MISOPROSTOL DISTRIBUTION AT ANTENATAL CARE VISITS FOR PREVENTION OF POSTPARTUM HEMORRHAGE
Ministry of Health, Zambia is the government ministry charged with administering the health system in Zambia. The Ministry’s work is driven by its vision to provide the people of Zambia with equity of access to cost-effective, quality healthcare as close to the family as possible.

Venture Strategies Innovations (VSI) is a California-based nonprofit organization committed to improving women’s health in developing countries by creating access to effective and affordable technologies on a large scale. VSI’s innovative approach involves partnerships that build upon existing infrastructure, resources and markets. VSI focuses on reducing barriers to access and enhancing human capacity to bring about sustainable improvements in health.

Bixby Center for Population, Health, and Sustainability is a research center located at the University of California, Berkeley School of Public Health. The Center is dedicated to developing innovations to improve reproductive health in resource-poor settings, including reliable health information systems, local access to essential technologies, and guidelines for prioritizing interventions to maximize health impact. The Center assists in the implementation of maternal health programs and seeks to improve the health outcomes of the world’s poorest and most vulnerable women and their families.
Executive Summary

Maternal mortality in Zambia is a significant public health concern. While the maternal mortality ratio has declined in recent years, the current maternal mortality ratio (603 deaths per 100,000 live births) is still higher than the figure targeted to reach the fifth Millennium Development Goal of 162 deaths per 100,000 live births by 2015. Postpartum hemorrhage (PPH), or blood loss greater than 500mL after childbirth, is the leading cause of maternal mortality worldwide. The risk of PPH and maternal death is highest in settings where women deliver at home and without skilled attendants.

Misoprostol is a uterotonic tablet that is inexpensive, heat-stable and simple to administer. It effectively reduces postpartum blood loss and has the potential to reduce PPH and related maternal mortality in such settings. Several studies demonstrate that community-level distribution of misoprostol, combined with education on its use, can increase the number of women protected from PPH with a uterotonic at home births. Utilizing antenatal care (ANC) as a point of distribution of misoprostol to pregnant women could be an effective strategy to increase uterotonic coverage in settings such as Zambia, where ANC attendance during pregnancy is high but the majority of women deliver at home.

To determine if distribution of misoprostol at antenatal care visits is feasible, a pilot project was conducted between January 2009 and March 2010 at a total of nineteen health centers in five rural districts in Zambia. Misoprostol was distributed to eligible women at ANC visits for use during home delivery if they were unable to reach a facility. In addition, Safe Motherhood Action Groups (SMAGs) provided community education about birth preparedness, the importance of delivering in a facility, the risks of PPH, and correct use of misoprostol. Of the 5,574 women who attended ANC and participated in the pilot project, 5,232 (94%) women took misoprostol home with them at an average gestational age of 25 weeks.

A follow-up evaluation was conducted in March and April 2010 in two of the five districts (Petauke and Kalomo) to assess the feasibility and effectiveness of distribution of misoprostol through ANC visits, as well uterotonic coverage and acceptability of misoprostol. Women who had delivered between January 2009 and March 2010 were surveyed around both facilities where misoprostol was available (intervention areas) and those where only the standard care was available (control areas). In total, 1,989 women (1,047 in intervention areas and 942 in control areas) completed questionnaires retrospectively assessing their most recent pregnancy and delivery experience. In addition, the Evaluation Team conducted short interviews with five ANC providers and verbal autopsies of the ten identified maternal deaths.

In the evaluation sample, ANC attendance was near universal, with over 98% women reporting at least one visit. Women in both intervention and control areas reported attending an average of four ANC visits during their last pregnancy. Significantly more women in intervention areas reported receiving information during pregnancy on excessive bleeding during delivery (87% vs. 58%) and misoprostol (85% vs. 4%). Women in the intervention areas most commonly cited ANC providers and health facilities (78%) and SMAGs (33%) as sources of information on misoprostol. In intervention areas, approximately two-thirds of the women interviewed reported having been offered misoprostol at an ANC visit.
Significantly more women in intervention areas reported delivering in a facility (54% vs. 40% in control areas). The distribution of misoprostol in the intervention areas increased the proportion of women protected from PPH by a uterotonic drug at delivery, both at home and at health facilities. Almost half of the women delivering at home in the intervention areas used misoprostol (49%), compared to almost none in the control area. At facilities, the percentage of women receiving an injectable uterotonic drug was similar in intervention and control areas (44% vs. 46%, respectively); however, an additional 35% of women in intervention areas received misoprostol at delivery in a facility. Overall, with facility and home births combined, two out of three women in the intervention area (66%) received any uterotonic (injectable or misoprostol) at delivery to reduce their risk of experiencing PPH, compared to one in five in control areas (20%).

Of the 281 women in intervention areas who received misoprostol at ANC and delivered at home, 83% of women took misoprostol at delivery. The majority took the correct dose of misoprostol at the correct time via the correct route.

While reported referrals were higher overall in intervention areas (8% vs. 5% in control areas), bleeding-related referrals were higher in control areas. Women in control areas were more likely to report they had experienced postpartum symptoms (58% vs. 52% respectively). Approximately half of the women who took misoprostol reported experiencing no postpartum symptoms, the same frequency which was reported by women who had not used misoprostol. Significantly more cases of fainting, dizziness and nausea were reported by non-misoprostol users, with misoprostol users reporting significantly more shivering (35% vs. 30%).

