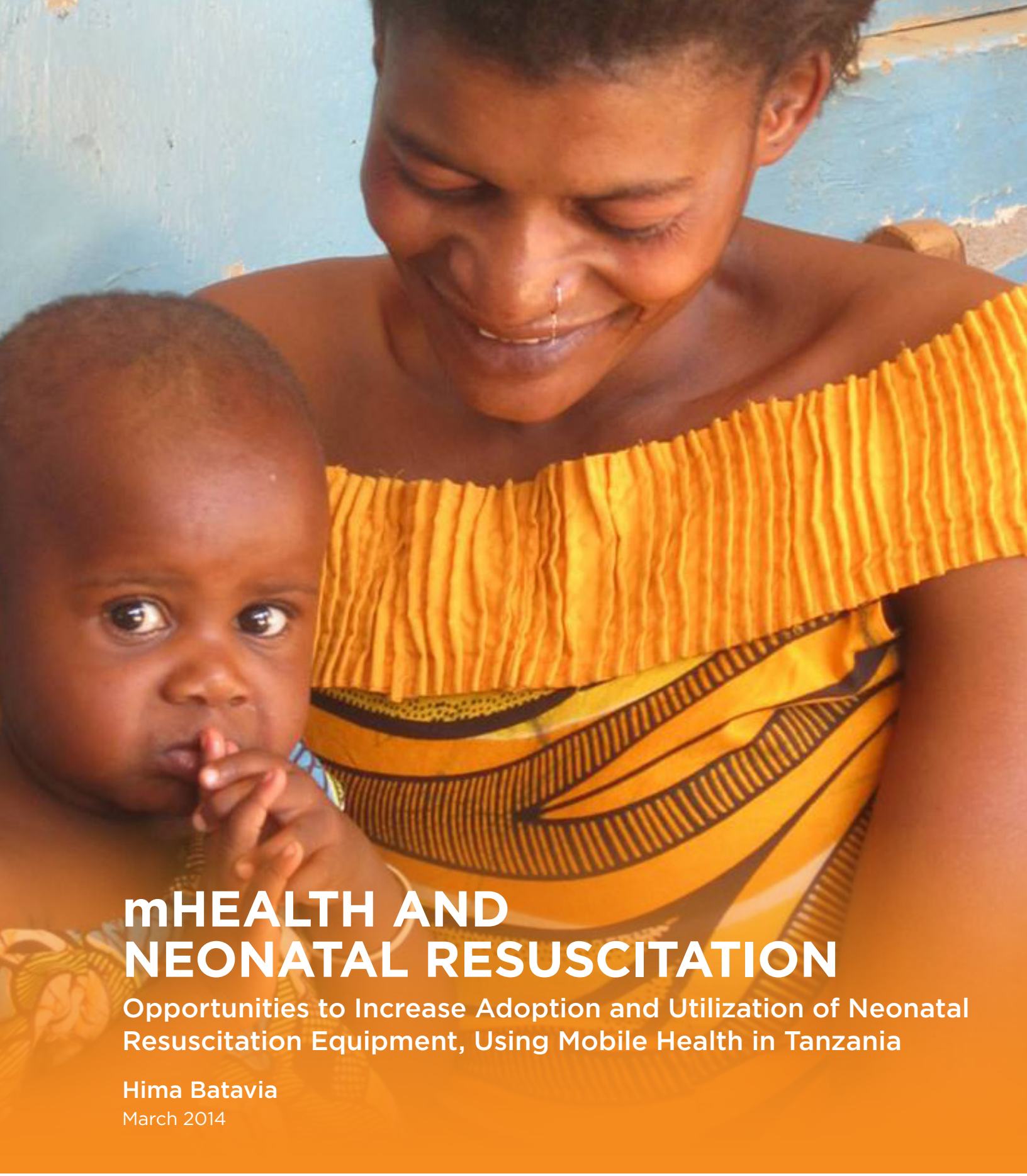

mHEALTH AND NEONATAL RESUSCITATION

Opportunities to Increase Adoption and Utilization of Neonatal Resuscitation Equipment, Using Mobile Health in Tanzania

Hima Batavia

March 2014

mHEALTH ALLIANCE

Prepared for the United Nations Commission on Life-Saving Commodities Neonatal Resuscitation Technical Reference Team

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We hope this report serves as a starting point for using mobile technology to advance existing government and partner efforts in reducing deaths from complications of birth asphyxia in Tanzania, and giving more newborns a chance at life.

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mHEALTH AND NEONATAL RESUSCITATION

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Executive Summary

The United Nations Life Saving Commodities Commission (UNCoLSC) for Women and Children was established in 2012 to support increased adoption and utilization of 13 commodities that have the potential to prevent a significant number of maternal, newborn and child deaths. As part of these efforts, the UNCoLSC has recognized the potential for mobile technology to support its goal, given the high penetration and utilization of mobile phones in low- and middle-income countries (LMICs). The mHealth Alliance, in collaboration with the UNCoLSC, has undertaken select research projects to explore the potential of mobile technology to improve the adoption and utilization of the 13 commodities.

Neonatal resuscitation equipment, used to prevent deaths from complications related to birth asphyxia, is one of these commodities. In 2013, a global review of opportunities for mHealth to support neonatal resuscitation was conducted. Following this review, Tanzania was selected as a focus country for deeper analysis.

In February 2014, a literature review and country visit was led by Hima Batavia and Nicolette Davis to understand: the scope of birth asphyxia in Tanzania; the current adoption and utilization of neonatal resuscitation equipment; government priorities and key stakeholders supporting the prevention of deaths from complications related to birth asphyxia; and opportunities for mHealth to improve identified gaps and barriers in the system.

The research found significant government support for improving the adoption and utilization of neonatal resuscitation equipment, specifically through the national rollout of the **Helping Babies Breathe** (HBB) program. As of January 2014, the HBB program has achieved one-third of its goal of training 14,000 health providers across regional hospitals, district hospitals, facilities and faith based organizations, in 18 of the 30 regions in the country. This roll-out has been made possible by donor support from the Children's Investment Fund Foundation (CIFF) and implementation support from non-governmental organizations (NGOs), including JHPIEGO and UNICEF.

Further, the review found an active and collaborative environment for utilizing mobile technology to strengthen Tanzania's public health system. The government has appointed an mHealth coordinator at the national level who leads a community of practice that invites international non-profit organizations to meet quarterly to present ideas for new mHealth solutions, share experiences and identify opportunities to collaborate. This forum contributes to reducing a duplication of efforts and maximizing impact.

