.

A second, large, multi-center, multi-national, cluster-randomized controlled trial, evaluated interventions of WHO ENBC and modified NRPTM in a before and after study[98]. The study focused on births in rural communities in Argentina, the Democratic Republic of the Congo, Guatemala, India, Pakistan, and Zambia, and reported that up to 20% of the births in these settings were attended only by a family member.(88) The study tested the hypothesis that the combination of the two training programs would incrementally reduce seven day mortality rates for infants (>28 weeks gestation and >1500 grams) born in developing countries. The educational intervention was targeted at trained birth attendants (nurses, midwives and physicians). Training using NRPTM was conducted in five countries. Sequential teaching and evaluation of the two educational programs, both of which employed the train-the-trainer model, occurred. The primary outcome measured was death from all causes within seven days of birth. Secondary outcomes included death in the first seven days due to birth asphyxia.

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Overall rates of stillbirth and “fresh” or very recent stillbirth declined from 23 per 1000 births to 15.9 per 1000 births. Furthermore, morbidity related to birth asphyxia, as measured by abnormal neurologic examinations on day seven, decreased from 8 to 6.4%). Both the Journal of Pediatrics and New England Journal of Medicine population support the hypothesis that improvements in seven day neonatal morbidity and mortality related to birth asphyxia are possible in low resource settings.

2.22. Feasibility of HBB training knowledge and psychomotor skills

The great deal of teaching and learning is well understood in health professions. Despite this, little is known about the retention and forgetting of the knowledge from the people trained. This aspect is referred to as the feasibility and the stability of the interventions and knowledge and the skills over period of time. According to the early educators and psychologists, the knowledge taught skill will rapidly forget the skill(89). This was demonstrated by the psychologists outside the field of medicine and nursing. The forgetting of the knowledge and the skill was demonstrate in the aircraft field which indicated that failure to have frequent training for the pilots will lead to discrete cockpit procedure and unsafe level within matter of weeks. However, the finding emphasized that the initial degree of learning and opportunities to practice could modulate the decay of skills. Furthermore, meta- analysis of the degradation of skills found out that, skill degradation is magnified in situation where the intervention is given and when not routinely used for a longer period of time.

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More studies on skill degradation in other fields indicated that skill and knowledge loss can happen immediately within the first day after the training and a year later when the skill learned is not put into practice. ” showing that the “average participant was performing at 92% of their peak performance level and further amplifying the need for over-learning and refresher training.(90) The only study that evaluated the “stability” factor in HBB plus training was performed in Tanzania (95) They demonstrated that a one day HBB plus course improved simulated performance but not clinical management of neonates. The authors concluded that, “birth attendants in a rural hospital in Tanzania performed significantly better in simulated neonatal care and resuscitation seven months after one day of HBB plus training interventions. Unfortunately, this improvement did not transfer into clinical practice”.

2.23. Training on HBB curriculum and Known effect on newborn morbidity and mortality

Intense study is required to demonstrate the impact of training of health workers, knowing the outcome of the HBB training impact on newborn morbidity and mortality. To determine the impact of HBB plus training on the newborn mortality and morbidity, more effort is required in terms of collaboration, large data set and more resource is required to design, conduct and monitor the outcome. However, there is available information and data that suggest some potential reduction in newborn morbidity and mortality in Macedonia(91) Zambia (98) South American, India, Pakistan and Africa Turkey(86) Malaysia(92) Uganda and Tanzania There is also an evidence of the effectiveness of home based neonatal care which was largely based on the work of Abay Bang and the team.

The team performed a field trial of home-based neonatal care in rural India with before and after evaluation of outcomes. They evaluated the effect of home-based neonatal care on birth asphyxia and compared the effectiveness of two types of workers and three types of resuscitation breathing techniques in home deliveries. Outcome measures included the following: the proportion of deliveries where the village healthcare worker attended the delivery; the incidence, case fatality (CF) and asphyxia-specific mortality rate; as well as, the “fresh” stillbirth rate during the different phases of field testing.

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Beginning in 2000, the government began encouraging institutional deliveries, with a $15.00 incentive paid to the family of infants born in an institution. Infant deaths were assessed using verbal autopsy reports. The modes of resuscitation were changed over the longitudinal studies. Traditional birth attendants used mouth-to-mouth resuscitation during baseline years (1993 to 1995), and the VHWs only observed from 1995 to 1996. During the intervention years, the delivery attendants used tube-mask ventilation (1996 to 1999) and bag-mask ventilation (1999 to 2003).

The incidence of mild birth asphyxia decreased by 60%, from 14% in the observation year (1995 to 1996) to 6% in the intervention years ($p < 0.0001$) and the incidence of severe asphyxia did not change significantly; however, the case fatality with severe asphyxia decreased by 47.5%, from 30% to 20% ($p < 0.07$) and further

reduced the asphyxia-specific mortality rate (ASMR). The implementation of mouth-to mouth resuscitation reduced ASMR by 12%, and the use of tube-mask ventilation further reduced the CF by 27% and the ASMR by 67%. The bag-mask showed an additional decrease in case fatality of 39%. The proportion of institutional deliveries increased from 0.5% to 2% during the incentive year. A second report by this research team, which is a longitudinal extension of their initial field trial of home-based neonatal care, included a large population based sample followed meticulously over seven years. In this paper, the interventions was implemented and before and after Controls in 30 intervention villages in Gadchiroli, India (nested) were compared to 47 randomly assigned control villages in the region.

The study was designed to evaluate the effect of home-based neonatal care on two main outcome variables: neonatal mortality rate (NMR) and sepsis-specific NMR, using baseline, standardized, community vital statistics in both control and intervention regions. A uniform cause of death analysis using verbal autopsy was used and performed by a single neonatologist. Three phases were described: baseline phase (1993 to 1995); observational phase (1995 to 1996); and 7-year intervention (1996 to 2003). The second and more comprehensive intervention focused on providing 8 to 12 home visits, recognition and treatment of sepsis, management or prevention of birth asphyxia, and management of low birth-weight infants. The study provided careful education and close supervision and training of VHWs with payment linked to work done.

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Data analysis compared two years of baseline data to the most recent two years of data. The study reported a decrease in the perinatal mortality rate by 56%; stillbirth rate decreased by 16%; NMR decreased by 44 points (70% reduction), which was contributed almost equally by early and late reductions. All changes described were significant ($p < 0.05$). The authors estimate that 161 neonatal deaths were averted. The relative contribution to averted deaths of each aspect of the intervention was as follows: sepsis management (36%); asphyxia management (19%); supportive care (34%); primary prevention (7%); and “other” (4%). This longitudinal study is an important example because of the sustained decreases in mortality meticulously demonstrated over time. There was no change in mortality rates in the control villages. The work of Bang et al. (2005 a/b) clearly demonstrated the importance of community support for

any childbirth intervention, and documented a very high rate of compliance with >90% of neonates receiving home-based neonatal care (HBNC). The paper very carefully described and reported methods and statistics. Although the interventions were parsed for the purpose of analysis, these interventions are clearly interdependent in the real world context.

One of the strengths of this study was the potential sustainability of a community-based intervention and the longitudinal follow-up, tangibly demonstrated by this region's success in meeting MDG-4. The authors described the critical and "curative role" of the VHW who was trained to give injections of Vitamin K and Gentamicin. One of the criticisms of the Bang et al. (2005) field trials was on the ability to achieve sustainable reductions in neonatal mortality, specifically, with the increased emphasis on care for sick and fragile infants, the potential to decrease NMR while postponing death in biologically frail infants. This was not seen; decreases in NMR were sustained with ongoing decreases in infant mortality rates as well. The study was limited by the field nature of the intervention and the reliability of data sources and verbal autopsy. The estimation involved many assumptions (untested). The demonstration of HBNC was feasible on a small scale; however, scale up considerations would need to be carefully planned and executed to achieve similar results.

A study-by-study analysis of community-based intervention packages (CBIPs) for improving perinatal health in the developing world is beyond the scope of this literature review. A recent systematic review of CBIPs identified nine large-scale studies with control groups and concluded that these interventions can have a substantial effect on both neonatal and perinatal mortality (98) The authors noted that further large-scale studies to test evidence-based CBIPs are needed, particularly in Africa where no large-scale studies have been undertaken. They also emphasized the urgent and competing need to focus on neonatal health in urban settings

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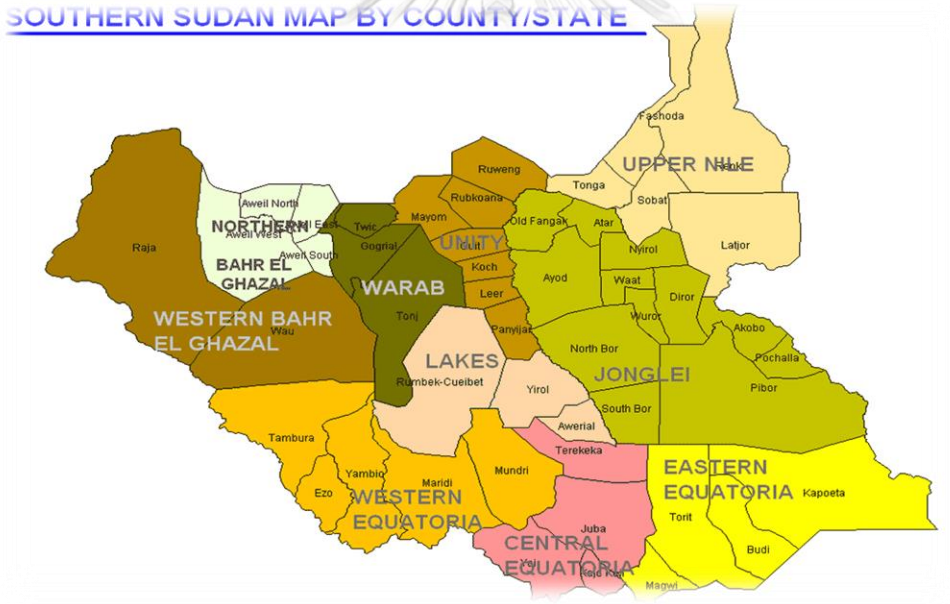
2.24: Background of the Study Area

The study was carried out in Republic of South Sudan. South Sudan is a landlocked country of approximately 640,000km2. It was formed in 2011, gaining independence from Sudan. It is bordered by Sudan, Ethiopia, Kenya, Uganda, Democratic Republic of Congo, and Central African Republic. South Sudan is divided

into 10 states, with the capital being Juba and additional 21 states have been created in the last one year. According to World Bank, South Sudan GDP per capita was USD 1,081

The terrain of republic of South Sudan rises from plains in the north and central areas to southern highlands along the border. The country's landscape is made up of hills and mountains in the north; rainforests in the south and southeast; and extensive flood plains and the Sudd wetlands in the center, north and northeast of the country. A large section of the White Nile river flows through South Sudan, and these wetlands are a vast swamp area formed by the White Nile, a main tributary of the Nile River, and make up more than 15% of the country's total area

Figure 3: Map of Republic of South Sudan Showing the state and County



Sources: *Geohive, 2015; CIA Fact book, 2015; South Sudan National Bureau of Statistics, 2012; ICRC, 2012; IFPRI, 2014; Dutch Coalition on Disabilities and Development, 2012:*

Key population:

Typical low resource country, the average family size in a private household is seven. 71% of households are female-headed. Polygamy is widely practiced: approximately 41% of women are in polygamous unions; therefore a large number of households are satellites of larger male-headed families. The population is largely rural,

with 83% of the population residing in rural areas. Five cities had an estimated population exceeding 100,000 prior December 2013 and the most recent escalation of violence; Aweil, Malakal, Wau, Yei and the capital Juba. Juba is the biggest city with a population estimated to be nearly 400,000. 72% of the population is under the age of 30: 51% of these are under 18, 32% under 10, and 16% under five.

Ethnic or tribal groups:

The Dinka is the largest ethnic group in the country (35.8% of the total population). The Dinka are broken down into roughly 10 sections based around a separate geographical territory. Each one is considered an individual political entity. They inhabit the vast arc of land running north, west, and south of the central Nile basin, covering the greater Bahr el Ghazal in the northwest and Upper Nile areas in the northeast. Many live as pastoralists. The Nuers are the second-largest group, and constitutes 15.6% of the population. The Nuer groups traditionally occupy Unity state, extending eastwards along the Sobat and Baro Rivers through the northern areas of Jonglei, and southern Upper Nile. Groups of Nuer are also found in southwestern Ethiopia[126] Other prominent groups include Shilluk, Azande, Bari, Kakwa, Kuku, Murle, Mandari, Didinga, Ndogo, Bviri, Lndi, Anuak, Bongo, Lango, Dungotona, Acholi CIA Within these groups are various sub tribes, usually based around specific geographical regions.

Civil wars:

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The root causes of both civil wars can be generalized as a conflict of religious identity between the Muslim North and largely Christian south, political autonomy for the South from Khartoum, and control of resources, especially oil following its discovery in the 1970s. The first civil war (1955–72) was between the Government in Khartoum and a separatist movement in the south. After 1963, most of the fighting was conducted by the military wing of the resistance called the Anya-Nya. The second (1983–2005) was between the Government and the Sudanese People's Liberation Army/Movement (SPLA/M). The conflict intensified when oil was discovered in the South and oil exploration increased in the 1980s.

The Comprehensive Peace Agreement (CPA) was signed on 9thJanuary 2005, and among its provisions was a referendum on independence six years after the CPA. On 9 January 2011 an overwhelming majority voted for independence, leading to a new

country, the Republic of South Sudan, on 9 July[129]Violent clashes erupted in Juba in 2013, between SPLA soldiers from rival political and ethnic groups. The violence quickly spread to other locations in late December 2013, with heavy fighting between Governments and this has continued in other part of the country.

Health system:

There were 1,487 health facilities in the countries of which Only 1,147 were functional, including two teaching hospitals, seven state hospitals, 27 county hospitals, 284 primary health care centres, 792 primary health care units, 10 private facilities, 14 specialized hospitals/clinics, and 10 police and military health facilities. Only 26% of all health facilities had infrastructure in good condition, while 33% needed complete replacement. Furthermore, the facilities lacked medical equipment, transport, communication, and water and power supplies. NGOs, both international and faith-based, comprise the majority of healthcare employers[5].In 2012, total expenditure on health was only 2.6% of GDP. (5). The number of functional health facilities functional and the health workers could be less than stated due to the ongoing civil war and most of the health workers fled to the neighboring countries.

Maternal Infant and child health: In 2014, there was only one qualified midwife for 39,088 people. 81% of women deliver at home; only 11.5% deliver in any type of health facility(28) .In 2011, only 19% of births were attended by skilled health personnel. Maternal mortality is among the highest in the world, with 2,054 deaths per 100,000 live births, as of 2006. This is the equivalent to a 1 in 7 chance of a woman dying of pregnancy-related causes in her lifetime. Many deaths are not reported as 90% of women give birth away from formal medical facilities. The under-five mortality rate is 99 deaths per 1,000 live births, compared to 253 in 1990. Acute respiratory infections, prematurity, birth asphyxia, and diarrhea are the main causes of death for children under five years.

Access to education: The majority of adults and children have not attended school due to decades of civil war. 70% of children have never attended any school. In 2012, the net enrolment rate (NER) – the proportion of children of school age who are enrolled in school – was 42%: 47.3% for boys and 36.3% for girls. The literacy rate of the total population aged 15 and over is 27%. Literacy among men is 40%; among women it is 16% the completion rate in primary schools is less than 10%, with girls half as likely to

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complete as boys. early marriage is the greatest barrier to girls' education, while cattle herding is the main barrier to boys completing their education.

Table 2 Summary of Indicator - Republic of South Sudan

Indicator	**Number /percentage**	Year
Population number (last census)	8,260,490	**2008**
Population number (projection)	11,296,173	**2013**
Population growth rate	4.12%	**2012**
Population density	13/km2	**2012**
Urban composition	18%	**2011**
Average household size	7	**2012**
Net migration rate	11.94/1,000	**2014**
People with disabilities %	5	**2010**
Age distribution	45.8% under 15	**2014**
Life expectancy at birth	55 years	**2012**
Under-five mortality	99/1,000 live births	**2012/13**
Maternal mortality	2,054/100,000 live births	**2006**
Malnutrition prevalence (GAM)	22.7%	**2013**
HDI ranking and value	**N/A1**	
Corruption perceptions index ranking (value)	171 (out of 175)	**2014**
People below the poverty line (%)2	51%	**2012**
Hunger index ranking (value)	72/76 (26.0)	**2014**
World Risk Index ranking (value)*	**N/A3**	
Gender Inequality Index ranking (value)*	**N/A4**	
Literacy rate	27%	**2009**
Infant mortality rate	75	**SSHS 2010**

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2.25. Health Systems for Mother and Newborn Care in South Sudan

In South Sudan, two decades of civil war resulted in a largely dysfunctional health system and contributed to the deteriorating health status of the population during

and after the long conflict leaving a third of the population without access to adequate health services making South Sudan one of the countries with high maternal and newborn mortality. In 2005, signing of the peace agreement gave way for rebuilding the health and other social infrastructure which was again destroyed by the ongoing conflict in other states. This has led to poor performance of the health system and has greatly affected the public health services at hospitals primary health care units and centers(3). Relative peace was restored and followed by recovery phase on rebuilding security, revitalizing the economy, strengthening the rule of law and delivering Basic health services to the population.

This has led in investment in physical infrastructures for health services and reopening of the health training institutions. It was expected that the reopening of the nursing and midwives institution will increased the health workforce of the trained clinicians to replace those who flee or were killed during the war. Maternal and newborn mortality has been recognized as one of the priority for Ministry of Health. This was reflected in the roadmap for maternal and newborn for reducing mortality and morbidity to address the main drivers of high maternal and newborn mortality.

The health system operates in line with the decentralization policy of the interim constitution of South Sudan of 2005 and the Local Government Act. According to the "Health Sector Development Plan 2011-2015," the decentralized organizational structure is based on four levels of administrative structure: central, state, county, and community (MoH & Government of South Sudan. However, the reality on the ground shows many functions underdeveloped, particularly at the lower levels.

The Central MoH provides policy guidance, leadership, and funds for services, and is responsible for monitoring and evaluation. The State MoH, located in each state capital, is responsible for annual management work plans, joint assessments, planning, monitoring and evaluation, the referral system, and implementation of government health care and services. The County MoH should oversee monthly management work plans, joint strategic planning based on local needs, assessment and analysis of local health and managerial needs, supervision, guidance and monitoring, the referral system, and implementation of health care and services. The Community MoH (Primary Health Care Units and Centers) provides implementation of the Basic Package of Health

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Services (BPHS), weekly work plans, outreach activities, the referral system, and community participation.

The BPHS outlines a package of health care services that is affordable and accessible to the majority of the population, at the primary and secondary health care levels. It covers curative, promotive, preventive, and managerial activities and NGOs are often the primary providers of health services.

The health care services in South Sudan are structured around four key levels: community, primary, secondary, and specialized care, linked by a referral system. Community health care is provided by community health workers, maternal and child health workers, and home health promoters. Primary health care units are meant to be the first point of contact and provide basic preventive, promotive, and curative care for around 15,000 people. These units is aim to provide higher-level services for around 50,000 people and, in addition to services offered by primary health care units, provide basic diagnostic laboratory services and maternity care. County hospitals and state hospitals is designed to provide secondary-level care, including comprehensive obstetric care, in-patient care, and surgery, for around 300,000 and 500,000 people, respectively. Numerous gaps and challenges are encountered at each of these levels, however, particularly in equipping and strengthening them to reach even minimum standards.

Maternal, newborn, and child mortality indicators used for monitoring progress toward the achievement of SDG 3 target 2 and 3 remain high. (South Sudan—Key Indicators/Trends in Maternal, Newborn, and Child Health. In South Sudan, nearly 7% of women aged 15 to 49 marry before their 15th birthday, a substantial reduction from 16.7% in 2006. However, 45% still married before the age of 18 in 2010, which is an increase from the 2006 average of 41%. Young women experience exacerbated problems during pregnancy and delivery due to incomplete body growth and are particularly at risk of obstetric fistulae and obstructed labor.

In 2010, the average rate of contraception use for women married or in union in South Sudan was 4%, only 0.5% higher than in 2006. Access to family planning is strongly linked to gender equity, empowerment of women, education, and employment, and is a vital component to saving lives and preserving health through preventing untimely and unwanted pregnancies(93),(94), (95),(96).

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Only 9.8% of women received ANC from a medical doctor, 16.4% from a nurse or midwife, and 28.6% from a traditional birth attendant Thus, only 26.2% of women in Southern Sudan received ANC by skilled health personnel in 2006; however, only 17% of women had the recommended 4 or more ANC visits. The majority of maternal deaths occur during labor, delivery, and the immediate post-partum period, and as most are preventable, it is essential that a skilled health professional be available during childbirth and only 4% of deliveries being delivered by a doctor and 7% by nurses and midwives.

A child born in South Sudan has a 25% chance of dying before their fifth birth day. High mortality in under-fives is associated with pneumonia, malaria, and diarrheal diseases. Malnutrition is common: 27.6% of children below five are moderately or severely underweight and 12.2% severely underweight. South Sudan has one of the lowest levels of immunization in the world. In 2010, only 4.3% of children aged 12 to 23 months had vaccination cards available, compared with around 13% in Southern Sudan in 2006. Measles vaccination coverage differed little between 2006 and 2010 (27.7% vs. 26.3%, respectively), as did the proportion of children who received all recommended vaccinations (2.7% in 2006 vs. 2.6% in 2010. One of the most important step taken by the government of republic of South Sudan is working toward the reduction of maternal and newborn mortality through provision of emergency obstetric and neonatal care (CEmONC) and promoting skilled birth attendant and strengthening the integration of family planning into primary health care services.

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Routine Essential newborn care for South Sudan

The routine care for newborn in South Sudan health care facility was adopted from the set of comprehensive recommendation designed by World health Organization to improve the health of the newborn through intervention before conception during pregnancy, soon after birth and in post natal period. The routine care which is also referred as essential care in South Sudan is a simple and cost effective measures that is used by both health workers and the primary caregiver to ensure improved neonatal outcome.

Routine Essential Newborn Care (ENC) is care that every newborn baby needs regardless of where it is born or its size. ENC should be applied immediately after the

baby is born and continued for at least the first seven (7) days after birth. Many ENC interventions are simple and can be provided by a Skilled Birth Attendant (SBA) or a trained Community Health Worker (CHW) or Traditional Birth Attendant (TBA) or by a family member supporting the mother in a health facility or at home. Components of the WHO essential new born care practices include cord care, breastfeeding, thermoregulation, eye care, immunization, danger signs and care of the low birth weight infants. The below details the adaptation and modifications of routine essential care for newborn in South Sudan.

