The non-pneumatic anti-shock garment, a first aid device in obsterical emergencies

Jaana Laine

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Author:	Jaana Laine
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Supervisor (Arcada):	Gun-Britt Lejonqvist (Degree Programme Director, LHS)
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Every day an estimated 830 women die due to complications of pregnancy and child birth. Maternal mortality has decreased 43 percent between the years 1990 and 2015. Still, 99 percent of the deaths occur in developing countries and most of these complications are preventable or treatable. The leading cause of maternal deaths is severe bleeding after child birth.

Abstract: This master´s thesis is a literature review about the use of the non-pneumatic anti-shock garment in obstetrical hemorrhages. The aim of the study has been to find results on how does the NASG effect obstetrical bleeding, recovery, and maternal mortality. The findings will serve Finnish Red Cross in humanitarian work in catastrophe areas.

Method: The study was conducted by descriptive literature review and depicted a qualitative answer to the research question. The selected articles (n = 16) were analysed with inductive content analysis.

Results: The review produced four main categories: 1) Physiological impacts, 2) Treatments, 3) Professional qualification and 4) Community effects. The analysis showed that with help of the non-pneumatic anti-shock garment (NASG) blood loss decreased 42-55%, vital signs and restoration of circulatory stabilized rapidly, mortality was reduced 34-66%, morbidity decreased 44-66% and there were 32-73% lower EAOs. The need of invasive treatments, like hysterectomies, decreased 45-56%. The NASG is not a definitive treatment and IV fluids, uterotonics, and blood products are needed. There were no severe side effects during NASG use and contraindicators are related to heart failure. Studies observed that the use of the NASG was easy to learn, to apply, and to observe the patient using it. It is known to be low-cost but before initialization it needs support and effort from local health policy makers.

Conclusion: The NASG has several positive results in obstetrical hemorrhages. It can be recommended for use in catastrophe areas and developing countries where delays in reaching definitive treatments are common and the resources of treatments are limited.

Keywords:	Non-pneumatic anti-shock garment, Obstetrical hemorrhage, Postpartum Hemorrhage, Maternal Mortality, Maternal Morbidity, Finnish Red Cross
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FOREWORD

I got my first experience with the non-pneumatic anti-shock garment in February 2016. Finnish Red Cross arranged a training to midwives who may use the NASG during their work in FRC missions in catastrophe areas. I was impressed. The NASG was so simple and easy to use. The training raised an interest to know more about it. The same year I was chosen to study at Arcada University of Applied Sciences in the Master´s program in Global Health care.

Master's thesis may be commissioned by an organization or company to suit their needs. Finnish Red Cross needed more scientific knowledge about the NASG, and I needed an aim for thesis. Connection was ready. Thesis work, reading and writing, has taken time but it has been interesting due the aim.

I am thankful to my family. They have let me get away from housework quite well during the writing process. Hopefully my shadow on the wall behind my desk will disappear, even though my daughter doubted it. Also, I thank Jari Koiranen, from Finnish Red Cross, supervisor Gun-Britt Leijonqvist, who guided thesis work in monthly meetings, and Kirsi Niinistö for checking the language of this thesis.

1 INTRODUCTION

> ”One woman who gave birth at home arrived to the emergency room bleeding heavily. She had no pulse, no blood pressure, and was pale and cold. Her relatives left her bedside to go outside and grieve her death. The doctors in the hospital had just received the NASG, and placed it on the woman. Within 2 minutes, her eyelids began to flutter and she began murmuring. The doctors called her relatives to tell them she was alive. The relatives returned, elated, and said to her: ”You need a new name. From now on you are Ayorunbo-she who has been to heaven and returned.” (Ojengbede, Butrick, Galadanci et al. 2014)

Every day about 830 women die due to complications of pregnancy and child birth. Most of these complications are preventable, treatable or diseases developed during pregnancy. Postpartum hemorrhage (PPH) is the most common single cause of maternal morbidity and mortality. About 25% of global maternal deaths are caused by it (WHO, 2016a**)**.

Non-pneumatic anti-shock garment was developed especially for postpartum hemorrhage (PPH) (Maternova, 2016). It has also been used in many obstetrical hemorrhage cases for stabilizing the situation before final treatment is reached in developing regions (El Ayadi et al., 2013; Brees et al., 2004; Fathalla et al., 2011; Hensleigh, 2002; Manandhar et al., 2015; WHO, 2016 a).

Finnish Red Cross (FRC) has added the NASG to the Emergency Response Units (ERU) medical devices recently for use in ERU projects in catastrophe areas. FRC has the endeavor to find researched information about its reliability and confidence. Consequently, FRC has ordered this study for that purpose.

The aim of the study has been to find results on how the NASG effects blood loss, recovery, and mortality especially for FRC purposes. The data collection was limited to original studies and patient reports that answer the research questions. The study is a descriptive literature review, the data collection was made mainly systemically. The results were analysed by using inductive content analysis.

The structure of the study begins with background information. It contains explanations about mortality, morbidity, and, obstetrical hemorrhages. Hemorrhages are the main cause of maternal deaths and there are global strategies to reduce mortality and morbidity

rates. The study describes them and the role of the NASG insaving women´s lives. The process of the review is explained in the methodology section: data collection, criteria, and analysis of the results. In the results four main categories emerged: Physiological impacts, treatments, professional qualification, and community effects. There are sub-categories under the main categories that were analysed and explained based on the found results. In the end of the study there are sections on discussion, recommendations, and conclusion. In those have presented summarised results, recommendations, limitations, and discussed them with own interpretations.

Figure 1. The non-pneumatic anti-shock garment, NASG. Photograph: Safe Motherhood Program

2 BACKGROUND

2.1 Mortality and morbidity

> *"***Maternal death** is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes" (WHO, 2017).

Most of maternal deaths and complications are preventable, treatable, and develop during pregnancy. Other complications may exist before pregnancy but are worsened during pregnancy, especially if they go unnoticed during antenatal care (WHO, 2016 a).

99% of the deaths occur in developing countries, more than half of them in sub-Saharan Africa and 1/3 in Asia. The annual number has decreased 43% from 532 000 to 303 000 between the years of 1990 and 2015 (WHO, 2015c). The rates are decreasing, but in sub-Saharan Africa the rate has not decreased as seen elsewhere (Buchmann et al., 2016). In 2015, 201 000 deaths from maternal causes occurred in sub-Saharan Africa. The difference in Maternal mortality ratio (MMR) is large between developing and developed countries. The mortality ratio in 2015 was 239/100,000 in developing countries versus 12/100,000 in developed countries (Alkema et. al., 2015; Buchmann, Stones & Niranjan, 2016; WHO, 2015a). There is also a difference between women in high and low-income countries and in rural versus urban areas (Hussein et al., 2016; WHO, 2016b; WHO, 2009).

> WHO´s definition of morbidity:"Direct obstetric morbidity results from obstetric complication of the pregnant state (pregnancy, labour and the puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above. This can include temporary conditions, mild or severe, which occur during pregnancy or within 42 days of delivery, or permanent/chronic conditions resulting from pregnancy, abortion or childbirth. Morbidity can lead to death." (Holly et al. 2002)

Morbidity is also defined "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy". Signs of dysfunction that follow life-threatening conditions can be recognized in some

cases. In morbidity cases women have had some pregnancy-related complication and have been treated in intensive care unit, been in surgical operation etc. (Say et al. 2004). A term extreme adverse outcomes (EAOs) is a combination of maternal mortality and severe morbidity (Fathalla, 2011).

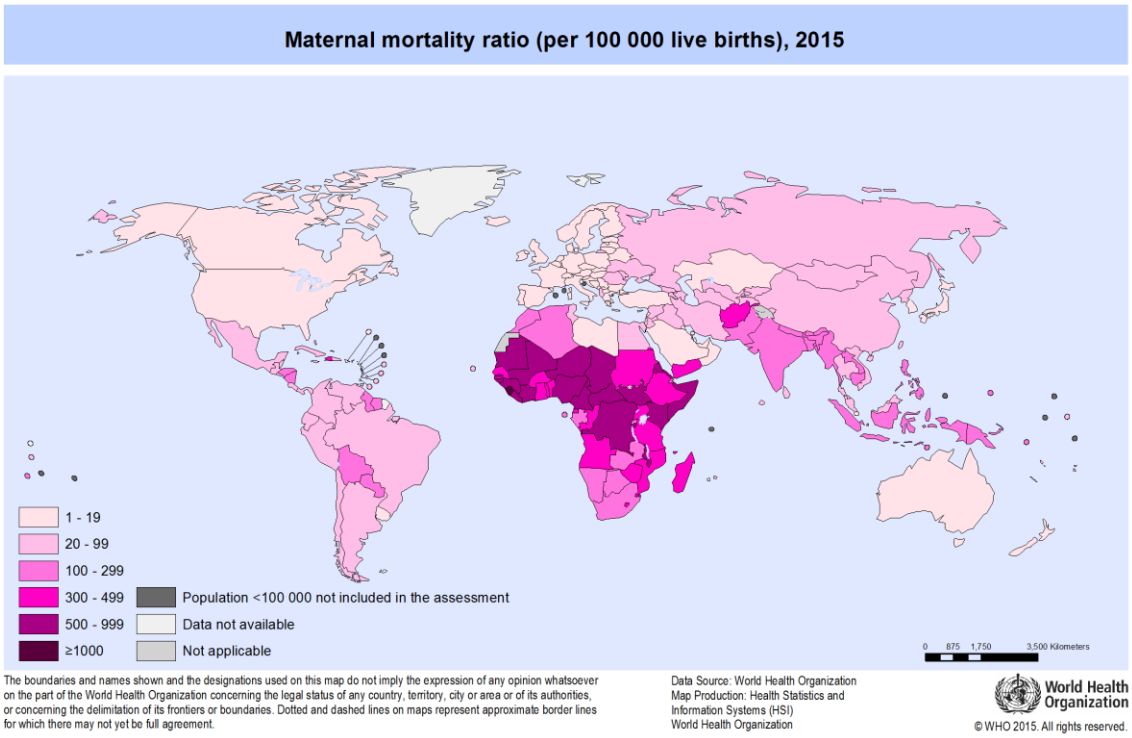


Figure 2. Maternal Mortality Ratio. Photograph: WHO

2.1.1 The risks of maternal mortality and morbidity

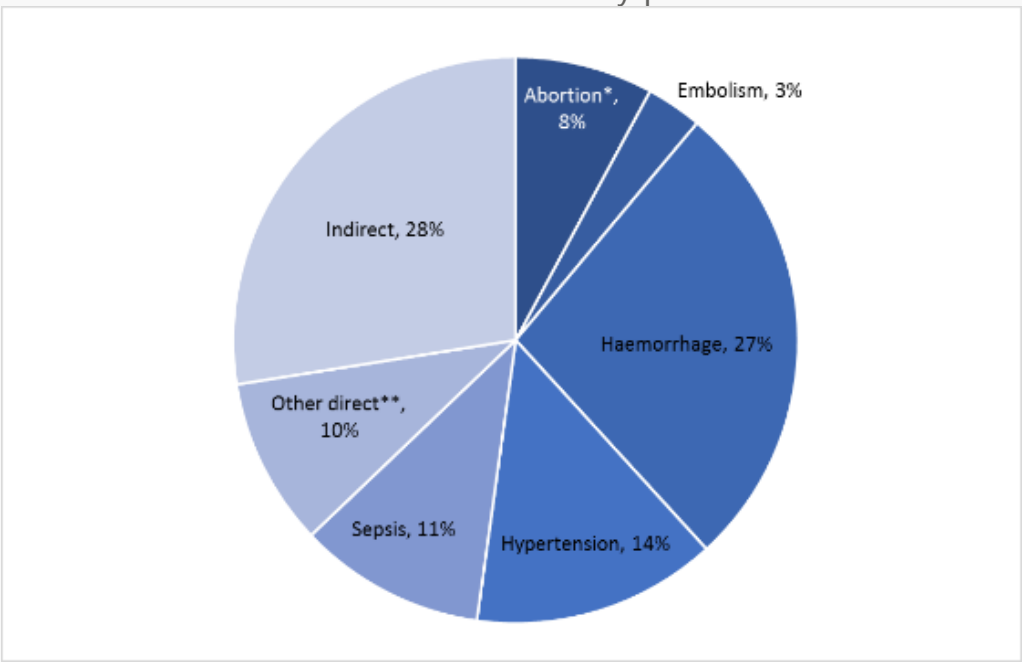


Figure 3. The causes of maternal deaths. Photograph: Say L et al.