Given the nature of birth asphyxia, and neonatal resuscitation, mHealth solutions during labor were found to be inappropriate. However, significant opportunities to collaborate and leverage existing mHealth efforts that focus on antenatal and post-natal care were identified. This includes:

A. **Caregiver Messaging:** Preparing caregivers of pregnant women, such as husbands, mothers and mothers-in-law, through existing SMS health education programs, to recognize key risk signs of birth asphyxia and to demand action from providers through existing SMS health education programs

B. **Provider Refresher Training:** Using mobile technology to send reminder and/or refresher training content to providers on neonatal resuscitation techniques and protocols

C. **Intelligent Referrals:** Utilizing existing mHealth clinical decision support tools for CHWs to help them recognize risk signs and factors that would predispose a pregnant woman to deliver a newborn with birth asphyxia, in order to initiate more "intelligent referrals," that trigger providers at facilities to adequately prepare

D. **Supply Chain Management:** Leveraging existing mHealth reporting tools to track the availability and performance of neonatal resuscitation equipment, in addition to the status of order fulfillment

E. **Patient and Death Registration:** Drawing from efforts utilizing mobile technology for birth registration, including reports of whether a newborn required neonatal resuscitation or died from a lack of neonatal resuscitation, in order to better understand and respond to the utilization of neonatal resuscitation equipment more critically

As a next step, the UNCoLSC should initiate efforts to collaborate with the mHealth coordinator at the MOHSW, and leading non-profit organizations in Tanzania, to ensure the interests of increasing access to neonatal resuscitation equipment are integrated into existing mHealth programs.

Acronyms and Abbreviations

AMBU	Artificial mask and breathing unit
CHW	Community Health Worker
EmOC	Emergency Obstetric Care
mHealth	Mobile health
HBB	Helping Babies Breathe
HIV	Human immunodeficiency virus
IMCI	Integrated Management of Childhood Illness
IVR	Interactive voice response
JSI	John Snow International
LMIC	Low and middle income countries
MDG	Millennium Development Goal
MNCH	Maternal, Newborn, and Child Health
MOHSW	Ministry of Health and Social Welfare (Tanzania)
NGO	Non-governmental organization
PMTCT	Prevention of Mother to Child Transmission
SADC	Southern African Development Community
SMS	Short messaging service
TCRA	Tanzanian Communications Regulatory Authority
UNCoLSC	United Nations Life Saving Commodities Commission for Women and Children
UNICEF	United Nations Children's Fund

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1 Context

The United Nations Commission for Life Saving Commodities for Women and Children (UNCoLSC) was established in 2012 to increase access to life-saving medicines and health supplies for vulnerable populations in low- and middle-income countries (LMICs). A selection of 13 commodities were identified and analyzed to understand the gaps and barriers preventing widespread adoption and utilization.

This analysis revealed an opportunity to leverage the ubiquity and utility of mobile technology in LMICs to support increased access to the 13 commodities, by improving patient knowledge, provider skills, care coordination, and supply chain management, among other applications.

The mHealth Alliance has since undertaken a series of research efforts to identify opportunities for mobile technology to support the goals of the UNCoLSC. In December 2013, a global review of opportunities for mobile health (mHealth) to support the adoption and utilization of neonatal resuscitation equipment, to prevent deaths from birth asphyxia, was conducted [1]. Based on initial findings of this review, Tanzania was selected as a focus country for a deeper analysis on the current landscape for neonatal resuscitation equipment.

In February 2014, a literature review and field visit to Tanzania was conducted by Hima Batavia and Nicolette Davis to understand: the scope of birth asphyxia in Tanzania; the current adoption and utilization of neonatal resuscitation equipment; government priorities and key stakeholders supporting the prevention of deaths from complications related to birth asphyxia; and opportunities for mHealth to improve identified gaps and barriers in the system.

This report outlines the findings from the research and aims to serve as a foundation for informing the development of a country strategy.

THE OPPORTUNITY EXISTS TO LEVERAGE THE UBIQUITY AND UTILITY OF MOBILE TECHNOLOGY TO IMPROVE POPULATION HEALTH.

A METHOD WAS DEVELOPED TO UNDERSTAND NEONATAL RESUSCITATION EQUIPMENT IN TANZANIA AND THE BARRIERS TO ITS ADOPTION AND UTILIZATION.

2 Methodology

To understand the current landscape of neonatal resuscitation equipment in Tanzania and the barriers to adoption and utilization, a literature review, combined with semi-structured interviews with key stakeholders, was conducted in February 2014.

The literature review included an analysis of peer-reviewed articles and grey literature published between 2009 and 2013. The analysis of peer-reviewed literature focused on birth asphyxia, neonatal resuscitation and mHealth in Tanzania, and it was conducted using two key databases: PubMed and Google Scholar. Established search terms for the literature review included “neonatal resuscitation in Tanzania,” “newborn resuscitation in Tanzania,” “birth asphyxia in Tanzania,” “neonatal resuscitation devices in Tanzania,” “neonatal resuscitation training in Tanzania,” “mobile health in Tanzania,” “mHealth in Tanzania,” “mHealth and neonatal resuscitation in Tanzania,” and “mHealth and maternal health in Tanzania”. Grey literature, including mHealth case studies in Tanzania and program descriptions, were reviewed from the following knowledge management portals: Mobile Development Intelligence, mHealth Working Group, Center for Market Innovations, and Health Unbound. Overall, 23 articles were identified and 16 were selected for further analysis.

Interviews with stakeholders were conducted using a snowball methodology. Overall, 18 stakeholders from 14 organizations in the governmental, public and private sectors were interviewed. The interview guide and list of stakeholders can be found in the Appendix.

This report is both a synthesis and analysis of the findings from the literature review and stakeholder interviews.

BIRTH ASPHYXIA AND FAILURE TO INITIATE SPONTANEOUS RESPIRATIONS ACCOUNT FOR APPROX. 15,000 NEONATAL DEATHS ANNUALLY IN TANZANIA.

3

Background

Over the last two decades, Tanzania has made significant strides in reducing its child mortality rate. However, in contrast, its newborn mortality rate has remained almost constant over the same period of time. Nearly 30% of all child deaths under the age of five are attributed to newborn deaths [2], hindering efforts made to achieve Millennium Development Goal (MDG) 4 by 2015.

Additionally, the causes of neonatal deaths in Tanzania have not changed over the past decade, with the highest risks occurring within the first 24 hours of birth. Neonatal infections (approximately 30%), preterm births (approximately 30%) [3], and complications related to birth asphyxia (between 27-30%) [4] still account for the top three causes of neonatal deaths.