Thermoregulation (keep the baby warm): The care stipulates that care givers and mothers ensures the newborn is immediately dried after birth, placed on the abdomen (skin to skin), and covered with a clean towel/cloth and a hat on the head. The guideline for the care recommend delaying of bathing the baby for the first 24 hours.

Breathing (Help the baby breathe): Care givers and mothers must assist the newborn baby to take its first breath by immediately rubbing its back and feet to stimulate it to cry and by clearing the mouth if it having any difficulty in breathing.

Keep baby clean: Care givers and mothers wash their hands before touching the newborn baby, cut the umbilical cord with a clean blade, keep the cord area clean and dry, not put anything on the cord stump with exception of chlorohexidine antiseptic (gel or liquid) application as soon possible after cutting the cord and then daily for 7 days.

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Help baby feed (Breast feeding : Care givers and mothers assist the newborn to breastfeed within 1 hour after birth and make sure the baby receives the first milk (colostrum) and only breast milk and no other fluids for the first 6 months.

Help the small baby survive: Care givers and mothers give extra special care to the small baby by practicing ENC plus kangaroo mother care(KMC) which means placing it naked skin to skin on the mother's chest and continuing this day and night.

Help protect from HIV: Care givers and mothers ensure the newborn of a HIV positive mother is brought to the facility for early infant diagnosis (EID) testing at one month.

Chapter Three

Research Methodology

3.1 Research Design

The study was quasi experimental, designed to test the effectiveness of Helping Babies Breathe –plus training on improving the knowledge, psychomotor skills, competency and reduction of neonatal mortality within 24 hours due to asphyxia in tertiary hospital using pre and post-test study of intervention and Control groups. The design of the study was chosen because, it was not ethical feasible to conduct a randomized control trial.

The health workers in the intervention hospital (Juba Teaching Hospital) received training while the health workers in Control group (Wau Teaching Hospital) did not receive training.

This was obtained by comparing the two groups at the end of intervention period

A = O1a O2a X O3a

B= O1b, o2b O3b

A= intervention group

B= Control group

O1= Pre test

O2 =Post-test

03 = Three months follow up (test)

X= Intervention

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3 .2 Research setting

3.2.1 Juba Teaching Hospital (intervention hospital)

The study was carried out at Teaching Hospital (JTH) in maternity ward, operating theater (OT) and newborn unit. Juba Teaching Hospitals is located in Jubex state (former central Equatoria). It one of Teaching tertiary public funded hospital and

serves an estimated population of 90- 100,000.JTH provides, general medicine, obstetric gynecological services and is a teaching hospital for medical doctors and other health care professionals. It is a referral center for the County Hospital and primary health care Center in the region. The Hospital provides antenatal, delivery, postpartum services for women and there is one specialized neonatal unit. The hospital also has a Kangaroo Mother Care Unit for the management of preterm or low birth weight babies. Babies who have complications at birth or during the postpartum period are treated in the special newborn care unit, which is staffed with doctors and nurses. The special newborn care unit provides treatment for neonatal sepsis and respiratory distress syndrome.

The hospitals is designed to be a 586 bed capacity, its operation capacity now exceeds the planned capacity with patient sleeping on the floor of the hospitals and corridor. However, at the time of the study, the bed occupancy capacity and rate has reduced due to the ongoing political turmoil as many flee the country for safety in the neighboring countries.

There are two delivery unit in Juba Teaching Hospital, at the maternity and the operating theater (OT). The low risk vaginal delivery take place at the main labour ward at the maternity which is staffed with nurse's midwives, nurse midwives, intern doctor and community health workers while the high risk virginal deliveries take place within the operating theater staffed with nurses, medical doctors and anesthesiologist and this is also where high-risk vaginal deliveries and cesarean sections takes place. In each delivery room there is a neonatal resuscitation corner where the resuscitation of newborns takes place. In the past one year ending December 2016, a total of 6, 317 mothers delivered at the hospital, 1, 317 were neonate admitted in the neonatal ward with 377 due to newborn asphyxia. The ratio of neonates who died as result of asphyxia was reported to be 21% (JTH Annual report 2016).

The table below gives summary of the neonatal admission, total death, and number of neonates admitted and deaths due to asphyxia collected over the period of January – December 2016

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Table 3 Number of admission and death due to asphyxia in Juba Teaching Hospital

Months	Total admission	Admission Asphyxia	Total newborn hospital deaths	Deaths due to asphyxia
January	145	29	16	6
February	113	23	14	9
March	87	25	10	7
April	103	20	15	5
May	93	26	7	5
June	124	25	16	6
July	119	45	10	7
August	123	44	9	6
September	138	44	12	6
October	166	41	11	9
November	107	33	12	5
December	79	22	11	9
TOTAL	**1397**	**377**	**143**	**80**

Source Juba teaching Hospital 2016

3.2.2 Wau Teaching Hospital (control hospital)

Wau teaching Hospital located in Western Bar El Ghazel state in Wau County. Like Juba Hospital, it is one of the public funded hospital. The hospital provides general health, medicine, obstetric, gynecological services, and is also teaching hospital for medical and nursing students and at same time act as referral for the County Hospital and primary health care Center in the greater Bar el Ghazel region.

The Teaching hospital is estimated at 350 bed capacity but due to the increasing demand for health service it now for more than its bed capacity with patient sleeping on the floor or corridors of the hospital. The hospital also has a Kangaroo Mother Care Unit for the management of preterm or low birth weight babies. Babies who have complications at birth or during the postpartum period are treated in the special newborn care unit, which is staffed with doctors and nurses. The special newborn care unit provides treatment for neonatal sepsis and respiratory

The hospital has maternity ward and operating theater (OT). The low risk mother delivers at the main labour ward at the maternity which is staffed with nurse's midwives and community health workers while the high risk vaginal deliveries take place within the operating theater staffed with nurses, midwives, medical doctors and anesthesiologist and this is also where high-risk vaginal deliveries and cesarean sections take Place. In each delivery room there is a neonatal resuscitation corner where the resuscitation of newborns takes place. The hospital has high neonatal mortality estimated at 20 % in the control hospital (2016).

3.3 Study period

The pre and post intervention study lasted for a period of five months as follows

- Baseline line information was established for both intervention and control for a period of one month followed by immediate training of the health workers
- Intervention period lasted for three (3) months and
- Follow up and end of post intervention data collection lasted for one month period

3.4 Study population

The main study population were the health workers (Nurses, midwives, clinical officers, intern medical doctors, community maternal and newborn health care and Community health Workers) providing care for mothers and newborn at maternity, operating theater, children ward and newborn health care unit at Juba and Wau teaching hospital who has limited or no exposure to Health Babies Breathe training.

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3.5. Sample and sample size calculation

All the health workers in maternity, newborn health, newborn unit, operating theater and children ward at Juba and Wau Teaching hospital were selected to participate in the study. This was based on the relatively small number of health workers in each of the unit and the rational schedule and the study being effective study. Therefore, all the available health workers during the study at intervention hospital were selected and trained on Helping Babies Breathe protocol

The sample size was computed by comparing the change in the quantitative proximal and distal outcomes of knowledge, psychomotor skills, competency and reduction of neonatal mortality from the baseline and post interventions at baseline, immediate post intervention and three months between intervention and control group between means using G- power – analysis

Means: Difference between two independent means (two groups)

Analysis:	A priori: Compute required sample size	
Input:	Tail(s)	= Two
	Effect size d	= 0.50
	α err prob	= 0.05
	Power (1-β err prob)	= 0.80
	Allocation ratio N2/N1	= 1
Output:	Non centrality parameter δ	= 2.8284271
	Critical t	= 1.9789706
	Df.	= 126
	Sample size group 1	= 64
	Sample size group 2	= 64
	Total sample size	= 128
	Actual power	= 0.8014596

N=error

Where

Alpha error is 0.05,

Two tailed alternative hypothesis, Z alpha =1.96,

Beta error=0.05 or

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Power= 80%,

Effect Size- change in the mean change of the outcome (Knowledge, Practice competency three months immediate and one months after end of training interventions) or three months from baseline between the intervention group and control group which is 50% ,Dropout rate =20%. Using manual computation using G- Power analysis command in the computational sample size, the final sample size for adjusting 20% is 77 per group).However, because of the ongoing conflict, the available health workers that participated in the intervention were 40 and control was 30 respectively.

3.6 Sampling techniques

The sampling method for this study was in two staged sampling. The first stage was the selection of the hospital for intervention and control and the second stage was selection of the health workers in the two hospitals

3.6.1. Selection of hospital

Purposive selection of the hospital was conducted and one hospital was selected as intervention and one hospital as control. This was because only two tertiary hospitals were functional and the remaining one closed down during the fighting which occurred in December 2013. In addition, the hospital selected has similar characteristics (Public Teaching hospital funded by government of republic of South Sudan, staffed with specialist and generalist medical officers, nurses /midwives having similar services)

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3.6.2. Selection of Health Workers

The second stage was selection of health workers from maternity, children ward, operating theater and neonatal unit to participate in the training of helping Babies' Breathe training intervention and for Control. The plans was to select Health workers through simple random sampling from the existing available health workers lists using computer generated number listhttps//www.random.org/sequence/?min=1&max=130&col=1&format=html1rnd=new. However due to the limited number of health workers, all the available health

workers who gave consent and met the inclusion criteria were selected to participate in the study.

3.7 Inclusion and exclusion criteria

The inclusion criteria for the health care providers who participated in the study were:-

Inclusion criteria

1. Medical officers/doctors, nurses, midwives, maternal Child Health Officer, community health workers and clinical officers working and practicing in maternity, operating theater and children ward.
2. Health providers self-reported that they actually provide routine care services at delivery and neonatal unit or departments
3. Health workers willing to be available for data collection and during the period of study

Exclusion criteria

1. Health workers who received training on helping Babies Breathe within the last three months prior to the study abroad

3.8 Recruitment and data collection procedure

The health worker were identified and recruited from maternity, newborn operating theater and children ward. After the completion of the recruitment process, an invitation was send to those health workers who met the inclusion criteria to participate in the study. A written consent was obtained from the health workers (Appendix 1) before training.

Data was collected on the socio – demographic and professional characteristic, encounter with the newborn with breathing problem and prior expose to resuscitation training for the past six (6) months. This was collected using the socio demographic and professional characteristics questionnaire. High dropout rate was minimized by asking the participants to consent their readiness and willingness to participate in the entire period of the study for at least three months post training indicating clearly the sequence of the study at one months, three months and post intervention assessment.

The participants did not receive their final score at baseline, posttest including other information on their performance during the intervention period. The result of all the score was discussed at the 3months evaluation. This was done to avoid distractions of the participants due to the result obtained. The selected research assistants received training on the helping Babies protocol and quality improvement cycle.

3.9 Research Instruments/Tools

The knowledge and skills of nurses, midwives, doctors, clinical officers and community health workers were assessed using socio demographic questionnaire demographic and the standard tool of the HBB package, which has been validated and used in other low income countries (LIC). The folowing below describes the research instruments/tools used during the study.

3.9.1 Socio demographic questionnaire demographic questionnaires

A socio demographic questionnaire was used to collect information on socio economic and demographic and professional characteristics of the health worker (Appendix2). Information was collected on health workers age, Gender marital status, education level qualification, place of work, Salary income, year of experience and past training on resuscitation.

Additional information was also collected on the exposures of the health workers to the neonates with breathing problem and prior resuscitation training.

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3.9.2 Helping Babies Breathe plus Knowledge multiple Choice questions

The knowledge check list questionnaire was used to measure the knowledge of the health workers on HBB[24]. (Appendix 3) The knowledge check list contained 17 multiple Choice questions on each of the HBB protocols on preparation for birth , drying the neonates, recognizing the neonates is breathing or not, positioning the head, clearing the airway, cutting the cord and position the baby skin to skin . Each of the questions has four choices with only correct answer to the statement.

The health workers are expected to answer 14 of the 17 questions correctly to successfully complete the written knowledge for which scores of >_ 80% indicates a

passing mark. A mean knowledge score of the health workers was used to evaluate the change in knowledge of the health workers before and after intervention and 3 months after implementation

3.9.3. Helping Babies Breathe plus Bag and Mask Check list

This was practical observation tool used for testing the psychomotor skills of the health workers on HBB plus (Appendix 4). The observation checklist tool was made up of five (5) observation steps. The Bag and Mask ventilation skill check was made up of checking the equipment's, application of the mask to make it firm seal, ventilation of 40 breathe per minute Looking for chest movement, what to do to improve ventilation if the chest does not move through the following steps and maneuvers a) Head – reapply mask and reposition head. b) Mouth – clear secretions and open the mouth and c) Bag – squeeze the bag harder. The practical skill was tested in a simulated environment of using Neonatal mannequin and self-inflating bag and mask device. The participants were scored using the bag and Mask ventilation performance checklist consisted of the following parameters a) Demonstrating appropriate BMV technique; b) Demonstrating the appropriate steps and sequences of BMV; and c) Demonstrating the corrective maneuvers to employ if BMV is not effective. The seven critical item on the bag and mask checklist was scored 1 when done correctly and zero (0) when not done. The score was awarded when the health workers (learner) was observed in maintaining the appropriate seal with the mask, use of correct rate of ventilation assess the chest rise and demonstrate how problems with the bag and mask ventilation would be corrected if the baby does not improve. The heath workers (participants) observed was not given any feedback on their performance during the simulation, and were given a single attempt to complete the demonstration. If the participant scores higher in the HBB plus Bag – Mask Ventilation, This was an indication of improved integration of knowledge and psychomotor skill related to Bag and Mask ventilation.

The Bag – Mask ventilation was administered by trained research assistant / primary investigator and the health workers must complete all the seven items correctly to be successful to complete. The bag-mask ventilation skills checklist was a 7-item checklist of skills to perform effective ventilation and corrective measures to improve ventilation and a learner must perform 100 % (7 of 7 steps) correctly to pass (24) .A

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mean bag mask score denoting skills of the health workers in the intervention and control was used to evaluate the change in psychomotor skills before and after. However, in the control group, the psychomotor skill test was not administered at baseline due to the prevailing insecurity which made it unsafe for the trainers and participants but was administered at immediate post intervention and 3 months follow up.

3.9.4 HBB Objective Structural Clinical Examination. (OSCE A).Checklist

Objective Structural Clinical Examination (OSCE A) (Appendix 5) which was made up of 13 observation steps consisting of scripted information on Preparation for birth, drying the baby thoroughly, ability to recognize the baby is not breathing, positioning of the head and clearing the airway, evaluation of the breathing, clamping or tying and cutting the cord, position skin to skin and communication with mother. Successful completion requires a total score of 10 correct of 13 steps and the health worker being observed must include the Dries thoroughly, Recognizes Baby is not crying and positioning and clearing the airway.

OSCE A is a performance assessment of preparation for birth and routine newborn care, and a learner must perform ≥ 80 % (10 of 13 steps) correctly to pass, including three essential steps.

3.9.5 Helping Babies Breathe Objective Structural Clinical Examination B (OSCE B) checklist

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Objective Structural Clinical Examination **(**OSCE B) (Appendix 6) was made up of 18 scripted scenario on preparation for birth, drying of the baby, recognize the baby is not breathing, ventilation at 40 breathes per minutes (30-50) acceptable, looking for chest movement, evaluate breathing, call for help, improve ventilation thorough, re-positioning the head, reapplication of mask, clear secretion, open mouth slightly and squeezing the bad hardly.

The 18 items reflects the key components of the training course for newborn survival. Each item was scored 1 if carried out correctly and any partial or incorrect action was scored zero. OSCE B was a performance assessment of a complex

resuscitation scenario that requires bag-mask ventilation, and a learner must perform ≥ 80 % (14 of 18 steps) correctly to pass, including four essential steps of recognizing the baby is not breathing, ventilate at 40 breathe per minutes and look for chest movement and improve ventilation[24].

A mean score was used to determine changes in psychomotor competency of the health workers within the intervention and control at pre, post and 3 months post intervention. Repeated measure ANOVA was used to test changes within group and unpaired sample t- test was used to determine the anticipated changes between groups (both within and between the groups)

3.9.6. The self-evaluation checklist

This check list was made up of 25 questions for the immediate care of the neonates and neonatal resuscitation as per the HBB protocol with check boxes (Appendix 7). After completing care of each of the neonates, the health worker completes the self-evaluation checklist based on the steps taken according to the HBB standards. The evaluation of the competency of the health workers was based on the mean scores of knowledge, psychomotor (bag and Mask) and OSCE A&B of the participants in the intervention and control group

3.9.7 Hospital registry and forms

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Data on the number of neonatal mortality was collected from the hospital register at the delivery room, operating theater and neonatal unit admission book pre and post implementation period.

In the pre implementation phase, hospital monthly record was used to collect the number of deliveries, neonates with breathing problem; neonates resuscitated using HBB protocols and the perinatal mortality due to asphyxia outcome at base post training and end of intervention.

For easy follow up, a simple form (was design by the research team to track deliveries, used of HBB protocol for newborn with birth asphyxia and the outcome of the resuscitation within 24 hours (appendix 8). The mean ratio of the perinatal death

was used to determine the outcome /changes of the intervention within the period of four months.

Table 4: Summary of the Quality Improvement Cycle for HBB Intervention

	Checklist/Tool	Thematic HBB Tools	Appendix
Baseline information	Socio demographic questionnaire demographic questionnaires	13 self-filled questionnaire	2
Knowledge and skill competency	Knowledge assessment	17 multiple choice questions	3
	Bag-and-mask skill	7-step skill observation checklist	4
	OSCE A	13-step observation checklist	5
	OSCE B	18-step observation checklist	6
	Preparation at birth	5-step skill observation checklist	9
HBB skills and competency practice	Daily skill check	7-step skill observation checklist	4
	Self-evaluation checklist	21-step checklist	7
	Peer evaluation process	HBB schematic protocol	11
	Weekly review meetings	Notes of the meeting	8
	Neonatal data	Hospital and maternity registry	8

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3.10 Research variables used for measurement of the intervention

The following were the study variable that was measured during the period of implementation

- Socio economic - demographic and professional characteristics of the health workers
- Helping Babies Breathe knowledge
- Helping Babies Breathe Psychomotor skills
- Helping Babies Breathe Competency
- Ratio of neonatal deaths reduction

3.11. Reliability

Reliability of the questionnaires was significant in research study for repeatability and internal consistency of the questionnaires making sure that all the items within the questionnaire measure a similar concept. The questionnaire for socio demographic and professional characteristics was tested among five (5) the health workers from Nimule Hospital not within the study area to establish the consistency of the different observers/raters. Reliability of socio demographic questionnaire was tested by half split method using Karl Person Coefficient. The 64 items in the socio demographic and professional characteristics questionnaire were split into two halves of 32. The mean of the sum of the split items of the socio demographic and professional characteristics of the health workers was computed at 0.98 (Appendix 2)

The HBB instruments Multiple Choice Questionnaire for HBB Knowledge Check (Appendix 3), Observation checklist for bag and mask ventilation skill check for psychomotor skills (Appendix 4) Observation checklists- objective structured clinical examination for testing psychomotor skills and competency (Appendix 5&6) were adapted as whole from American Academy of Pediatrics and was used in similar environment and its reliability was not tested in this study.

3.12 Validity

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The validity of the HBB instruments was high as it was only adopted with minimal and negligible changes from the previously tested by American Pediatrics Association in low income countries. For this study, the HBB instruments for assessing the knowledge of the health workers was a standard tool which has been validated and used in other low setting countries where HBB and skills evaluation have been conducted[24]. The HBB tools has been used to evaluate health workers knowledge, psychomotor skills and competency in low resourced countries like Kenya[108, 23], Tanzania[96, 105]. However face validity of the instruments was carried out in South Sudan and Thailand by experts in content and methodology.

3.13 Timing of Measures

Planning for the timing of measure was done. Health workers were taken into confidence and assured of confidentiality of their responses. The below were the timing of the measures.

3.13.1 Helping babies Breathe plus knowledge

Baseline, post and three months

A multiple choice questions (MCQ) was administered to assess the knowledge of health workers on HBB plus regarding neonatal resuscitation. Health workers in the intervention and Control group were given 20 minutes HBB plus MCQ. The maximum score for 14 of the 17 questions. A score of 1 was awarded for correct answers and 0 for incorrect answers. A score of >_ 80% indicates a passing mark. The intervention and control groups were then tested at post training and three months respectively to assess the mean changes in their knowledge.

3.13.2 Helping babies breathe plus psychomotor skill and competency measure

Pre, post and three months measurement

Only the intervention group was observed before training for bag and mask skills and competency of HBB plus regarding neonatal resuscitation and this was repeated immediately after the training (Post-test). The control groups were observed at post training and three months follow up due to the difficulty of administering the tools before training. During the time of baseline, there was outbreak of fighting among the different factions in south Sudan which affected the administration of the psychomotor skill and competency checklists to the participants and it was not safe to both participants and the facilitators. In addition, the psychomotor skill and competency checklist require more than one hours for administration and it was not possible at the time due to the prevailing security situation which made it difficult and complicated to determine the baseline line psychomotor skill and competency of the health workers in the control group. However the two groups were then tested three months at the same

period respectively to assess the mean changes in their knowledge, psychomotor skills and competency.

3.13.3. Measure of neonatal mortality

Data on the ratio of neonatal mortality was collected from the hospital register at the delivery room, operating theater and neonatal unit admission book pre and post implementation period.

13.13.4. HBB Training curricula content

The content of the HBB training curricular was

1. **Preparation** for birth with details of how to identify a helper and reviewing emergency plan, preparing area for delivery, hand washing and preparing area for ventilation and checking equipment's
2. **Routine care of newborn**: the training teaches the participants on how to dry newborn thoroughly, if meconium clear the airway, check if the baby is crying, keeping the baby warm, checking breathing, and cutting the cord as well as how to cut the cord with skill of how to demonstrate
3. **Golden minute:** The teaching focused on how to clear the air way, stimulating the baby and checking if the baby is breathing well. The participants were also taught the skills of positioning the head, clearing the airway, providing stimulations to breathe and evaluating breathing
4. **Ventilate** with bag and mask with skills of how to initiate ventilation and using the bag and mask to ventilate.