There are several reasons for maternal mortality and morbidity. Some of those are maternal-related and others are environmental-related problems.

Severe bleeding, mostly after childbirth, is one of the common causes for maternal deaths (25%). It is called postpartum haemorrhage (PPH). The other causes are hypertension during pregnancy, infections, sepsis, complications from delivery, unsafe abortion, and indirect causes, like interaction between medical conditions and pregnancy (SoWMy, 2014; WHO, 2016 a).

The most important factor leading to MMR is substandard practice and poorly trained health workers. If the health workers had performed better, the majority of the deaths would have been avoided (Boltman-Binkowski, 2015; Merrali et al. 2012; Nyamtema et al., 2011; SoWMy, 2014). Variety of the health workers *motivation* and *morale* has also been reported to be causes for MMR (Hussein et al, 2016).

Childbirth at an early age has a direct connection to higher risk of complications and death. The highest risk of maternal mortality is for adolescent girls under 15 years old. In developing countries the mortality ratio is 1/180 and in developed countries the ratio is about 27 times higher, 1/4900. The leading cause of death among adolescent girls is complications in pregnancy and childbirth (Nyamtema, Urassa & Roosmalen 2011; (WHO, 2014; WHO, 2015a; WHO 2012b).

Untreated diabetes mellitus type 2 and gestational diabetes increase risks of miscarriages, preterm labour, caesarean section, hypertension, pre-eclampsia, and obstetric trauma. The lack of calcium can cause maternal eclampsia and pre-eclampsia (WHO, 2012b). The maternal undernutrition range is from 10 to 19% in many developing countries. It may increase risks for complications during pregnancy and delivery (Nyamtema et al., 2011; WHO, 2012). Maternal iron-deficiency and undernutrition increase the risk of maternal deaths. It has been accounted that at least 20% of maternal mortality is caused by anemia. Estimated global number of overweight adult women is 35%. Overweight increases risks for hemorrhage, eclampsia, pre-eclampsia, difficult delivery and birth defects. (WHO, 2012b).

The key problem is the lack of access to good quality care before, during, and after childbirth. Most of complications develop during pregnancy and most of them are preventable or treatable when the necessary medical interventions exist and are well known (Boltman-Binkowski, 2015; Buchmann et al., 2016; Hussein et al., 2016; Nyamtema et al., 2011; SoWMy, 2014; WHO, 2015a). Avoidable factor is patient delay. Reasons for delays are such as cultural issues, failure to recognize danger signs and mistrust of the health system (Buchmann et al., 2016; Merrali et al. 2012; Nyamtema et al., 2011; SoWMy, 2014). The ineffective and inappropriate referral system is a noticed problem. Obstetric emergency

cases were reportedly poorly managed prior to arrival, with mismanagement of referrals causing delays (Hussein et al, 2016).

Under-equipped health facilities are common in middle- and low-income countries, imposing limitations to actions in hemorrhage cases (Buchmann et al., 2016; Merali et al., 2014; Nyamtema et al., 2011; SoWMy, 2014). These factors can be anaesthesia-related: lack of operation theatres and suboptimal intensive care units, or lack of essential drugs and supplies. Limitations in health care facilities, such as lack of record keeping, team work, missing records, and poor organisation of rotas cause problems to health care facilities (Hussein et al, 2016). Poor blood transfusion system has been noticed to be one of the causes for MMR. Several problems in the system can be identified. Lack of accessibility to a blood bank, lack of blood donors, blood collections, poor infrastructure, and blood safety concerns (Hussein et al, 2016; Merali et al., 2012; SoWMy, 2014).

2.1.2 Recommendations to reduce mortality and morbidity rates

Guidelines and recommendation for safer antenatal care and delivery have been given to avoid pregnancy and labour related complications. Guidelines and recommendations are based on scientific researches.

Health care during pregnancy, ***antenatal care*** **(ANC)**, is provided by skilled health-care professionals. ANC includes: risk identification, prevention, and management of pregnancy-related or concurrent diseases, health promotion, and health education. ANC reduces maternal and perinatal morbidity and mortality by detecting and treating pregnancy-related complications. ANC attends to identification of pregnant women and girls who are in increased risk of possible complications during labour (Alkema et al., 2016; WHO, 2016d).

The implementation of ***effective referral intervention*** is important to achieve the benefits of emergency obstetric situations. The referral system is mainly improving utilisation of health services and it can increase the number of women who seek care from health professionals during their deliveries (Alkema et al., 2105; Hussein, Kanguru, Astin & Mun-

jana, 2012; Nyamtema et al., 2011; Sphere, 2011). ***Effective transport system***, and creating it easily reachable, is mentioned in several studies. Long distances are major problems in many situations (Pyone et al., 2012; SoWMy, 2014: Sphere, 2011; WHO 2012a; WHO, 2009).

The educational impact of birth preparedness and complications interventions may increase knowledge about birth preparations and possible complications in community level. It is targeted to women and preferably also to their families. Birth preparedness and complications readiness may increase the use of a skilled attendant at birth (Buchmann et al., 2016; Nyamtema et al., 2011; Pyone et al., 2012; Solnes et al. 2015; SoWMy, 2014; Yuan et al., 2014; WHO, 2010).

It is recommended that women get ***appropriate and safe care*** during delivery with the current best practises. Health care is based on scientific knowledge and evidence-based *guidelines*, adjusted for local circumstances. Safe caesarean section, anaesthesia and possibility to blood transfusion should be available in health care facilities (Buchmann et al., 2016; SoWMy, 2014; Sphere, 2011; WHO, 2016c). High quality care is reducing delays in providing and receiving health care, and it maximizes use of resources when it is needed (WHO, 2016c).

Training and refresher courses for health workers are recommended. The evidence of effectiveness in the Emergency Obstetric Care (EmOC) sub strategy is strong. Clinical guidelines, based on WHO recommendations, and regular training for EmOC are needed. (Alkema et al., 2105; Buchmann et al., 2016; ICM, 2013; Pyone et al. 2012; SoWMy, 2014; Sphere, 2011; WHO, 2010; WHO, 2012b; WHO, 2016b; WHO, 2016c; WHO, 2009).

Good management and leadership are related to influence health care providers, communities, policy makers, policies, and funding of health system. Effective leadership and management create functional health care, increase maternal health care services, and the use of them (Alkema et al., 2105; Buchmann et al., 2016; Nyamtema et al., 2011; ICM, 2013; Pyone et al., 2012; Solnes et al. 2015; WHO, 2010).

Community mobilization in low-income settings, such as slums, should be integrated with effort to deliver services for the most vulnerable people. ***Improvements in health services,*** such as vaccination campaigns, infectious disease surveillance, and a general improvement in environmental conditions accompanied by behavioural change decrease mortality rate (Alkema et al., 2105; More et al., 2012; Yuan et al., 2014). Implementing initiatives like health insurance programmes, improvements in midwifery services and community health worker development have positive effect on maternal health at national and even village level (Alkema et al., 2105; Hussein et al., 2016; SoWMy, 2014; Yuan et al., 2014).

2.2 Hemorrhage

Obstetric hemorrhage may be caused by spontaneous or induced abortion or ectopic pregnancy in early pregnancy. In late pregnancy and in labor, bleeding may result from placental abrubtion, placenta previa, or uterine rupture. Bleeding following childbirth is associated with weakness of the uterus to contract (atonic uterus), injuries to vagina, cervix or uterus, and retention of placental tissue (WHO, 2003).

Postpartum hemorrhage (PPH) refers to more bleeding than normal after giving birth. 1-5% of women have PPH. It is commonly defined as blood loss of 500ml or over within 24 hours after birth (WHO, 2012a). Intervals between onset of bleeding and death in the absence of medical interventions have been estimated. Postpartum hemorrhage leads to death after two hours without medical interventions and antepartum hemorrhage after 12 hours. In other obstetrical complications: ruptured uterus one day, eclampsia two days, obstructed labour three days, and infection six days (WHO, 2009).

2.2.1 Prevention of postpartum hemorrhage

Routine and frequent uterine tone assessment is a crucial part of immediate postpartum care for early identification of uterine atony. Oxytocin is the most recommended uterotonic and should be offered to every woman during the third stage of labour, after neonate has born. 10 IU (international units) oxytocin is given intramuscularly or intravenously. It is not recommended that a mother who has received oxytocin sustain uterus massage

as preventing PPH. The other uterotonics are ergometrine/methylergometrine or the fixed combination of oxytocin and ergometrine. Orally used 600µg misoprostol is recommended if other uterotonics are unavailable. If skilled birth attendants are not present, trained community health care workers and lay health workers are able to use misoprostol. It is strongly recommended for the prevention of PPH (WHO, 2012a, WHO, 2016c).

Late umbilical cord clamping, 1 to 3 minutes after birth, is recommended for all births unless the neonate is asphyxiated and needs resuscitation. Continuous uterine massage is not recommended to prevent PPH but it is recommended for PPH treatment (WHO, 2012a).

Controlled cord traction (CCT) is recommended for preventing PPH among trained birth attendants, but contraindicated in cases where skilled attendants are not assisting. (WHO, 2012a). CCT is associated to reduced mean blood loss, incidence of manual removal of the placenta, and duration of the third stage of delivery (Du, Ye & Zheng, 2014; WHO, 2012a).

2.2.2 Treatment of postpartum hemorrhage

WHO (2012a) and International Federation of Gynecology and Obstetrics (FIGO) have published recommendations for treatment of postpartum hemorrhage. Recommendation in low-resource settings has added application of the NASG in obstetric hemorrhages (Lalonde & FIGO. 2012).

WHO recommendation in obstetrical hemorrhage (2012).

Medical management in PPH:

1) Oxytocin injection by intravenous is the first line medicine and strongly recommended.
2) If oxytocin is not available, or bleeding continues without responding to oxytocin, intravenous ergometrin, combination of ergometrin, and oxytocin or prostaglanding, including sublinqual misoprostol 800µg are recommended.
3) Intravenous isotonic crystalloids are preferably used as colloids.

4) If other uterotonics fail to stop bleeding, the use of tranexamic is recommended.
5) Blood transfusion, when needed.