Complications related to birth asphyxia and the failure to initiate spontaneous respirations account for approximately 15,000 neonatal deaths annually in Tanzania [5]. Several interwoven reasons explain these sobering statistics, including: birth asphyxiation not historically being a national priority; an insufficient number of skilled providers due to localized training and poor provider targeting; and a lack of available equipment to initiate resuscitation [6]. Further, weak systems for qualifying and capturing the causes of perinatal deaths, combined with fears of job termination, indicate that the number of asphyxia-related deaths may be higher [7]. For instance, the definition of “birth asphyxia” is often mired by the use of the Apgar score, which is the method used to identify birth asphyxia, but is oftentimes reported to be inaccurate [8]. Additionally, low rates of skilled birth attendants, coupled with high rates of home delivery, make newborn deaths and causes of death difficult to register [9]. Since many neonatal deaths are not reported or are misclassified as fresh stillbirths, it is difficult to draw a true estimation of birth asphyxiation-related deaths [10].

As a result, reducing birth-asphyxiation-related deaths requires a multi-faceted approach that includes enabling and encouraging facility-based deliveries, the presence of skilled providers, the availability of appropriate equipment,

as well as the ability to register and document deaths with ease. Studies have shown that resuscitation is one of the most cost-effective interventions to reduce neonatal mortality [11].

In 2009, the Tanzanian Ministry of Health piloted the Helping Babies Breathe (HBB) program, which is an evidence-based curriculum to teach neonatal resuscitation techniques in resource-limited areas. The program places a strong emphasis on the "Golden Minute" following birth to restore spontaneous respirations, combined with a one-day program that utilizes simulation-based training to teach health providers essential skills [12]. The program was implemented in eight hospitals between September 2009 and March 2012, and it resulted in a statistically significant reduction in neonatal deaths, rates of fresh stillbirths and use of facemask ventilation, in addition to an increase in the use of stimulation and suctioning.

The results of this program led the government of Tanzania to support a national rollout of HBB, which is currently underway in the country and is the flagship program for addressing asphyxiation-related deaths [13].

Further, over the years, surveys have been conducted to assess the availability of appropriate neonatal resuscitation equipment [14] in hospitals and health centers across Tanzania. Studies taken place between 2007 and 2010 have found high rates of available neonatal resuscitation equipment at district hospitals (90-100%) [15, 16, 17], whereas health centers and dispensaries were found to have lower rates of availability (57-69%) [18]. In a six-district study conducted in 2009, drugs used for resuscitation, such as adrenaline, were available but not administered due to a lack of trained personnel [19].

MOBILE TELEPHONY HAS BECOME THE FASTEST GROWING MEDIA TECHNOLOGY IN TANZANIA. APPROX. 90% OF HOUSEHOLDS HAVE ACCESS TO A MOBILE PHONE.

4

Current Situation of Enabling Environment

In order to identify both feasible and high impact mHealth opportunities in Tanzania, it is crucial to assess 1) the current status of the environment that is critical to enabling a reduction in asphyxiation-related deaths and 2) the usage of mobile technology to improve the adoption and utilization of preventative medical equipment. This section outlines the key components of the enabling environment, including policy, service delivery, product, supply chain management and telecommunications.

Policy Environment

National Strategy

In April 2008, the Ministry of Health and Social Welfare (MOHSW) in Tanzania, launched the **National Road Map Strategic Plan To Accelerate Reduction of Maternal, Newborn and Child Deaths in Tanzania** [20], which is known as "one plan" amongst partners. The seven-year plan calls for a system-wide approach to improving newborn health, including in-service training on essential newborn care, availability of neonatal resuscitation equipment at all dispensaries, facilities and hospitals, and a neonatal essential equipment and supplies list [21].

At the time of the plan's launch, the MOHSW reported a total lack of basic essential newborn care with resuscitation equipment, like Artificial Manual Breathing Unit (AMBU) bags and oxygen, at primary and secondary facilities in the country. As a result, the stated goal was to equip all labor wards in the country with facilities to care for neonates by 2015 [22].

In 2009, the MOHSW conducted a situational analysis of newborn health in the country. This analysis identified poor procurement processes and a lack of health care personnel trained in newborn care and resuscitation as the key causes of limited adoption and utilization of neonatal resuscitation equipment[23]. Further, the MOHSW recognized a deficiency of neonatal units within district

hospitals due to a lack of space, funding and prioritization. To rectify this gap and ease implementation, the MOHSW prioritized newborn health in the district health plan and outlined intentions to offer district hospitals lacking neonatal units the opportunity to consult with those that already had such units.

Finally, the MOHSW also identified the poor condition of newborn health data as a barrier to reducing neonatal mortality. The MOHSW reported that a weak recording system, lack of trained personnel, and unrecorded deaths during home deliveries were all key contributing factors to the poor state of newborn health data. To strengthen the quantity and quality of newborn health data, the MOHSW laid plans to review and audit facility registers more frequently and institute verbal autopsies at the community level [24].

Helping Babies Breathe Program

Following the situational analysis, the MOHSW reinforced birth asphyxia as a priority area for reducing neonatal mortality and committed to launching the HBB program nationally to train and teach newborn resuscitation to healthcare providers [25]. The program launched in September 2009 as a pilot, conducting 40 master trainings at prominent hospitals in the country [26]. As of January 2014, the HBB program has achieved one-third of its goal of training 14,000 health providers across regional hospitals, district hospitals, facilities and faith based organizations, in 18 of the 30 regions in the country. This has been made possible by donor support from the Children's Investment Fund Foundation (CIFF) and implementation support from non-governmental organizations (NGOs), including JHPIEGO and UNICEF. These organizations are leading the trainings, in addition to managing procurement and distribution of neonatal resuscitation equipment. They also conduct follow-up visits 4-6 weeks after training to check skill levels and assess the readiness of a facility to fully adopt the capacity to deliver neonatal resuscitation care [27].

In spite of this large-scale effort, a 2010 study aimed at determining the effect of the HBB training program on the skills and management strategies of trained providers found that seven months after the program, performance improved when tested under a simulated setting, but did not translate to delivery room management. The average time it took a provider to initiate facemask ventilation from birth actually

increased in the period after HBB training. The authors of the study point to limited resources, high staff turnover, varying staff educational backgrounds, and limited ongoing training and local mentoring as reasons for the decline in performance [28].