Acceptability of misoprostol was very high in both intervention and control areas. The majority of women in intervention areas reported they would use misoprostol at their next delivery (90%) and recommend it to a friend (88%); these numbers were also high for women in control areas (75% and 69%, respectively). While women in intervention areas reported being willing to pay over 7,500 kwacha on average for misoprostol, women in control areas would pay an average of around 11,500 kwacha ($2.50 USD).

Providers interviewed during the evaluation strongly recommended that misoprostol be available in facilities as they have found it to be an important option when oxytocin is out of stock. In addition, the providers interviewed felt that the availability of misoprostol reduces the need for referrals as well as maternal deaths related to bleeding. Furthermore, verbal autopsy interviews conducted during the evaluation found that most of the maternal deaths in control areas were bleeding-related, compared with no bleeding-related deaths in the intervention areas.

As a result of the evaluation of the misoprostol distribution pilot project, we recommend that misoprostol distribution, in conjunction with continued education at both the facility and community levels and adequate monitoring, be scaled up at all government and private ANC facilities. This includes the training and support of both ANC providers and community health agents, including SMAGs, where they are available. As ANC attendance is extremely high in Zambia, it is a key contact point to provide messages about safe delivery and prevention of PPH to pregnant women. This evaluation demonstrated
that women who accept misoprostol and deliver at home can use it correctly and safely, and when misoprostol is available, women are no more likely to deliver at home than at a facility. Since almost half of women in Zambia continue to deliver at home, the availability of misoprostol to women can make an important contribution to reducing PPH-related referrals and maternal deaths, bringing the maternal mortality ratio closer to the target of 162 deaths per 100,000 live births set out in Millennium Development Goal 5.
Acknowledgements
This pilot project could not have been completed without the expert staff and colleagues at the Ministry of Health, Zambia, whose dedication to this pilot and invaluable contributions to its development led to its successful implementation. Rabecca Kalwani, VSI’s National Program Coordinator in Zambia, provided valuable insight in developing the tools and processes for the Zambian context. Dr. Reuben Mbewe, Deputy Director, Public Health & Research (Reproductive & Child Health) within the Ministry of Health, Dr. Mary Nambao, Acting Reproductive Health Specialist, and Dr. Christine Kaseba provided important oversight of the project’s development. In addition, the project benefited from the contributions of the District Health Management Teams, antenatal care providers and Safe Motherhood Action Group members. Society for Family Health also deserves recognition for contributing the misoprostol tablets used in the pilot.

The evaluation could not have been completed successfully without the assistance of the previous and current district maternal and child health staff in Petauke and Kalomo, the evaluation supervisors, and the team of interviewers who conducted interviews with women across Petauke and Kalomo.

Contributors
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**Acronyms**

<table>
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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AMSTL</td>
<td>Active Management of the Third Stage of Labor</td>
</tr>
<tr>
<td>ANC</td>
<td>Antenatal Care</td>
</tr>
<tr>
<td>CSO</td>
<td>Central Statistics Office</td>
</tr>
<tr>
<td>DHMT</td>
<td>District Health Management Team</td>
</tr>
<tr>
<td>DHS</td>
<td>Demographic and Health Survey</td>
</tr>
<tr>
<td>EmONC</td>
<td>Emergency Obstetric and Newborn Care</td>
</tr>
<tr>
<td>MOH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NHC</td>
<td>Neighborhood Health Committee</td>
</tr>
<tr>
<td>PPH</td>
<td>Postpartum Hemorrhage</td>
</tr>
<tr>
<td>SMAG</td>
<td>Safe Motherhood Action Group</td>
</tr>
<tr>
<td>TBA</td>
<td>Traditional Birth Attendant</td>
</tr>
<tr>
<td>VSI</td>
<td>Venture Strategies Innovations</td>
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</tbody>
</table>
Background

1.1. Postpartum Hemorrhage in Zambia

Giving birth in Zambia continues to be perilous as women face a lifetime risk of dying in pregnancy or childbirth of one in 27. Zambia’s maternal mortality ratio has been estimated at 603 deaths for every 100,000 live births (Hogan et al., 2010). Although the rate has decreased in the last ten years, the current maternal mortality ratio is still higher than the 162 figure targeted in order to reach the fifth Millennium Development Goal by 2015. The most common causes of maternal death in developing countries include hemorrhage, obstructed labor, hypertensive disorders, sepsis and unsafe abortion (Khan et al., 2006).

Postpartum hemorrhage (PPH) is defined as excessive bleeding (bleeding more than 500ml or bleeding sufficient to cause deterioration in the woman’s clinical condition) after childbirth, and accounts for approximately 34% of maternal deaths in sub-Saharan Africa (Khan et al., 2006). Since there are no risk factors that consistently identify who will experience PPH, interventions that could prevent or treat excessive bleeding are out of reach for the many women who deliver with skilled attendants. Currently, only 47% of Zambian women deliver with a trained professional and 52% deliver at home; in rural areas up to 67% of deliveries occur at home (CSO, 2007). Therefore, preventing PPH is the preferred course of action especially for those women for whom treatment is not easily accessible.

1.2. Misoprostol for PPH

Active management of the third stage of labor (AMTSL) can significantly reduce postpartum blood loss, thereby preventing PPH. AMTSL is a set of interventions that includes the provision of a uterotonic drug, most commonly oxytocin, controlled cord traction and uterine massage after placental separation (Prendiville et al. 2000).