13.14. Interventions

13.14.1. Selection of research assistant and health workers

Selection of the right research assistants and willing heath workers was very significant for the training and sustaining the HBB plus resuscitation skill and knowledge overtime. The selection of the research assistants was based on the criteria outline in the HBB plus implementation guideline, while the Health workers selection

was based on the inclusion and exclusion criteria for the study. The selection was done before the actual HBB training. A total of six research assistant and 40 health workers were selected for training and 30 for control.

13.14.2. Survey of the availability of equipment's and material necessary for HBB

The necessary equipment's such bag and mask, suction devices were checked and tested and its availability in each of the unit was ensured and follow up was made by the research assistants who were assigned in each ward. To aid learning and practice of the trained health workers, HBB mannequin was provided at each of the delivery room for routine daily bag and mask skill check, self-evaluation check list was given to each of the delivery and resuscitation room for recording the clinical record of the health worker. HBB poster were placed both at the delivery room and resuscitation area alongside with the mannequin for health workers review.

Following the training of the health workers in the intervention units, the HBB equipment for training was available to the health workers practice and skill observation. There was sufficient ventilation equipment for facility delivery rooms, resuscitation practice corners, and adequate numbers to ensure ongoing mentoring and supportive supervision of health workers daily ventilation practice, equipment checks, death audits, resuscitation debriefings. The availability and provision of the equipment was always discussed at the weekly meetings to review the progress and management of neonates with asphyxia

The meeting with hospital administrators helped in providing the necessary supplies and equipment 'sin spite of the prevailing situations

13.14.3. Training of the Research Assistants

One time training was conducted for research Assistants by the researcher on HBB curriculum. The research assistants were selected from Juba teaching hospital and the Nursing and midwifery school. The research teams comprised of three (3) teams of

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two AAP/HBB TOT/research assistants to provide a ratio of at least one trainer to three trainees. The research assistant were trained for a period of three days focusing on general knowledge on HBB and facilitation skills which facilitated the rapid start of the training of the health workers and intervention of the study.

13.14.4. Training of the health workers.

The training for the health worker lasted for two days based on the mixed skills of the health worker that were selected for training using the ratio of one research assistants to 3- 6 trainees. Where the selected health workers did not participated in the two days training due to the nature of the work, a special arrangement was made for training for health workers at their work place. Each of the topic were evaluated using the checklist, observation checklist and self-assessment questions, at the end of training, an evaluation was conducted immediately by the research team (trainers) as post-test training assessment

3.14.5 Helping Babies Breathe Course structure

The Helping Babies Breathe plus provider course was two day training eight hours long. There was two training with ratio of 20 per session for two days. The training was conducted for nurses, midwives, community maternal health workers, clinical officers and intern doctors selected from maternity, newborn unit, operating theater and the children ward. Training was facilitated by experienced Midwives who were trained in helping babies breathe and are teaching in Juba College of Nursing and Midwifery. The standard protocol for training of health workers on HBB was followed and this was both made available in English and Arabic language.

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The HBB intervention was taught in English and this created some challenges to other health workers who were not too conversant with English Language. Most of the health workers trained widely speak Arabic. The Arabic version of the HBB developed and tested by American Academy of pediatrics was used initially on assumption that Arabic language was widely spoken among the health workers to aid the process of learning. However, the Arabic version proved to be too difficult for the participants as most of them speak simple Juba Arabic for South Sudan compared to

the classical Arabic used for developing the training protocol by AAP. Besides Arabic language was official language before independent South Sudan.

Currently, most of the south Sudanese had their education in the neighboring countries where English is the medium of instruction. Again, all the health training instructions in south Sudan adopted English as medium of instruction. To avoid the difficulty due to the use of English in teaching the course, a mix form of instruction was used and assistance was sought from trainers who were conversant in both Arabic and English language

The researcher and the research assistants employed didactic, demonstration and group discussion techniques of delivery the HBB package to the participants. Health worker were allocated to practice in pairs during the training. In order to share experience, facilitators/trainers were rotated within the assigned pairs of participants. The participants/health workers were oriented on the neonatal stimulator and tested for the four assessment of MCQ, Mask and bag, OSCE A and B. All the participants completed the training course using the action plan, learner's workbook, and newborn simulator, bag and mask ventilation equipment's

The health workers were asked to complete the four areas of the learners assessment to establish their baseline knowledge using multiple Choice Questionnaires (Appendix 3) consisting of 17 MCQ questions that tested resuscitation knowledge
The bag-mask ventilation skills checklist (Appendix 4) was a 7-item checklist of skills to perform effective ventilation and corrective measures to improve ventilation and a learner must perform 100 % (7 of7 steps) correctly to pass. Objective Structural Clinical Examination (OSCE) A (Appendix 5) was a performance assessment of preparation for birth and routine newborn care, and a learner must perform ≥ 80 % (10 of 13 steps) correctly to pass, including three essential steps. Finally, OSCE B is a performance assessment of a complex resuscitation scenario that requires bag-mask ventilation, and a learner must perform ≥ 80 % (14 of 18 steps) correctly to pass, including four essential steps.

The participants were scored for their knowledge, psychomotor skills and competency at baseline, posttest and after three months. During the training intervention the health workers were allowed to practice with the simulator until they

gain enough knowledge and skills on HBB before the actual implementation of the intervention in wards and units of the selected hospitals. For consistency in scoring of the participants and avoiding variation among the research assistants, orientation was provided using the HBB guidelines developed for observation and each health workers was scored by one trained research assistant except OSCE A and B which was scored by two research assistants due to it being complex task to perform

All the health workers were asked to complete the four areas of the learners using the same assessment tools at the end of the training and scored for resuscitation knowledge. The bag-mask ventilation skills checklist required 7/7 100 to pass and OSCE A and B 80% to pass to evaluate change in knowledge, psychomotor skill and competency after training and before interventions.

At the end of the training, participants were asked for their feedback using the Likert scale of strongly agree, agree and strongly disagree

3.14.6. Daily bag and mask drills Assessment evaluation

During the entire intervention, the health workers performed equipment checks and run drills of HBB on NeoNatalie using the checklist. Where the health worker encounter neonates with birth asphyxia, the research team and assigned supervisor conduct group evaluation using the written check list(Appendix 4) and at the same time , the health workers evaluates their performance using the self-evaluation checklist (Appendix 7). Each health workers who conducted resuscitation of neonates with birth asphyxia signs in the delivery registers and the designed form for the research against post resuscitation procedure column. In the existing delivery registers, there was no column for indicating the procedure and this was solved by designing different form to capture the health workers actions.

3.14.7. Quality Improvement Cycle planning and standards

In February 2017, the study team organized a half-day review workshop with hospital leadership, including the hospital director, administrator, Director of the children ward department, nursing, nursing supervisors and unit in charges.

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During this workshop, the existing practices on neonatal resuscitation and intrapartum outcomes were discussed based on an interim analysis of the data from the past four-month baseline period. A root-cause analysis of neonatal resuscitation practice was conducted, which identified the inadequate adherence to current practice recommendations and possible causes for this. The study team familiarized the workshop participants with the concept of a QIC. A multi-disciplinary quality improvement team (QIT) of the workshop participants was formed with the nursing in charge of maternity ward as the lead person. The QIT decided to reconvene to develop a QIC with the aim of improving adherence to neonatal resuscitation protocols at the hospital.

The QIT conducted meetings with the staffs at each delivery unit to discuss the causes of inadequate adherence to clinical practice and how to improve it. These meetings identified the need for continuous skill enhancement, equipment support, and periodic review and reflection meetings. As a result of the meetings, the hospital decided to set a goal to reduce intrapartum related death by 50% through HBB protocol training and subsequent improvement of knowledge and adherence (Figure 5). The meeting identified five key quality improvement processes to improve the adherence to neonatal resuscitation protocol:

1. Training on the HBB protocol
2. Being prepared for all births, that is, readiness for neonatal resuscitation for each birth
3. Bag-and-mask skill check on a mannequin on a daily basis
4. Self-evaluation on the managing of babies
5. Peer evaluation after neonatal resuscitation

To assess the progress of the implementation of the quality improvement process, the QIT provided HBB training, conduct four (4) sessions of weekly review meetings as a part of the QIC. To monitor the progress of HBB QIC implementation, a progress board was created for placement at each delivery unit (Appendix 9).

3.14.8. Implementation of HBB quality Improvement Cycle

In the last week of February 2017, the health workers received 2 day training on HBB quality improvement cycle. The training was provided for all the health workers in

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maternity, operating theater for obstetrics, newborn unit and children ward. To maintain the standard and the quality of HBB resuscitation, weekly review meeting was conducted to discuss the progress and challenges with the HBB quality improvement and implementation of the HBB QIC standards

Two research assistants were allocated each in maternity, operating theater and neonatal unit working in turn (day and night) and were provided with the record form design for collecting all the activities, practices of the health workers. Each steps taken by the health workers during resuscitation was reviewed by the trained research assistant working alongside with the participants at the resuscitation table. Where the research assistant (trained and skilled health workers) found that the practice of the health workers was not according to HBB protocol and endangers the newborn survival, always the research assistant were asked to intervene in professional way and save the neonates lives.

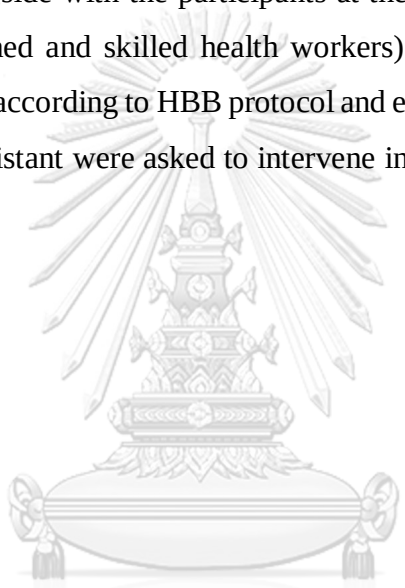

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Table 5: Summary of the implementation of strategies for HBB QIC

Component	Activity	Facilitators/Participants
HBB training	Two-day training. First day on HBB knowledge and skills as per standard package and second day on components of HBB QIC standards, training of trainers on how to conduct Weekly review and reflection meeting, how to fill self-evaluation checklists and conduct review evaluations.	Facilitators: HBB trainers Participants: Staff of the delivery units
Setting up HBB QIC standards	At each unit, development of QIC goals and objectives, development of a place for daily bag-and-mask skill checks, QIC weekly review and reflection meetings, use of self-evaluation checklists and peer reviews after each resuscitation.	Facilitators: Study team Participants: Staff of the delivery units
QIC Weekly review and reflection meeting	At each unit, the unit in-charge facilitates the weekly review and reflection meetings on the progress of implementation of HBB QIC standards.	Facilitators: HBB trainers Participants: Staff of the delivery units
Daily bag-and mask skill check	At each unit, each staff member completes a bag-and-mask skill check on the mannequin before starting duty.	Facilitators: Unit in-charge Participants: Staff of the delivery Units

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Self-evaluation checklist after each delivery	**Self-evaluation checklist, which consists of a list of steps for immediate newborn care and neonatal resuscitation as per HBB protocol with checkboxes. After completing care of each newborn, the nurse midwife will complete the self-evaluation checklist based on the steps taken as per the HBB protocol**	**Facilitators: Unit in-charge Participants: Staff of the delivery units**
Peer review after each resuscitation	A mounted poster with the steps of the HBB protocol will be displayed at each resuscitation table, so that peers can review with the colleague completing resuscitation on whether the steps were followed.	Facilitators: Unit in-charge Participants: Staff of the delivery units
Refresher training	A one-day training course provided to all the Delivery unit staff on the HBB protocol.	Facilitators: HBB trainers Participants: Staff of the delivery units

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(Adapted from QIC, 2013)

3.15 Newborn care for the control group

Health workers in the control site received no intervention and continued to provide routine essential care for the newborn according to the national ministry of health protocol of care cord, keeping the baby warm , eye care, immunization, recognition of the danger signs and care of the low birth weight infants (Details described in Chapter 2)

3.15. Data management

The research team collected Data on socio demographic and economic information from all health workers who have consented to participate in Interventions and Control population using the socio- demographic questionnaire (appendix 2) before the training.

Research assistants collected information on health workers resuscitation (appendix 2) from the hospital resuscitation sites using HBB protocol and checklists.

The research assistant verified the recorded number of newborn delivered and complete the observational form for health worker resuscitating a newborn with asphyxia using the HBB protocol and this was regularly reviewed by the research coordinator. An additional form was created and placed at the resuscitation table in each unit to record still birth, neonatal deaths. Each of the form completed was verified by the researcher for accuracy and ensure that data collected in the entire unit were similar and identical. At least 20% of the data were verified by researcher. Within the period, data were tracked from the general register and recorded by the research assistant to avoid data loss and checked for completeness and accuracy.

Data was entered into excel and exported to Statistical Package for the Social Sciences (SPSS) version 20 which was used for data analysis and management. Hard copies of the observation records have been kept and stored in filling system and secure for reference. Missing data was checked using SPSS Software packages.

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3.16. Data analysis

Data was entered into excel, exported to SPSS version 20, coded, cleaned and locked up before detail analysis was made on background characteristic , socio cultural , neonatal knowledge , skill, competency and ratio of neonatal mortality within 24 hours after resuscitation.

Frequency, Chi- Squared test and Exact fisher test were used to analyze the socio – demographic and professional characteristic of the health workers which included age , qualifications , year of experience , ethnicity , place of work, monthly

income , level of education and prior exposure to resuscitation education for intervention and control group

The academic qualification of the health workers were grouped into those who have completed college or tertiary education , nursing , community health workers including maternal and newborn professional course.

Mean, standard deviation, range was used to assess knowledge, skill and competency of the health workers in intervention and control group

Descriptive and inferential statistics were performed using SPSS for Windows version 20.0 and statistically valid inferences was made from the data

Categorical variables was explored by Chi- squared test. Values lower than 0.05 was considered statistically significant. Repeated measure ANOVA was used to test the mean difference within the group at baseline, immediate post intervention and 3 months follow up within the group.

Unpaired t-test was used for testing the mean difference between the intervention and control for skill and competency at baseline, immediate post intervention and 3 months follow up. Un-paired sample t - test was a choice because the sample size between the intervention and control group was not equal and data collected was normally distributed with same standard deviation and Frequency and percentage was used to determine the ratio of neonatal deaths due to asphyxia.

3.17 Ethical consideration

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Ethical approval for the study was sought from South Sudan Health Research Institute, Ministry of health, Juba teaching Hospital and Ethical review of College of Public Health Science, Chulalongkorn University provided ethical approval for the study. In addition to approval from the institutions, several meeting were held with hospital administration and the health workers on the study protocol.

Informed consent both verbal and written was obtained from the participants and the risk was explained along with confidentiality and privacy measures to ensure that their data is safeguarded and not utilized for any purpose outside the purpose of this study. During the study, risk to harm to the newborn was averted by intervention of the research assistants in the course of resuscitation. The research assistant and the

researcher conducted follow up on the neonates for 24 hours within the ward and those discharge before 24 hours were conducted through phones.

The ethical approval from South Sudan Health Research Institute, Ministry of health, Juba teaching Hospital was done without indication of training of the health workers in the control group in case of proven effectiveness in the intervention group. Due to the prevailing security situation at the time of study, the Ethical Review Board waived the necessity to repeat such a training in the control are due to safety reason for the trainers and the participants at the time of the research

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Chapter Four

Result

This chapter data analyses and presents results from the different objectives of the study conducted. Data was collected, analyzed and presented both descriptively and analytically in order to answer the research objective of this study as 1) Assess change in health worker knowledge, on neonatal resuscitation before and after the training interventions 2) to assess change in psychomotor skills of trained health workers regarding neonatal resuscitation before and after the training intervention 3) to assess change in the competency of the health workers regarding managing neonates with birth asphyxia before and after training intervention and 4) to determine the change in reduction in the ratio of perinatal mortality due to asphyxia of hospital admission within 24 hours of birth before and after training interventions.

To compare changes before and after training in the intervention group with the control group. At the end of the study, the objectives were accomplished and the result is presented in the chronology of the objectives

4.1 Recruitment and allocation of Health Worker

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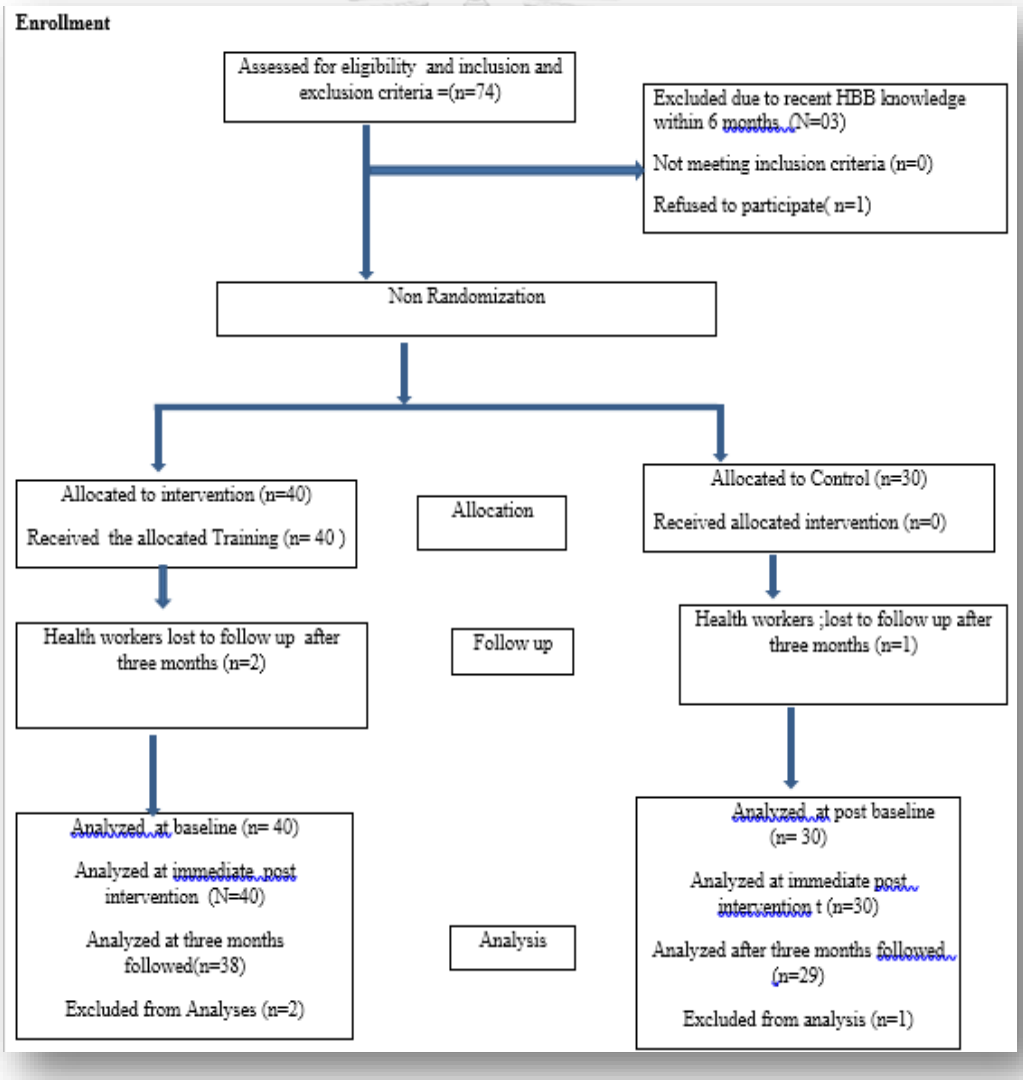
Figure 4 is the summary of the recruitment and allocation of the health workers who participated in the training, assessment, quality improvement cycle during the Helping Babies Breathe (resuscitation) intervention and 3 months follow up to intervention and control group.

A total sample size required for the study was 77 health workers per group (Intervention and control). However, only 70 health care workers were enrolled during the HBB training at pre and immediate intervention for both intervention and control group. The number of health worker who completed the training and assessment on helping Babies Breathe (resuscitation) at pre, and immediate intervention was 70 and 67 health workers were available at three months follow up.

Three (3) participants, two (2) from intervention and one (1) from control group were lost to follow up at the end of 3 months as result of the ongoing conflict in South Sudan and fled the country due to their ethnicity and were not included at the final analysis. In spite of 50% of the needed sample size, it was still possible to conduct statistical analysis to test the hypothesis and achieve the study objective. This could be as result of over estimation of the sample size for the groups due to the wrong assumption of the effect size which was set at only 20% but the intervention group achieved more than 50% between baseline and immediate post intervention.

Figure 4 Flow Chart for Recruitment and allocation health Workers



4.2 Socio Demographic and professional Characteristics

The table6 and 7 below details the socio demographic and professional characteristic of the health workers who participated in the study.

Majority of the health workers were aged between 25 years to 35 years. Nurses and midwives were the majority in intervention and control group and were predominantly female (82.5%) in intervention and 80%) providing newborn care (Table 6)

Most of the health workers were working in maternity labor room) 23 (57.5%) and 19(63.3%), children ward 16 (40%) and 7(23.3%) and operating theater 1(2.5%) and 4(13.3%) respectively

Majority of the health workers self-reported to be registered nurses and midwives with tertiary and college education (77.5% of the intervention versus 73.3% in control).

The level of income in the middle income bracket of 1001- 2,000 South Sudan Pound varies between intervention and control group with control group slightly receiving higher income compared to intervention. The difference however is not significant.

The duration of practice among the health workers ranged from less than one year to over five years with most having practiced over five years (32.5%) intervention and versus (36.7%) in control group and , there was no significant difference between intervention and control group (Table7).

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Table 6: Demographic and professional characteristics of the Health workers at baseline

		Intervention		Control				
Demographic Characteristics		**Freq. (N=40)**	**(%)**	**Freq. (N=30)**	**(%)**		***p*- value**	**Statistical test**
Age in years	25-35	25	62.5	20	66.7	0.130	0.719	Chi-square
	36 above	15	37.5	10	33.3			
Gender	Male	7	17.5	6	20.0	0.071	0.790	Chi-square
	Female	33	82.5	24	80.0			
Education level	Primary eight	6	15.0	4	13.3	0.748	0.781	Fisher Exact
	Secondary	3	7.5	4	13.3			
	College/ tertiary	31	77.5	22	73.3			
	Diploma in Midwifery	1	2.5	0	0			
	Community H.W Training	1	2.5	0	0			
Professional qualification	Nurse	12	30.0	10	33.3	5.690	0.623	Fisher Exact
	Midwives	17	42.5	11	36.7			
	Maternal Child health officer	3	7.5	1	3.3			
	Nurse practitioner	1	2.5	0	0			
	Clinical officer	2	5.0	2	6.7			Fisher Exact
	Community Health workers	4	10.0	2	6.7			
	Skilled birth attendants	1	2.5	1	3.3			
	Intern Doctor			3	10.0			

Significant level at 0.05. Rounded at one decimal place

The 25-35 years in case of age is based on the fact that it represents the youthful age group. Fishers Exact test have been used for cell counts less than 5.