This finding suggests that, while the national rollout of the HBB program is a significant achievement, consistent monitoring, refresher training, and retraining for new staff may be required to realize the desired results.

Mobile Health Strategy

In 2011, the MOHSW appointed Dr. Mwendwa Mwenesi as the national mHealth coordinator, signaling that the approach of using mobile technology to strengthen its public health system is a significant priority for Tanzania. Since then, a national mHealth strategy has been developed, an mHealth community of practice (COP) has been established to improve coordination and knowledge sharing amongst global health partners leading mHealth programs, and the MOHSW has adopted an mHealth disease surveillance program from the CDC Foundation.

The mHealth COP meets quarterly and provides a venue for existing and new partners to present mHealth program ideas to enable collaboration and reduce duplication of efforts. Further, partners have an opportunity to share results on mHealth programs in operation, as well as experiences with technologies and technology providers [29].

Last year, the COP developed a national mHealth strategy to more systematically guide the country's activities and processes for introducing new mHealth programs in Tanzania. However, in parallel, a national eHealth strategy was released, which sits under a separate government department. With the belief that mHealth is a subset of eHealth, the COP is currently in the process of harmonizing strategies and efforts to release a unified document. Establishing an mHealth technical working group to drive the implementation of the strategy will follow. A key goal of the mHealth strategy and guidelines will be to mandate that the mHealth coordinator vet all new programs as part of the approval process. Currently, many mHealth programs are still being solely approved by relevant disease departments in the MOHSW, leading to multiple programs being implemented and phones being distributed at a single facility [30].

Service Delivery

According to the national standard guidelines, nursing officers and nurse midwives are responsible for identifying and initiating basic resuscitation (suctioning, provision of supplementary oxygen) in the case of birth asphyxia during delivery, while doctors are responsible for performing advanced neonatal resuscitation (such as insertion of an endotracheal tube) [31]. However, in practice, especially in rural areas where there is a dearth of qualified personnel, clinical officers and medical attendants may also be involved in delivery [32]. Nevertheless, data from the HBB program, which is implemented as a "train-the-trainer" model [33], shows that to date nurses and nurse midwives are the most common cadres trained on the protocol.

Maternal and child health aids and traditional birth attendants have historically supported pregnant women in antenatal and post-natal care and coordinating referrals to facilities during delivery. However, these groups are now largely being phased out of the government health system and being replaced with higher cadres [34]. Further, Community Health Workers (CHWs), who also support in taking a patient's medical history, antenatal care, and post-natal care, are not considered government employees, but rather volunteers, who in some cases receive salaries from NGO programs. The government has recently requested that NGOs hire and train CHWs who have completed a secondary education, to ease the process of eventually absorbing the CHWs into the government system [35]. While these cadres are not directly involved in addressing birth asphyxiation, they may have a role in identifying women at-risk of delivering an asphyxiated newborn due to predisposing factors, and then sending appropriate information to referral facilities during delivery.

Training health cadres on neonatal resuscitation techniques remains a key intervention to improve the adoption and utilization of preventative equipment. A 2008 study found that 60% of nurse midwives had between 0 to 5 years of neonatal care training and only 19% had training on the guidelines for neonatal care [36].

Product Portfolio

As part of the HBB program, all facilities trained on the protocol receive neonatal resuscitation equipment, which is being procured and distributed by JHPIEGO and funded by CIFF.

The equipment that is procured is developed and manufactured by Laerdal, a global medical supplies company. Depending on the type of facility, a precise quantity of silicone resuscitators and masks in size 0 and 1, penguin suction devices, and NeoNatalie kits for simulated training are distributed. For instance, dispensaries receive 2 silicone resuscitators and 2 masks of each size, 3 penguin suction devices and 1 NeoNatalie kit, whereas district hospitals receive 6 silicone resuscitators and 3 masks in each size, 20 penguin suction devices and 3 NeoNatalie kits [37].

Supply Chain Management

JHPIEGO worked with Tanzania's Medical Supply Department (MSD) to facilitate procurement of the Laerdal products by sharing specifications to sensitize the team on neonatal resuscitation equipment and outlining size requirements. Though the country typically operates on a "pull" system from facilities for ordering and distributing medical commodities, JHPIEGO is currently "pushing" neonatal resuscitation equipment to health facilities to lubricate the system and generate demand.

On a recent supportive supervision visit to 16 facilities, JHPIEGO found that orders of penguin suction devices were not being fulfilled due to a historical stock of the previously used foot operated product, which research has shown is considered to be less effective [38]. This indicates that the supply chain system still requires further strengthening to ensure a consistent and reliable supply of neonatal resuscitation equipment.

NEONATAL RESUSCITATION EQUIPMENT

FIGURE 1. Neonatal resuscitation equipment manufactured by Laerdal and distributed to dispensaries, facilities and district hospitals in Tanzania as part of the Helping Babies Breathe program.

The current challenge with the supply chain system in Tanzania is the discrepancy between orders and fulfillment. Zonal warehouses often fulfill orders based on what is available, rather than what is requested by a facility. Typically, a record of this discrepancy is not kept, and consequently impacts future projections of health commodities, which are based on fulfillment numbers rather than request numbers. This limitation can significantly jeopardize the consistent availability of a health commodity [39].

Stock-outs of medical commodities still remain a significant challenge in Tanzania, and many program efforts to generate demand for health services and products are constantly confronted by this barrier to progress. According to the Consumer Forum on Medicines and Diagnostics (COFMED), a civil society organization under the Southern Africa Regional Program on Access to Medicines (SARPAM), effective planning versus availability is the key problem. In general, central warehouses have nearly six months of buffer stock for essential medicines, but delays in ordering, distribution and inaccurate data to inform forecasting exercises limit efficient allocation of the stock [40].

The impact of current efforts to manage stock-outs has been limited to reporting the scope of the problem, rather than action and response. This is due to delays in relaying and processing data collected and restricted access to the data collected, reducing the ability of organizations to mobilize and respond to stock-outs [41].

Telecom Environment

While radio was historically the most effective communication tool in Tanzania, as recently as 2005, mobile telephony has become the most visible and fastest growing media technology in the country. As of September 2013, there were 26,855,735 mobile phone subscribers in the country, a penetration rate of approximately 60% [42, 43]. While formal research has not been conducted to survey the percent of health providers in Tanzania that own a mobile phone, the perception amongst stakeholders is that between 80-90% of health providers own a basic handset [44, 45, 46]. Further, while mobile penetration is 60%, approximately 90% of households have access to a mobile phone through family and community members [47].