A recent study estimated that use of AMTSL in Zambia saves 467 lives and US $145,000 in facility costs per 100,000 births, as compared with expectant management of the third stage of labor (allowing the placenta to deliver spontaneously without uterotonics) (Fullerton et al., 2006). However, this study was limited to facility deliveries and did not recognize the large proportion of women in Zambia who deliver at home. Therefore, the life-saving impact of using uterotonic drugs was likely underestimated in the study.

Uterotonic drugs exist in both injectable and tablet forms. While very effective in managing PPH, injectable uterotonics require proper storage (refrigeration). In addition, clean injection supplies and skilled providers who are trained in administering safe injections are needed at the time of delivery. In rural settings, where many women deliver at home, widespread use of injectable uterotonics is not feasible. Many rural health centers may not have the infrastructure or trained staff available to provide these drugs.

Misoprostol provides an important alternative intervention for prevention and treatment of PPH given the requirements for administration of injectable uterotonics. Misoprostol is a prostaglandin analogue that has been recognized by the international community for its potential to reduce PPH-related
morbidity and mortality in resource-poor settings due to its relative efficacy, ease of administration, and stability in field conditions (Derman et al., 2006; Caliskan et al., 2003; Oboro & Tabowei, 2003). It is inexpensive, easy to store, and has an excellent safety profile (el-Refaey et al., 1997). Extensive research has demonstrated that 600 μg of misoprostol taken orally is the preferred dose for prevention of PPH and symptoms of its use such as shivering or nausea are generally self-limiting (Lumbiganon et al., 1999; Derman et al., 2006).

Where oxytocin is not available or feasible – due to lack of refrigeration, supplies (such as syringes), or trained staff – misoprostol can be an essential drug for prevention and treatment of PPH. The convenience, low cost and ease of administration also make misoprostol a key drug for maternal health programs. The International Federation of Gynecology and Obstetrics and the International Confederation of Midwives (FIGO/ICM) have recommended that in home births where a skilled attendant is not present, misoprostol may be the only available technology to control PPH (ICM/FIGO, 2006). To effectively manage PPH in low resource settings where most women deliver at home, misoprostol is often the only available option. In May of 2008, Zambia became the third country in Africa to register misoprostol for use in prevention and treatment of PPH, and in 2010, the Pharmaceutical Regulatory Authority approved the registration of a second misoprostol product for PPH and treatment of incomplete abortion and miscarriage.

1.3. Rationale for ANC Distribution of Misoprostol to Prevent PPH at Home Births

All women should be encouraged to deliver at a health facility with a skilled attendant who can administer AMSTL to prevent and manage PPH and other complications at delivery. However, there continue to be barriers for both women and providers keeping women from receiving a uterotonic drug at delivery. As many women in Zambia still deliver at home, and 53% deliver without a skilled attendant, complementary strategies to reach women with life-saving interventions such as misoprostol are needed. Since 94% of women in Zambia attend at least one antenatal care (ANC) visit with a skilled provider (CSO, 2007), these visits provide an important opportunity to distribute misoprostol and enable those who cannot reach a facility at the time of delivery to have access to this life-saving technology.

Recent research has demonstrated that when educated about proper use of misoprostol, women are capable of retaining information and safely self-administering misoprostol at home births after distribution by a community health worker (Rajbhandari et al., 2010; Sanghvi et al., 2010). When misoprostol is distributed for use at home births, higher numbers of women have access to a uterotonic drug for prevention of PPH, especially lower-income women and women who cannot reach a facility to deliver (Rajbhandari et al., 2010). Safety is not compromised by including community-level health workers in misoprostol distribution and the incidence of adverse events is often found to be higher in areas without misoprostol due to the use of traditional medicines and herbs. Moreover, in Afghanistan, births with skilled providers were found to be higher in areas where misoprostol was made available directly to women, likely due to reinforcement of messages by community health workers of the importance of delivering in a facility (Sanghvi et al., 2010).
As high numbers of women in Zambia attend at least one ANC visit, this is an ideal contact point for reaching as many pregnant women as possible with messages about safe delivery, risks of PPH, and the use of misoprostol.

### 1.4. Partners

**Ministry of Health, Zambia:** The MOH, particularly the Division of Reproductive Health, supported the pilot intervention facilitation, enabling the participation of public providers and facilities, and providing substantial support for the evaluation process. The Emergency Obstetric and Newborn Care (EmONC) Working Group in the MOH also provided technical support for the implementation of the pilot project.

**Venture Strategies Innovations (VSI):** VSI has implemented community-level misoprostol distribution programs in eight developing countries in Africa and Asia. VSI provided financial and technical support to this project, including the development of data collection tools, training materials, monitoring and evaluation design, and data analysis management.

**Bixby Center for Population, Health and Sustainability at University of California, Berkeley:** With VSI, the Center provided technical assistance in the design and management of this project.

### 2. Pilot Project Description

#### 2.1. Goals and Objectives

The goal of this project was to prevent PPH at home births with misoprostol tablets among women who were unable to reach a facility to deliver. To reduce the number of women who die due to excessive bleeding at home births, this project distributed misoprostol tablets at ANC visits to women and provided education on birth preparedness, the importance of facility delivery and the use of misoprostol in the event women could not reach a facility for delivery.