Table 7: Occupation, place of work, income duration work and knowledge at baseline

		Intervention		Control				
Demographic and social characteristics		**Freq. (N=40)**	**(%)**	**Freq. (N=30)**	**(%)**		***p*-value**	**Statistical test**
Primary area	Newborn care	11	27.5	8	26.7	5.987	0.097	
	Sick children ward	4	10.0	1	3.3			
	Maternal and newborn care	25	62.5	17	56.7			
	Obstetrics/Obstetrician			4	13.3			
Current place of work	Maternity ward	23	57.5	19	63.3	4.135	0.129	Fisher Exact
	Children ward	16	40.0	7	23.3			
	Operating theater (OT)	1	2.5	4	13.3			
Monthly income	300- 1000 SSP	18	45.0	8	26.7	2.896	0.235	Chi-square
	1001- 2,000 SSP	14	35.0	16	53.3			
	2,001 SSP and above	8	20.0	6	20.0			
Duration of practice	≤ 1 year	12	30.0	6	20.0	0.980	0.806	
	Two – three years	10	25.0	8	26.7			
	Four – five years	5	12.5	5	16.7			
	Over five years	13	32.5	11	36.7			
knowledge	Baseline	17	42.5		48		0.6	Unpaired test
Psychomotor skill	Baseline (baseline)	10	26	*	*			
Simple Competency	Baseline (baseline)	10	26.9	*	*			
Complex competency	Baseline (baseline)	7	17.5	*	*			

*Significant level at 0.05. Rounded at one decimal place. Fishers Exact test have been used for cell counts less than 5. Based line knowledge was tested by unpaired t – test, *psychomotor skill and competency for simple and complex neonatal resuscitation at baseline cannot be compared due to lack of assessment for control at baseline.

4.3. Encounter with newborn/infant with breathing problems

Table 8 details the encounter of health workers with newborn with breathing problems and resuscitation education exposure. Among the health workers who received training and assessment on neonatal resuscitation, 72.5% reported frequently encountering newborn with breathing problem on daily basis compared to 53.3% in the control group. However, a good proportion (40%) of health workers in the control group reported having encountered newborn with breathing problem on weekly basis (frequently).

4.4. Exposure to resuscitation education /training

Table 8 is the overview of the health workers exposure to resuscitation education prior to the study in both intervention and control group. In the intervention group 47.5% never received any prior formal training on neonatal training in the intervention group versus 10% in the control group. Of those health workers who reported to have received other forms of neonatal resuscitation, 27.5% in intervention and 43% among the control received training in Cardio Pulmonary Resuscitation(CPR) which is highest among the control group, followed by other training in other pediatric resuscitation (10%) in intervention and 20% control and 10% each on advanced pediatric life support. However, a good proportion of health workers constituting 15% received training on essential New born care (ENBC) in the intervention and none received this in the control group.

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Table 8: Encounter with neonates with breathing problems and exposure to resuscitation education /training.

		Intervention (N=40)		Control(n=30)	
Variables		**Freq**	**Percent (%)**	**Freq**	**Percent (%)**
Encounter with newborn/infant who is not breathing well	Very frequently (almost on daily basis)	29	72.5	16	53.3
	Frequently (Weekly)	10	25.0	12	40.0
	Never	1	2.5	1	3.3
Resuscitation Education Exposure	Cardiopulmonary Resuscitation	11	27.5	13	43.3
	Essential Newborn Care (ENBC)	6	15.0	-	-
	Other infant resuscitation or life support	4	10.0	6	20.0
	Pediatric Advanced life support	4	10.0	3	10.0
	No prior Resuscitation exposure	19	47.5	3	10.0

Note: *15% of the health workers in intervention received training on ENBC) which made the group different from the Controls although this did not affect the result at baseline for both groups.*

4.5**: Health workers knowledge on HBB at baseline, immediate post intervention and three months follow up**

Table 9 below is the measure of knowledge of health workers for intervention and control group tested from baseline to 3 months follow up. Both groups were similar at baseline with slight mean difference which was not significant (mean 42.5% intervention compared to mean 48.0% control).

The intervention showed significant increase at immediate post intervention and 3 months follow up compared to the control group. There was no significant increase among the health workers in intervention on timing and clamping of cord (baseline 40%, immediate post intervention 40% and 3 months follow up 38%). In the control group, there was significant increase for actions on priorities in the first minute of life (baseline 60%, immediate post intervention73%) and declined to 69% at 3 months.

Similarly, the control group had high percentage score in normal heart rate at baseline (73%) compared to intervention at 57%. At immediate post intervention both groups showed significant percentage increased (100% intervention versus control 87% and maintained for intervention at 100% and slightly reduced to 79% in the control group).

Table 9: Knowledge on HBB of intervention and control group at base line, immediate post and three months follow up

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Variable	Intervention				Control			
Knowledge	Pre (%)	Post (%)	3-Mon (%)	Stat. Sig	Pre (%)	Post (%)	3-Mon (%)	Sta Sig
Priorities in the first minute of life.	37.0	100.0	89.0	**0.000***	60.0	73.0	69.0	0.36
Preparation for birth and emergency planning.	30.0	97.0	87.0	**0.000***	43.0	50.0	59.0	0.44
Preparation for area of delivery	40.0	100.0	97.0	**0.000***	33.0	43.0	52.0	0.25
Newborn who can receive routine care	13.0	85.0	50.0	**0.000***	27.0	30.0	21.0	0.65
Routine care for healthy newborn	45.0	100.0	92.0	**0.000***	67.0	70.0	59.0	0.46
Timing of cord clamping of the cord	40.0	40	38	**0.34**	33.0	27.0	21.0	0.36
Response to newborn who is limp and not breathing	32.0	100	79	**0.000***	23.0	20.0	24.0	0.76
Response to newborn with meconium stained fluid	25.0	100.0	68.0	**0.000***	27.0	23.0	21.0	0.60
Action during the golden minute	40.0	95.0	87.0	**0.000***	47.0	43.0	52.0	0.79
Begin ventilation in newborn who is limp, quiet and not crying	48.0	95.0	97.0	**0.000***	50.0	50.0	45.0	0.92
Correct use of bag and mask techniques for newborn who is not breathing	42.0	100.0	37.0	**0.000***	40.0	47.0	41.0	0.76
Ongoing monitoring of breathing the first few minutes	57.0	95.0	87.0	**0.000***	73.0	77.0	72.0	0.90
New bag and Mask Ventilation correct man over	45.0	97.0	82.0	**0.000***	60.0	57.0	66.0	0.49
when to stop ventilation	50.0	100.0	95.0	**0.000***	33.0	37.0	48.0	0.09
Steps to keep the baby warm - Skin to skin	45.0	97.0	97.0	**0.000***	67.0	67.0	66.0	1.00
Actions to ensure hygiene and cleanliness	**60.0**	**100.0**	**95.0**	**0.000***	**60.0**	**70.0**	**72.0**	**0.27**
Normal newborn heart rate	57.0	100.0	100	**0.000***	73.0	87.0	79.0	0.36
Average mean Score	**42.5**	**94.2**	**81.0**		**48.0**	**51.2**	**51.0**	

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*Significant level at 0.05 Rounded at one decimal point and tested by repeated measure ANOVA. Tested using repeated measure ANOVA at baseline, immediate post intervention and 3 months follow up

4.6. Knowledge of the health workers in intervention and control

Table 10 presents the test mean scores of the participants within the intervention and within the control at baseline, immediate post intervention and three months follow up tested by repeated measures ANOVA. In intervention, there was significant increase in terms of knowledge between the baseline and immediate post intervention (mean difference increase of 55.2 (50.9-59.6) $P<0.05$) and this decreased slightly between the immediate post intervention and three months follow up with mean difference of 13.3(-17.7—8.87) , $p<0.05$). This mean decrease between the immediate post intervention and 3 months follow was not statically significant.

In the control group, there was slight increase in knowledge between baseline and immediate post (mean difference of 3.1(-3.0-9.4) $p> 0.05$) and this increased further at 3 months follow up (mean difference of 0.3(-0.1—6.0) $p>0.05$) which was not statistically significant.

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Table 10: Mean difference of Knowledge, of the health workers within the intervention and within the control Group at baseline immediate intervention and 3 moths follow up

	Intervention			Control		
Variable	Mean df 95%CI			Mean df 95% CI		
Knowledge	**Mean**	**Mean dif. /CI**	**P.Value[a]**	**Mean**	**Mean dif. CI**	**P.Value [b]**
Baseline	42.5± 17.3			48.0±13.9		
Intermediate post	97.8±3.4	55.2 (50.9-59.6)	<0.001	50.9±15.7	3.1(-3.0-9.4)	0.9
3 months follow-up	84.7±7.7	-13.3(-17.7—8.87)	<0.001	51.2±11.2	-0.3(-0.1—6.0)	0.9

Rounded at one decimal place Data expressed a mean difference.

*Significant level at 0.05.[a] Control within Intervention groups, [b] Control within control group was tested by Repeated Measure-AVOVA

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4.7. **Knowledge mean score between intervention and control at baseline, immediate post intervention and three months follow up**

Table 11 shows the knowledge mean difference between intervention and control group at baseline, immediate intervention and three months follow up tested by unpaired t test.

In terms of outcome, there was no significant difference in knowledge between intervention and control group at baseline ($p>0.05$). However, this significantly increased in intervention at immediate post intervention and 3 months follow up ($p>0.05$)

Table 11: Knowledge Mean difference of the health workers between the intervention and control Group at baseline immediate intervention and 3 months follow up

	Intervention	**Control**	***Mean df(CI)***	***P*-Value[a]**
Knowledge				
Baseline	42.5± 17.3	48.0±13.9	-5.5(-11.4-0.32)	0.064
Intermediate post intervention	84.7±7.7	50.9±15.7	46.6 (40.8-52.5)	< 0.001*
3 months follow-up	97.8±3.4	51.2±11.2	33.8(27.8-39.7)	<0.001*

Rounded at one decimal place. Data are expressed as Mean score difference test*significant level at 0.05 [a] Control between Intervention and control groups tested by unpaired t- test

4.8: Health workers Helping Babies Breathe psychomotor skills

The health workers were tested for their psychomotor skill regarding the seven steps which included 1) Check equipment and select the correct mask 2) Apply the mask to make a firm seal 3) Ventilate at 40 breathes per minutes 4) Look for chest movement 5) Reapply mask and reposition head 6) Clear secretions and 7) open mouth Squeeze the bag harder at baseline, immediate post intervention and 3 months follow up.

In the intervention group, psychomotor skills increased from 26% to 95.3% at immediate post intervention and 94.3% 3 months follow up.

A categorical variable was created as a measure for health care psychomotor skills. The result reveal that skill of health workers checking equipment and selecting correct equipment increased from 40% to 97 % immediate post intervention and slightly declined to 87.0% at 3 months. Similar result was obtained on ventilating at 40

breaths per minutes, looking for chest movement, reapplication of the mask and position the head, clear secretion and open mouth and squeezing the bag harder. There was significant increase in psychomotor skill variables from baseline to 3 months follow up

In the control group, the baseline line information was not obtained. Psychomotor skills declined from41.9% at immediate post intervention to 39% at 3 months follow up and there was no significant change in in the categorical variable of psychomotor skill between immediate post intervention and 3 month follow up (Table 12).

Table 12: Psychomotor skills on the HBB of health worker in intervention and control group at base line, immediate post and three months follow up

	Intervention				**Control**			
Variable	Pre (%)	Post (%)	3-Mon (%)	Stat. Sig	Pre (%)	Post (%)	3-Mon (%)	Stat. Sig
Check equipment and select the correct mask	40.0	97.0	87.0	0.000*	**-	57.0	45.0	1.000
Apply the mask to make a firm seal	50.0	97.0	95.0	0.000*	**-	47.0	41.0	0.448
Ventilate at 40 breathes per minutes	23.0	95.0	97.0	0.000*	**-	43.0	31.0	0.537
Look for chest movement	25.0	93.0	100.0	0.000*	**-	33.0	41.0	0.212
Reapply mask and reposition head	13.0	100.0	100.0	0.000*	**-	33.0	41.0	0.602
Clear secretions and open mouth	18.0	95.0	97.0	0.000*	**-	47.0	52.0	0.813
Squeeze the bag harder	15.0	90.0	84.0	0.000*	**-	33.0	28.0	0.787
Average mean Score	**26.3**	**95.3**	**94.3**	**0.000***	****	**41.9**	**39.9**	

*Significant level at 0.05 and tested by unpaired t test. Rounded at one decimal point

** No baseline conducted for control group for bag and mask due to insecurity at time

4.9. Psychomotor skill on HBB of the health workers at baseline, immediate post intervention and 3 months

Repeated measures ANOVA was used to test for the psychomotor skill for the intervention and control group at baseline, immediate post intervention and 3 months follow up (Table 13). When compared from baseline to 3 months follow up, the intervention had significant increase between base line and immediate post intervention with mean difference of 69.2(62.8-75.7) $p<0.05$ and this increased at 3 months follow up(mean difference 0.1(-0.3-0.8), $p<0.05$)

In the control group, the baseline was not tested and only the immediate post intervention and 3 months follow-up was tested. From the outcome, there was no significant increase in psychomotor skill in the control (mean difference -3.4 (-11.0-4.10, $p>0.05$.)

Table 13: Psychomotor mean difference on HBB of the health workers within the intervention and within the control Group at baseline immediate intervention and 3 months follow up

	Intervention			**Control**		
Variable	**Mean df 95%CI**			**Mean df 95% CI**		
Bag and mask	**Mean**	**Mean dif. /CI**	**P.Value[a]**	**Mean**	**Mean dif. CI**	**P.Value [b]**
Baseline	26.1±19.9			**-**		
Intermediate post intervention	94.4±8.5	69.2(62.8-75.7)	<0.001*	40.9±18.9		
3 months follow-up	95.4±6.8	0.1(-0.3-0.8)	<0.001*	43.8±16.7	-3.4 (-11.0-4.10)	0.37

*Significant level at 0.05. Data expressed as mean difference. **No baseline conducted for control group for bag and mask due to insecurity at time [a]. Control within Intervention groups, [b] Control within control group determine by repeated measure-ANOVA.

4.10: Psychomotor skill between Intervention and control group at immediate post intervention and 3 months follow up

Table 14 below details the mean difference between intervention and control group at immediate intervention and three months follow up tested by unpaired t test. When examined from the immediate post intervention and 3 months follow up, there was significant increase in psychomotor skill in the intervention compared with the control group ($p<0.05$).

Table: 14 Psychomotor mean difference of the health workers between the intervention and control Group at baseline immediate intervention and 3 months follow up

	Treatment	**Control**	***Mean df. (CI)***	***P*-Value**
Bag and mask				
Pre-test	26.1±19.9	-**	**-	**-
Immediate post test	94.4±8.5	40.9±18.9	51.5(44.4-58.6)	<0.001*
3 months follow-up	95.4±6.8	43.8±16.7	53.4(46.2-60.7)	<0.001*

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Rounded at one decimal place. *significant level at 0.05 Data are expressed as Mean score difference Control between Intervention and control groups tested by unpaired T-test.

4.11: Health worker competency for simple resuscitation

Health workers were tested for competency for simple resuscitation at baseline ,immediate post intervention and 3 months follow up in the intervention group showed a significant changes with mean score increasing from 27.0% at baseline to 88.9% at immediate post intervention and remaining 89.2%, 3 months follow up($p<0.05$).

Within intervention group, only 10 % of the health workers correctly performed actions to recognize that babies were not breathing, keeping the baby warm, positioning the head and clearing the airway and stimulating breathing. Further, none (0%) of the health workers performed action of rubbing the back and recognizing that the baby is not breathing well.

In control group, health workers were only tested at immediate post intervention and 3 months follow up. At immediate post intervention, 37.5% of the health workers correctly performed action for simple resuscitation for newborn and this reduced to 35.8% 3 months follow up. There was no significant changes in other categorical variables actions for simple resuscitation throughout the actions performed by the health workers (Table 15).

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Table15: Psychomotor skills on the HBB of intervention and control group at baseline, immediate post intervention and three months follow up

	Intervention				Control			
Variable	**Pre (%)**	**Post (%)**	**3-Mon (%)**	**Stat. Sig**	**Pre (%)**	**Post (%)**	**3-Mon (%)**	**Stat. Sig**
Identifies a helper and make emergency plan	65.0	90.0	55.0	**0.005***	**-	90.0	72.0	**0.031***
Prepares the area for delivery	63.0	95.0	87.0	**0.002***	**-	30.0	29.0	0.489
Clean hands and maintain clean techniques throughout	43.0	95.0	95.0	**0.000***	**-	53.0	72.0	0.202
Prepares an area for ventilation and check equipment	30.0	100.0	84.0	**0.000***	**-	33.0	59.0	0.070
Dries Thoroughly	20.0	92.0	100.0	**0.000***	**-	33.0	17.0	0.202
Removes wet cloth	15.0	93.0	95.0	**0.000***	**-	30.0	38.0	0.537
Recognizes Baby is not breathing	10.0	80.0	89.0	**0.000***	**-	33.0	17.0	0.134
Keep warm	10.0	80.0	84.0	**0.000***	**-	37.0	41.0	0.602
Position Head and Clear Airway	10.0	90.0	95.0	**0.000***	**-	27.0	10.0	0.161
Stimulates breathing by rubbing the back	10.0	80.0	100.0	**0.000***	**-	20.0	21.0	0.712
Recognizes the baby is not breathing well	0.0	93.0	95.0	**0.000***	**-	23.0	34.0	0.326
Clamps or ties and cuts the cord	45.0	78.0	89.0	**0.000***	**-	43.0	28.0	0.255
Position skin to skin on mother chest	30.0	90.0	92.1	**0.000***	**-	40.0	27.6	0.212
Average mean Score	**27.0**	**88.9**	**89.2**		**-	**37.8**	**35.8**	

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Rounded at one decimal point *Significant level at 0.05 and tested by repeated measure ANOVA **No baseline conducted for control group for simple resuscitation competency OSCE A due to insecurity

4.12 Competency on simple resuscitation on HBB of intervention and control group at baseline, immediate post intervention and three months follow up

Table 16 summarizes the competency for simple resuscitation for the health workers in the intervention and control group tested by repeated measures ANOVA at

baseline, immediate post intervention and 3 months follow up. Within the intervention group, there was significant increase of competency for simple neonatal resuscitation from baseline and immediate post intervention (mean difference of 61.2(57.0-66.5 $p<0.05$) and deceased slightly at 3 months follow up (mean difference 0.3.1(-4.6-5.32). However, the mean difference between the immediate post intervention and 3 months was not statically significant ($p>0.05$).

Health workers in control group were not tested at baseline for simple resuscitation but tested at immediate post intervention and 3 months, Result showed that there was no significant increase in competency of health workers between immediate post intervention and 3 months follow-up($p>0.05$).

Table 16: Simple psychomotorcompetency mean difference on HBB within intervention and within control group at pre-test, immediate post intervention and three months follow-up

	Intervention			Control		
	Mean df	95%CI		Mean df 95% CI		
OSCE A	Mean	Mean dif. /CI	P.Value [a]	Mean	Mean dif. CI	P.Value [b]
Baseline	26.9±14.6			**-	**-	**-
Intermediate	89.3±8.1	61.2(57.0-66.5	<0.001*	38.9±8.5		
3 months follow-up	88.8±8.5	0.3.1(-4.6-5.32)	0.90	41.3±14.4	-2.65(-8.42-3.1)	0.36

*Significant level at 0.05. Rounded at one decimal place Data expressed as mean difference. **No baseline conducted for control group due to insecurity. [a] Control within Intervention groups, [b] Control within control group determine by Repeated measure

4.13: Health workers mean competency difference between intervention and control group at post and 3 months between the groups

Table 17 below details the mean difference between intervention and control group at immediate intervention and three months follow up tested by unpaired t test.

When examined from the immediate post intervention and 3 months follow up, there was significant increase in competency for simple resuscitation skill in the intervention compared with the control group ($p<0.05$)

Table 17: Simple psychomotorcompetency mean difference on HBB between intervention and control group at pre-test, immediate post intervention and three months follow-up

Variable	Intervention	Control	*Mean df 95% (CI)*	*P*-Value[a]
OSCE A				
Baseline	26.9±14.6	**-.	**-.	**-.
Intermediate post intervention	89.3±8.1	38.9±8.5	47.6(42.2-52.8)	<0.001*
3 months follow-up	88.8±8.5	41.3±14.4	50.3(44.8-55.7)	<0.001*

*Significant level at 0.05. Data are expressed as mean score difference. **No baseline conducted for control group due to insecurity problems, time [a] Control between Intervention and control groups was tested by unpaired t test

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4.14: **Health worker competency for complex neonatal resuscitation (OSCE B)**

Table 18 shows tested health workers competency for complex resuscitation action for newborn at baseline, immediate post intervention and 3 months. There was significant increase of competency for complex neonatal resuscitation from 35.7% at baseline to 88.7% at immediate post intervention and the percentage increase from immediate post intervention decreased to 81.7% 3 months.

In the control group, test was conducted at immediate post intervention and 3 months follow up. The percentage score for the health worker decreased from 36.5% to 33.1% 3 months follow up.

Both group had higher score for action for preparation for birth at baseline immediate post intervention. (Intervention= baseline 82.5%, immediate post intervention 85.0% and 3 months 86.8%) and (control = immediate post intervention 80% and 3 months 55.2%) There was no significant change in this actions after intervention for both groups (Table 18).

Within the intervention group, action for drying thoroughly and removing wet cloth decreased from baseline 100% to 92.1% immediate post intervention and further declined to 25% 3 months period. The decreased was significant ($P<0.05$). At baseline in intervention group, none (0%) of the health workers correctly performed actions to start ventilation within Golden minutes, ventilate at 40 breathes /minutes (30-0 minutes) and looking for chest movement although it increased significantly ($p<0.05$).