Manoeuvres and other procedures in PPH:

1) Uterine massage is a therapeutic measure and strongly recommended. Retained placenta can cause hemorrhage. CCT and oxytocin are needed to expel it or in case of no respond, manual removing.
2) The use of intrauterine balloon tamponade due to uterine atony, if uterotonics are not available or there is no response to treatment. Balloon tamponade can be obtained with use of liquid-filled condoms or surgical gloves
3) Bimanual uterine compression, and further, the use of external aortic compression are recommended until appropriate care is available.
4) The use of *non-pneumatic anti-shock garment* is recommended while waiting for transfer to appropriate care. The garment has weak recommendations based on low-quality evidence.
5) Uterine artery embolization. The manoeuvre needs significant resources, special facilities, and the training of health care workers. It is also a costly treatment.
6) Surgical interventions: compression sutures, vessel ligations, sub-total, and in the end total hysterectomy.
7) Uterine packing is NOT recommended.

Application of these interventions requires training. Complications associated with these procedures and interventions and maternal discomfort must be reported (WHO, 2012a; WHO, 2016c).

There is robust evidence on the use of misoprostol to control PPH and prevent one-third of maternal deaths. Misoprostol is a low-cost medicine that is possible to utilise orally, rectally, and vaginally. It is also temperature-stable, as opposed to oxytocin and ergometrine. (Pyone et al., 2012).

Amount of blood loss is often visually underestimated compared to measurement of blood collected in a plastic drape. Recommendation is to collect and measure blood loss for

possible replacing (WHO, 2009). Blood transfusion services should be functioning in the health facility at all times (WHO, 2016c).

2.3 Strategies for reduction of maternal mortality

The global challenge of the eight Millennium Development Goals (MDGs) started in the beginning of 2000. It included eight developing goals and number 5 was to improve maternal health. The first target in MDG 5 was to reduce the maternal mortality ratio 75% between years 1990-2015. The second target was to achieve universal access to reproductive health for all women by 2015 (UN, 2015b; UN, 2016).

Figure 4. Milleniun Development Goal 5. Photograph:SlideShare

95 countries with MMR above 100/100 000 live births were included in the evaluation of progress concerning MDG 5, 9 countries achieved the target, 39 reduced ratio about 50%

and 21 countries decreased ratio about 25% (WHO, 2015a). The target was achieved partly, 44-45 percent of the target, less than half (UN, 2013; WHO, 2016a). In 2014 71% percent of births were assisted by skilled health personnel globally. The rate has increased 59% from 1990 but at the end of the project only half of the pregnant women received the recommend amount of antenatal care (UN, 2013).

Alkema´s et. al (2015) systematic analysis had MMR data from 171 countries out of 183. Worldwide MMR ratio decreased from 385/100 000 to 216/100 000 between years 1990-2015; total number of 10,7 million women died during the MDGs period. It has been counted that during the years 2016-2030 3.9 million women will die if each country continues to reduce its MMR 2,9% annually, which has been the reduce rate during 2000-2015.

The next global challenge, Sustainable Development Goals (SDGs) era started in September 2015 and it is following MDGs. United Nations general assembly and 193 member countries adopted 17 goals of SDGs and the goals are to be achieved before 2030. Each goal has specific targets. Target number 3 is Good Health and Well-Being. One of its targets is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030. MMR is still 14 times higher in developing regions than in the developed regions. Received ANC has increased during MDGs but still only half of all women in developing regions receive the recommended amount of health care they need. Child births have decreased, but the decrease in maternal mortality ratio has slowed down. The use of contraceptives should be increased together with the demand of them. Governments investments in health workers, social protection, and supply chains are taking action to achieve the target. To achieve these goals, cooperation with UN, government, civil societies, development partners, youth groups, faith-based organizations, communities, and private sector is needed (UN, 2015a).

Figure 5. Sustainable Development Goals. Photograph: WHO

Figure 6. WHO´s strategie for EPMM. Phograph: MamaYe, Tanzania

WHO Strategies towards ending preventable maternal mortality (EPMM) started 2015. It is one of the actions to achieve SDGs. Targets and strategies are grounded in human rights, and focusing significant inequities in access, quality, and outcomes of care between countries. The key interventions for EPMM are to strengthen health systems to give correct and high quality treatment effectively in maximum available resources and tailored to the local context (WHO, 2015b).

In 2016, WHO launched, with many international societies, the report: Time to respond A report on the global implementation of Maternal Death Surveillance and Response

(MDSR) and, MDSR Technical Guidance, information for action to prevent maternal death (2013a). An essential component of MDRS is Maternal death review (MDR), which includes investigations of maternal deaths. Reports are published to decrease and to avoid preventable maternal mortality. Created data collection tools and technical guidance are for gathering information about MMR. For creating high quality national data collection systems, it is critical to advocate them at the highest possible political level for support and resources. All maternal deaths need to be reported and reviewed. By classifying, recording, and investigating deaths gaps become visible. By preventing possible gaps and creating higher quality care of a child birth it is ensured that other women do not die due the same reason (WHO 2016b; WHO 2013a).

WHO is supporting poor countries to deliver integrated, cost-effective, and evidence-based health care for mothers during pregnancy, childbirth, and postpartum period and health care for babies. WHO invests especially in training midwives and making emergency obstetric care available round-the-clock. These elements are the key to reduce maternal mortality (WHO, 2015a). WHO has published handbooks about maternal and newborn health care for health workers' counselling sessions as well as information on how to prepare for labour, danger signs in pregnancy and postabortion care (WHO, 2013a).

WHO recommendations on postnatal care of the mother and newborn (2013) is based on the knowledge of specialists and universities, organizations and evidence of systematic reviews. The focus of guidelines are for low- and middle-income countries in resource-limited settings and for maternal and newborn care after delivery. Recommendations are for health professionals who are responsible for providing postnatal care to women and new-borns (WHO, 2013c).

UNFPA (United Nations Population Fund) has worked with governments, partners, and policymakers to help build a well-trained and -supported midwifery workforce in low-resource settings. The support of UNFPA started in 2008 and includes education of midwives to take care of pregnancies, deliveries, to provide comprehensive sexual and reproductive health services and to promote health in communities (UNFPA, 2017). Jhpiego, an affiliate of John Hopkins University and UNFPA, developed nine interactive e-learning modules on midwifery skills and family planning, also including lessons about PPH

and obstructed labours. The lessons are endorsed by WHO and federations of obstetrics, midwives and nurses (UNFPA, 2013).

3 THE NON-PNEUMATIC ANTI-SHOCK GARMENT

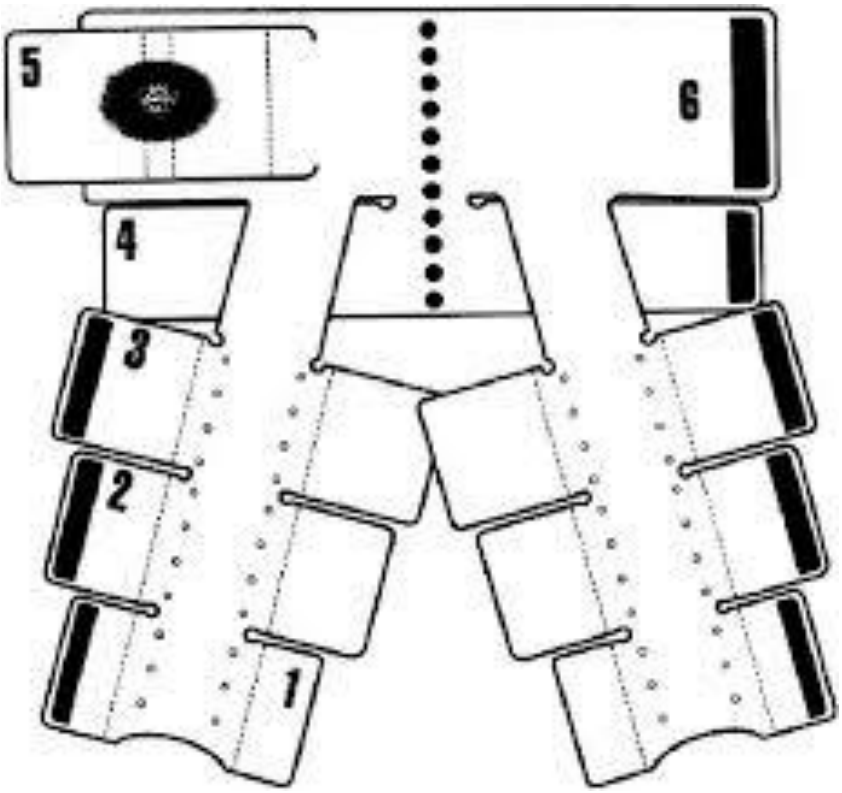


Figure 7. The NASG with six segments. Wrapping from part one to part 6. Photograph: ResearchGate

The NASG (in rare cases called Life wrap) is a first aid device used to stabilize women suffering from postpartum hemorrhage. It is reusable multiple times after sterilization in a diluted bleach solution. The NASG is made of neoprene, with six segments that wrap around a woman´s legs and lower abdomen, and using Velcro to hold it attached. The NASG squeezes blood from lower extremities and centralizes blood circulation to brains, lungs and heart, and can keep these vital organs functioning. It can be worn from 12 to 24 hours, during transport, while getting to other treatments like IV fluids, oxygen, vaginal surgery, and partly opened abdominal surgery. Any trained person has the possibility to put on the NASG, but removing the NASG requires trained medical staff. The NASG

is removed once a woman is stabilized in terms of her pulse and blood pressure. Systolic blood pressure, pulse, and bleeding must be monitored while removal. The NASG must be removed one segment at a time and removal takes minimum 1 hour (Maternova, 2016).

The history of the NASG begins in the 1900s when an inflatable pressure suit, pneumatic anti-shock garment (PASG) was used to maintain blood pressure during surgery. In the 1940s, after modifications, the suit was refined for use as an anti-gravity suit (G-suit). In the 1970s, a half-suit known as MAST (Military Anti-Shock Trousers) was created. It was used in the Vietnam War for resuscitating and stabilizing soldiers with traumatic injuries before and during transportation. In the 1980s MAST was adopted for use in emergency rescue services to stabilize lower body injuries like pelvic and abdominal hemorrhages. In the early 1990s a team of scientists at NASA (The National Aeronautics and Space Administration) developed a NASG which was used for the first time in Pakistan in 2002 in some patient cases during the treatment of bleeding. A short case series was published on the treatment of six women. Dr. Suellen Miller read the article and joined forces with the writer, Dr. Paul Hensleigh, to make a real impact and decrease maternal death by using NASG at the community and primary health care levels to stabilize and transport women with obstetric hemorrhage (Safemotherhood, 2017).

2007 UNFPA provided NASGs to Nigerian hospitals to prevent maternal deaths and learning material to use it. An interview after a short experience of using NASG showed positive results about the use of it (UNFPA, 2007).

WHO (2012) has given a recommendation about the NASG. It can be lifesaving for a person suffering from PPH if the bleeding is stabilized for safe transport to a comprehensive obstetric care facility. One method to stabilize bleeding is to use NASG. WHO has estimated that the recommendation is weak and evidence about using NASG is low quality (WHO, 2012).