The main objectives of this pilot intervention and evaluation were to:

- Provide necessary evidence that women can safely self-administer misoprostol for prevention of PPH at home births after being educated on and receiving the drug at ANC visits.
- Demonstrate that ANC visits are a feasible and effective channel for distributing misoprostol for PPH prevention to women who cannot return to a facility to deliver and so, give birth at home.
- Determine whether women find misoprostol to be an acceptable means of preventing PPH at home births.

#### 2.2. Location

The project was conducted in 19 health centers in five districts of Zambia: four each in Kapiri Mposhi, Petauke, Kalomo and Mungwi and three in Masaiti. The project districts vary geographically and can be seen in Figure 1. Each health center in the project served the population in its **catchment area**, generally a 20 to 30 kilometer radius around the health center.
Districts were chosen for this project from different areas of the country, and the health centers chosen in each of the project districts were selected based on their remoteness and need. In addition, each of the health centers and catchment areas chosen had Safe Motherhood Action Groups (SMAG) (see below) actively working in them.

The population, expected deliveries and ANC resources of the participating districts and health centers are presented in Table 1.

Table 1: Population, expected deliveries and ANC characteristics of project districts, Zambia

<table>
<thead>
<tr>
<th>District</th>
<th>Kalomo</th>
<th>Kapiri Mposhi</th>
<th>Masaiti</th>
<th>Mungwi</th>
<th>Petauke</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>34,677</td>
<td>35,927</td>
<td>32,159</td>
<td>41,285</td>
<td>55,597</td>
<td>199,645</td>
</tr>
<tr>
<td>Expected deliveries/year</td>
<td>1,804</td>
<td>1,866</td>
<td>1,672</td>
<td>2,146</td>
<td>2,891</td>
<td>10,379</td>
</tr>
<tr>
<td># ANC static clinics</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td># ANC outreach clinics</td>
<td>32</td>
<td>25</td>
<td>47</td>
<td>47</td>
<td>0</td>
<td>151</td>
</tr>
<tr>
<td># ANC providers</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>38</td>
</tr>
<tr>
<td># SMAGs</td>
<td>72</td>
<td>72</td>
<td>72</td>
<td>72</td>
<td>72</td>
<td>360</td>
</tr>
</tbody>
</table>

Source: Ministry of Health, Zambia
2.3. Project Timeline
This pilot involved two stages: intervention and evaluation. The intervention was implemented over the course of 15 months, from January 2009 to March 2010, when community awareness efforts were ongoing and misoprostol was distributed in the 19 pilot health centers.

The evaluation took place during March and April 2010 and included women who had delivered during the period of intervention.

Figure 2: Timeline of pilot intervention and evaluation: January 2009–April 2010

The following two sections describe the methodology of the intervention and the results of the intervention phase of the pilot project. The methods and results of the evaluation will be presented in Section 5 and 6 below.

3. Intervention Methodology

3.1. Strategy and Design
The pilot intervention was comprised of two main components: 1) a community awareness campaign on birth preparedness and the role of misoprostol in PPH prevention, and 2) distribution of misoprostol through ANC visits.

3.1.1. Community Awareness Campaign
A variety of communications strategies were used in the project to create awareness and educate communities on PPH and the use of misoprostol.

Media
A community awareness campaign used radio, posters and pamphlets, and one-on-one interaction to convey four main messages: 1) the importance of delivering in a health facility; 2) birth preparedness and planning early for a safe delivery 3) PPH identification (two chitenges soaked with blood) and consequences; and 4) misoprostol as a means of prevention of PPH. More specifically, the campaign encouraged women to attend ANC throughout pregnancy and informed them that the tablets were available at pilot health centers. The campaign reinforced the instructions given at ANC on correct use of misoprostol to prevent PPH at home births if women were unable to deliver at a health facility. Women were encouraged to attend ANC visits with a family member (one or more) of their choice, especially those people who were likely to be present at the time of delivery (a “support person” such as the woman’s husband, mother, sister, mother-in-law, etc.), so they could also receive the information.
The messages of the campaign were also brought into the community through SMAGs. SMAGs are community organizations affiliated with certain health centers whose 20 to 25 members are comprised of traditional birth attendants (TBAs), members of the Neighborhood Health Committees (NHCs), community health workers and influential community members. Where SMAGs are present, each health center has two to three SMAG groups; each group is responsible for a given number of villages, and together, these two to three groups cover the health center’s catchment population. SMAGs support Maternal, Newborn and Child Health activities in the community and generate awareness about maternal health in the community, educate women and families on danger signs in pregnancy, inform communities about safe motherhood services, and assist families needing referrals for emergency obstetric and neonatal care.

In addition to these activities, SMAGs associated with the intervention health centers conducted community meetings on the key messages comprising the project’s awareness campaign. As the SMAG program is still in the process of being scaled up in Zambia, not all health centers have SMAGs. However, the catchment areas of all 19 health centers selected for participation in the misoprostol pilot program were covered by SMAGs.

While misoprostol distribution at ANC began in January 2009, SMAGs were not oriented and actively conducting community awareness activities until April and May 2009. Approximately 360 SMAGs were oriented to the project across the five districts by ANC providers, with supervision by District Health Management Teams (DHMTs). The training on PPH and misoprostol was incorporated into general orientation meetings on safe motherhood that lasted for five days. Mungwi district conducted SMAG mobilization and training in April 2009, while Masaiti, Petauke, Kapiri Mposhi and Kalomo districts had their SMAGs’ orientation in May 2009. During the 12 months during which SMAGs were active, they held over 800 community sensitization meetings.