Tanzania registers the highest average number of text messages sent per month per subscriber in East Africa. In 2012, almost 5 billion text messages were sent and received, and between April and June 2013, the average user sent 237 text messages. In general, the average user spends approximately 25,000 ksh a month on mobile phone minutes and text messages.

The use of mobile data and Internet is still nascent in the country. As of 2010, there were approximately 2.21 million mobile Internet users, a penetration rate of about 5%, and as of December 2012, smartphone penetration was approximately 13% [48]. While the TCRA reports that the number of all Internet users is increasing at approximately 24% per year, it currently does not track penetration in its quarterly reporting activities [49].

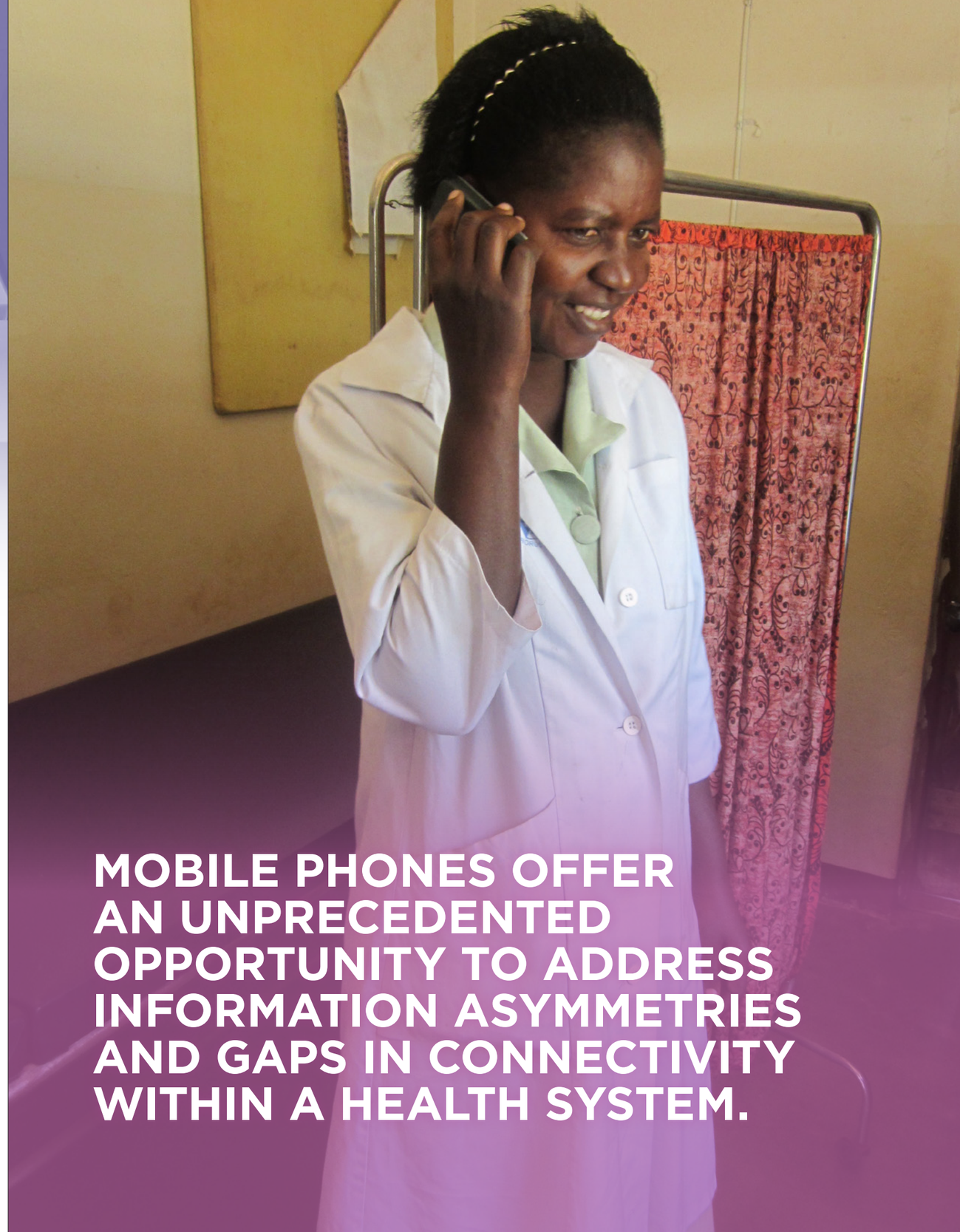
The leading mobile service providers in the country include Vodacom (36%), Airtel (32%), Tigo (24%), Zantel (7%) and Benson (1%) [50]. All telecommunication providers offer discounts for calls or text messages between members to improve user loyalty. Users often receive discount offers that give them the opportunity to buy larger amounts of credit, calls or text messages at a lower price.

As a result of high penetration, availability of mobile devices and knowledge about the use of the devices, Tanzania was identified as fertile ground for mHealth solutions in a 2012 survey [51].

However, according to stakeholders, network coverage in rural areas and health facilities can still be a significant challenge when implementing mHealth programs reliant on GPRS or broadband connectivity [52, 53, 54, 55].

In fact, the Tanzanian government, in collaboration with the World Bank, recently announced a large subsidy to improve network infrastructure in rural areas, and awarded Vodacom, Zantel, Airtel and Tigo tenders to facilitate development [56].

Both Tigo and Vodacom are especially active in the mHealth sector, working with NGO partners through their foundations and CSR departments to support programs and participating in the mHealth COP [57].



MOBILE PHONES OFFER AN UNPRECEDENTED OPPORTUNITY TO ADDRESS INFORMATION ASYMMETRIES AND GAPS IN CONNECTIVITY WITHIN A HEALTH SYSTEM.

5

mHealth Opportunities

mHealth in Tanzania

There is significant mHealth activity across Tanzania, largely being led by international NGO partners, in collaboration with the MOHSW. The majority of mHealth solutions focus on patient education, CHW support tools, supply chain management and disease surveillance that support goals related to maternal and child health or reproductive health. While CHW support tools are still largely in pilot stages, patient education, supply chain management and disease surveillance solutions have achieved regional and national scale. This discrepancy may be a function of technology choice. Patient education, supply chain management and disease surveillance tools are largely utilizing SMS and USSD on basic mobile phones, whereas CHW support tools are being built as applications on android smartphones or java-based phones that are purchased by organizations for the programs. Few mHealth solutions were found to be using interactive voice response (IVR) technology, which may be due to the cost of development, which was said to be higher than SMS and USSD [58].