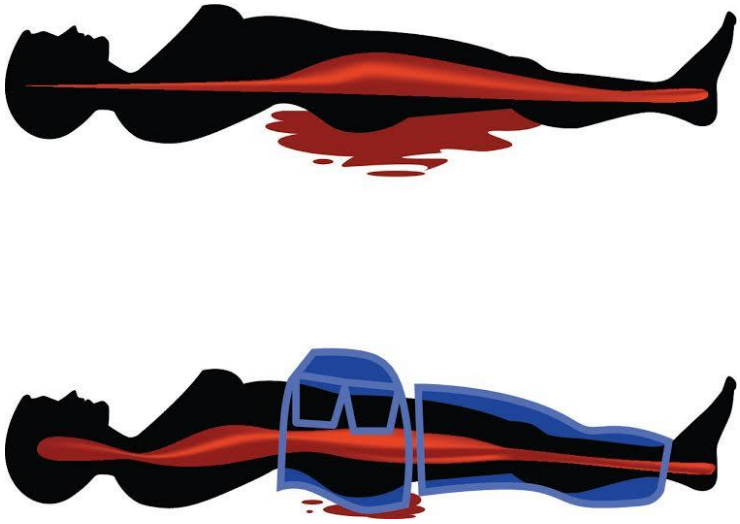


Figure 8. The NASG squeeze blood from lower extremities. Photograph:Safemotherhood

3.1 Knowledge, acceptance, implementation, and cost effectiveness

There are studies about the NASG that do not answer the research question of this study. These studies include valuable results. The results are presented in this chapter, not in the discussion part. It was a decision to separate clearly the results of this study and the excluded studies.

A study about awareness of the NASG was conducted in Nigeria. Awareness was wide, almost 96% of the respondents had heard about it through various sources like seminars, textbooks, journals, and the internet. Majority could explain various advantages and contraindicators. But one of the results of the study was that knowledge is mainly theoretical, only 35% of the respondents had had opportunities to apply the NASG (Kolade et al., 2014).

Sharma, Negandi, Das et al. (2017) did a pilot study in Bihar, India about the acceptance of the NASG. After training and appropriate introduction to the practise of using the NASG, the initiative did not make a difference in improving the PPH management over six months. The writers recommended implementation research studies. A similarly

aimed project was completed in Nigeria. Acceptance of the NASG was overwhelming and the device was called "the life safer". The results of the trial were promising and significant reductions in blood loss and EAOs were recorded. The NASG got a lot of positive publicity, and media response has been strong. The study has been important for building local capacity. It has given a new tool in the face of daunting maternal capacity (Ojenbede, et al., 2014). In a Mexican study most of the resistance to NASG use came from doctors in high-level facilities. Doctors needed published evidence of the physiologic effects, and nurses were more interested about application and removal of the NASG (Berdichevsky, Tucker et al., 2010).

According to research, barriers to scaling up the NASG are limited health infrastructure, resistance by providers and policy makers, lack of defenders and policy makers, and low political will (Jordan, Butrick, et al., 2016). Other barriers were lack of repetition and retraining in NASG use (Ohaeri & Ogbeye, 2017). Also challenges were inadequate return and exchange programs (Jordan, Butrick, et al., 2016; Sharma, Negandhi, et al., 2017) and lack of motivation among health care providers (Sharma, Negandhi, et al., 2017).

Facilitators to scaling up the NASG are local and international defenders, disseminations of clinical trial results, recommendations by WHO and FIGO (Jordan et al., 2016), well-developed and tailored trainings (Berdichevsky, Tucker et al., 2010; Jordan et al., 2016; Ohaeri & Ogbeye, 2017; Ojenbede, et al., 2014; Sharma, Negandhi, et al., 2017). Reported factors in scalinging up NASG were good availability (Ohaeri,& Ogbeye, 2017), strong leadership (Sharma, Negandhi, et al., 2017), feedback to providers, and clear referral protocols as well as training in higher-level facilities where patient might be transferred (Ojenbede, et al., 2014).

Cost-effectiveness of the non-pneumatic anti-shock garment was researched in Zambia and Zimbabwe. Early application of the NASG at the primary health clinic has the potential to be cost-effective. Women who received the NASG earlier recovered more quickly and survived delays better before reaching their definitive care. These factors effected to the costs and the NASG can be said to be a cost-effective device (Downing, El Ayadi et

al., 2015). Sutherland, Downing et al. (2013) got similar results among severe hypovolemic shock patients in Egypt and Nigeria.

4 AIM OF THE STUDY AND THE RESEARCH QUESTION

Aim of the study has been to find results on how the NASG effects blood loss, recovery and mortality in obstetrical emergencies based on the results. Finnish Red Cross is using the NASG in challenging environments and situations mostly in developing countries. This study seeks to illustrate results about the use of it and shares knowledge and competence to use it under FRC operations.

The research question is:
How does the NASG effect obstetrical bleeding, recovery and maternal mortality?

5 RESEARCH METHODOLOGY

The study is a descriptive literature review and the data collection has been made systemically from databases and partly manually. The results have been analysed by using inductive content analysis.

5.1 Descriptive literature review

Literature review is an essential tool for health care professionals. It gains a comprehensive overview and summary of the available information on a particular topic. Literature review is generally more useful than one individual study because it allows to see a wider context. The literature review process is a research methodology commencing with a research question, followed by a research design, and at the end of the presentation is a discussion of the results (Aveyard, 2010).

Descriptive literature review has been used in nursing science frequently; it is diversified and settled already. It tries to understand and describe a phenomenon. In clinical nursing it can be used to gather data. Descriptive literature review is based on a research question

and produces a descriptive and a qualitative answer. The method consists four stages: 1) Forming the research question, 2) Selecting data, 3) Constructing the description and 4) Observing of the results (Kangasniemi et al, 2013).

Focus in qualitative research is to understand, explain, discover, and clarify situations. Study designs and methods of data collection is far less clear than in quantitative method. (Ranjit, 2011). Simple summaries about the measures are used in descriptive statistics with simple graphics analysis (Research methods Knowledge Base, 2006).

Descriptive review was chosen as a method of this study. The studies chosen to review are mostly quantitative studies. The core reason of using the descriptive method is to gather scientific data, present it more readable and understandable shape, and describe the research item. The results will be used to guide implementation of the NASG to clinical work (Kangasniemi et al., 2013, Ranjit, 2011).

The purpose of descriptive review is to find answers about phenomena (Burns & Grove, 2005; Polit & Beck, 2012) or emphasize the key abstracts and relationships between them (Burns & Grove, 2005; Fitzgerald & Rumrill, 2005). The analysis contains key elements that are related together. Those elements need to be recognized and highlighted during presentation, teaching, and using NASG.

5.2 Content analysis

The content analysis is a method for analysing documents. It allows the researcher to test theoretical issues to enhance understanding of the data (Cavanagh, 1997). The content analysis is commonly used in nursing studies. It has possibility to be used in qualitative and quantitative data and in an inductive or deductive way. Whether to use inductive or deductive analysis depends on the aim. Deductive content analysis is useful if the aim is to test a previous theory in a different situation or comparing categories at different time periods. Inductive content analysis is used in studies where there are no previous studies about the same phenomenon or data is fragmented (Elo & Kyngäs, 2007). In their article Elo and Kyngäs (2007) have explained and referred Cavanagh (1997). The method of

using the system is to distil words during analysis into fewer content-related categories and classified words and phrases, with the same meaning, are in the same categories.

This study gathers data together from available studies and raises awareness of the NASG. The categories in inductive content analysis are derived from the data. The categories have been formed from specific to general. Specific words and sentences are observed and divided into categories by meaning and the next stage groups categories to a more general direction (Elo& Kyngäs,2007; Lauri & Kyngäs, 2005).

6 LITERATURE REVIEW PROCESS

This chapter provides transparent information of the review process from September 2016 to October 2017. The study offers scientific knowledge about the NASG in preventing obstetric emergency situations, mortality and morbidity by using data collection and content analysis.

Data identification, selection, and analysis were based on the research question, excluding and including criteria. Systematic data collection and the including criteria guided the data collection and highlighted the reliability during collection and content analysis. Inclusion and exclusion principles are presented in Table 1.

6.1 Data collection criteria

When a study uses secondary sources, like books and studies, data collection needs a strategy. Data collection is the most important part of the process, and if these mistakes are made, it leads to wrong results (Whittemore, 2005). A research tool is reliable when data collection can made with the same set of information or similar conditions. The reliability of the instrument is higher when differences are minimal between comparable results. If collected information gives different measurements, it is a reflection of the instrument´s reliability (Ranjit, 2011).

Table 1. Including and exclusion criteria

Inclusion criteria	***Exclusion criteria***
Research, case report	Other type of data
Published in Academic Journal or recognized Professional Journal	Published in other magazines
In English, Finnish or Swedish	In other languages
Handling NASG and obstetric emergencies	Not handling the NASG and obstetric emergencies
Answer to the research question	Not answering to the research question
The same data has been used once in this study	The same data has been used in several studies and in this study

Data collection criteria are presented above in Table 1. The characters were modified during data collection. The research aim was the primary criteria. After exploring available studies, articles and case reports, the data collection criteria were modified to the final form. The collection of irrelevant data and articles based on research were avoided by using the inclusion and exclusion criteria. Also studies based on the same data used in several studies were excluded.

6.2 Data collection

The data search process started with guidance from an information specialist in February 2017. EBSCO Academic Search Premier, MEDLINE, CINAHL, and PubMed were used for data collection. Used search word was non-pneumatic anti-shock garment. Different spellings were also used for searches, like nonpneumatic anti-shock garment, non pneumatic anti shock, and non pneumatic anti-shock garment. The same search words were used in every database. The search strategy was not restricted to any language or to any

time interval. The data collection search was done four times during the study process. The first search was done in February 2017 and the last October 2017.

Table 2 presents the data collection process and the numbers of included and excluded records (Stolt et al., 2016). In the beginning all available data was searched about non-pneumatic anti-shock garment. Found data included mainly articles, case reports, and studies. By searching all the studies an overview of the NASG, the availability of data, research aims, and the amount of studies was gathered.

Four databases were used for data gathering. The number of found studies was limited. Based on this observation, this study did not have any time limitation among the found studies. By using including and excluding characters duplicate studies, studies which were not about the NASG, studies which have used the same data in several research papers and studies which were not answering the research question were excluded. The accepted studies covered the research question, were available, and were about the NASG.

Table 2. Search process in numbers

Records identified through databases	***Excluded, based on exclusion characters***	***Eligible***
EBSCO Academic Search Premier, **29**	19	29-19=**12**
Cinahl, **13**	13	13-13=**0**
Medline, **29**	29	29-29=**0**
PubMed, **31**	30	31-30=**1**
Manual search,**6**	3	6-3=**3**

EBSCO Academic Search Premier search turned up 29 records. In the end of data collection 12 studies from this database were included. From Cinahl found 13 records but after exclusion none of them were included into the data. Medline found 29 records but none were included in the study. 31 records were found on PubMed and after exclusion one study included in the study. The last data search was done in October 2017. The record numbers were from EBSCO Academic Search Premier 30, Cinahl 13, Medline 30, and PubMed 31.

A manual search was also used in the data collection process (Stolt et al., 2016) and reference lists were searched through from studies and articles. From the internet found web pages and possible studies for this study. Six studies were found manually, from Safe

Motherhood program webpages or references lists and three of those were included in the study.