The SMAG Report Forms also allowed SMAGs to provide comments on the education sessions they organized over the months that they were providing community education on the project. The community responses to the meetings were overwhelmingly positive, and SMAGs reported women being very receptive to the messages and information about safe delivery, ANC attendance and misoprostol. Women expressed eagerness for more education sessions.

3.1.2. ANC Distribution of Misoprostol
Static and outreach ANC clinics served as the entry point for women to receive misoprostol tablets and education on PPH and the use of the tablets at delivery for PPH prevention. In addition to their existing activities, all ANC providers in the 19 pilot health centers were trained to provide an education session on blood loss, PPH risks and misoprostol for the prevention of PPH to all pregnant women. ANC providers screened women attending ANC for medical eligibility\(^1\) to receive misoprostol, offered the tablets if eligible, and gave instructions for their use in the event the woman could not deliver at a

\(^1\) Medical criteria for excluding women included potential for high-risk pregnancy, expected to need Caesarean section, chronic disease (including high blood pressure, diabetes and cardiac disease) and allergies to prostaglandins.
health facility. All women who accepted misoprostol were provided with a pictorial pamphlet about its correct use for PPH along with the tablets. ANC providers emphasized the importance of attending ANC throughout pregnancy and delivering at a health facility. They also advised women to return their misoprostol tablets to the health provider if they came to the facility to deliver.

3.2. Project Personnel and Training

3.2.1. Organizational Structure
The Department of Reproductive Health at the Ministry of Health (MOH), Zambia and Venture Strategies Innovations (VSI) collaborated closely in the design and implementation of the pilot project. Staff from both VSI and the MOH assisted in the development, coordination and organization of project training, implementation and data management. A Project Manager, VSI National Program Coordinator Rabecca Kalwani, oversaw the day-to-day activities of the project. In addition, a district team made up of the Maternal and Child Health Coordinator, District Health Information Officer and Manager of Planning and Development supervised the pilot activities in their respective districts (Figure 3).

Figure 3: Misoprostol pilot project: Organizational structure (showing 1 of 5 districts), Zambia

3.2.2. Launch and Training
The project was officially launched in January 2009, with the training of 15 trainers from DHMTs. A week later, 32 ANC providers, mostly nurses and clinical officers, received training on the components of the project, including knowledge and identification of PPH, management of PPH with misoprostol, screening women for eligibility, distribution of misoprostol, and all relevant documentation needed for monitoring.
the project. Upon completion of the training, the providers were supplied with enough packaged misoprostol to last the first three months of the project. The Project Manager supplied restock of misoprostol to each district as needed. District Coordinators were also provided posters, job aids and brochures to distribute to health centers to facilitate communication with women and the community about PPH and misoprostol.

3.3. Data Collection and Management
Data was collected on every woman attending ANC during the first visit and at subsequent visits using the Misoprostol Addendum. This form recorded basic ANC information and whether and when misoprostol was distributed to women. Providers also kept a record of the entry and exit of misoprostol tablets from the facility using the Misoprostol Receipt and Distribution Log. In addition, as noted above, SMAGs reported monthly on their community awareness activities using the SMAG Report Form. The design of the intervention phase of this project was such that follow-up data was not collected on the women who accepted misoprostol at ANC. Instead, a random sample was used to measure outcomes of misoprostol distribution during the evaluation phase of the project, which is discussed below in Sections 5 and 6.

The district Safe Motherhood Coordinators collected this data on a monthly basis. It was checked for completeness and sent to the Project Manager in Lusaka. A data manager at the Ministry of Health entered all of the Misoprostol Addendum forms in SPSS 10 and emailed all data on a monthly basis to the VSI Monitoring and Evaluation Team. The VSI Monitoring and Evaluation team conducted the analysis in Stata SE 10.1.

4. Results of the Pilot Intervention
The results of the distribution phase of misoprostol are based on the Misoprostol Addendum forms completed with all women who attended ANC during the pilot intervention phase (January 2009 to March 2010).

4.1. ANC Attendance and Program Coverage
Based on data collected from the Misoprostol Addendum forms, 5,574 women attended ANC at the pilot facilities during the intervention period.

Figure 4 shows ANC attendance over the course of the intervention. Mungwi district had the highest number of women participating in the project, followed by Kalomo and Petauke.
Participation in the project was slow during the first four months of implementation (January to April 2009). ANC providers were trained throughout January 2009, and misoprostol distribution did not become widespread until the end of February or beginning of March in most districts. Therefore, only 121 women were enrolled in the project during January and February 2009. Another reason for lower numbers during the first four months of implementation is that the facilities delayed misoprostol distribution until the SMAGs had been oriented to the project and had begun educating their communities on the campaign messages. As mentioned above, trainings for SMAGs were held in Mungwi in April 2009 and the remaining four districts in May 2009.