Though CHW support tools remain small-scale, programs focusing on specific districts and facilities are significantly advancing the skillset of its target CHWs on topics including family planning, home-based HIV care and MNCH. Organizations are spending between USD $80-200 on handsets, depending on the complexity of the application and need for memory and processing power. Many organizations believe that purchasing mobile phones is a worthy capital investment for improving monitoring and evaluation activities, akin to buying facilities a laptop or computer, and critical to improving the performance and accountability of CHWs. Training a CHW on a mobile support tool has found to take approximately two days, accompanied by approximately two additional weeks to gain comfort in a demo mode [59]. Community health

workers are often initially resistant to mHealth solutions due to a perception that it will require additional work. However, programs have found that CHWs eventually find that using mHealth solutions makes their life easier, especially when it involves monthly reporting requirements.

Further, there is strong indication of collaboration amongst partners to create more integrated and comprehensive mHealth solutions. For instance, D-Tree International and Pathfinder have created an mHealth tool that supports CHWs to assist patients in making family planning decisions. The tool has been integrated with Pathfinder's family planning stock management system, so that CHWs can "intelligently refer" patients to facilities with the desired product in stock.

Another example is the CDC Foundation's mHealth Public-Private-Partnership, which has established an SMS patient education program called "Healthy Pregnancy, Healthy Baby", or "Wazazi Nipendeni", on the Text to Change platform that NGO partners are now using for their specific health focus areas. Launched in 2012, the program has amassed nearly 400,000 [60] subscribers and aims to be the most trusted short code for reliable health information in Tanzania. "Healthy Pregnancy, Healthy Baby" is working in collaboration with the MOHSW and other key partners, including: the Elizabeth Glaser Pediatric AIDS Foundation (EGPAF) on Prevention of Mother to Child Transmission (PMTCT) of HIV; PATH on immunization messaging; and the John Hopkins University Center for Communication Programs (JHUCCP) on its Safe Motherhood Campaign. Partners provide support to the program by developing content and training CHWs to recommend the program to pregnant women and enroll them [61]. Currently, telecommunication companies, such as Airtel, are supporting "Healthy Pregnancy, Healthy Baby" by zero-rating SMS messages that are sent to pregnant women or caregivers. However, the CDC Foundation is also exploring sustainable business models, including using the service to generate demand for other related services.

No evaluations have been conducted on the program to date, but JHUCCP is planning to evaluate the behavior change impact of women enrolled in the program, as well as evaluate the difference between self-enrolling and being enrolled by a CHW. Early results have shown that literacy is still a challenge among pregnant women, which limits the impact of SMS and leaves registration into the program highly

reliant on television and radio mass media campaigns. As a result, the program is now considering adding an Interactive Voice Response (IVR) component to complement the SMS messages. In addition, there appears to be a demand for an mHealth question and answer (Q&A) service. When JHUCCP launched the SMS program under the Safe Motherhood Campaign, it received nearly 2 million questions to the shortcode, which was not set up to answer the questions. The CDC Foundation is now considering launching an USSD-based application to meet this demand.

Given the high penetration rate of mobile money in Tanzania, mHealth solutions are being integrated with this functionality to deploy incentive payments for CHWs and pregnant women, as well as to transfer payment to taxi drivers for referral transportation. Some organizations, like Pathfinder International, have gone completely cashless, adopting mobile money across the organization and into its programs.

However, despite significant progress, mHealth solutions still suffer from common challenges including patchy network coverage, limited electricity for charging mobile phones, maintaining and servicing mobile phones purchased for a program, and a lack of evidence on the impact and cost-effectiveness of mobile solutions to support scale-up and longevity. SMS-based patient education programs that rely on funding are often challenged by the inability to predict accurate demand. When JHUCCP launched a family planning SMS program with FHI360, nearly 620,000 individuals enrolled, which was much more than the program budget could support.

mHealth for Neonatal Resuscitation

Given the nature of complications from birth asphyxia and the need to utilize neonatal resuscitation equipment in the “golden minute” after birth, the use of mobile phones during service delivery is not appropriate. Instead, mHealth solutions to support the adoption and utilization of neonatal resuscitation equipment are more appropriate prior to and after delivery.

There are limited existing mHealth solutions in Tanzania that support neonatal resuscitation equipment, and nurse, nurse midwives and doctors are seldom targeted. However, there are many opportunities to extend existing mHealth program efforts or leverage existing technology and implementation lessons.

Six key mHealth opportunities have been identified to support the adoption and use of neonatal resuscitation equipment and should be considered in Tanzania: caregiver education, provider refresher training, intelligent referrals, supply chain management, patient registration and death registration.

Caregiver Education

Current mHealth patient education programs largely target pregnant women with the overarching goal of delivering at a facility, as 54% of deliveries are still home-based. As a result, no programs currently include messaging on birth asphyxia and neonatal resuscitation.

Programs that have performed rigorous content assessments have determined that messaging on birth asphyxia and neonatal resuscitation may not be appropriate for two reasons: a) it is a provider driven skillset that has to be managed at a facility and b) during the “golden minute” pregnant women, who are just recovering from labor, may not be best positioned to give advice or demand action from providers.

However, there may be an opportunity to target other caregivers – a husband, mother or mother-in-law. The key behavior that pregnant women and caregivers in Tanzania look for immediately following delivery is whether the newborn baby is crying. If a newborn baby is not crying, it could be an indication of birth asphyxia and the need for resuscitation. If given the necessary key messages prior to delivery, this could be a trigger point for caregivers, who may be in a better position to demand action if they are present.

The “Healthy Pregnancy, Healthy Baby” program by CDC Foundation and the “Safe Motherhood Campaign” by JHUCCP both include a registration process in their programs. Users send an SMS to a short code and are then prompted with five questions, one of which includes classifying himself/herself as either a: birth supporter, partner of pregnant women, pregnant woman or general information seeker. This may present an opportunity to send customized messages on birth asphyxia and neonatal resuscitation to birth supporters and partners of pregnant women.

Provider Refresher Training

Training healthcare providers, specifically nurses, nurse midwives and doctors, on the HBB protocol is a key part of the national strategy to address mortality from birth asphyxia. However, Dr. Augustine Massawe of Muhimbili University of Health and Allied Sciences noted that when skills are not frequently used, they often go stale. Further, turnover of nurses and nurse midwives is high within facilities and across facilities. As a result, refresher training is critical to maximize the long-term value of the HBB program. Currently, the HBB program does include follow-up components, but these are often not carried out due to insufficient funds, transportation challenges and time constraints. Unfortunately, there are no mHealth initiatives that support provider refresher training in the HBB program at this time. In the past, the American Medical Association has distributed CDs on neonatal resuscitation as a refresher-training tool for hospitals in Tanzania, an approach that was found to be useful.