Table18: Complex psychomotor competency on HBB of intervention and control at pre-test, immediate post intervention and three months follow-up

	Intervention				Control			
Variables	Pre (%)	Post (%)	3-Mon (%)	Stat. Sig	Pre (%)	Post (%)	3-Mon (%)	Stat. Sig
Prepares for Birth	82.5	85.0	86.8	0.819	-	80.0	55.2	**0.030***
Dries thoroughly and removes wet cloth	100.0	92.1	25.0	**0.000***	**-	76.7	79.3	1.000
Recognizes baby is not crying	25.0	97.5	94.7	**0.000***	**-	43.3	62.1	0.110
Keep warm, position head , and clear airway	12.5	100.0	97.4	**0.000***	**-	53.3	55.2	1.000
Stimulates breathing by rubbing the back	22.5	80.0	97.4	**0.000***	**-	40.0	48.3	0.537
ventilate with bag and mask	75.0	97.5	89.5	**0.000***	**-	16.7	24.1	0.264
Cut cord and move to area for ventilation, or ventilate by mother	12.5	87.5	78.9	**0.000***	**-	40.0	27.6	0.212
Start ventilation within Golden minutes	0.0	85.0	84.2	**0.000***	**-	20.0	13.8	0.326
Ventilate at 40 breathes /minutes (30-0 minutes)	0.0	97.5	86.8	**0.000***	**-	16.7	17.2	1.000
Look for chest movement	0.0	95.0	92.1	**0.000***	**-	16.7	17.2	1.000
Recognizes the baby is not breathing	25.0	95.0	89.5	**0.000***	**-	26.7	31.0	0.489
Call for help	**75.0**	**82.5**	**84.2**	0.000*	**-	**23.3**	**37.9**	**0.134**
Continues for ventilation	50.0	92.5	100.0	**0.000***	**-	16.7	24.1	0.326
Improves ventilation	75.0	95.0	92.1	**0.000***	**-	16.7	17.2	1.000
Recognizes the baby is not breathing	12.5	80.0	78.9	**0.000***	**-	43.3	27.6	0.169
continues ventilation	26.7	38.5	34.3	**0.000***	**-	43.3	27.6	0.096
Recognizes baby is breathing and heart rate normal	25.0	95.0	86.8	**0.000***	**-	36.7	17.2	0.110
Stop ventilation ,	22.5	90.0	71.1	**0.000***	-	46.7	13.8	**0.005***
Average mean score	**35.7**	**88.1**	**81.7**		-	**36.5**	**33.1**	

* Significant level at 5% rounded at 1 decimal place**No baseline conducted for control group for simple resuscitation competency due to insecurity problems.

4.15: Competency of Health workers on complex resuscitation within intervention and control group at base line, immediate post and three months follow up

Table 19 is the summary of repeated measure ANOVA for competency of health workers for complex resuscitation in intervention and control group at base line immediate post and 3 months follow up. When compared from baseline to 3 months of follow up, the intervention group had significant increase between baseline and immediate post intervention ($p<0.05$) and this decreased at 3 months follow up (mean difference 2.74(-6.71-1.22) but the changes remained insignificant ($p>0.05$)

In the control group, the health worker were tested at immediate post intervention and 3 months follow up and there was no significant change in the competency for complex neonatal resuscitation ($p>0.05$)

Table 19: Competency of Health workers on complex resuscitation within intervention and control group at base line, immediate post and three months follow up

	Intervention			Control		
	Mean df 95%CI			Mean df 95% CI		
OSCE B	Mean	Mean dif. /CI	P.Value[a]	Mean	Mean dif. CI	P.Value [b]
Baseline	17.5±8.9			**-		
Intermediate post intervention	90.9±7.1	73.47(69.5-77.36)	<0.001*	33.1±8.7		
3 months follow-up	88.3±10.8	-2.74(-6.71-1.22)	0.17	36.5±13.0	-3.63(-8.2-0.93)	0.12

*Significant level at 0.05, Rounded at one decimal place. Data expressed as mean difference. **No baseline conducted for control group due to insecurity problems. [a]

Control within Intervention groups, [b] Control within control group tested by Repeated measure-AVOVA P.Value[a] mean difference tested between baseline, immediate post intervention and 3 months follow up P.Value mean [d]ifference between the immediate post intervention and 3 months follow up

4.16: Competency of Health workers on complex resuscitation between intervention and control group at immediate post intervention and three months follow-up

Competency of health workers for complex resuscitation was tested by unpaired t-test between intervention and control group. Table 20 details the mean difference between intervention and control group at immediate intervention and three months follow up. There was significant increase in health workers competency in the intervention compared to the control group ($p<0.05$)

Table 20: Competency of Health workers on complex resuscitation between intervention and control group at immediate post intervention and three months follow-up

Variable	Intervention	Control	*Mean df 95%(CI)*	*P*-Value[a]
OSCE B				
Baseline	17.5±8.9	**-	**	**-
Intermediate	88.3±10.8	33.1±8.7	54.4(49.8-59.1)	<0.001*
3 months follow-up	90.9±7.1	36.5±13.0	55.2 (50.4- 59.9)	<0.001*

. *Significant at level 0.05. Rounded at one decimal place and data are expressed as mean difference. **No baseline conducted for control group due insecurity problems

[a] Control between Intervention and control groups was tested using unpaired T- test

4.17: Summary of Helping Babies Breathe intervention at baseline, immediate post intervention and 3 months follow up

Table 21 summarizes the overall changes of the health workers HBB knowledge, psychomotor skill, and competency for simple and complex neonatal resuscitation at baseline, immediate post intervention and 3 months follow up. Within the groups, repeated measures ANOVA was used to test for significance of the changes, while significance between the groups was tested by unpaired- test .The overall result showed that there was significant change in knowledge, psychomotor skill and competency of the health workers within and between the intervention compared to control groups at immediate post intervention and 3months follow up ($p<0.05$)

Table 21: Summary on HBB Knowledge, Psychomotor skills, competency for simple and complex neonatal resuscitation of the health workers at baseline immediate intervention and 3 moths follow up

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	Intervention	Control	Mean df. (CI)	P-Value[a]
Knowledge				
Pre- test	42.5± 17.3	48.0±13.9	-5.5(-11.4-0.32)	0.064
Immediate post intervention	97.8±3.4	51.2±11.2	46.6 (40.8-52.5)	<0.001*
3 months follow-up	84.7±7.7	50.9±15.7	33.8 (27.8-39.7)	< 0.001*
P-value[b]	0.001*			
Bag and mask				
Pre-test	26.1±19.9	-*	-	-
Immediate post test	94.4±8.5	40.9±18.9	51.5(44.4-58.6)	<0.001*
3 months follow-up	95.4±6.8	43.8±16.7	53.4(46.2-60.7)	<0.001*
P-value[b]	0.001*			
Objective Structural Clinical Examination (OSCE) A				
Pre- test	26.9±14.6	-*	-	-
Intermediate	89.3±8.1	38.9±8.5	47.6(42.2-52.8)	<0.001*
3 months follow-up	88.8±8.5	41.3±14.4	50.3(44.8-55.7)	<0.001*
P-value [c]	0.001			
Objective Structural Clinical Examination(OSCE) B				
Pre test	17.5±8.9	-**	-	-
Intermediate	88.3±10.8	33.1±8.7	54.4(49.8-59.1)	<0.001*
3 months follow-up	90.9±7.1	36.5±13.0	55.2 (50.4- 59.9)	<0.001*
P-value [c]	0.001*			

Data are expressed as Mean difference. *Significant level at 0.005 [a] Control between intervention and control group tested by unpaired t- test [b] P-value within group tested by repeated AVOVA, 0.001and 0.001 between pre-test , immediate post intervention and 3 months follow up. [c] P-Value within group tested by repeated ANOVA ,0.001 and 0.001 between immediate post intervention and 3 months follow up **No baseline conducted for control group for bag and mask, OSCE A and B due to logistical problems, and time

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4.18 Newborn birth Registry pre and post implementation at intervention and control site

A total of 4981 live births were recorded in the hospital registry; 2127 live births registered before implementation from November 2016 to February 2017, and 2062 after implementation from March to June 2017Pre intervention has seen a total of 2127 births registered of which 1116 were in the intervention health facility and 1011 at

Control health facility. 158 were newborn identified with asphyxia, none received neonatal resuscitation using HBB protocol with 56 neonatal deaths, 25 within twenty four hours and 24 were reported after twenty four hours

Post intervention registry showed that 2062 live birth were registered of which 1112 was at the intervention and 950 at Control health facility. 219 were newborn identified with asphyxia, 126 received neonatal resuscitation using HBB protocol with 51 neonatal deaths, 20 within twenty four hours and 24 were reported after twenty four hours respectively. Figure 2.

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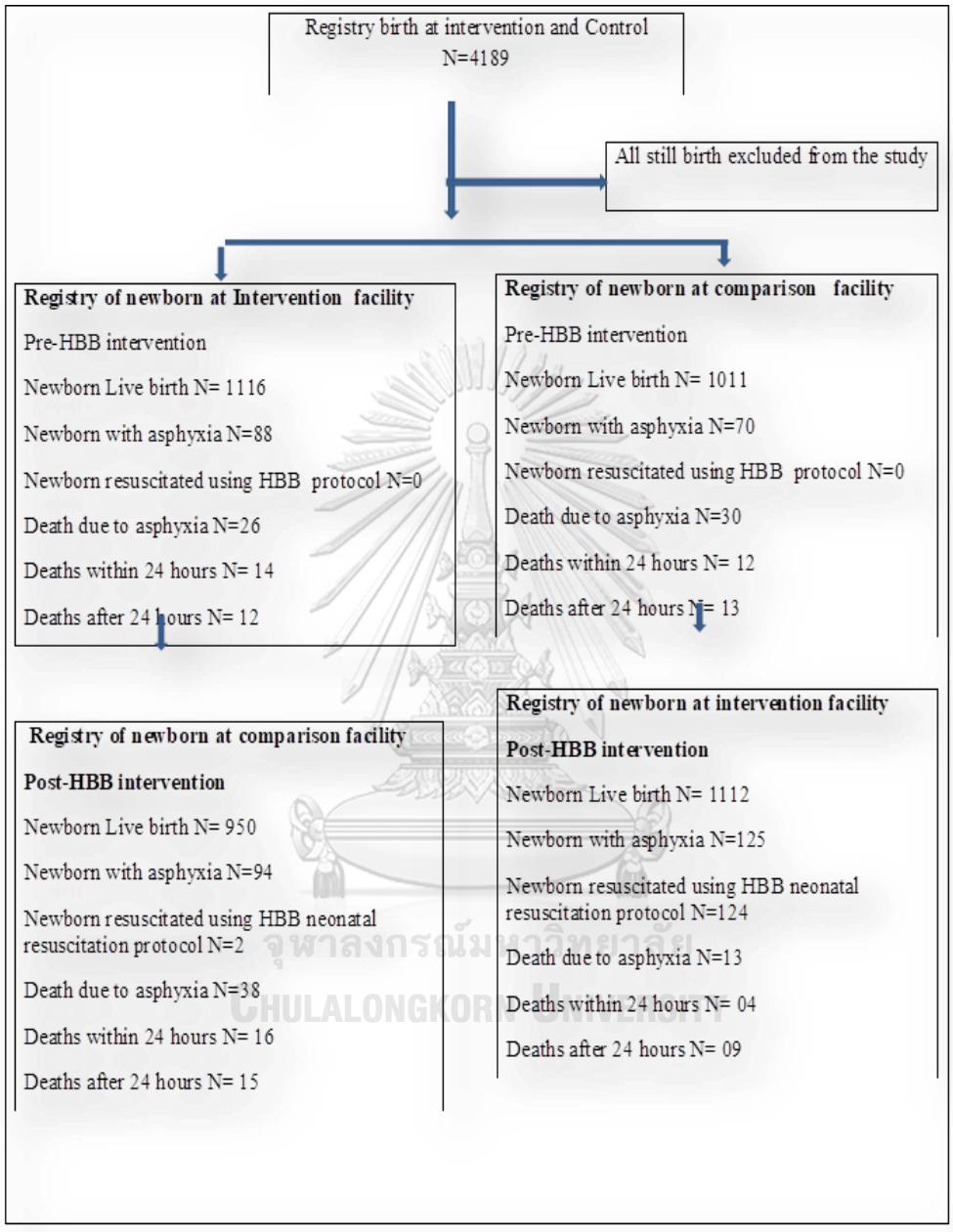
Figure 5: Flow Chart for Birth Registry before and After Implementation



4.19 **Early newborn Mortality within 24 hours pre and post implementation**

Table 22 is the composite summary of early newborn mortality due to asphyxia within 24 hours in intervention and control. When compared at pre and post implementation, there was significant reduction in the intervention than the control

group in term of newborn mortality within 24 hours. Newborn mortality reduced from 51.9% pre implementation to 23.5% post implementation. The percentage decreased in the control group remained insignificant (48.1% to 48.1% both pre and post implementation).

Table 22: Early newborn Mortality

Variable		Before Intervention		After Intervention		
	Intervention /Control	Frequency	Percent (%)	Frequency	Percent (%)	P.Value
Delivery (SDV+CS)	Intervention	1116	52.40	1112	53.9	-
	Control	1011	47.50	950	46	-
	Total	2127	99.9	2,062	99.9	
Newborn Birth Asphyxia	Intervention	88	55.7	125	57.1	0.18
	Control	70	44.3	94	42.9	-
	Total	158		219		
Newborn resuscitated using HBB	Intervention	0	00	124	98.4	0.001*
	Control	0	00	2	1.6	0.114
	Total	0		126		
Asphyxia deaths	Intervention	26	50.9	4	30.7	0.001*
	Control	25	49	9	69.2	0.110
	Total	**51**		**13**		
Death within 24 hours	Intervention	14	51.9	4	23.5	0.001*
	Control	13	48.1	13	48.1	0.110
	Total	27		17		

*Significant level at 0.05. Rounded at 1 decimal place Tested by Pearson Chi square test 2x2 sided significance for birth asphyxia, newborn death within and after 24 hours before and after implementation

4.20: Test of significance for early newborn Mortality Reduction

The pre and post implementation period on early newborn mortality among the intervention and control group was tested using Pearson Chi square. Test. Within the intervention group, there was significant change ratio of early newborn mortality compared to the control group within the 24 hours after conducting resuscitation ($p<0.05$) (Table 22)

Chapter Five

Discussion & Conclusion

The purpose of this chapter is to summarize the study that was conducted and review the results obtained. It will then seek to draw upon work done in the similar area to compare and contrast these findings. Building upon the theoretical frameworks underpinning this study this chapter will also seek to assess how the aims of the research have been fulfilled and draw upon work done in the similar area. After a short discussion on the strengths and limitations of the study, the chapter will end by providing some recommendations for future research and directional guidance for policy.

5.1: Helping Babies Breathe training at Glance

The introduction of HBB educational curriculum in 2009 has contributed to the improvement of resuscitation knowledge, skills and performance of health workers particularly for front line health workers in simulated environment and impacted on the reduction of neonatal mortality in low resource countries(97). Implementation of HBB training combined with quality improvement cycle has not been conducted in South Sudan and this study could be the first as there is no known published study that tested knowledge, skill competency and early new-born mortality reduction within 24 hours. It is also the first study to identify the positive impact of HBB training on health workers and new-born mortality in tertiary hospital South Sudan.

One of the advantages of the training was that HBB curriculum focuses more on practice than theory. The advantage of having many practical sessions within the modules and self-reading and assessment made the course very interesting.

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5.2: Socio demographic and professional characteristic of the health workers

The health workers in the study in both groups comprised mainly of midwives and nurses (78.3%) and the remaining 22.7% were clinical officers, intern doctors, community health workers, skilled birth attendant and Community Maternal Child health Workers (Table 6). The skewed distribution in favour of the nurses/midwives was most likely derived from the differential population of nurses/midwives compared to doctors and community health workers and clinical officers in average health institutions in South Sudan. In addition, it is very significant to add that most of the maternity and new born ward in the teaching hospital are staffed with nurses and midwives owning to lack of medical doctors and specialist. The few generalist and specialist doctors fled the country. The majority of the health workers were female and this was true as midwifery and nursing professions are predominantly young female. Majority of the health workers practiced for an average of five year (Table 6).

The health workers self-reported attend births and frequently encounter newborn with breathing problem. On monthly income, health workers self-report depending on meager monthly salary with majority getting between 300- 1000 South Sudanese Pound (SSP), the low salary scale in the public service. The low salary scale was source of demotivation for all the health workers and was not commensurate with the increasing economic situation aggravated by the ongoing conflict in regions of South Sudan

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The level of education among the nurses in our study followed the partner of curriculum for South Sudan and the neighboring countries in the East African countries with seven years to complete primary to education, four years for secondary education and three years minimum in college and university. Professional course like nursing and midwifery, clinical medicine and public health at diploma level takes three years, medical doctors course take five years and community health workers training takes minim of nine months. In south Sudan, the required educational level to pursue nursing and midwifery is completion of secondary education. However, given lack of health professional, those who have been in active services such as community health workers are given preference to join nursing and midwifery colleges.

The training and qualification of the health workers was almost similar in both groups (Table 6 and 7). Most health workers self-reported to have completed college or university for nursing and Midwifery, However, the level of education has not led to improved knowledge and psychomotor skills at baseline in both groups of the study. In summary, the professional background of the healthcare workers in the intervention group who attended the HBB training had similar characteristic and working environment with that of control group. Both the intervention and control hospital are teaching hospital with similar set up and supported by the government of Republic of South Sudan. This therefore makes the finding to be generalized to other similar health care settings and public hospitals in the country as well other low income developing countries with similar health systems and environment.

5.3: Prior Exposure to Resuscitation Training

Health workers prior exposures to resuscitation education training was thought to influence the new HBB knowledge and skill acquisition. In our study, we did not include those three of the health workers who had prior training and any other neonatal training within the last 6 months before the implementation of the HBB training program and quality improvement cycle. This was because; the study assumed that, the exposure provided some knowledge that could interfere with the interpretation of the results of the study. In our study, 90% of the health workers in control group and 53.3% of the health worker self-reported to have received neonatal resuscitation training on either Cardio pulmonary resuscitation, Essential Newborn care, other pediatric care and advanced life support.

Despite the proportion of health workers in both groups having prior training on neonatal resuscitation, the study recorded very low baseline passed mean score for knowledge, skill and competency in both group. Comparing the baseline mean score of the health workers in our study with other studies, our mean score was quite remarkably higher than that was reported by other studies in the low income countries conducted by Madge E. Buus-Frank as part of her doctoral study to examine the effect of prior exposure was documented in the Pilot Testing the effectiveness and stability of a Structured Curriculum for Newborn Resuscitation - Helping Babies Breathe plus using

videotaped simulations among the health workers in Zambia using quasi experimental study[147].

The study look at the influence of prior exposure to neonatal resuscitation education at baseline and new acquisition of knowledge. In the study 26 to 28% of the health workers had prior exposure to some form of resuscitation training in a time period > 6 months; notably, 21% of the sample had either NRP™ and/or the WHO Essential Newborn Care (ENBC) training. However, the study result showed that there was an overall low rate of resuscitation training, data that further illustrates the novel nature of resuscitation training and the magnitude of unmet needs in Zambia. The study sample had higher baseline levels of resuscitation training, nearly double those rates reported by others.

Another previous study on evaluation of helping babies breathe implementation in Honduras using pre and posttest design reported a mean pass score of 12% versus our finding of 42.5% (30). Our passed baseline mean score could be higher due to the effect of many of the health actor and WHO trying to improve skill and competency among the south Sudanese health care workers. Notably the critical issue here with the study finding was that of retention of skill and competency over a period of time based on the high number of health workers in the control with 90% exposed to neonatal resuscitation training but had low passed mean score at the baseline or pre training test. Additional, a good proportion of health workers in intervention were exposed to Essential Newborn care but their mean pass score was low at the baseline assessment.

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Study conducted on HBB neonatal resuscitation indicated that, even if births occur in health facilities, rather than at home, only 2 to 12% of the personnel conducting the deliveries have been trained in newborn resuscitation (30). The study concluded that the higher rates of resuscitation among the health workers could be due to the effort of Ministry of Health to improve newborn resuscitation capacity.

The critical issue identified by the study was stability or durability of resuscitation knowledge and skills over time that must be considered in light of the baseline group characteristics. Like in our study, the control group had higher baseline rate of exposure to resuscitation training; however, they did not score higher on measures of knowledge or psychomotor skills. This highlights the well documented

concerns in the stability of knowledge and skills from prior resuscitation programs, and raises the issue of timing of appropriate retraining in the future.

Away from Zambia, the most recent study from the United Kingdom suggests that when tested in a simulated environment, resuscitation skills deteriorate within a three to five-month period. Furthermore, the study indicated that providers who pass or fail testing often have equal levels of confidence in their resuscitation capabilities, suggesting a lack of insight into their performance(97). Similar results were found in an 8-year longitudinal assessment of neonatal medical trainees. However much less is known about the stability of knowledge and skills in low resource settings in the developing world (98).

5.4: HBB Knowledge of the health workers

The overall mean knowledge pass rate for the intervention at baseline using HBB Multiple Choice Questions was 42.5 % and control 48%. There was slight difference between the intervention and the control groups mean pass score at base line assessment however, this has no statistical and clinical significance between the two groups. There was slight advantage in the mean score in the control group over the intervention group at the baseline assessment (Table 9).

This difference in the pass mean score at baseline among the control group could be attributed to the self-reported exposure to various resuscitation education over the past one year compared to the intervention group. Of recent there was no known formal psychometrics performed beyond field test on HBB multiple Choice questions.

Despite the difference in prior education and professional characteristics seen in our study, Helping Babies Breathe was beneficial and appropriate regardless of profession, as demonstrated by statistically significant gains in post-test scores for both physicians and nurses.

Most significant in our study was that, health workers who received training were able to achieve high score in simulated environment despite lack of previous training on Helping Babies Breathe. Furthermore, result of the study shows that helping babies is an effective ways of addressing lack of knowledge among health workers who are often the first to act in resuscitating newborn with asphyxia.

A recent Helping Babies Breathe implementation evaluation study conducted in India had similar lower knowledge mean score at baseline of 46% which is close to the baseline obtained in this study for both the intervention (42.5%) versus control group (48%). In addition, the same study found out those health workers who had prior training scored higher at 69%. This is not similar to the result obtained in our study among control group where majority of the participants were exposed to various resuscitation education training but had low pass score.

In India, health workers attending HBB training for the first time did not score higher than those who attended HBB training program before. The low baseline knowledge mean score among the first timer reveled in this study is similar to the study in India but raises concern on the future retention of the HBB resuscitation knowledge[97]HBB training implementation contributed to the improvement of knowledge of health workers in Juba teaching Hospital after two day of training.