We estimated the project’s coverage based on a comparison of the estimated deliveries for one year in the pilot health facility catchment areas and the actual number of women who attended ANC during 12 out of 15 months of the intervention (April 2009 to March 2010, Table 2). Based on this comparison, the project’s coverage was approximately half of expected deliveries overall. However, there was variation in this estimation between districts: some areas reached only a quarter of estimated deliveries (Masaiti, 27%) and others reached the majority of expected deliveries (Kalomo, 69%; Mungwi, 81%). While the accuracy of the delivery estimates is difficult to verify, these differences between districts highlight the importance of addressing challenges and strengths at the district level when implementing a pilot project. Many factors influence the level of coverage in a district, such as community awareness efforts, quality of care, geography, etc.
### Table 2: Estimated deliveries and actual ANC attendance by district

<table>
<thead>
<tr>
<th>District</th>
<th>Kalomo</th>
<th>Kapiri Mposhi</th>
<th>Masaiti</th>
<th>Mungwi</th>
<th>Petauke</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Deliveries* (12 months)</td>
<td>1,804</td>
<td>1,866</td>
<td>1,672</td>
<td>2,146</td>
<td>2,891</td>
<td>10,379</td>
</tr>
<tr>
<td>Number of women who attended ANC April 2009-March 2010 (% of estimated deliveries)</td>
<td>1,249 (69%)</td>
<td>893 (48%)</td>
<td>457 (27%)</td>
<td>1,742 (81%)</td>
<td>1,022 (35%)</td>
<td>5,363 (52%)</td>
</tr>
</tbody>
</table>

*From Table 1

### 4.2. Misoprostol Distribution

Coverage of misoprostol distribution at ANC visits was high in the pilot sites: 94% of women attending ANC during the intervention period (January 2009 – March 2010) took misoprostol home with them. The vast majority of women who took misoprostol home did so at their first visit. The average gestational age at which women took misoprostol home was 25 weeks. The remaining 6% who did not take misoprostol home were either deemed medically ineligible to receive misoprostol, the tablets were not available for the provider to give the woman, or the woman wished to receive them at a subsequent visit, possibly after obtaining permission from her husband or relatives.

### Table 3: ANC attendance and misoprostol distribution in project districts, January 2009-March 2010

<table>
<thead>
<tr>
<th>District</th>
<th>Kalomo</th>
<th>Kapiri Mposhi</th>
<th>Masaiti</th>
<th>Mungwi</th>
<th>Petauke</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANC Attendance</td>
<td>1,272</td>
<td>950</td>
<td>498</td>
<td>1,826</td>
<td>1,028</td>
<td>5,574</td>
</tr>
<tr>
<td>Took misoprostol home</td>
<td>1,195 (94%)</td>
<td>814 (86%)</td>
<td>487 (98%)</td>
<td>1,758 (96%)</td>
<td>978 (95%)</td>
<td>5,232 (94%)</td>
</tr>
<tr>
<td>Mean gestational age (weeks) when took misoprostol home</td>
<td>26</td>
<td>25</td>
<td>24</td>
<td>24</td>
<td>26</td>
<td>25</td>
</tr>
</tbody>
</table>

### 5. Evaluation Methodology

In order to determine whether the intervention met its stated goals and objectives, an evaluation of the pilot project was carried out in March and April of 2010.

The purpose of this evaluation was to determine:

- If it is feasible to distribute misoprostol to pregnant women at ANC, including the rate of ANC attendance, at what point in pregnancy women take misoprostol home, and at what rate women take misoprostol home and subsequently use it at delivery.
- Whether messages about PPH and misoprostol are widespread and understood among women in the communities.
• If making misoprostol available to women through ANC has an effect on where women choose to deliver.
• If making misoprostol available through ANC visits increases coverage with a uterotonic drug for prevention of PPH.
• If women using misoprostol at home deliveries use it correctly.
• If misoprostol availability has an effect on excessive bleeding at delivery and bleeding-related referrals.
• What symptoms women using misoprostol experience compared with those who take other uterotonics or no drug to manage bleeding.
• If misoprostol is acceptable to women.

5.1. Design and Methods

5.1.1. Evaluation Design
Time and resource limitations restricted the evaluation survey to two of the five districts in which the pilot intervention was active (Petauke and Kalomo). These two districts were chosen because they had high ANC attendance during the intervention period, ensuring a sufficiently large sample size for inference to all five districts. They are also both rural districts and geographically distinct, with Petauke in Eastern Zambia and Kalomo in the Southwest, supporting the relevance of the evaluation results to Zambia’s sizeable rural population.

As described above, during the intervention phase of the project, misoprostol was distributed at four health facilities each in both Petauke and Kalomo. Every health facility in Zambia is associated with a population living within a corresponding catchment area. The catchment populations associated with the facilities distributing misoprostol in Petauke and Kalomo constituted the intervention population. Facilities not participating in the pilot program in these two districts were selected for the evaluation, and the catchment populations around these facilities were chosen to constitute the comparison population. We refer to the catchment areas associated with facilities where misoprostol was available and not available during the pilot project as intervention areas and control areas, respectively.

The primary outcomes of interest included the rates of facility versus home delivery in control and intervention areas, as well as rates of bleeding, referral, need for additional intervention, and experience of postpartum symptoms. Without the ability to follow up with women immediately after delivery, retrospective recall for these indicators was used. For this evaluation, women were asked to recall details of their delivery event up to 15 months afterward, which raises questions of recall accuracy; however, there is evidence that women can accurately recall incidents of bleeding during pregnancy and delivery, though accuracy may vary by level of education (Hasan et al., 2010; Umeora & Egwuatu, 2009).