There is an opportunity to include a mobile component in the HBB training program to support provider follow-up. This could range from simple solutions, such as sending SMS messages reminding providers to practice the protocol or share the knowledge with a colleague, to more advanced solutions, such as distributing memory cards with preloaded videos on neonatal resuscitation techniques. Currently, providers receive a small paper-based booklet in English or Swahili with pictures during HBB training sessions. This could be complemented with an IVR system to add audio to the experience, field clarification questions by providers, and track the number of providers engaging in refreshing his/her knowledge.

EGPAF and D-Tree International both have mHealth solutions focused on provider training. EGPAF is in the early stages of translating PMTCT paper manuals to mobile phones, which will be complemented by pictures to remind health providers of key practices. D-Tree International has also been leading research and implementation of electronic protocols of Integrated Management of Childhood Illness (IMCI) which has been found to improve clinician adherence from 60% to 84%.

Intelligent Referrals

One of the largest challenges facing the health system in rural areas of Tanzania are effective referrals. This includes relaying accurate information on the nature of the referral, and available transportation to execute the referral. As a result, a number of organizations are focusing on this problem, including JHPIEGO and the Etislat/Zantel program called “mHealth for Safer Deliveries”, in collaboration with D-Tree International and Pathfinder.

The solutions generally combine a screening protocol to assess the risk of complications for pregnant women, triggers to initiate emergency referrals and systems to deploy payment to preselected drivers at fixed rates for

transportation. JHPIEGO’s program, MAISHA, which launched in 2008, and introduced the mHealth solution **eMNCH** in 2010, has found an increase in the rates of risk factor detection and facility deliveries. Similarly, the “mHealth for Safer Deliveries” program, launched in 2010, found that facility deliveries had increased from 30% to 72% [62] by mid-2013. Pathfinder is in the early stages of its program, with plans to launch the first phase in April 2014. The program will also include training for CHWs on standard MNCH curriculum, in addition to emergency system and obstetric care for facility providers, which will include modules on birth asphyxia and neonatal resuscitation techniques. All of its emergency protocols require approval from the Association of Gynecologists and Obstetricians of Tanzania.

In each of these programs, there is an opportunity to link risk factor screening of pregnant women with the risk of delivering a newborn with birth asphyxia. Research has shown that there are predisposing antenatal and intrapartum risk factors for birth asphyxia. A study in Uganda found that women who did not attend antenatal care or attended fewer than four visits were more likely to deliver babies with birth asphyxia. Further, febrile illness during pregnancy, including confirmed and suspected cases of malaria, antepartum hospitalization, antepartum or intrapartum anemia, antepartum hemorrhage and severe preeclampsia/eclampsia were all significantly associated with birth asphyxia [63]. Dr. Augustine Massawe of Muhimbili University of Health and Allied Sciences in Dar es Salaam also believes that factors including preterm labor, previous neonatal death or still birth, multiple pregnancies, disproportionate size of fetus, diabetic mother, anemia and HIV could also contribute to increasing the risk of birth asphyxia.

Identifying these risk factors during antenatal care using mobile technology could prompt more intelligent referrals during delivery, encouraging providers at facilities and hospitals to prepare neonatal resuscitation equipment and trigger their memory of the protocol.

Supply Chain Management

The prevention of mortality from birth asphyxia is predicated on the availability and utilization of neonatal resuscitation equipment. Therefore,

tracking the availability and utilization of neonatal resuscitation at health facilities is critical to achieving this goal.

Currently, MSD manages the procurement, storage and distribution of 800 commodities across sexually transmitted infection medicines, essential medicines, malaria, family planning, ARV/HIV, lab/diagnostics, immunization and tuberculosis for 5,000 facilities in the country. This process is managed by the Electronic Logistics Management Information System (eLMIS), and complemented by a mobile reporting system called the Integrated Logistics System (ILS), which is implemented by John Snow International (JSI) and was developed by the software firm Dimagi. Presently, neither eLMIS nor ILS support or track neonatal resuscitation equipment [64].

However, JSI is currently in discussions with the UNCoLSC to add the 13 essential commodities, including neonatal resuscitation equipment, to its system for rollout across 5,000 facilities by September 2014. The ILS system, which launched in November 2010, was designed to complement the existing ordering and reporting system, specifically to prevent stock-outs and provide a national snapshot of stock across the country. Every month, the health facility or store facility charge is required to send an SMS with a count of stock on hand of each of the commodities in the system. Facilities also receive SMS reminders to submit paper-based orders during their ordering period to the zonal level to initiate fulfillment. Currently, the system has contributed to improving reporting rates from 50% to 75%, driving 100% adherence of facilities ordering only during its assigned time period, and enabling 75% visibility into the current stock medical commodities in facilities across the country. JSI reports that stakeholders are beginning to trust ILS as a source of credible data, but support is still required to instill change management training at the regional level on effectively utilizing and responding to data being collected.

While the program has not yet figured out how medical equipment will be tracked and reported, it will be working through the design over the next few months. Organizations have suggested that JSI should consider tracking the following three key indicators in the new system: a) what is the availability of equipment? b) does the equipment work? c) have orders been fulfilled? These organizations have also recommended that the UNCoLSC consider making the reporting data openly available, to encourage action and accountability, in the case of stock-outs.

Patient and Death Registration

Similar to tracking the availability of neonatal resuscitation equipment, monitoring the utilization of this equipment is critical in assessing the impact of training efforts and addressing gaps in service delivery.

Currently, facilities keep registers to track the nature of deliveries, but do not list equipment used or not used. Though registration of perinatal deaths is institutionalized with a register that includes a column for “cause of death,” the register is both mired by poor maintenance and limited by inaccurately determining the cause of a perinatal death. The perception amongst stakeholders is that the process and requirements for a maternal death audit, which takes between 8-10 hours post-labor, has weakened the efforts of perinatal and neonatal death audits.