However, the level of knowledge attained at post training declined at the end of three (3) months evaluation. The study on HBB training have shown that the HBB knowledge MCQ written scores improved by 55.3% from 42.5% at pre-training to 97.8% immediately after post training (pre- test). Similar to the study finding, a formative educational evaluation of Helping Babies Breathe assessments by Singhal et al 2013, in Kenya among the trainers and learners (Nurses and doctors) has shown that the pass rate of knowledge MCQ based test increased from 75% to 95% after similar training intervention. In the same training, the pass rate for the simulated practical skill and competency was 20% for the health workers (learners).

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Despite the good increase in the pass scores in knowledge based written test in our study, the intervention group had low score on timing and clamping of the cord. This remained a concern among the health workers. Failure to pass a written test on timing and clamping is not a good indicator for newborn care because all the participants in the intervention were drawn from the unit providing care for neonates and one of the most important care for neonates is clamping and cutting of the cord at the delivery room. Our study finding concurred with a quasi-experimental Study conducted to evaluate stability of HBB knowledge, skill and competency among the Zambian health workers in 2012 that found out that knowledge on timing cord and

clamping remain controversial both in developed and developing world. The Helping Babies Breathe plus question about when to time and clamp the cord had extremely low pass rates (5.9% overall; 12% in the intervention vs. 0% in the control). The study further indicated that, the proper timing of cord clamping was a point of significant controversy in on-site discussions during the training sessions as well.

In our study evaluation of the HBB training, we found out that 5.2% failed the written test at post training and this further increased to 19% at the end of three months. The result of the failed pass mean score which was unsatisfactory among the health workers was demonstrated by other studies limited skills and competency in neonatal intubation and ventilation. (23) (99)

Using simulated based environment for teaching and learning had greatly improved the HBB knowledge of the health workers in neonatal resuscitation but this knowledge was not retained at three (3) months. Authors of helping babies breathe noted that maintaining the level of the knowledge acquired for long period of time was a challenge. Most of these studies found a rapid deterioration of acquired skills and, to a lesser extent, knowledge, in the months following the training(100)

5.5: HBB Psychomotor skill and competency of the health workers

According to the author's literature review, most of the study conducted on HBB training and evaluation, BMV baseline scores was not obtained(97). In this study, we established our baseline line level psychomotor skill and competency for the intervention before embarking on training the health workers in South Sudan on the simplified HBB protocol.

During our study, we administered, BMV checklist, Observational Structural Clinical Examination (OSCE) A and B to all our intervention group baseline , immediate intervention (post) and 3 months follow up while in control group , it was administered at immediate intervention (posttest 0 and 3 months follow up. Most time, OSCE A and B was considered too difficult to be administered to the participants during pre-training period.

Based on the pre assessment of the practical skill and competency of health workers in the intervention group, we tailored support to each of the participant's ability and understanding the training and that facilitated the good result at post training.

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Obtaining the skill and competency baseline at pre training further helped our trainers to identify and address the common problems related to neonatal resuscitation as the health workers were assumed to have skill and competency of performing the live saving intervention. For better result in establishing changes in the practical skills of the health workers, it is necessary always to administer OSCE A and B both pre and post training.

Our study also demonstrated improvement in practical skills and competency of the health workers after training. Practical skills remained high after three months in the intervention site while decreasing further in the controlled site. One points of interest in this study was that, the practical psychomotor skill and competency of the health workers improved greatly and was retained after 3 months follow up. It is surprising to find out that health workers retained skill and competency at three (3) months follow up. Similar major studies about retention of practical skills and competency conducted in Rwanda and Kenya indicated that it was most time difficult to retain skill and competency at three (3) to six (6) months after helping babies training intervention.

In our study evaluation of the HBB training, we found out that 11.9% failed the practical skills at post -test and 18.3% at three months and they did not meet the pass scores. The finding in the study on the failed pass score which is unsatisfactory among the health workers concurred with other studies reporting where limited skills and competency in neonatal resuscitation.(32)

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Another pre and post study, evaluating the development and testing of a performance checklist to assess neonatal resuscitation mega code skill., indicated that despite significant improvements in overall test scores and pass rates following training, scores and improvement were disproportionate for those assessments that involved demonstration of skills (bag-mask ventilation, OSCE A, OSCE B) (67). Relating this to pyramid of clinical competence in medical education postulate, by George miller indicated that, acquisition of knowledge occurs earlier and more easily than acquisition of skills. Miller's framework of progressively more complex and higher-level thinking moves from knowledge ('knows', multiple-choice questionnaire), to demonstration of skills ('knows how', bag-mask ventilation), to performance assessments ('shows how', OSCE).

In our study, participants demonstrated mastery of neonatal resuscitation knowledge, or the 'knows' level of Miller's pyramid, as evidenced by high post-test scores and pass rates for the multiple-choice questionnaire. Health workers struggled more with assessments that required skills and higher-level performance, as evidenced by low score at baseline in both groups.

The persistence of the practical skill and competency among the health workers in our study could be attributed to the implementation of quality improvement cycle which focused on practical application of HBB steps and problem solving. Many studies on HBB reported decline in practical skill within 3 – 6 months of receiving neonatal resuscitation training. Similarly in some instances, it was reported that practical skill and competency fades faster than the knowledge (98) .However, this was not true with our study findings.

An evaluation of staff retention of advanced cardiac life support on basic life skill among the registered nurses in United states using repeated quasi experimental study design infer that practical psychomotor skill and competency tend to diminish within three month earliest after training. However, in contrast, our study finding indicated that health worker retained their practical skills past 3 months period. This confirms that HBB is practical course that requires actions with periodic reinforcement of the skill through review, problem solving and self-assessment to ensure higher retention of knowledge and skill learned.

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Furthermore, a study assessing educational impact of a hospital-based modified neonatal resuscitation program in Ghana among midwives focusing mainly on the retention of midwives knowledge, evidence-based neonatal resuscitation practices, competency and short- and long-term educational effects of teaching a neonatal resuscitation program in a hospital setting after training indicated that knowledge and skill remained stable within the period of 9 - 12 months post training. This concur mostly with the retention of practical skill and competency found in our study among the health workers.

Many of the researchers who conducted similar study advocated for means of retention of knowledge, skill and competencies among the trainee health workers and recommended refresher training courses between post training and implementation[151]

In this study, we introduced and implemented quality improvement cycle as means of improving knowledge, skills and competency of the health workers during the implementation and retention after three months and beyond. This should be part of the future HBB training to enable retention of practical skills and competency among the health workers.

5.6: Early neonatal mortality within 24 hours (ENBM)

The training intervention reveals potential benefit of not only improving the knowledge, skills and competency of the health workers alone but has also impacted on the newborn outcomes. Pre – intervention information indicated that, most of the newborns never received resuscitation according to Helping Babies Breathe protocol.

Health workers were not practicing the correct steps in resuscitating newborn with asphyxia including those who require stimulation, bag and mask ventilation for neonates with breathing problems. Additionally, prior to the implementation of our study, health workers were having challenges with proper identification of newborn with breathing problems and initiation of resuscitation within the golden minute. Much of the skills required for neonatal resuscitation was lacking before the implementation of the HBB and quality improvement cycle. When the HBB training and quality improvement cycle was introduced and implemented, health workers competent and skill in resuscitation increased by two folds and this skill was retained at three months follow up.

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The study also documented the trend toward the overall reduction in mortality within24 hours in live births after three months of implementation at both sites. Our result at intervention site demonstrated decreased ratio of early new born mortality by half within 24 hours of life after receiving resuscitation by trained health workers. There was no significant decrease in the ratio of early new born mortality in the control site. Although, there was notably decreased in the ratio of early new born deaths at intervention site, the three months period for baseline and implementation was not enough to make the interpretation of the result conclusive and generalized. We have noted there is need for longer period for baseline and implementation because of variation in the new born data in registers especially at the time political turmoil. Despite the differences outlined above, the study actually demonstrated that training of

health workers has effect on the knowledge and practical skill of the health worker in addition to new born mortality reduction.

On the Global context, few studies have demonstrated the long term of effect HBB training of health workers in on early neonatal outcomes. Similar to our study finding, a large before and after design study conducted in Tanzania to determine the early newborn mortality and fresh still births after helping babies Breathe among the birth attendants in eight (8) hospital using pre and post study design shows that training and targeted implementation of helping Babies Breathe was associated with significant reduction in primary outcome of early neonatal mortality (within 24 hours) and the rate of fresh stillbirths and early perinatal mortality. The study indicated that early newborn mortality significantly reduced from 13.4% to 7.1 per 1000 live- born deliveries and the reduction in ENM was significant for both normal and low birth weight as well as term and preterm infants.

5.7 Strength of the study

As the strength of the study, first, the training used the research instruments which was previously validated and standardized adapted from American Academy of pediatrics and used to evaluate HBB knowledge, skills and competency of health workers in similar setting in low income countries like Kenya, Rwanda and Uganda(101)'. (79)

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The second strength of the study was the dedication and commitment of the health workers, research assistants and the trainers to the project despite the ongoing conflict that has torn the country apart. The research assistants diligently provided training, monitor and support the health workers on daily basis and ensured the equipment's were available at least for neonatal resuscitation in each station. This commitment from both the health workers and research assistants lead to the sustained impact on knowledge and practical skills of the health workers and early neonatal mortality reduction in South Sudan where resources for providing quality care for newborn remained far unavailable compared to other low resourced countries.

Third strength of the study was training mainly the nurses and midwives by default who were always available in the labour and newborn unit to monitor and care

for the newborn and the mother. Additionally our study encouraged at least two skilled birth attendants to focus on the newborn and the mother. The norm has been that health workers tend to focus more on the mother than the newborn. This gave an opportunity for health workers to care for the baby experiencing asphyxia.

Lastly, the implementation of the weekly meeting, introduction and use of self-evaluation checklist to review implementation challenges with neonatal resuscitation using the HBB protocol and the development of the quality improvement cycle allowed the participating health workers to discuss learn and get involved in creation of appropriate behaviors for implementation, track and comply with the resuscitation protocol at all times.

5.8 Limitations

Despite the study being extensive, there were still many limitations to it, some due to inherent issues with the study designs used and some due to conflict, time and finances which had direct and indirect effect to the study result as indicated below

First, the study's ability to evaluate resuscitation practices was limited by the small numbers of infants who required active resuscitation; however, the authors were able to demonstrate improvements in preparation for resuscitation.

Second, the pre and post-test design of the study with the introduction of quality improvement cycle created problem for us to limit our ability to know the effect of HBB training alone at the experienced changes during the implementation on knowledge, skills and competency leave alone the significant reduction of the early neonatal mortality. However, there was no ongoing similar intervention at the hospital during our implementation.

Third, the validity and representatives of the data collected pre implementation on neonatal deaths and use of appropriate resuscitation remained a concern because of the problem and challenges.

Fourth, the Helping Babies Breathe programme in our study in South Sudan was taught in English, and this created some challenges to other health workers who were not too conversant with English vocabulary as most of the health workers widely speak

Juba Arabic as opposed to classical Arabic widely spoken in North Sudan which was used for translating the HBB protocols.

Fifth, Health worker ability to adhere to neonatal resuscitation protocol without the introduction of quality improvement cycle remained limited. This was observed in the early phase of the implementation immediately after training and adherence improve as health workers become comfortable with the quality improvement cycles

Sixth, this study was limited by its small sample size which was half of the sample determined for the study.

Seventh, the study was limited by lack of pre-training BMV data, precluding an assessment of BMV skills improvement due the prevailing insecurity. This affected the comparison of level of psychomotor skills and competency between intervention and control at baseline to draw conclusion on the effectiveness of then training.

5.9: Recommendations

Based on the finding of the study, the author recommend that since training of health workers on HBB has demonstrated the effectiveness in improving the knowledge , psychomotor skill and competency found by the study, it is recommended that longer term randomized controlled clinical trial should be carried out to determine the effectiveness among the community and health facilities. Randomized control trial is the best approach to determine the real effectiveness of the HBB compared to result obtained from quasi experimental study with limited number of participants and settings. Besides, carrying out Randomized Control Clinical Trial will strongly help to determine the effects of then training on knowledge, psychomotor skill and competency and subsequent reduction of early neonatal mortality within 24 hours.

The study result is beneficial to the health planners and policy makers in planning for the inclusion and roll out of the HBB training in all the tertiary, county hospital and primary health care facilities as well as community setting as part of the health system in South Sudan which has been stagnated due to the ongoing conflict, financial constraint and lack of qualified health professionals. This reform should start by training a pool of trainers before training of health workers in places of high neonatal

mortality .The training should also consider modification for some of the content that were poorly performed by the health workers such as improving skills and performance for clamping and cutting of the cord at the delivery room and practicing the correct steps in resuscitating newborn with asphyxia.

The author is making strong recommendations to consider blending quality improvement cycle as part of HBB training as first step in improving adherence of health workers. This approach seems to be a workable strategy for scaled up and retention of knowledge, psychomotor skill and competency as the required capacity of the health workers in South Sudan is still missing and yet not available. This is true because during the training and early implementation of HBB intervention, health workers were experiencing difficulty in adhering to the guidelines and protocol before the introduction of quality improvement cycle. By introducing and blending quality improvement cycle into HBB training cycle, the long term effect of adherence to the HBB protocol will be easily achieved and long term training effect will be sustainable. Once HBB training of health workers is roll out, Quality improvement cycle will provide a strong foundation for adherence and feasibility and stability of HBB knowledge, psychomotor skill and competency which could lead to early neonatal mortality reduction due to asphyxia

In the limitation section of the study, it was clearly indicated that baseline information for psychomotor skill and competency of the health workers for the control group was not established during the implementations of HBB for the control group making it difficult to compare the groups. Without the two groups not measured at the same time during intervention, it become difficult to determine the changes in knowledge, psychomotor skill and competency result of training interventions. It is strongly recommended that researcher and program implementer to take into account establishing baseline for each of the group before any intervention.

The author also strongly recommends a large number of infant and sample size for health workers before and after implementation to determine the effect of training on knowledge, psychomotor skill competency and reduction of early newborn mortality within 24 hours due to asphyxia. Although our study demonstrated positive effect on improve the knowledge, psychomotor skill, competency and reduction of early

newborn mortality due to asphyxia, the pre and post implementation data period was limited (only four months) which was not quite adequate to allow effective determination of the actual effect on the newborn survival due to asphyxia. It is further recommended that data for pre and post implementation should obtained for at least one to two years for this kind of study.

The role of government and MOH remain crucial in implementation of HBB training and roll out in republic of South Sudan. Despite the HBB training result being piloted in tertiary hospital, it is recommended that proper implementation of the HBB in primary and community setting will help to reduce the burden of care within the tertiary hospital to primary health care and community with high neonatal mortality. The advantage to the Ministry of health and government of south Sudan is that, the protocol was tested within the tertiary hospital and should be reciprocated. The MOH and Government taking lead in the implementation of HBB will take health care to the lower level to in order to reduce the high neonatal mortality. MOH has been involved in similar approach of improving health system in past and this could be one of the innovative novel idea that can be easily implemented in South Sudan. It is also recommended that government should take into considerations the aspect of improving the infrastructure and equipment's for the scale up process of HBB interventions.

It is recommended by the author that a simpler version of the HBB training protocol and guideline be made for the local context including reviewing some of the context where health workers performed poorly. The current HBB training protocol and guidelines is in English and Arabic which was too difficult for some of the participants to understand. Translating the existing HBB version into simpler version (Arabic and English) before the country wide roll out will easy the process. Similarly MOH and government lead approach of reviewing the context and translating it into simpler version will be viable approach for feasibility and stability of HBB and could be recommended for other countries intending to pilot and roll out HBB training with similar context.

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5.10: Conclusion

The study has highly demonstrated that health worker in Juba Teaching Hospital in South Sudan significantly improved their knowledge of neonatal resuscitation after participating in two (2) day training course. With the ongoing conflict, it was expected that training of health worker on HBB might not have the hypothesized impact but this was proven to be wrong. Although the knowledge was found to decline during the 3 months follow up of implementation. Very interestingly, the practical skill and competency of the health workers remained intact over the three months period and even continue to increase strongly among the health workers evaluated.

The training and implementation has also positive effect on the neonatal survival rate in the teaching hospital, overall , there was significant reduction in number of neonates dying from asphyxia related illness compared to the pre – implementation . This may prove directly replicable in other similar settings, not only in South Sudan but in other low income countries as well.

HBB training require minimal equipment's for newborn resuscitation and combing this with quality improvement Cycle and periodic refresher training will contribute to increased knowledge , skill , competency and most significantly in the reduction of asphyxia related death in hospital setting and also in long run prepare them for newborn emergencies related to asphyxia. South Sudan could benefit from the scale up of the training project

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Training of health workers in helping babies breathe in South Sudan has had very significant impact in reducing the ration of mortality among newborn with asphyxia within 24 hours. As the training and quality improvement of cycle has demonstrated that health worker even in conflict setting can easily acquire knowledge and retain skill like in other normal simulated environment, closer examination of rolling the educational aspect of helping babies will be paramount in reducing the high mortality rate among the newborn when combined with quality cycle. Result from this study has demonstrated that knowledge can easily be acquired by health workers in any setting. Although skills and competency has been proven to be difficult to acquire, careful selection of teaching methodology and focusing on practical aspect of the course

similarly demonstrated that practical skill like knowledge can easily be acquired and retained.

Most importantly bag and mask was challenging part of the helping babies breathe before training of the health workers which most times was ignored to be administered pre training to health workers which always make it difficult to focus on the right mastery skill to be taught to the participant. Aware of the difficulty of acquisition of skills and competency as identified pre training led to focusing on best approach of educational teaching on bag and mask using various methods to achieve ventilation by golden minute taking into account the varied training background and clinical exposure to resuscitation education among the health workers.

This study has demonstrated high level of practical skills and competency over three months period and shown decline to the overall resuscitation knowledge of the health workers which remained unique to this study, several helping babies breathe follow up study raised concern in the decline in basic neonatal resuscitation skill over time.

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APPENDIX

Appendix: 1: Informed consent form of health workers version 1 25 November 2016

I, _____ _____ years old, is being invited to participate in a study entitled *Actions to Help Babies Breathe At Birth: Training Interventions to Improve Health Workers Competency and Practices on Helping Babies Breathe In Tertiary Hospital in South Sudan, A Quasi -Experimental Study* to be conducted by Christopher Vunni Draiko, as a requirement of his Dissertation for his PhD studies at the College of Public Health Sciences Chulalongkorn University, Bangkok Thailand.

I understand that this is a research study which will determine the Effectiveness of training Interventions on health workers Knowledge Practice, competency and neonatal mortality reduction

I will take part in ongoing onsite education training and a willing to participated in discussions on knowledge, skills before and after the training and any changes on knowledge and skills and competency as part of the standard of Helping Babies Breathe to enhance my individual learning in Juba teaching Hospital

I understand that this is a research study which will determine effect of training intervention on health workers knowledge, skills, practices competency o and reduction of neonatal deaths in Juba teaching Hospital withal the selected Health workers

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It is anticipated that training intervention carries no risk. You are only required to commit for period of five months. I also understand that the direct benefit I will get form the study in receiving training on Helping Babies and helping to learn the skills and practice at work place with support of mentor on neonatal resuscitation for participating in this study

I understand that, I can opt out from the study anytime and my withdrawal will not affect whatever benefit of the services provision by me or receiving similar service from Juba Teaching Hospital. I also understand that the information provided by me during the interventions from baseline till the end of the study will strictly be kept confidential and my identity will not be revealed in any report that will come out and published

I have consented and confirmed that I will participate in the training intervention for the next five months from training until the end of the study. I will voluntary provide any information required .any information provided my me during the study time line will not be taken against me and the my services

I understand that I am free to contact Christopher Vunni Draiko at *+256 786224828* or via email at chrissvunni@gmail.com if I have questions. I may also contact the Chair of the proposal/project Committee,) at this phone number 8982020 or email address: *scmcaeierc@gmail.com*.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate in this research.