5.1.2. Organizational Structure
The evaluation was designed and carried out by VSI’s Monitoring and Evaluation Specialist and a consultant working with VSI with experience in impact evaluation and survey design (the “Evaluation Team”). The Team also received substantial assistance from the MOH of Zambia.
The VSI Evaluation Team hired, trained and managed five Field Supervisors and approximately 30 Interviewers (primary data collectors) in each district. A Field Supervisor was responsible for a survey team of five to seven Interviewers over a four- to six-day period of data collection in each catchment area (Figure 5). Local SMAGs and TBAs served as community guides, identifying women who had recently delivered in the communities.

The total training and survey time in each district was approximately two weeks. More extensive information about the sampling design, training and surveying process can be found in Appendix 1.

**Figure 5: Organizational structure for evaluation of misoprostol pilot**

5.1.3. Survey Tools

The Evaluation Team used two survey tools to capture outcomes: the **Postpartum Survey** and the **Verbal Autopsy**. The Postpartum Survey was administered to eligible women (delivered a baby between January 2009 and March 2010) after obtaining their informed consented to participate in the interview.

The Postpartum Survey explored knowledge about bleeding after delivery (i.e. PPH), most recent delivery experience, correct knowledge and use of misoprostol (if applicable), postpartum symptoms, and referral. Because the evaluation was retrospective and PPH was not directly measured, delivery experience and bleeding were based on women’s recall.
To capture information about maternal deaths, the Field Supervisors used a **Verbal Autopsy** tool developed by the Bixby Center for Population, Health and Sustainability at the University of California, Berkeley. Supervisors worked closely with health center staff, SMAGs and TBAs to identify any maternal deaths that had occurred in the catchment area between January 2009 and March 2010. The **Verbal Autopsy** was then conducted by the Field Supervisor with a family member or neighbor in order to determine whether a woman’s death could be classified as a *maternal death*.²

The Evaluation Team conducted short interviews using a structured questionnaire with five providers, including nurses and “in-charges” of facilities, who had been providing misoprostol over the period of the pilot project. A total of one provider in Petauke and four providers in Kalomo (two from the same facility) were interviewed, representing four facilities total. Four of the providers are women, one is male, and at the time of the interviews, their ages ranged from 26 to 55. Most of the providers provide ANC services, though all those interviewed also assist with deliveries. Four of the five providers reported having attended over 100 deliveries in the past year.

### 5.2. Data Entry and Analysis

The Field Supervisor collected completed questionnaires at the end of each day in the field. When the team returned to the district center, the completed questionnaires were collected by the Evaluation Team and reviewed for completion and accuracy.

Two data managers entered the data in **Microsoft Access** concurrently to ensure consistency. The data was then analyzed in **Stata SE 10.1**. One-sided t-tests were conducted to determine the comparability of the intervention and control populations. Results were calculated using frequency tables and cross-tabulations. Differences between groups were assessed by χ² test for association and t-tests to compare means. Significance was assessed using a criterion of p<0.05.

### 5.3. Ethical Approval

Ethical approval for this evaluation was given by the University of California, Berkeley Committee for Protection of Human Subjects (#2009-3-21). Women participating in this evaluation provided written informed consent in order to participate in the postpartum survey.

### 6. Results of Evaluation

For this evaluation sample, women who had delivered between January 2009 and March 2010 were eligible to be interviewed. The evaluation sample has the potential to, and likely does, include some of the same women who completed **Misoprostol Addendum** records when they accepted misoprostol during the intervention phase of this pilot described above. However, the evaluation sample does not attempt to link any of the records of women who accepted misoprostol to their **Misoprostol Addendum** form. The structure of the evaluation is such that the women in the intervention areas of the evaluation

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² 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, 1992).
should be assessed on outcomes in comparison to women in control areas based on the availability of misoprostol in intervention areas for the 15 months prior to this evaluation.

The total sample of women surveyed in the evaluation was 1,989 (1,047 in the intervention area and 942 in the control area), in excess of the sample size needed to obtain 98% power for inference (See Appendix 1). Due to time and travel constraints, six health centers were surveyed in Kalomo, compared with eight in Petauke, and subsequently, the sample size was slightly smaller in the former. Across both districts, ten maternal deaths were identified and followed up with verbal autopsies to determine circumstances of death.

Table 4: Summary of evaluation data collection

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postpartum Interview</td>
<td>1,047</td>
<td>942</td>
<td>1,989</td>
</tr>
<tr>
<td>Verbal Autopsy</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Provider Interview</td>
<td>5</td>
<td>-----</td>
<td>5</td>
</tr>
</tbody>
</table>

6.1. Antenatal and Delivery Characteristics of the Evaluation Sample

In order to accurately compare the outcomes in intervention and control areas, it was necessary that the women in the areas be similar and comparable. As Table 5 below shows, there were no significant differences in the characteristics of the women between the survey areas.