In August 2017 was contacted the leader of Safe Motherhood Program, Professor Suellen Miller for possible new studies and to find one missing study. Professor Miller has done lots of research and been a member in most studies concerning the NASG. She offered her help for data gathering but the studies she offered and mentioned were already found in previous searches. The missing data was neither available in her archive or databases.

The list of 16 included studies is presented in one list in Appendix 1. The selected studies were done mainly in developing countries, in Egypt, Nigeria, Zambia, Zimbabwe, India, Pakistan, and Colombia, in rural and urban areas, and from primary health care centres to high-complexity obstetric hospital.

Obstetric hemorrhage and mortality are the subjects of 13 studies and in three of the studies the effect of NASG to blood flow or how the size of the patient can impact of the effectiveness of the NASG were researched. Those studies were made with the help of volunteers in developed countries. 13 of the included studies are quantitative and three are qualitative case reports.

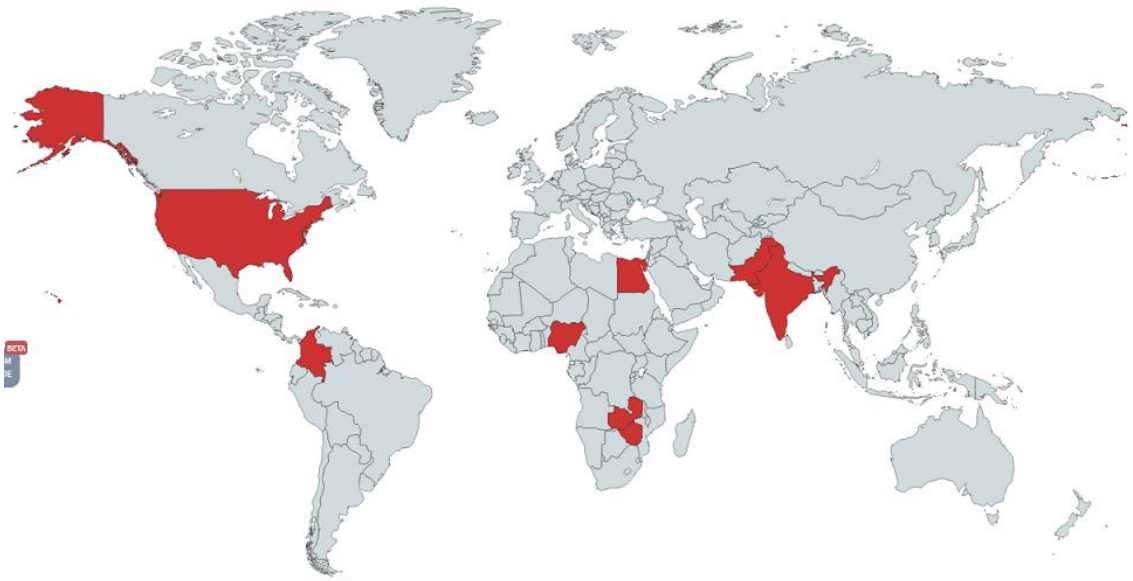


Figure 9. Countries where included studies have done. Photograph:https://mapchart.net/world.html

In Egypt and Nigeria, seven studies were conducted between 2004 and 2008 with mostly the same research group. Data was gathered from the same hospitals and the aim was same in all studies. One of those studies was included in this study. That study collected information from all previous studies, years, and countries. The decision to exclude the other six studies was made to avoid the use of the same data several times in this study.

6.3 Inductive content analysis

The included 16 studies were analysed with inductive content analysis. The selected studies were mainly analysed with quantitative analysis but content analysis changed the results to qualitative. The analysis process had three phases: preparation, organizing, and reporting (Elo & Kyngäs, 2007).

In the preparation phase data gathering was done by using selection criteria (Table 1). After the selection of the studies a theme was selected to the analysis, related to the research question. Selected studies were read through several times and notes and headings were written down in the margins to describe all words considering the aim. All the headings were organized from margins on the coding sheets and grouped by meanings and similarities. Created sub-categories were named by using content-characteristic words

(Appendix 2). After creating the sub-categories, the list of sub-categories were grouped under higher generic category. The four main categories were formed from the generic categories. The main categories are: 1) Physiological impacts, 2) Treatments, 3) Professional qualification, and 4) Community effects.

6.4 Ethical issues

Ethics is about good and bad, right, and wrong. Many ethical issues come up during research work and need to be considered. The ethical principles of data gathering and publishing are commonly approved upon. The principles are created to achieve high quality and validity knowledge. Ethically good research is required to follow good science policy. Researcher:

- needs to follow common science procedure: honesty, carefulness, preciseness during data gathering, evaluation, publishing results, and proposing them.
- respects previous researchers and their results in own work.
- applies the criteria of science research and does ethically sustainable data gathering, follows research and evaluation methods. The knowledge of science and the characters of it are guiding the research work. The results are reliable, truthful, and published results are transparent.
  (Hirsjärvi et al, 2009).

If the used method or procedure is known to be inappropriate, the research is unethical. It is also unethical if the results are something that researcher wants to get, selected samples are highly biased, an invalid instrument is used or wrong conclusions drawn. Incorrect reporting is unethical and serving own or someone´s else interest (Ranjit, 2011.)

In this study ethical issues are:

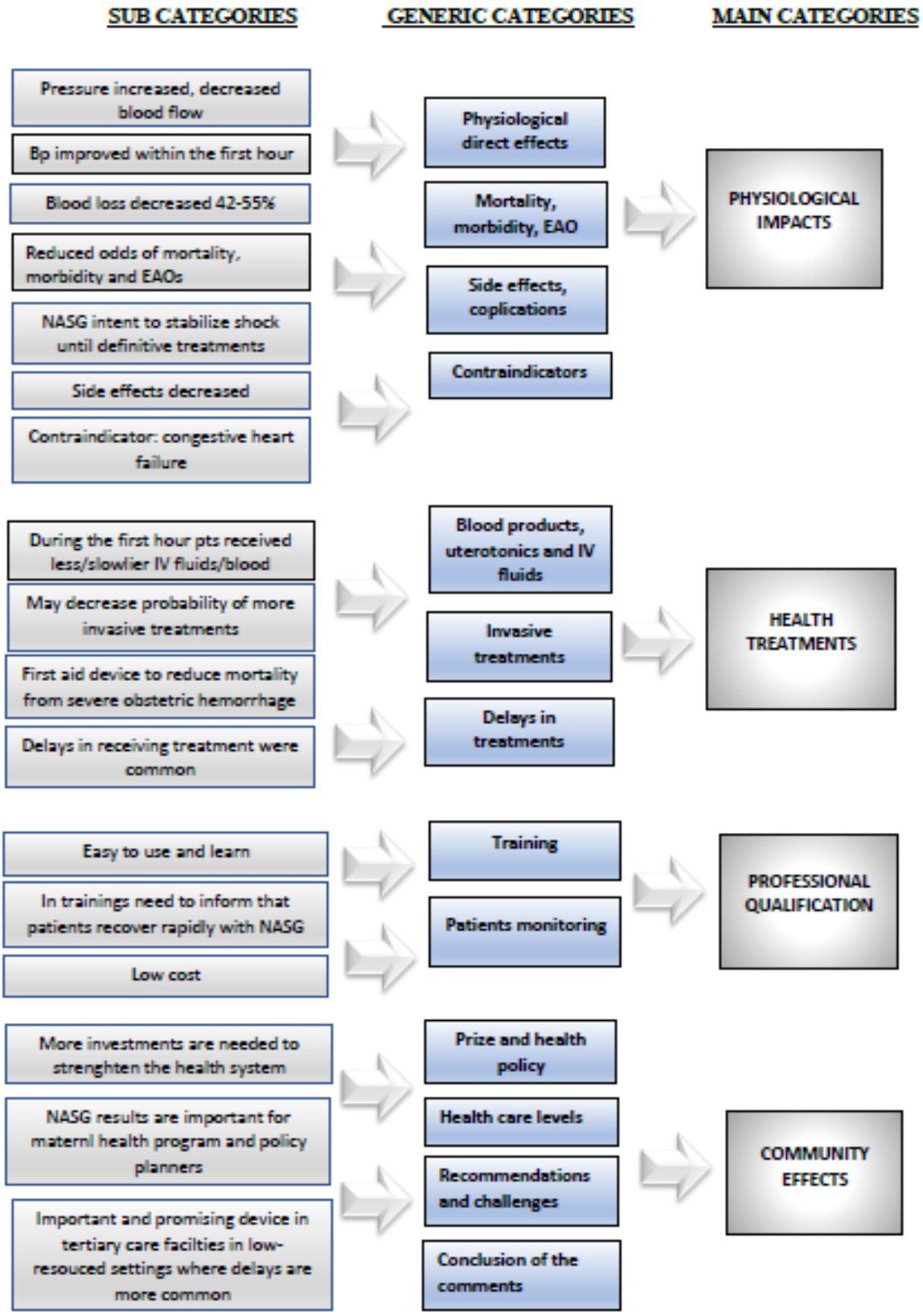
- What kind of studies were selected and analysed?
- How the results were excogitated and are they reliable and truthful?

When the research is done ethically in a correct way, it tells about researcher's reliability and ability to do scientific research professionally.

The objective of the study has been to find results on how the NASG effects blood loss, recovery, and mortality for FRC and support the use of it in disaster areas. In study used well known databases to reach the aim and to do the study truthfully. The search process was done systematically, and repeated the search several times. All available articles and studies were collected at the beginning about the NASG. The data selection was done by using including and excluding criteria. Those helped to choose original studies that are answering to the aim and research question.

The content analysis was done by following the analysing methods. Information on how to do analysis was found from articles considering content analysis. Guidance was also offered by Arcada and Diak during work. The studies were read several times, notes were made about methodology, aims, results, bias, and a table of the included studies created. From these studies results that were answering to the question were collected into a table of results and descriptions. The studies were checked to verify all results and descriptions were noticed and counted to the analysis. The process was done in a coherent way (Kangasniemi et al, 2013).

Table 3. Produced categories by using content analysis



7 LITERATURE REVIEW RESULTS

The analysis formed four main categories. Each of them consist generic categories and several sub categories. The core findings are represented in Figure 10. The main four generated categories are 1) Physiological impacts, 2) Treatments, 3) Professional qualification, and 4) Community effects.

7.1 Physiological impacts

Physiological impacts to blood loss, mortality, morbidity, stabilization, and recovery related to use of the NASG appeared in the analysed studies. In some studies, the aims were to test the NASG on healthy volunteers and find out how it affects blood flow and pressure between skin and the NASG. These studies may provide physiological explanations of how the NASG decreases blood loss and consequently affects mortality and morbidity rates.

7.1.1 Physiological direct effects

Blood loss: Bleeding was controlled with the NASG rapidly (1,3), and with no significant further bleeding (7,15). Blood loss decreased in the NASG phase 42-55%, from 370-560ml to 70-256 ml (6,7,11,13,16). In some studies blood loss decreased significantly (7,11,16).

The NASG has been used during invasive treatments and no difference has found in blood loss during operations (7,15). The NASG and Bakri Balloon has been used in massive PPH in one study (1). In another case, in massive PPH complicated by DIC (disseminates intravascular coagulation), when blood comes nonclotting (3). Bleeding was successfully temporized in both studies (1,3). The Bakri Balloon was set inside the uterus and filled with 500ml of liquid. External and internal uterine compression slowed down uterine blood loss sufficiently to allow definitive treatments (3).