No existing mHealth solutions that focus on utilization of neonatal resuscitation equipment through patient and death registration were found. However, there is an opportunity to learn from the birth registration system implemented by UNICEF in collaboration with the Regulation Insolvency Trusteeship Agency (RITA) in Tanzania, with support from the Corporate Social Responsibility department of Tigo, a leading telecommunication company. In Tanzania, less than 20% of newborns are registered at birth and less than 10% have a birth certificate. The challenge has been that families are required to travel to the district level to complete registration. The program, implemented by UNICEF, aims to bring the birth registration process to the community level, by using SMS to send relevant information to the national database. The first phase, launched in 2013 in one region, registered 150,000 children in just five months. Tigo developed the application and built it into SIM cards, which were then distributed to health facilities or village offices on a basic handset for use. The program plans to introduce the mHealth solution to two additional regions in 2014.

This program illustrates that a basic SMS program with strong integration into national systems can contribute to better understanding of population demographics.

6

Conclusion

Deaths from complications of birth asphyxia due to weak availability, adoption and utilization of neonatal resuscitation equipment can be prevented through targeted interventions that strengthen existing health systems. The penetration and adoption of mobile phones offers an unprecedented opportunity to address information asymmetries and gaps in connectivity between caregivers, patients, providers and institutions within a health system.

The nature of birth asphyxia calls for interventions that integrate and complement the continuum of care for pregnant women, supporting efforts especially during antenatal care. Our research revealed an opportunity for the UNCoLSC to leverage existing promising efforts in Tanzania to improve maternal, newborn and child health using mobile technology. This includes equipping caregivers with the information to trigger action from providers based on key danger signs, supporting providers with options to refresh training on neonatal resuscitation protocols, identifying women at risk of birth asphyxia during antenatal care and initiating more informed and intelligent referrals to providers at facilities and hospitals, and using mobile phones to track the availability, condition, and utilization of neonatal resuscitation equipment to monitor where knowledge and skill gaps may persist.

The MOHSW in Tanzania is an enthusiastic supporter of mHealth solutions to improve health outcomes related to MDG 4. It has not only appointed an mHealth coordinator at the national level to oversee country activities, but also established a community of practice across international organizations to collaborate, share knowledge, and drive scale of high impact solutions.

As a next step, engaging the principal secretary at the MOHSW, the mHealth coordinator, and institutions involved in mHealth implementations will be critical to establishing a Tanzania program that leverages existing efforts and aligns with national programs and objectives. In this way, the potential to use mHealth to increase adoption and utilization of neonatal resuscitation equipment can be advanced.

WEAK AVAILABILITY, ADOPTION AND UTILIZATION OF NEONATAL RESUSCITATION EQUIPMENT CAN BE PREVENTED THROUGH INTERVENTIONS THAT STRENGTHEN EXISTING HEALTH SYSTEMS.

Appendix A

Interview guide

1. Problem

A. What is the scope of the problem of birth asphyxiation in Tanzania?
B. Geographic concentration of the problem?
C. Profile of most marginalized / underserved women?

2. Policy Environment

A. Is birth asphyxiation and NNR equipment considered a priority at the government level?
B. What guidelines / strategic plans is birth asphyxiation and NNR equipment part of?
C. What Ministry supports programs focused on birth asphyxiation and NNR equipment?
D. Is there are coordinating body / technical working group focused on birth asphyxiation and NNR equipment?
E. Is NNR equipment included on the Essential Medicines List? Any other recommended commodities lists?

3. Healthcare Delivery and Provider Training

A. According the national standard guidelines, which cadre of health professionals are responsible for managing complications from birth asphyxiation?
B. What is the training program for this health cadre?
C. What is the current status of training for this health cadre?
D. Provider knowledge of birth asphyxiation management? Gaps and barriers to improving knowledge and practice levels?
E. How does birth asphyxiation feature in the training program?
F. What tools are provided to the health cadre to learn, and support the management of birth asphyxiation?
G. Are any mobile or wireless technologies used to support provider training?
H. How are births and deaths at birth registered in Tanzania? What initiatives exist to support this goal?

4. Product / Supply Chain Management

A. What types of NNR equipment are available in Tanzania? (brands, companies, cost, shelf-life, replacement rate, maintenance)
B. What organizations procure NNR equipment?
C. What is the forecasting process for NNR equipment?
D. What is the procurement cycle for NNR equipment?
E. Who are the major donors of NNR equipment in Tanzania?
F. What is the shortage or surplus of NNR equipment in the country?
G. What bottlenecks are there in the procurement process impacting the accessibility of NNR equipment?

Appendix A

(continued)

H. According to the HBB report, there is high availability of bag and mask resuscitators in PHCs in Tanzania? What factors have led to this outcome?
I. How is NNR equipment tracked across the supply chain – from entry into country / manufacturer to utilization at the facility level? Up to what level does data exist? Where does it break down?
J. What initiatives currently exist to track NNR equipment / health outcomes from birth asphyxiation cases?

5. Telecom environment

A. What is the mobile phone penetration in Tanzania?
B. Urban/rural split?
C. Basic phone / smartphone penetration? Barriers impacting the latter?
D. Schemes supporting mobile phone ownership by health providers?

6. Patient Knowledge

A. What campaigns and initiatives exist to improve patient knowledge of pregnancy related risks such as birth asphyxiation?
B. What is the current behavior of rural/urban pregnant women with regards to antenatal care, and delivery?
C. What initiatives/schemes exist to improve current health practices around maternal health?
D. What has worked / not worked?

7. Mobile Health

A. What are three high-impact opportunities to improve accessibility and utilization of NNR equipment with the support of mobile phones and connectivity?
B. What mHealth programs supporting NNR equipment or RMNCH more broadly in Tanzania has the potential for national scale?
C. Do any mHealth programs exist in Tanzania that support for birth asphyxiation and NNR equipment could be added on it?

Appendix B

Stakeholder List

Janita Ferentinos, CDC Foundation
Asia Kassim Hussein, UNICEF
Dunstan Bishanga, JHPIEGO
Erica Thomas, JHPIEGO
Gaudiosa Tibaijuka, JHPIEGO
Christopher Awinia, PRAXIS Research
Dr. Mohammed Makame, PATH
Lucy Fulgence Silas, D-Tree International
Waziri Nyoni, John Hopkins University Center for Communication Programs
Roland Van de Ven, Elizabeth Glaser Pediatric AIDS Foundation
Chrispine Kimario, Elizabeth Glaser Pediatric AIDS Foundation
Marasi Mwencha, John Snow International
Colin Spurway, BBC Media Action
Mustafa Kudrati, Pathfinder International
Benjamin Mrema, Pathfinder International
Dr. Mwendwa Mwenesi, Ministry of Health and Social Welfare, Tanzania
Dr. Augustine Massawe, Muhimbili University of Health and Allied Sciences
Woinde Shisael, TIGO

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