Name of Health workers: _____

Signature of Health worker: _____

Date_____

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Appendix 2: Socio- economic demographic and professional characteristic questionnaire

1. How old are you? _____

2. Gender
   a. Male
   b. Female

3. What is your primary language?
   a. English
   b. Dinka
   c. Nuer
   d. English
   e. Kuku
   f. Madi
   g. Acholi
   h. Lutogo
   i. Bari
   j. Zande
   k. Others specify

.4. What is your level of education?
   a. Primary eight
   b. Secondary education
   c. College or tertiary education
   d. Others Specify: _____

5, what is your professional qualification?
   a. Nurse
   b. Nurse midwives
   c. Maternal and child health officer
   d. Nurse practitioner
   e. Nurse tutor
   f. Medical doctor
   g. Clinical officer

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h. Community Health workers
i. Skilled birth attendants
j. Traditional birth attendants

.6 What is your primary area /role /practice?

a. Obstetrics
b. Newborn care
c. Sick children ward
d. Maternal and newborn care
e. Others specify: _____

7 Where you are currently assigned or place of work

a. Maternity ward
b. Children ward
c. Maternity operating theater (OT)
d. Primary health care center (PHCC)
e. Others specify _____

8 I am currently working in

a. Juba Teaching hospital
b. Primary Health care center
c. Juba College of Nursing and Midwifery

9 What is current monthly income?

a. 300- 600 SSP
b. 701- 1000 SSP
c. 1001- 1,500 SSP
d. 1,501- 2,000 SSP
e. 2,001- 3000 SSP
f. 3,001- 4,000 SSP
g. 4,001- 5,000SSP
h. 5,001- 6,000 SSP

10. How long have you worked in your current practice/role?

a. Less than one year
b. One year
c. Two – three years

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d. Four – five years

e. Over five years

11 How often do you encounter newborn/infant who is not breathing well?

a. Very frequently (almost on daily basis)

b. Frequently (Weekly)

c. Infrequently (one – two times years)

d. Never

12 I have received the following training on newborn resuscitation (Tick one)

a. Cardiopulmonary Resuscitation (CPR) participants' instructors

b. Pediatric Advanced life support participants' instructors

c. Essential Newborn Care (ENBC) participants' instructors

d. Other infant resuscitation or life support participants' instructors

13. When did you receive the most recent training on newborn resuscitation?

Training on Resuscitation	Month /Year	
a. Cardiopulmonary Resuscitation (CPR	_____	_____
b. Pediatric Advanced life support	_____	_____
c. Essential Newborn Care (ENBC)	_____	_____
d. Other infant resuscitation or life support	_____	_____

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Appendix 3: Multiple Choice Questionnaire for HBB Knowledge Check

Select the best answer to each question or statement

Circle the letter of the correct answer

1. In the first minute after birth the health workers should
    a. Bathe the newborn baby
    b. Help the newborn baby breathe
    c. Feed the newborn baby
    d. Not touch the newborn baby
2. To prepare for birth
    a. The health workers identify a helper and review the emergency plan
    b. The health worker ask everyone but the mother to leave the place of delivery
    c. Health workers prepare equipment's only when it is needed
    d. Health worker does not need helper
3. To prepare the area for delivery, the health workers or birth attendant should
    a. Open all doors and windows to get fresh air
    b. Clean space for the bay is not required
    c. Make sure the area is clean, warm and well lit
    d. Keep the room temperature cold
4. Which baby can receive routine care at birth?
    a. A baby who is not breathing
    b. A baby who is gasping
    c. A baby who is breathing and crying
    d. A baby who is limp
5. Routine care for baby at birth includes
    a. Drying, removing the wet cloth and bathing the baby
    b. Drying, removing the wet cloth and positioning the baby skin –to –skin
    c. Bathing and putting clean clothes on the baby
    d. Drying and wrapping the baby in wet cloth
6. When should the umbilical cord be clumped or tied and cut during routine care?
    a. After the placenta is delivered
    b. Around 1 to 3 minutes after birth

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c. Immediately after the baby is born

d. Before the baby has cried

7. A baby is quiet, limp and not breathing at birth, what should health workers do?

a. Dry the baby thoroughly

b. Shake the baby

c. Throw cold water on the face

d. Hold the baby upside down

8. A baby is born through meconium stained amniotic fluid, which statement is true?

a. Stimulate the baby and clear airway

b. Meconium cannot be inhaled into the lungs

c. Clear airway before drying the baby

d. All babies born through meconium stained fluid can receive routine care

9. What should health workers do in the golden minute?

a. Bathe the baby

b. Deliver the placenta

c. Evaluate the heart rate

d. Help the baby breathe if needed

10. A newborn baby is quiet, limp and not crying. The baby does not respond to steps to stimulate breathing, what should health workers do next?

a. Slap the newborn baby's back

b. Hold the newborn baby upside down

c. Squeeze the baby ribs

d. Begin ventilation

11. Which of the following statement about ventilation with bag and mask is true?

a. The mask should cover the eyes

b. Air should escape between the mask and face

c. Squeeze the bag to reduce gentle movement of the chest

d. Squeeze the bag to give 80 to 100 breathes per minute

12. Which of the following signs MUST be monitored in the newborn baby during the first few hours after birth?

a. Length

b. Breathing

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c. Smile

d. Urine output

13. A newborn baby chest is not moving with bag and mask ventilation, what should health worker do?

a. Stop ventilation

b. Reapply the mask and get better seal

c. Slap the newborn baby back

d. Give medicine to the newborn baby

14. The health worker can stop ventilation if

a. The newborn Baby is blue and limp

b. Newborn baby heart rate is 80 per minute

c. Newborn baby heart rate is 120 per minute and the chest is not rising

d. The newborn heart rate is 120 per minute and the baby is breathing and crying

15. What should health workers do to keep the newborn baby warm?

a. Open all the windows to allow warm air to circulate

b. Give the newborn baby a bath after birth

c. Place hot water bottle next to the newborn baby skin

d. Place the newborn baby skin –to –skin with the mother

16. What should health worker do to keep the newborn baby clean?

a. Wash hands before touching the baby and help mother to wash hands before breathing

b. Wash hands before touching the newborn baby and help the mother to wash hand before breastfeeding

c. Reuse the suction devices before cleaning

d. Keep the umbilical cord tightly covered

e. Do not touch the baby

17. A newborn baby heart rate should be

a. Faster than your heart rate

b. Slower than your heart rate

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Appendix 4: Observation checklist for bag and mask ventilation skill check for psychomotor skills

Directions

Complete this evaluation with learners before they attempt the OSCE evaluations. Use the comments below the numbered steps to score the performance. Note the number of steps done correctly on the first attempt. Give feedback to the learner*. Repeat the evaluation until all steps are done correctly.*

	Done	**Not done**
1. Check equipment and select the correct mask	□	□
Test function of bag and mask.		
Make sure mask fits the baby's face.		
2. Apply the mask to make a firm seal.	□	□
Extend the head, place mask on the chin, then over the mouth and nose.		
A firm seal permits chest movement when the bag is squeezed.		
3. Ventilate at 40 breaths per minute.	□	□
The rate should not be less than 30 or more than 50 breaths per minute.		
4. Look for chest movement.	□	□
Check that every ventilation breath produces chest movement.		
5. Improve ventilation if the chest does not move:		
a) Head – reapply mask and reposition head	□	□
b) Mouth – clear secretions and open the mouth	□	□
c) Bag – squeeze the bag harder	□	□

Score on first attempt _____ of 7

All steps done correctly _____ (facilitator initials)

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Appendix 5: Observation checklists- objective structured clinical examination for testing psychomotor skills and competency

Scripted OSCE - Station A

Instructions to the facilitator:

Read aloud to the learner the following instructions and the case. Provide prompts where shown in green. As you observe the learner tick _ the boxes "**Done" or "Not done**" for each activity. Indicate the baby's response to the learner's actions using the neonatal simulator or words if using a mannequin. For example, when the learners evaluate crying, show or say that the baby is not crying. Comment on the learner's performance only at the end of the evaluation.

I am going to read a role play case. Please listen carefully, and then show me the actions you would take. I will indicate the baby's response with the simulator (OR in words), but I will provide no other feedback until the end of the case."

"You are called to assist the delivery of a term baby. There are no complications in the pregnancy. The baby will be born in less than 10 minutes.

Introduce yourself and prepare for the birth and care of the baby."

Prepares for birth	**done.**	**Not Done**
Identifies a helper and makes an emergency plan.	□	□
Prepares the area for delivery	□	□
Cleans hands and maintains clean technique throughout.	□	□
Prepares an area for ventilation and checks equipment	□	□

Prompt: After 5-7 minutes give baby to learner and say, the amniotic fluid is clear. Show how you will care for the baby."

DRIES THOROUGHLY*		
Removes wet cloth	□	□
Evaluates crying prompt: Show or say the baby is not crying		
RECOGNIZES BABY IS NOT CRYING *	□	□
Clears airway and stimulates breathing	□	□
Keeps warm	□	□
POSITIONS HEAD AND CLEARS AIRWAY *	□	□
Stimulates breathing by rubbing the back	□	□

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Evaluates breathing *Prompt: Show or say the baby is breathing well*		
Recognizes baby is breathing well	□	□
Clamps or ties and cuts the cord	□	□
Positions skin-to-skin on mother's chest	□	□
Communicates with mother	□	□

Scoring: Successful completion requires a total score of 10 correct of 13. AND "Done" must be ticked for **DRIES THOROUGHLY, RECOGNIZES BABY IS NOT CRYING**, and **POSITIONS HEAD AND CLEARS AIRWAY**.

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Appendix 6: Observation checklists- Objective Structured Clinical Examination for testing psychomotor skills and competency

Scripted OSCE - Station B

Instructions to the facilitator:

Read aloud to the learner the following instructions and the case. Provide prompts where shown in green. As you observe the learner, tick ——————————— the boxes "Done" or "Not Done" for each activity.

Indicate the baby's response to the learner's actions using the neonatal simulator or words. Note the time between birth and beginning ventilation. Comment on the learner's performance only at the end of the case.

"I am going to read a case. Please listen carefully, and then show me how you would care for this baby. I will indicate the baby's response with the simulator (OR in words). I will provide no other feedback until the end of the case." You are called to assist at the birth of 34 week (7 ½ months) gestation baby. You arrive two minutes prior to birth. Introduce yourself and show what you will do."

	Done	**Not Done**
Prepares for a birth		
Identifies a helper, Prepares the area for delivery, Cleans hands	□	□
Prepares an area for ventilation and checks equipment	□	□
Prompt: After 2 minutes give baby to learner and say,		
"The amniotic fluid is clear. Show how you will care for the baby		
Dries thoroughly and removes wet cloth	□	□
Evaluates crying ***prompt: Show or say the baby is not crying***		
Recognizes baby is not crying	□	□
Clears airway and stimulates breathing	□	□
Keeps warm, Positions head, clears airway	□	□
Stimulates breathing by rubbing the back	□	□
Evaluates breathing	□	□
RECOGNIZES BABY IS NOT BREATHING		
Ventilates with bag and mask	□	□

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Cuts cord and moves to area for ventilation OR ventilates by mother	□	□
Starts ventilation within The Golden Minutes (at ____seconds)	□	□
VENTILATES AT 40 BREATHS/MINUTE (30-50 acceptable)	□	□
LOOKS FOR CHEST MOVEMENT		
Evaluates breathing ***Prompt: Show or say the baby is not breathing***		
Recognizes baby is not breathing	□	□
Calls for help	□	□
Continues ventilation	□	□
Prompt: Say, "Please show what to do if the chest is not moving with ventilation."		
After one or more steps to improve ventilation, say "The chest is moving now."		
IMPROVES VENTILATION		
Head- repositions head, reapplies mask	□	□
Mouth-clears secretions, opens mouth slightly	□	□
Bag-squeezes bag harder	□	□
Evaluates breathing and heart rate ***Prompt: Show or say the baby is not breathing; heart rate is normal***		
Recognizes baby is not breathing but heart rate is normal	□	□
Continues ventilation	□	□
Prompt: After 3 minutes say, "The heart rate is 120 per minute and the baby is breathing."		
Recognizes baby is breathing and heart rate is normal	□	□
Stops ventilation; monitors baby and communicates with mother	□	□

Scoring: Successful completion requires a total score of 14 correct of 18. Partial credit may be given. AND "Done" must be ticked for **RECOGNIZES BABY IS NOT BREATHING**, **VENTILATES AT 40 BREATHS PER MINUTE**, **LOOKS FOR CHEST MOVEMENT**, and **IMPROVES VENTILATION**

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Appendix 7:Self-Assessment Checklist -Knowledge and Psychomotor Skills

Preparation for birth

1. When should a skilled person be present at birth?
    a. If problem occurs
    b. At every birth

2. When should you wash your hands?
    a. When they look dirty
    b. Before and after caring for a mother or a baby

Dry baby thoroughly

3. A baby is not dried, but she is placed on a cloth besides the mother, what happens
    a. The baby can become cold
    b. The baby will stay warm

4. What can happen when a baby in hales meconium?
    a. The baby can have breathing problem
    b. Meconium rarely causes a breathing problem

Is the baby crying?

5. A baby cries after birth and then breathes quietly and regularly. What should you do?
    a. Provide routine care
    b. Provide help to breathe

6. A baby is not crying. He is not breathing or moving and is limp what should you do?
    a. Give routine care
    b. Provide help to breathe

Keep warm, check breathing, cut cord

7. What can you do encourage breastfeeding
    a. Keep mother and baby together
    b. Give warm tea to both mother and baby

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How to clamp and ties umbilical cord

8. You notice bleeding from the umbilical cord even though a ties is in place what should you do?

   a. Place another ties between the first one and the baby's skin

   b. Wait to see if the bleeding will stop on its own

Clear airway and stimulate breathing

9. How long should it take to dry the baby, clear airway, stimulate breathing?

   a. Less than 1 minute – The golden minute

   b. Two minutes

10. Suctioning for long time or suctioning for deeply can

   a. Make a baby breathe

   b. Keep the baby from breathing

Is the Baby breathing well?

11. If the baby is not breathing well after drying, clearing the airway and rubbing the back once or twice, you should give

   a. More stimulation

   b. Ventilation with bag and mask

12. Which baby is not breathing well?

   a. A baby who is breathing quietly and regularly

   b. A baby who takes one deep breath followed by long pause

Initiate ventilation

13. How do you select the correct masks?

   a. Select the mask that covers the chin, mouth and nose but not eyes

   b. A good seal between the mask and the face

14. To help open the baby airway, you should position the baby head

   a. Slightly extended

   b. Hyper flexed

Is the baby breathing well?

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15. When you are giving ventilation with bag and mask. The baby is gasping, what should you do?

a. Stop ventilation and observe closely with mother

b. Continue ventilation

16. A baby begins to breathe well after 30 seconds of ventilation with bag and mask. How will you care for this baby?

a. Monitor the baby closely with the mother

b. Provide routine care

Call for help, improve ventilation

17. A baby does not breathe after brief ventilation, what should you do first?

a. Squeeze the bag harder to give a larger breathe

b. Call for help

18. A baby chest does not move with ventilation. What should you do?

a. Stimulate the baby

b. Re apply the mask to the face and reposition the head and neck slightly extended

Heart rate, normal or slow

19. You are breathing for the baby with bag and mask. When should you check the heart rate?

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1. After every 10 breathes with the ventilation bag

2. After one minute of ventilation

Ventilate until the baby is breathing well, then monitor with mother

20 A baby has been ventilated for more than 3 minutes with bag and mask. The heart rate is 120 beats per minute. The baby is not breathing. What should you do?

a. Slowly decrease the rate of ventilation and watch for breathing

b. Stop the ventilation and wait at least one minute to see if the baby breathes

21. A baby has been ventilated for 10 minutes with bag and mask, the baby is now breathing and has heart rate of more than 100 beats per minute. What care does this baby need?

- Routine care with mother
- Close monitoring with specialty consultation or referral

Continue ventilation and seek advanced care

22. You have provided ventilation with bag and mask for 5 minutes. The baby's chest is moving, but the heart rate is about 70 beats per minute

3 Continue ventilation, activate the emergency plan and seek advice from specialty

4 Stop ventilation and observe to see if the heart rate improves

23. After ten minutes of ventilation with good chest movement, the baby is not breathing and there is no heart beat rate (no cord pulse, no heart beat rate by stethoscope). What should you do?

1. Stop ventilation. The baby is dead
2. Continue ventilation for another 10 minutes

Transport mother and baby together

24. A baby needed ventilation with bag and mask. She is breathing fast and cannot breastfed. What should you do?

6. Leave mother and baby alone to rest
7. Explain the baby condition to the mother and birth companion

25. A premature baby will take to the district hospital with difficulty. How should you advise the mother?

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3. Advise her not to travel for at least a week

4. Advise her to go with baby if possible

Appendix 8: Progress Note in Each of the Unit

Unit	Weeks			
	Week 1	Week2	Week3	Week 4
Macerated still birth				
Fresh still birth				
Neonatal death				
Non breathing baby with B&M				
Non breathing Bag &Mask within 1 minute				
Resuscitation corners available				
Adequate and functional suction				
Adequate and functional bag and mask				
Mannequin for skill check				
Weekly meeting				

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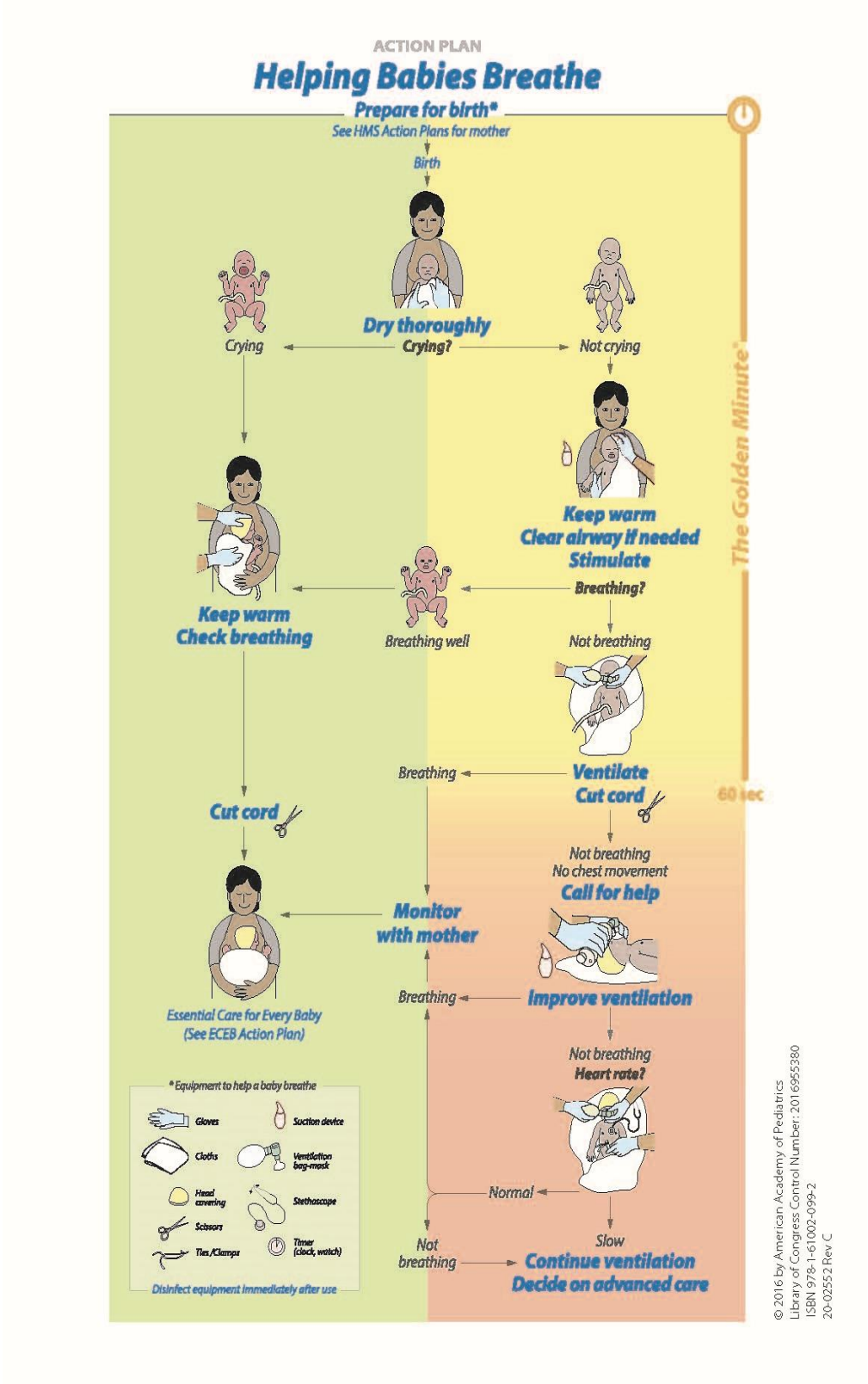
Appendix 9: Preparation for a Birth

HBB actions	Done	Not done
Presentation/demonstration, Practice with the Action Plan, Check yourself		
Skill practice in pairs with feedback from table facilitators/ research assistants		
Demonstration of Preparation for a Birth exercise by facilitators/ Research assistant		
Practice in pairs with feedback and repetition to correct		
Group discussion questions – Preparation for a Birth		

Appendix 10: Helping Babies Breathe (Resuscitation) Delivery register

Name	Date of birth	Time of delivery	Route of delivery	APGAR score	Weight	Temp	Birth Asphyxia Present?	Resuscitated using HBB	Discharged	Referred	Name of staff

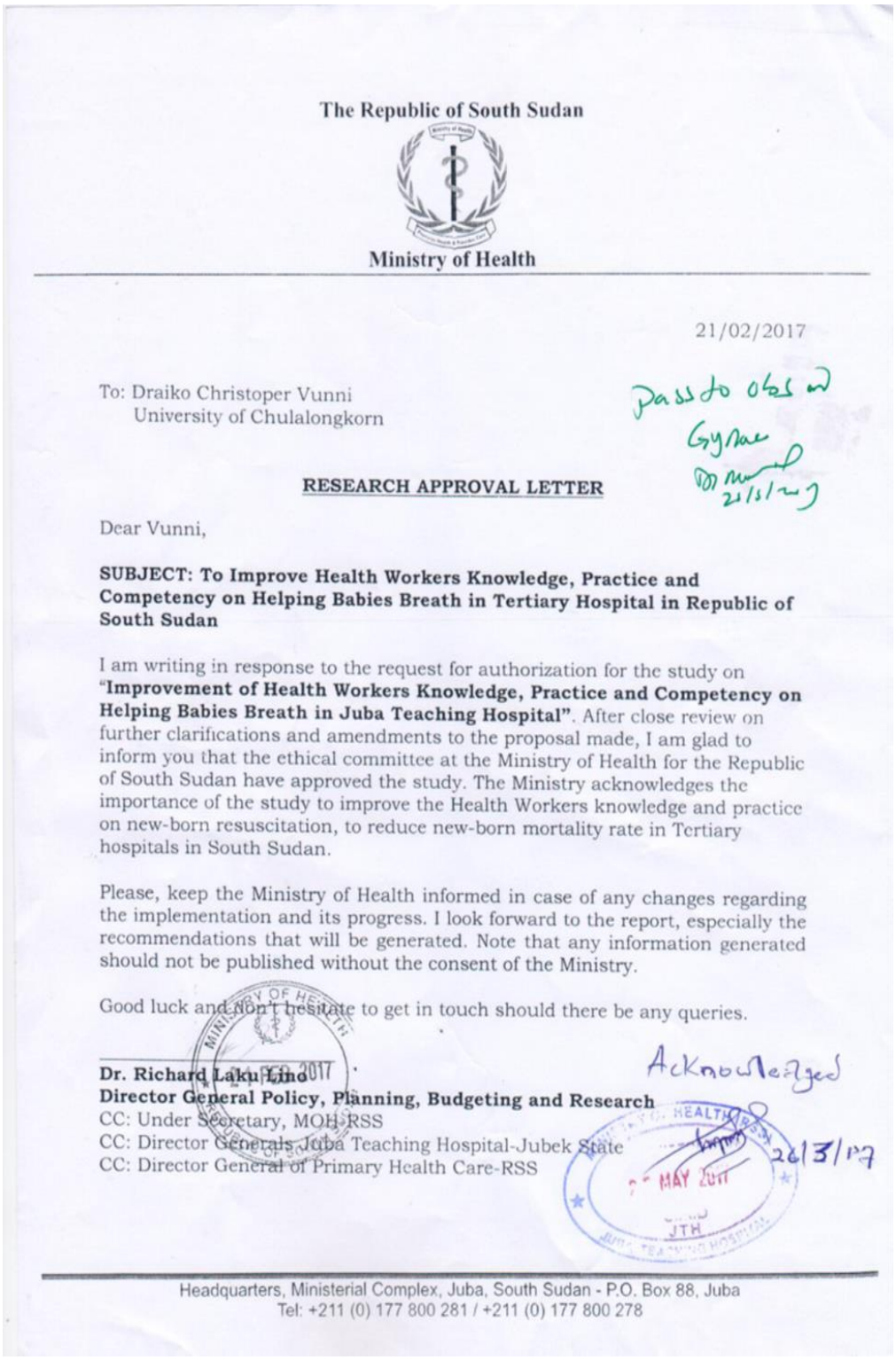
Appendix 11: Helping Babies Breathe Schemic Protocol



Appendix 12: HBB Training Schedule for the Health Workers

Time	Topic	Presenter
8:00-9:00am	Registration and small group formation	All
9:00-930am	**BREAK FAST**	**Research Team**
9: 30- 10:00am	Welcome and Introduction	Research Team
10: 00- 10:00am	Program overview on HBB	Research Team
10: 00- 10: 30am	Review of pre training exercise	Research Team
10: 30-11:00am	Overview of learning kit	Research Team
	Break TEA	**All**
11: 000-11:30am	Testing of the health workers knowledge on resuscitation using HBB MCQ	Research Team
11: 30- 12:00PM	Assessing the health workers psychomotor skills using the HBB bag and mask ventilation	Research Team
12: 00- 12:30 Pm	Assessing the health workers psychomotor skills using the HBB OSCE checklist	Research Team
12: 00- 1: 30 PM	**Break -Lunch**	**All**
2:00- 3:-400 PM	Assessment on Bag and mask and OSCE Continues	Research Team
4: 00- 5:00PM	Question and comments	Research Team
5; 00- 6: 00 PM	Closure	Research Team
DAY TWO		
8:00- 9:00AM	Review of day one plan	All
9:00- 9:30 AM	BREAK FAST	All
09: 00- 10:00 AM	Routine care of new born and Demonstration	Research Team
10:00- 11:00 AM	The Golden Minute	Research Team
11:00-11-30 AM	BREAK FAST	All
11:00- 11:30 AM	Golden minutes continues	Research Team
	The newborn needing more extend of resuscitation Effective bag and Mask Ventilations	Research Team
1:00- 2: 00 PM	BREAK – LUNCH	All
2: 00- 5:00PM	Post training test on HBB knowledge , Bag and mask ventilation	Research Team

Appendix 13: Approval letter



The Republic of South Sudan

Ministry of Health

21/02/2017

To: Draiko Christoper Vunni
University of Chulalongkorn

Pass to obs w
Gynae
21/2/17

RESEARCH APPROVAL LETTER

Dear Vunni,

SUBJECT: To Improve Health Workers Knowledge, Practice and Competency on Helping Babies Breath in Tertiary Hospital in Republic of South Sudan

I am writing in response to the request for authorization for the study on "**Improvement of Health Workers Knowledge, Practice and Competency on Helping Babies Breath in Juba Teaching Hospital**". After close review on further clarifications and amendments to the proposal made, I am glad to inform you that the ethical committee at the Ministry of Health for the Republic of South Sudan have approved the study. The Ministry acknowledges the importance of the study to improve the Health Workers knowledge and practice on new-born resuscitation, to reduce new-born mortality rate in Tertiary hospitals in South Sudan.