Physiological direct effects: The mean external abdominal pressure significantly increased upon the application of the NASG (9). Full NASG application increased Internal iliac artery resistant index (RI) significantly. High RI leads to decreasing blood flow in the vein (10). Distal aortic blood flow also decreased with the NASG (12). The compression ball may affect the blood flow to the uterus independently (9). The study provides a physiological explanation of how the NASG might reduce PPH, but cardiovascular profile would differ significantly between euvolemic volunteers and women with hemorrhagic shock (10).

Pressure had an inverse relationship with a weak applier and an overweight patient and a strong applier with an underweight patient. There was significant variation of BMI (Body Mass Index) and applier strength (9). Difficulties emerged in availability of patients' size variation (2).

The NASG helped avoid metabolic derangements (1). Blood pressure (Bp) and heart rate (HR) improved in 5-60 minutes of usage (3,14,15), mean arterial pressure (MAP) was greatar than 70 after 5 minutes (15), and shock index (SI) <1 was low, after the first hour (1). HR and Bp stabilized in 6-24 hours (1,3,15) and international normalized ratio (INR) was 1,5 after eight hours (3). Hemoglobin (Hb) increased during the NASG treatment (3,15).

Stabilization and recovery: Most women´s vital signs and restoration of circulatory stabilized rapidly (14), even in 5 minutes (15) in the NASG phase. Rapid stabilization was also observed with the NASG and Bakri Balloon (1,3). 48% recovered in the 1st hour and 100% within 6 hours (1). Vital signs were normalized in 24 hours (1,3). In the experimental study vital signs remained stable among the volunteers (10). In cases where the NASG was applied before transfer to definitive treatment, shock recovery was 28% faster (4).

The NASG was removed after stabilization in 12-57 hours (1,3,14,15). The NASG is intended to stabilize hypovolemic shock until patients receive definitive treatment in higher-complexity level hospital or facility (2,5,7,8,14,16). The patients were discharged from hospital in good condition. The hospital day variation was from 3 to 6 days (1,3,15).

7.1.2 Mortality, morbidity and EAO

Mortality: The NASG intervention was associated with significantly reduced odds of mortality. Among the overall sample mortality, mortality is reduced between 34% to 66% (2,4,6,7,13,16), and there are 59% significantly reduced odds of mortality among the most severe women (6). The NASG could be associated with better outcomes in women with an 80%, or higher, likelihood of dying at the time of the placement of the NASG (1). There were no or few mortalities (1,3,14,15), one had prolonged shock followed by multiple organ failure and death (14). More women died in the NASG phase in one study. The higher mortality might cause by worse condition on study entry. The sample size was too small to draw meaningful conclusion; it may be due to change (11). Women who died received lower rates of blood transfusions (5).

Morbidity: The NASG shows a trend of reducing obstetric hemorrhage-related severe morbidities (2,4,7,11,13,14,15). Morbidities were defined as organ system dysfunctions related to severe obstetric hemorrhage (11). Morbidity decreased significantly from 44% to 66% (7,13). Some patients that survived without evidence of morbidity (14,15) or major complications (1) or organ dysfunctions were found (2).

Extreme adverse outcomes (EAO) decreased with the use of garment significantly (2,11,13), from 32% to 73% (4,7,8,11,13). Delays and MAP had effects to outcomes. A delay of 60 minutes or more from start of hemorrhage to study admission was strongly related to EAO (8). Women with MAP < 60 mmHg had 19 times higher risk to suffer the combined adverse outcomes (13). From a few studies no adverse events were found (1,3,15).

Increased mortality risk was found in certain maternal conditions, especially macerated stillbirth or the presence of another life-threatening co-morbidity (5). The proportion of women with high gravity, ≥ 5-6 previous pregnancies (5,13), uterine atony, placental abruption, ruptured uterus, placenta previa, hypertensive disorders of pregnancy, sepsis or anaemia had significantly higher risk of mortality despite application of the NASG (5). A bigger proportion of those who died had higher respiratory rate, estimated blood loss was higher and they were treated in tertiary care facilities (5). In some cases bleeding started

outside of facility and patients were transferred in. These patients were in more severe shock (13). The NASG contributed to the survival of the majority of women suffering obstetric hemorrhage and hypovolemia, but certain maternal conditions effected it negatively (5).

7.1.3 Side effects and complications

It has been mentioned that when the NASG is properly applied there should not be any discomfort or dyspnea. If those appear, individual panels should be adjusted. The NASG should be removed, if symptoms continue, until the underlining disorders are identified and corrected (14). In the NASG phase there was significantly less nausea (7,11), vomiting (7,11,14), aspiration (14), less respiratory symptoms, and abdominal pain (7). Patients were comfortable and did not feel pain (3,15). Two studies mentioned no side effects (2,9). In two of the studies patients´ urine output decreased 73% (2,15), to abnormal level. In most studies that was not a problem (1,2,3,9,14,15).

With the use of NASG adverse outcomes are reported infrequently (3,15), nor have any infectious complications been presented (1). It has been mentioned that it is safe to use (15).

7.1.4 Contraindicators

There are some limitations in using the NASG. Important contraindicators are congestive heart failure (3,14,15), mitral stenosis, pulmonary hypertension, bleeding above diaphragm (3,14), and a viable pregnancy (14).

In cases of suspected heart failure or respiratory distress close observation immediately after the NASG placement is recommended. The abdominal segment should be opened in the case of respiratory distress or heart failure (3,15).

7.2 Treatments

The NASG does not provide definitive help in obstetrical bleeding and other treatments are needed. Blood products, uterotonics, and IV fluids are treatments needed in hemorrhage cases. If these are not working, invasive treatments should follow. Delays in treatments while using the NASG came out in many studies. They included analyses of why and where delays occurred and possible reasons for delays.

7.2.1 Blood products, uterotonics, and IV fluids

Blood products: Women received less blood transfusion during the 1st hour (1,7,8,11,13), and women also received in total a smaller volume of whole blood (1,7). In one study there was no difference in the proportion of received blood transfusions (11). One study researched reasons for mortality among women who had the NASG during their treatment. There was a connection between mortality and blood transfusions. The proportion of women who died have received blood transfusions significantly less than women who survived (5). Probability of higher rates and volumes of blood transfusions may decrease while using the NASG. Only 40% of women required a transfusion despite the magnitude of the bleeding. Even their physiological results indicated 90% probability of need for massive transfusion (1). But the systematic review announced that there is no difference between NASG use and standard care on use of blood products (2).

Uterotonics: In one study of the NASG phase patients received more prophylactic uterotonics in the beginning of admission (7), but later during the treatment there was no difference in studies (7,13). In one study, patients received significantly less uterotonics in the NASG phase (16).

IV fluids: Significantly fewer women in the NASG phase received ≥ 1500 ml crystalloid fluids in the first hour (7,11,13,15). Patients needed to wait for transfusions longer (8), but fluids did not significantly differ by the second hour (13,15). In the NASG phase there was no significant difference in the proportion of women who received IV fluid treatment, but women who survived received 20% lower median IV fluid than those who died (5).

7.2.2 Invasive treatments

Four studies reported results that the NASG can reduce invasive treatments, like hysterectomies, placement of uterine compression sutures or uterine artery embolization (1,7,11,13). Estimated decrease is from 45% to 56% (7,13).

The NASG is recommended to use during operations. The abdominal and pelvic segments should be opened immediately prior to making incision and then replaced as soon as the surgery is completed (7,13,15). These recommendations were followed during invasive treatments (1,7,13,15).

7.2.3 Delays in treatments

The word delay came up in studies several times. Delays occurred in reaching definitive facilities, in treatments, and in developing environments.

Women with obstetric hemorrhage often face delays in recognizing PPH (8), reaching emergency obstetrical care facilities (8,13,15,16), and delays in receiving definitive therapies after arrival, like transfusions (8,13,15,16). Prolonged delays lead to EAO, like hypovolemic shock, multiple organ dysfunction pathway, and death (2,8,11,13,14,16).

Delays were shortest in relatively higher-resourced urban settings where most patients were already in the hospital for delivery. Delays were longest in the lowest-resource settings, where the majority of participants started hemorrhaging at home or at a low-level clinic (8). The NASG phase faced more delays in treatments (7,8,11,13). It may be explained as a result of the device (11), but delays in fluid/blood administration must be avoided (5,8,11,15).

7.3 Professional qualification

Training: The NASG is a health device used by health care workers. Training is needed before starting to use the NASG. Patient monitoring and unwrapping are simple but need medical staff and their skills. Information about those and faced challenges have been analysed in included studies.

The NASG is easy to learn how to apply and use. (1,2,8,13,14,15). It is possible to teach the use of it to non-medical personnel (8). Anyhow, the use of it requires body knowledge (2). In some studies health facilities were understaffed and increased the pressure of PPH treatments (7,16). Individual training methods for doctors and nurses need to be considered. In one study noticed that personnel had different needs regarding knowledge about the NASG (9). During training, it is important to inform that patients recover rapidly with the NASG, but patients still need treatments, like IV fluids, blood etc. (8,11,13,14). Training should emphasize the need of aggressive PPH treatment without delays (7,8,11). Skills to treat hemorrhage have improved during the study (7,13,16). Also the acceptance of the active management of the third stage of labour (AMTSL) has increased (7).

Early diagnosis of hemorrhage, application of the NASG, and rapid treatment are the keys to successful outcome in obstetrical emergencies (8,13,14). The standard medical protocol with the NASG has been used in PPH/OH treatment in many studies (1,2,3,4,5,6,7,8,11,13,14,15,16). When the patient is a small woman, it is necessary to wrap the NASG more securely around the patient. Weaker providers need to be as strong as possible and seek assistance from a stronger member of staff if needed (9).

Patient monitoring: High technical monitoring methods are not needed in NASG use (15). During the NASG application vital signs, blood pressure and pulse, have been followed (1,3,4,7,8,9,10,11,13,14,15,16) and bleeding observed (1,3,4,5,7,8,11,13,14,15,16). Also urine output need to be monitored (5,7,8,13,14,15,16) and medical treatment must be used if necessary (14,15).

7.4 Community effects

Price and health policy: Price of the NASG and health policy are the factors which effect the use of the NASG. A political decision to invest in the NASG, and to support the use of it, has strong power to the extent of its use. Studies are giving evidence-based information that this health device has positive impact to maternal care and should be incor-

porated into health care. Mainly the NASG has been researched in rural areas in developing countries. In some studies, it has also been used in higher level facilities, with reporting of the results of care. Comments about the NASG were collected from analysed studies. They are collected information concerning what the studies have found out about the NASG and how it has been experienced based on given results.

The found results about the NASG are important for maternal health program and policy planners (2,4). The NASG is a low-cost health device (1,2,3,8,13,15), and more investments are needed to strengthen the health system (2,5). The price and possibility of reuse makes the NASG an attractive option in diminishing PPH effects. It should be considered as a policy option while the standard conditions for care are being optimized (2).

Health care levels: The NASG is an important and promising health device in tertiary care facilities in low-resourced settings where delays are more common (1,2,6,8,11,12,13,15,16). The use of it has been associated with reduced odds of death (8,16). The results support the NASG implementation at the primary health clinic level before transfer to the referral facility (4,6,8).

The NASG has also been researched in high-complexity level and reported experiences suggest its effectiveness across a wide range of setting and resources. It is believed that the NASG is a viable tool for managing in every level of facilities and should be part of the protocol (1).

7.5 Recommendations based on analysed studies

The NASG is one of the rare devices that have positive effects in maternal hemorrhage (2,13) and underlines the importance of it (2). It is an effective device for the control of severe hypovolemic shock (1,14). There are promising findings (11,13,14) for saving women´s lives (13,14). The NASG is a protective device against mortality, morbidity, and extreme adverse outcomes (4,8,11,13). It has a strong positive effect (3,4,7,15) and is useful for patients with obstetrical hemorrhage (11), also among patients with massive postpartum hemorrhage complicated by coagulopathy (3). The NASG has potential to make an even greater impact in postabortion hemorrhages because delays are longer in

these cases (16). It should be a first line intervention, part of the protocol in severe hemorrhage cases (1), and received results should not be ignored (4).

The NASG is created to be a first aid device and does not replace other treatments in hemorrhages (2,5). There is still need of IV fluids, uterotonics, possible blood products, and invasive treatments if needed.

This health device offers valuable nonoperative and nonpharmaceutical treatment (3). The NASG can reduce the impact of delays in reaching definitive facilities and therapies (2,6,7,8,11,13,14). Possible side effects are mentioned to be rare but there are mentioned contraindicators when the NASG is not recommended, such as congestive heart failure, pulmonary hypertension, and viable pregnancy (3,14,15).

Careful monitoring and evaluation strategy to assess the impact is highly recommended (2). There is a possibility of some complexities associated with NASG use. These include difficulties to secure storage, availability, adequate size to fit anthropometric variation of population and ensure safe re-use i.e. appropriate cleaning and number of re-uses. The expansion of manufacture capacity for NASG and harmonization of clinical pathways to include the NASG are aspects that need to be addressed (2).

8 DISCUSSION AND CONCLUSION

8.1 Discussion

The results of the study and background part´s information are similar in hemorrhage treatments. Like, the NASG is for first aid, and hemorrhage patients need medicines, IV fluids, and medical knowledge. Recovery was faster in all studies, excluded and included. Same challenges were also noticed, like need for political support. Training, refreshers, and delays in treatments in developing countries, came out in both parts. Also, in background studies observed NASG awareness, knowledge, and acceptance. In the included studies these subjects were given no attention.

In developing countries, where delays are more common, the NASG has proved to be a good invention for saving women´s lives. Delay was mentioned in reaching definitive facilities and receiving treatments in emergency cases. One of the effects of the NASG, rapid stabilization, was noticed to have influence on delayed treatments as well. The support of health policy was noticed to be important in implementing the NASG.

The NASG is recognized to be easy to use, but there is a need for a training before initialization and came out from analysed studies. Patient monitoring, vital signs, and bleeding observation, are necessary while the NASG is being used or removed. During studies health personnel improved their skills to treat hemorrhages.

Challenges in the use of the NASG have been mentioned, such as manufacture capacity, availability, safe reuse, and storage. Ethical issues that came out from the studies concerned price. In high-income countries the price of the NASG is reasonable, 55-170 USD. In low-income countries, where birth rate is high, it can be too expensive investment to health facilities, midwives, and birth attendants.

In content analysis some negative results about study methods came out. In systematic literature review (Pileggi-Castro, 2015) it is said," the retrieved evidence is dominated by observational studies, which rendered mostly evidence of low quality due to inherent research design limitations". In minority of the studies patients´ urine output was not normal during NASG use.

The NASG was developed about 15 years ago. Even though the invention has been researched, found results are promising, and WHO and FIGO have added the use of the NASG in its recommendation, it is not known worldwide. This raises the question of why it is so unknown. Is the high rate of maternal deaths a silent, sad, and accepted truth in developing countries? In countries where the maternal mortality rate is high deaths can be a part of the everyday life, an accepted sad occurrence. Low language skills, low education rate and poor knowledge about evidence-based results of maternal health can be some of the reasons.

Maternal deaths are common in many low-income countries. Could that affect people´s opinion that they are a normal part of life and are thus more accepted than in high-income countries? If availability of treatments, like IV fluids, blood, and uterotonics, are limited, it can lead to ethical selections. If the reuse and storage of the NASG is not effective, can those problems affect health personnel and whose hemorrhage is treated by the NASG? Midwives and birth attendance may use those only in special cases and not for everyone who would need those. These questions are large and complicated, and not easy to solve. Supporting by equipment and education is not simple either. Cultural differences, acceptance, and continuous development are challenges which need time and capacity.

This study has some limitations that should be acknowledged. It has used systematic search strategy without limitation of publishing year. Studies over 10 years old were included because of the lack of newer studies. In some studies the number of patients were low. Other limitations were the number of accepted studies done by same research groups, and several observational studies which may be low quality. Maternova is the company selling the NASG. The lead researcher of the NASG is writing a blog in the company´s home pages. Connection between researcher and company, selling the product, can be seen as complex and may decrease the value of the researcher´s impartiality. Reliability of the NASG may increase after new studies.

Maternal mortality ratio has decreased during the 20th century with the help and support of MDGs and SDGs goals. Initialization of the NASG means need for training and support to health care personnel. The work may need at least one devoted named person in every country, who leads implementation and training, and puts effort to the work. Global acceptance, positive health policy, and support guarded by organisations like WHO or UNICEF are recommended to support implementation of the NASG. Also new studies, like cluster randomized studies (cRCT), performed by other research groups are recommended.

8.2 Conclusion

The NASG is one of the rare inventions that might reduce maternal deaths and severe outcomes in developing countries. Based on the study results it has several positive effects: decreased blood loss, rapid recovery, and low-cost without severe side effects or many contraindicators. The NASG could be warmly recommended for use in developing countries and in environments with limited resources or treatments, like Red Cross work in catastrophe areas. Even one saved maternal life compensates the price of the device and decreases the open-ended amount of human suffering.

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APPENDICES

Appendix 1. List of review artickles

Number	Year, country	Author	Data collection, Method	Research quest/item	Population/number of interviews/researches	results	barriers
1	2017, Colombia	Escobar et al.	Descriptive case series	The experiences of using the NASG in PPH in high-complexity obstetric hospitals.	77 cases	48% recovered in1st hour, after 6h all. Effective.	
2	2015	Pileggi-Castro et al	A systematic review	The effect of NASG use compared with standard care in PPH	6 studies	Potentially able to reduce mortality and severe morbidities. Use of NASG should consider in dev.countries	many observational studies-> low quality

3	2014, USA	Jelks et al.	Case report	Massive PPH, complicated by DIC, tewmporized with Bakri Balloon and NASG	2 cases	Within the 1st hour bleeding minimized. Successful outcomes without need for operation. Decreased need for fluid, blood and transfusions.	
4	2014, Zimbabwe and Zambia	El Ayadi et al.	Reanalysis from data, 2009-12 from a Cluster Randomized trial	Per-protocol effect of earlier reseach. NASG application at the PHC prior referral hospital compared applic. in RH.	366 app. In BHC: 512 app in RH	Mortality reduced 60%,65% reduced odds of EAO, 28% faster recovery.	Per-protocol approach is prone to bias. Unmeasured confounding may have biased estimation.
5	2013, Nigeria	El Ayadi et al.	2007-12 Evaluation of previous data	Reason for mortality. Evaluation of died women with PPH and NASG patient.	201 deaths	Macerated still births, anemia, huýpertensio, sepsis, multiparity, tertiary care facil., uterus ruptura, placenta abnormalities, dicrease mortality.	Observational data, collection not initially planned, forms were often filled retrospectively, dates+ time not always complete , comobidities over-under reported, majority of forms came from facilities with greater experience, high proportions of data missing for several characteristics.

6	2012, Egypt, Nigeria, Zambia, Zimbabwe, India	El Ayadi et al.	Combined analysis of 5 quasi-experimental studies	Effectiveness of NASG in obstetric hemorrhage in tertiary care facilities	1947 control, 1616 intervention	Blood loss 50% lower, overall 38% reduced odds of mortality , 59% among the most severe women	Data is from observational studies. Every studies bias can become exaggerated to this study.
7	2011, Egypt	Morrise et al.	6/2005-8/2008, Controlled before-after	The impact of NASG in uterine atony in CEmOC facilities in referral hospitals.	169 before, 269 after NASG	Blood loss reduced significantly, emergency hysterectomy decreased significantly,fewer EAO 11%-3%, faster recovery.	More people in pre-int group,had MAP <60mmHg, started to bleed at home or clinic, more unconscious (4,9-1,9%). In NASG phase treatment slighty slower, less IV fluids and blood products, more prophylactic uterotonics (79-87%). Possible selection bias:enrollment is dependent on clinical choice, not all women enrolled in the study who had eligibility criteria.
8	2011, Egypt, Nigeria	Turan et al.	2004-08, Pre- and interventio groups	Effects of NASG in delays of transport and treatment in PPH and	pre 295, intervention 509	NASG can reduce the impact of delays, but not replace treatment.	Missing data when bleeding started, small sample sizes fron Nigeria

				postabor-tion hemor-rhag (PAH) in referral hospitals.			
9	2011, USA	Stenson et al.	Pre-post measure-ments of pressure	The effect of NASG to external ab-dominal pressure, effects of BMI and applier to non-preg-nant volun-teers.	20	NASG increases the pressure significantly. Underweight patient have significant higher pressure compare over-weigt patients.	Only external pressure was measured,. Small sample size and non-pregnant., most volenteers had normal weight
10	2011, USA	Lester et al.	6/2008-1/09, pre-post measure-ments of pressure	To estimate the change in blood flow to the pelvis with the NASG by using ul-trasound doppler.	10	The median value in-creased significantly in internal iliac artery.	Uterus arteries would be more specific to esti-mate the blood flow with NASG. A small sample size.

11	2011, Egypt	Fathalla et al.	6/2006-5/08, pre- and intervention	To determine if NASG decreases extreme adverse outcomes from obstetric hemorrhage	226 pre, 208 intervention	In admission NASG group patients had severe condition. Blood loss was significantly lower.EAO decreased in intervention group, 2,9%versus 4,4%. With NASG had higher mortality, 4% versus 1%, explained to cause of the worse condition on study entry.	Should be tested in larger studies.
12	2010, USA	Hauswald et al.	pre- and intervention.	To determine whether blood flow to the pelvis decrease by using NASG sn sn improvised PASG.	12 nonpregnant volunteers	Mean flow decreased in the abdominal aorta 33%, with PASG 56%	Nonpregnant volunteers: postpartum uterus is larger and blood flow greater. Volunteers were not bleeding or hypovolemic
13	2010, Egypt and Nigeria	Mourad-Youssif et al.	Data collection 2004-08. Sub-analysis of previous studies pre- and intervention.	To report the effect of the NASG for PPH	343 pre, 511 intervention	NASG showed promise for reducing blood loss, emergency hysterectomu, morbidity and mortality.	Non-randomized pre/post-intervention design includes possibilities for bias: eligibility criteria, limited enty into the study. Skill levels may have improved over time.