Please, keep the Ministry of Health informed in case of any changes regarding the implementation and its progress. I look forward to the report, especially the recommendations that will be generated. Note that any information generated should not be published without the consent of the Ministry.

Good luck and don't hesitate to get in touch should there be any queries.

Dr. Richard Laku Lino
Director General Policy, Planning, Budgeting and Research
CC: Under Secretary, MOH-RSS
CC: Director Generals Juba Teaching Hospital-Jubek State
CC: Director General of Primary Health Care-RSS

Acknowledged
26/3/17

Headquarters, Ministerial Complex, Juba, South Sudan - P.O. Box 88, Juba
Tel: +211 (0) 177 800 281 / +211 (0) 177 800 278

Appendix 14: Trail Registration

28 August 2017

To Whom It May Concern:

RE: Actions to Help Babies Breathe at Birth: Training Interventions to Improve Health Workers Knowledge, Practices and Competency on Helping Babies Breathe

As project manager for the Pan African Clinical Trial Registry (www.pactr.org) database, it is my pleasure to inform you that your application to our registry has been accepted. Your unique identification number for the registry is **PACTR201708002469225**

Please be advised that your trial is registered under an initiative within our system that allow us to capture data of trials that are already in progress or completed. As such, your trial registration may not adhere to the mandates set forth by the International Committee of Medical Journal Editors for registration requirements, and it is your duty to be transparent to any journal that may ask about the retrospective status of your registration.

Please note you are responsible for updating your trial, or for informing us of changes to your trial. Additionally, please provide us with copies of your ethical clearance letters as we must have these on file (via email or post) at your earliest convenience if you have not already done so. Please do not hesitate to contact us at +27 21 938 0835 or email epienaar@mrc.ac.za should you have any questions.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Yours faithfully,

Elizabeth D Pienaar

www.pactr.org Project Manager

+27 021 938 0835

THE SOUTH AFRICAN MEDICAL RESEARCH COUNCIL
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Appendix 15: TREND Statement Checklist

TITLE and ABSTRACT				
Title and Abstract	1	Information on how units were allocated to interventions	Actions To Help Babies Breath At Birth: Training Interventions To Improve Health Workers Knowledge, Practices And Competency and reduction of newborn mortality In Tertiary Hospital Of The Republic Of South Sudan A Pre And Post Study Design	
		Structured abstract recommended		Abstract
		Information on target population or study sample	Health workers and newborn with birth asphyxia	Abstract
INTRODUCTION				
Background	2	Scientific background and explanation of rationale	Whether training of health workers on Helping Babies breathe (HBB) improves knowledge, practical skill in tertiary health facility of republic of South Sudan has not been studied. The study examined the effectiveness of training on the prospective outcome of knowledge practical skill and subsequent newborn mortality in the hospital setting	Introduction
		Theories used in designing behavioral interventions	Not applicable	Introduction
METHODS				
Participants	3	Eligibility criteria for participants, including criteria at different levels in recruitment/sampling plan (e.g., cities, clinics, subjects)	The following selection criteria were applied: Medical officers/doctors, nurses, midwives, maternal Child Health Officer, community health workers and clinical officers working and practicing in maternity, operating theater and children ward. Health providers self-reported that they actually provide routine care services at delivery and neonatal unit or departments and Health workers willing to be available for data collection and during the period of study	Methods
		Method of recruitment (e.g., referral, self-selection), including the sampling method if a systematic sampling plan was implemented	Participants were randomly selected through simple sampling from the existing available health workers. In order to arrive at the required number of the health workers, the study employed simple random sampling using computer generated number list https//www.random.org/sequence/ ?min=1&max=130&col=1&format=html1md=new.	Methods

		Recruitment setting	The health worker were identified and recruited from maternity, newborn operating theater and children ward of Juba Training Hospital (Intervention site) and Wau Teaching Hospital (Control). After the completion of the recruitment process, an invitation was send to those health workers who met the inclusion criteria to participate in the study. A written consent was obtained from the health workers. All newborn delivered in maternity , newborn unit and operating theatre who met the inclusion criteria were included in the study	Methods
		Settings and locations where the data were collected	Pre and post data were collected doing the training mean while post training follow up date and newborn resuscitation were collected form the area of practice, maternity , operating theatre and newborn unit	Methods
Interventions	4	Details of the interventions intended for each study condition and how and when they were actually administered, specifically including:	The training covered four main lessons i) Preparation for birth ii) routine care iii) The golden minute and iv) ventilation with normal or slow heart rate.	
		Content: what was given?	Each topic was introduced by the main facilitators followed by demonstration and return demonstration by the participants. This was followed by self-directed and self-assessment exercise using the learner work book. The training comprised of six classroom hours and two hours for practical. A series of procedures surrounding births were reviewed through practical exercises under the supervision of the trainers. Scenarios reproducing routine care and neonatal resuscitation at birth were performed on a NeoNatalie new born simulator. During the training, one simulator, a stethoscope, resuscitator and suction device were made available for every two trainees. The training was practical and was taught both in English and Arabic.	Methods
		Delivery method: how was the content given?	The intervention was delivered to a group 20 health workers each	Methods
		Unit of delivery: how were subjects grouped during delivery?		Methods
		Deliverer: who delivered the intervention?	The HBB training intervention course was facilitated by two senior midwives who were trained as research assistants (master trainer) and assisted by the principal investigator and the research assistants. The newborn resuscitation was conducted by the health workers in various unit selected	Methods

		Setting: where was the intervention delivered?	The intervention was delivered at the main hospital training hall and the observation was at maternity , newborn unit and operating theatre	Methods
		Exposure quantity and duration: how many sessions or episodes or events were intended to be delivered? How long were they intended to last?	Two training session was conducted to allow adequate time for facilitators and participants to learn and practice. The ratio of one facilitator and six participants was maintained to support participants to learn in pairs as standard protocol indicated in the training. The duration lasted for 2 days	Methods
		Time span: how long was it intended to take to deliver the intervention to each unit?	The training intervention was delivered in 6 hours each for two days and practical seasons was 2ominutes. Observation of health workers practicing resuscitation was observed throughout the 3 month period by the research assistants. Bag and mask drill was delivered every morning 5 days a week for 3 months	Methods
		Activities to increase compliance or adherence (e.g., incentives)	Health workers were provided breakfast and lunch during the two days training interventions and support supervision during morning drill of mask and bags	
Objectives	5	Specific objectives and hypotheses	Our study objectives were: To assess change in health worker knowledge, psychomotor skills competency of the health workers regarding managing neonates with birth asphyxia after training intervention and the ratio of perinatal mortality due to asphyxia of hospital admission within 24 hours of birth after training interventions Meanwhile we hypothesized that HBB training would result in 20% increase in knowledge, skill and subsequent reduction of early newborn mortality among newborn born with asphyxia.	Introduction
Outcomes	6	Clearly defined primary and secondary outcome measures	The main primary outcome was the any improved knowledge, skill and competency of the health workers on HBB protocol. The secondary outcome is the ratio of early newborn reduction with asphyxia within 24 hours	Methods
		Methods used to collect data and any methods used to enhance the quality of measurements	Data was collected by the use of a questionnaire with 17 multiple choice questions to assess the knowledge of health workers on the HBB protocol, a 7-step checklist for bag-and-mask skill check,5-step checklist for preparation at birth skill checks, a 13-step checklist with simulation for the first Objective Structural Clinical Examination (OSCE), A self-observation questionnaires consisting of 25 steps check list maternity and newborn register for	Methods

			recording delivery and neonatal registration form.	
		Information on validated instruments such as psychometric and biometric properties	The validity of the HBB instruments was determined by expert reviews and opinions. The study used HBB instruments for assessing the knowledge, practical skill and competency of the health workers was a standard tool which has been validated and used in other low setting countries where HBB and skills evaluation have been conducted (American Academy of Pediatrics, 2014)	Methods
Sample size	7	How sample size was determined and, when applicable, explanation of any interim analyses and stopping rules	Calculation of sample size was based on the ability to detect20% increase in knowledge, practical skill and competency and 20% reduction in newborn mortality with an error of 0.05, 20% and dropout rate of 50%. The study used this value as our references for the sample size calculation. Using G power, we determined a sample size of 74 participants in each arm to account for the losses but due to the ongoing conflict the actual participate for both arm was less than estimated sample size	
Assignment method	8	Unit of assignment (the unit being assigned to study condition, e.g., individual, group, community)	Participants health workers in one hospital was assigned intervention group subjected to training and observations and health workers in one tertiary assigned to Control group with no training and only observations	
		Method used to assign units to study conditions, including details of any restriction (e.g., blocking, stratification, minimization)	Participants health workers in one hospital was assigned intervention group subjected to training and observations and health workers in one tertiary assigned to Control group with no training and only observations	Methods
		Inclusion of aspects employed to help minimize potential bias induced due to non-randomization (e.g., matching)	The intervention and Control are in two tertiary hospital and the sample size are similar	
Blinding (masking)	9	Whether or not participants, those administering the interventions, and those assessing the outcomes were blinded to study condition assignment; if so, statement regarding how the blinding was accomplished and how it was assessed	The master trainers and principal investigator who participated in training intervention were not performing the assessment of the health workers during resuscitation. Trained research assistants who knew the participants during the hospital practice	
Unit of Analysis	10	Description of the smallest unit that is being analyzed to assess	Since the group of individual were assigned to intervention and Control group, the analyses were performed at the group level	

		intervention effects (e.g., individual, group, or community)		
		If the unit of analysis differs from the unit of assignment, the analytical method used to account for this (e.g., adjusting the standard error estimates by the design effect or using multilevel analysis)	Not applicable	
Statistical methods	11	Statistical methods used to compare study groups for primary methods outcome(s), including complex methods for correlated data	Paired sample test was used to measure the mean score at pre, post-test for both groups. Unpaired sample t-test was used to determine the mean changes of knowledge, psychomotor skills and competency between the intervention and Control group. Ration and percentage were used to measure changes in early newborn mortality within 24 hours	Results
		Statistical methods used for additional analyses, such as subgroup analyses and adjusted analysis	Not applicable	Results
		Methods for imputing missing data, if used	Data collected from pre, post and 3 months were collated and entered into excel and exported into SPSS version 20, analyzed and missing number was detected and presented	
		Statistical software or programs used	SPSS version 20,	
RESULTS				
Participant flow	12	Flow of participants through each stage of the study: enrollment, assignment, allocation and intervention exposure, follow-up, analysis (a diagram is strongly recommended)	Upload on Flow charts	Consort Flow chart uploaded
		Enrollment: the numbers of participants screened for eligibility, found to be eligible or not eligible, declined to be enrolled, and enrolled in the study	Upload on Flow charts	
		Assignment: the numbers of participants assigned to a study condition	Upload on Flow charts	
		Allocation and intervention exposure: the number of	Upload on Flow charts	

		participants assigned to each study condition and the number of participants who received each intervention		
		Follow-up: the number of participants who completed the follow-up or did not complete the follow-up (i.e., lost to follow-up), by study condition	Upload on Flow charts	
		Analysis: the number of participants included in or excluded from the main analysis, by study condition	Upload on Flow charts	
		Description of protocol deviations from study as planned, along with reasons	Upload on Flow charts	
Recruitment	13	Dates defining the periods of recruitment and follow-up	Health workers recruitment commenced in February 1st and ended in 25th February 2017 2017 , Training intervention was February 27st – 28th Intervention started March- May and follow up started in June 1st and Ended 0n 30th June 2017	
Baseline data	14	Baseline demographic and clinical characteristics of participants in each study condition	Baseline demographic and clinical characteristics of participants in each study condition Base line was on related to Helping Babies Breathe training intervention such as number of years in practice, prior exposure , qualifications, encounter with newborn with breathing difficulty for both intervention and Control group and participant who were lost to follow up and remained in the study	Methods
		Baseline characteristics for each study condition relevant to specific disease prevention research	Pre intervention data collection from the hospital registry for newborn asphyxia commenced in November 2016 and needed in February 30th 2017	Methods
		Baseline Controls of those lost to follow-up and those retained, overall and by study condition	The baseline is the same as above	
		Control between study population at baseline and target population of interest	Not applicable	
Baseline equivalence	15	Data on study group equivalence at baseline	The intervention and Control group did not statistically differ much with respect to	

		and statistical methods used to control for baseline differences	demographic and professional characteristics (age, gender, Education, qualification, prior newborn and resuscitation education p>0.05 in each). But the intervention group reported greater baseline frequency and percentage on the frequency of encountering newborn with breathing difficulty (72.5% of Health workers in intervention and 53.3% in Control were frequently managing newborn with breathing difficulty)	
Numbers analyzed	16	Number of participants (denominator) included in each analysis for each study condition, particularly when the denominators change for different outcomes; statement of the results in absolute numbers when feasible	The analysis of health workers during the baseline, pre and post-test in the intervention and Control group was 40/40 for intervention and 30/30 for Control. The 3 moth follow up analyses in intervention and Control group was 38/40 and 29/30 for health workers were around for the three month follow up excluding the lost to follow up	
		Indication of whether the analysis strategy was "intention to treat" or, if not, description of how non-compliers were treated in the analyses	The primary and secondary analyses was not intention to treat analyses and not all participants as assigned were not included at the three months of the study	
Outcomes and estimation	17	For each primary and secondary outcome, a summary of results for each estimation study condition, and the estimated effect size and a confidence interval to indicate the precision	Health worker knowledge increased from 4.2.5% pre training to 97.8% post training (C.I 49.7-60.9) and this decreased to 84.7% at 3 months (C.I (-15.7 - 10.3) and was insignificant (P=1.00).The HBB training has improved the knowledge of the health workers. In the Control group (Wau), the post and three months changes in knowledge was insignificant. Pre training knowledge was not established Pre post changes showed that skill score increased from 26.1% to 95.4% post training (CI 62.9-75.6) which was significant. At three months, the mean score decreased to 94.4% (CI -4.4-2.9). However the mean change was insignificant (P= 0.676). In the Control site (Wau), pre- test was not administered. At post-test, the mean score for the group was 44.3% and this decreased to 40.8% (CI-12.6-5.7). The increased was insignificant p= 0.446 The competency of the health workers on simple newborn resuscitation was measured at pre post and 3 months for intervention (Juba) and post ad 3 months for Control site (Wau). The result showed that knowledge of health workers in intervention site increased from 26.9% pre training to 88.8% post	

			training and this further increased to 89.8% three months follow up (CI=55.6-68.2) In the Control site, mean score decreased from 41.6% to 38.9% three months follow up (CI= -7.6-2.2) however the decreased was insignificant (P=0.277). The pre post primary outcome for complex resuscitation show that competency for health worker in intervention site increased from 17.5% to 90.9% (CI 69.3-77.7) and this decreased to 88.3% at 3 months follow up (CI-6.8 - 1.6). Health workers retained competency three months post training. In the Control group the pre – test was not administered. The mean score decreased from 36.4% to 33.1% three months follow up (CI -7.2- -0.1). Health workers in the Control did not gained any skill at the end of the study. There was reduction in early newborn mortality in the Juba teaching hospital from 15.9% to 3.2% C=15- 12.7.In the Control, there is no reduction in overall and early new natal morality and it remained slightly at the pre implementation period of 41% from 42% (CI=42-41). Training of health workers has impact on the reduction of early neonatal mortality within 24 hours.	
		› Inclusion of null and negative findings		
		› Inclusion of results from testing pre-specified causal pathways through which the intervention was intended to operate, if any	Not applicable	
Ancillary analyses	18	› Summary of other analyses performed, including subgroup or restricted analyses, indicating which are pre-specified or exploratory	No ancillary analyses conducted	
Adverse events	19	› Summary of all important adverse events or unintended effects in each study condition (including summary measures, effect size estimates, and confidence intervals)	No serious harm was observed on the health workers and the newborn except in few cases lack of oxygen due to power failure leading to death of newborn with severed asphyxia referred by health workers for advanced resuscitation	
DISCUSSION				
Interpretation	20	› Interpretation of the results, taking into	The study limitations might be that it has small number of sample for newborn to	Discussion

		account study hypotheses, sources of potential bias, imprecision of measures, multiplicative analyses, and other limitations or weaknesses of the study	accurately determine the effect of our training and the short period of the intervention. The study was not also randomized	
		Discussion of results taking into account the mechanism by which the intervention was intended to work (causal pathways) or alternative mechanisms or explanations	The study has demonstrated that HBB training of health workers was associated with significant increase in knowledge practical skills and reduction of neonatal mortality	
		Discussion of the success of and barriers to implementing the intervention, fidelity of implementation	the training used the research instruments which was previously validated and standardized adapted from American Academy of pediatric	Discussion
		Discussion of research, programmatic, or policy implications	The study strongly recommends that since HBB training in this study has demonstrated that it can effectively impact on the knowledge, skill, and competency of health workers in hospital setting and reduction of early neonatal mortality, there is need to consider the roll out of the training by Ministry of health and other supporting organization in the country particularly in rural setting where this protocol has put emphasis. The training must be conducted and roll out in phased approach of first training of pool of facilitators and then training of health workers where neonatal mortality indicators is highest	Discussion
Generalizability	21	Generalizability (external validity) of the trial findings, taking into account the study population, the characteristics of the intervention, length of follow-up, incentives, compliance rates, specific sites/settings involved in the study, and other contextual issues	Our result may not necessarily be generalized to other countries and facility setting but to South Sudan setting. Another pre and post training with larger population in health facilities to include larger randomized trial to determine the effect of training and early newborn mortality for at least one year followed up before assessing the impact	Discussion
Overall evidence	22	General interpretation of the results in the context of current evidence and current theory	The study identified improved knowledge skill competency and decreased mortality within 24 hours. This study like any other pre post study highlighted the evidence of HBB training effect on health workers and newborn mortality	Discussion

VITA

Christopher Vunni is a Public Health Consultant, lives in Uganda and has permanent resident in Republic of Liberia, Completed Master of Science, Public Health majoring in health Policy and Planning at International health Sciences University of Uganda and bachelor at Mbarara University of Science and Technology Faculty of Medicine under the scholarship provided by Madhvani Group of Companies. Currently a student of Doctor of Philosophy in Public Health Sciences at Chulalongkorn University, Thailand under private sponsorship. Christopher, prior to the PhD study was actively involved in humanitarian development work in Uganda, South Sudan and Liberia and worked in a number of organization. He worked in Public Health for the last 15years with expertise in managing teams, reproductive maternal health, Monitoring and evaluation of programs including the development of M&E plans, methodologies and indicators; undertaking baseline surveys, process, evaluations; monitoring and evaluating of health programmes in fragile and post-conflict environments; conducting data quality assessments, interpreting performance results and analysis of the implications of such results in the country context; report writing and promoting research uptake. His expertise has seen him manage projects mainly focused on health systems strengthening, reproductive health, maternal and newborn health family planning, and malaria, HIV/AIDS, and Community Health Workforce. He has deep knowledge of the development sector and has worked closely with senior officials from country governments and a multitude of international and donor agencies. From 2000- 2008, he worked for MOH, Uganda Christian University and Tear fund South Sudan program, providing technical assistance in health system developing the capacity of the County Health team on six WHO building blocks. From 2009- 2017, worked Malaria Consortium, Merlin, IRC, CHAI , Victoria University, and Conseil Santé in various capacities as project manager, coordinator, Monitoring and evaluation specialist. Christopher is an upcoming scientist who published with international journal. At moment, Christopher is engaged in implementing research on use Chlorohexidine gel for newborn cord care.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University