14	2004, Pakistan	Brees et al.	8-11/20013 Case series	To demonstrate the feasibility efficiancy and safety of the NIASG for resucitation and hemostasis in obstetric hemorrhage.	14	Quikly restored the vital signs of most women in severe cases and stabilized them while waiting blood transfusion.	Limited experience.
15	2002, Pakistan	Hensleigh	6-7/2001 Case report	To evaluate the feasibility, safety and effectiviness of the NASG in obstetric hemorrhage.	6	Rapidly restored vital signs. Bleeding decreased in all cases after applic.MAP was greater than 70mmHGg within 5 min. Mental status and blood pressure occured within in 5minutes after application in severe cases	Limited experience.
16	2015, Egypt, Nigeria, Zambia, Zimbabwe	Manandhar et al.	A secondary analysis of data	Analytic sample to women who had postabortion hemorrhage	953	Blood loss significantly decreased, mortality decreased 52%	Data mostly from quasi-experimental trials , study desing is susceptible to selection bias:patient selection, improved skill level over the long study periods. Imbalance between phases

Appendix 2.

		DESCRIBE	ARTICLE SATURATION
Physiological impacts	Physiological direct effects	Pressure increased with NASG, decreased blood flow	9,10,12
		Significant variation with pressure,BMI and strong/weak applier	9
		Difficulties in availability at site of use adequate size to fit to antropometric variation population	2
		Lower abdominal compression ball (may) affect the blood flow to the uterus independently	9
		Cardiovascular profile would differ significantly between euvolemic volunteers and women with hemorrhagic shock	10
	Physiological measures	Help to avoid metabolic derangement	1
		INR was 1.5 after 8 hours	3
		Heart rate and Bp stabilized during the first day	1,3,15
		HR improved within 60 minutes	3,14,15
		100% of patients shock Index (SI) was <1,0 after 1 hour	1
		Bp improved with in the first hour	3,14,15
		6 from 6 cases MAP was greater than 70 mmHg in 5 minutes	15
		Hb decreased during the NASG treatment	3,15

	Blood loss	Blood loss decreased in NASG phase,42-55% from 370-560ml to 70-256ml, in some studies significantly	6,7,11,13,16
		Bleeding controlled rapidly. No significant further bleeding	1,3,15/7,15
		Massive PPH complicated by DIC temporized with NASG and Bakri succesfully, valuable temporization option	1,3
		No differ in blood loss during sur blood loss	7,15
	Stabilization, recovery	Rapid or effective maternal stabilization/vital signs, in 15 minutes/with bakri	1,3,14,15/1,3
		NASG intend to stabilize hypovolemic shock until they receive definitive treatmentor higher complexity level of facility	2,5,7,8,14,16
		May be able to temporarily mitigate the effects of blood loss after delivery	2
		48% recovered in the 1st hour,100% recovered within 6 h	1
		NASG removed after stabilization after 12h-57h	1,3,14,15
		28% faster shock recovery when applied before transfer	4
		Vital signs remained stable in the volunteers during test	10
		Vital signs, normalized in 24 hours	1,3
	Hospital days	Discharce from hospital was 31% faster	7
		3-6 days in hospital	1,3,15
	Mortality	No or few mortalities	1,3,14,15
		Could be better outcomes in women with an 80% or higher likelihood of dying	1
		34%-66% reduced odds of mortality	2, 4,6,7,13,16
		Among the most severe women odd of mortality reduced 59%	6
		Mortality risk decreased significantly	13
		More women died in the NASG phase may be because of the worse condition on study entry	11
		Women who died received lower rates of blood transfucion	5
		One from 14 had prolonged shock followed by multiple organ failure and death	14
		In c-RCT studies mortality rates were not decreased significantly	2

	Morbidity	Shows to reduce PPH-related severe morbibidities	2,4,7,11,13,14,15
		Decreased 51-76%	7,13
	EAO	No major complications/organ dysfunctions	1,2
		No/infrequent adverse events with NASG	1,3,15
		Decreased odds of extreme adverse outcome /significantly	2, 4,7,8,11,13/11,13
		In NASG phase EAO decreased 30% among late admidded women	8
		The odds of EAO was higher among women with PPH compared PAH	8
		Women with MAP <60 mmHg had 19 times higher odds of suffering EAO	13
	Increased mortality risk	High gravity ≥5-6 increases mortality risk	5,13
		In tertiary care facilities mortality rates are higher	5
		Uterine atony, placental abruption, placenta previa and ruptured uterus are the biggest reasons to deaths	5
		A macerated fetus decreases 3 times higher the risk of death	5
		Women who died had 500ml higher median estimated blood loss and higher respiratory rate, 1500ml vs 1000ml	5
		Comorbidities, like anemia, hypertensive disorders of pregnancy and sepsis, increases risks to death	5
		Women who died received lower units of blood transfucion	5
		Risk was higher among patiens who started to bleed out of facility	13
		Severity of shock, MAP < 60	13
	Complicati-ons and side effects	No safety issues, complications or adverse events	1,3,15
		No report on side effects of the intervention or no significant side effects	2,9,11,15
		73% less reduced urine output with the NASG	7,15
		Side effects, like nausea, vomiting and abdominal pain, decreased	7,11,15

		Should not have any discomfort or dyspnea	14,15
		Not painful to use	3,15
		less respiratory symtoms/dyspnoea with NASG	7
		NASG and Bakri removed sequentially without incident	1,3
		NASG should be removed after disorder is identified and corrected even the patien has dyspnea or hypoxia	14
		After 3 years the majority of patients had no complications, even they had terminal shock when NASG was placed	14
	Contraindica-tors	Heart failure/mitral stenosis	3,14,15
		Pulmonary hypertension,diphragm rupture, bleeding above the diaphragm	3
		viable fetus	14
Treatments	iv fluids	During the first hour the NASG phase received slowlier/less iv fluids	7,8,11,13,15
		After 2 hours there were no significantly differ in received iv fluids	13
		During treatment received less iv fluids	5
	Blood pro-ducts	Women who died received lower rates of blood transfucion	5
		May decrease the probability of higher rated and volumes of blood transfucions	1
		No difference was observed between NASG and standard care in using of blood products	2
		By the end no difference in the proportion of women who received a blood transfusion	11
		Helped to avoid massive transfusion	1
		Patients received a smaller amount blood and/or blood products	1,7,8,1113
		Fewer women received less blood products in the NASG phase	1,5,7
	Uterotonics	During the first hr NASG phase received more and faster prophylactic uterotonics 87% vs 79%	7
		The NASG phase received uretrotonics less in the end of treatment	16
		No significant difference of treatment uterotonics	7,13

	Invasive treatments	Decrease the probability of more invasive treatment.	1,7,11,13
		Not required furter surgical procedures	3,15
		Remain during operations	1,7,13,15
		Emergency hysterectomy was significantly decreased 45-56%	7,13
		Does not preclude operative/medical interventions if deemed necessary	7,13,15
		The NASG phase had less manual vacuum aspirations 43%	16
	Reuse	Need to reuse	15
	First aid de-vice	Buy time to obtain definitive treatment	2,5,6,13,14
		First aid device to reduce mortality from severe obstetric hemorrhage	4,5,7,11,13,14,15,16
		NASG is not a replacement for treatment	2,5,8,11,13,14
		Allows additional time of hemodynamic stability to survive by while waiting for a blood transfu-cion or transfer	2,5,8,12,13
		Good access to definitive treament is needed.	2,8,11,13
	Delays	Delays in receiving treatment were common/always and can lead to irreparable organ damage and death	2,8,11,13,14,16
		There were delays in recognizing PPH, getting to the hospital and delay in being admitted to the study	8, 13,15,16
		Delays may explained by complacence in response to a result of the NASG	8,11
		Delays in fluid/blood must be avoided	5,7,8,11,15
		The delay to treatment was longer if bleeding started outside the referral hospital	8
		Delays in receiving iv-fluids and blood were more common in the NASG phase	7,8,11,13
		In postabortion hemorrhage cases delays were longer in receiving definitive treatment	16
Professional qualification	Training	Individual training methods could better standardize the amount of pressure generated	9

		Easy to use and learn (also to with no medical backround)	1,2,8,13,14,15
		Skills to treat hemorrhage may have improved about using NASG during study	7,13,16
		Training should emphasize the need of accressive PPH treatment with the NASG also and never to delay definitive treatment	7,8,11
		Needs body knowledge	2
		With training raised the acceptance of the AMTSL including prophylactic uterotonics	7
		In trainings need to inform that patients recover rapidly with NASG, but need iv-fluids, blood etc	8,11,13,14
		Early diagnosis, application and rapid treatment are the keys to successful outcome	8,13,14
		Hospital had lack of staff	7,16
		It is need to optimize the size of the patient and the strenght of the pressure	9
	Follow up	Close observation with removal in cases of suspected heart failure or respiratory distress	3,14,15
		Urine output must be monitored (and use medical treatment if it is needed)	5,7,8,13,14,15,16
		Vital signs and must be followed	1,3,4,5,7,8,9,11,13,14,15,16
		In the case of respiratory distress/heart failure, the abdominal segment should be opened if it is needed	3,15
		High technical monitoring methods are not essential	15
		Allow monitoring of bleeding and hemodynamic status	3
		After NASG implementatio in PPH careful monitoring and evaluation strategy to assess the impact is highly recommended	2
		The standard medical protocol used for PPH/OH treatment , in some studies limited possibility to the blood bank	1,2,3,4,5,6,7,8,11,13,14,15,16
Community effects	Price	Maintenance is minimal, needs standard cleaning	15
		Low-cost	1, 2,3,8,13,15
	Policy	NASG results are important for maternal health program and policy planners	2,4
		More investments are needed to strengthen the health system	2,5

	Health care levels	Viable tool in every level of of facilities	1
		Should be part of the protocol in high complexity hospitals	1
		The result support implementation at the primary health clinic level	4,6,8
		Important and promising device in tertiary care facilties in low-resouced settings where delays are more common	1,2,6,8,11,12,13,15,16
		Is associated with a reduced odds of death at tertiary facilities	8,16
Challenges and recom-mendations	Conclusions	Strong positive effect,useful for pts with obstetric hemorrhage	3,4,7,11
		In the NASG phase were better outcome:less blood loss, hysterectomie, morbidity, mortality	13
		May temporarily mitigate the effects of blood loss	2,5
		The c-RCT providing moderate quality evidence	2
		A first line and viable option, should be part of the protocol,Received results should not be ignored	1,4,15
		NASG improved maternal outcomes despite the worse condition on study entry	11
		Valuable nonoperative and nonpharmaceutical	3
		Highly protect against/significant reduce of mortality, morbidity and extreme adverse outcome	4,8,11,13
		May temporarily mitigate the effects of blood loss	2,5
		One of rare devices which have potential effects on maternal mortality and underlines the im-portance of it	2,13
		An effective device for the control of severe hypovolemic shock	1,14
		A promising finding for saving women´s lives	11,13,14
		NASG can reduce the impact of delays in reaching definitive facilities and therapies	2,6,7,8,11,13,14
		Is enhanced when used in a functioning health system prepared to manage all maternal complica-tions	5

	Method notices	Observational studies providing low quality evidence, and fared better than in c-RCTstudies	2
		The c-RCT providing moderate quality evidence	2
	Challenges	Difficult to ensure safe re-use, secure storage, availability adequate size	2