Women were 27 years old on average. Almost half the women had four or more live births (including the most recent pregnancy). The women in the sample were interviewed approximately six months after their last delivery. About 40% of women in both control and intervention areas reported excessive bleeding in a previous delivery (excluding the most recent pregnancy), which was not statistically different between the two groups.
Table 5: Characteristics of the evaluation sample

<table>
<thead>
<tr>
<th></th>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
<th>TOTAL (N=1,989)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age (range)</td>
<td>26.7 (15-54)</td>
<td>26.9 (13-49)</td>
<td>26.8 (13-54)</td>
</tr>
<tr>
<td>Live Births (including most recent pregnancy)^</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>193 (18.4%)</td>
<td>156 (16.6%)</td>
<td>349 (17.6%)</td>
</tr>
<tr>
<td>2</td>
<td>179 (17.1%)</td>
<td>176 (18.7%)</td>
<td>355 (17.9%)</td>
</tr>
<tr>
<td>3</td>
<td>163 (15.6%)</td>
<td>160 (17.0%)</td>
<td>323 (17.9%)</td>
</tr>
<tr>
<td>4-13</td>
<td>496 (47.4%)</td>
<td>445 (47.2%)</td>
<td>941 (47.3%)</td>
</tr>
<tr>
<td>Attended ANC during last pregnancy^^</td>
<td>1,036 (99.0%)</td>
<td>930 (98.7%)</td>
<td>1,965 (98.7%)</td>
</tr>
<tr>
<td>Mean number of ANC visits during last pregnancy (range)</td>
<td>3.8 (1-9)</td>
<td>3.9 (1-12)</td>
<td>3.8 (1-12)</td>
</tr>
<tr>
<td>Excessive bleeding in a previous pregnancy ( Experienced excessive bleeding in a previous pregnancy)^^^</td>
<td>417 (39.8%)</td>
<td>407 (43.2%)</td>
<td>824 (41.4%)</td>
</tr>
</tbody>
</table>

^No response in 16 clients in intervention area and 5 clients in control area
^No response in 7 clients in intervention area and 9 clients in control area
^^No response in 34 clients in intervention area and 21 clients in control area

ANC attendance during the most recent pregnancy was near universal in both the intervention and control areas, and women in the sample attended an average of four ANC visits. Additionally, 86% of women in the control areas and 83% of women in the intervention areas attended three or more ANC visits during their most recent pregnancy (Figure 6).

Figure 6: Number of ANC visits attended during most recent pregnancy (N=1,989^)

^No response in 45 clients in intervention areas and 46 clients in control areas
6.2. Coverage and Comprehension of Community Awareness Messages

During the postpartum interview, participating women were asked if they had received information on PPH and misoprostol, and if so, the sources from which they learned this information. As seen in Table 6, women in the intervention area were 50% more likely to have received information about bleeding after childbirth (87% vs. 58%). The most frequently mentioned sources of information on excessive bleeding in the control areas were health facilities or ANC providers, while in the intervention areas they were SMAGs and ANC providers (data not shown).

Most women in the intervention areas had received information about misoprostol (85%), while few women in the control areas had received any information on the drug (4%). The very small number of women in control areas who had heard of misoprostol reported having heard the information from ANC providers or at health facilities.

Table 6: Received information on bleeding after delivery and misoprostol

<table>
<thead>
<tr>
<th></th>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received information about bleeding after childbirth*^</td>
<td>915 (87.4%)</td>
<td>547 (58.1%)</td>
</tr>
<tr>
<td>Received information about misoprostol **^^</td>
<td>887 (84.7%)</td>
<td>40 (4.3%)</td>
</tr>
</tbody>
</table>

*p<0.01
^No response in 2 clients in intervention areas and 3 clients in control areas
^^No response in 3 clients in intervention areas and 5 clients in control areas

Health facilities or ANC providers were cited the most often as a source of information on misoprostol for women in intervention areas (78%)(Figure 7). SMAGs were also mentioned by a third of the women in intervention areas as a source of information on misoprostol. TBAs, radio and other sources appeared to be less common sources of information about misoprostol.

Figure 7: Sources of information about misoprostol in intervention areas (N=1,047)

[Bar chart showing sources of information]

*Other includes Drug Vendors and Brochures/Posters
Overall knowledge about PPH and misoprostol was higher amongst women in the intervention areas (Table 7). When asked during the postpartum interview what information they had received about excessive bleeding, the most common response was that it “can cause death.” Almost twice as many women in the intervention areas reported this than in the control areas (74% vs. 45% respectively) (Table 7).

Comprehension of the key messages about misoprostol was very high amongst women in the intervention areas. Most respondents in the intervention areas knew the function (80%), correct timing (82%), correct dose (74%), and correct route (77%) of misoprostol for PPH prevention, while very few women in the control areas knew this information. However, reported knowledge was higher among women in intervention areas in Petauke compared with Kalomo (correct knowledge of timing 91% vs. 71%; correct dose 85% vs. 61%; and correct route 85% vs. 68%) (data not shown).

Table 7: Knowledge of PPH and misoprostol

<table>
<thead>
<tr>
<th>Information about PPH</th>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPH can cause death*</td>
<td>772 (73.7%)</td>
<td>419 (44.5%)</td>
</tr>
<tr>
<td>Go to a health facility or get help from a midwife</td>
<td>127 (12.1%)</td>
<td>96 (10.2%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Information about misoprostol</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Misoprostol prevents, stops, or reduces the chances of bleeding after childbirth*</td>
<td>835 (79.8%)</td>
<td>35 (3.7%)</td>
</tr>
<tr>
<td>Correct timing (immediately after baby is born)*</td>
<td>861 (82.2%)</td>
<td>32 (3.4%)</td>
</tr>
<tr>
<td>Correct dose (3 tablets)*</td>
<td>773 (73.8%)</td>
<td>26 (2.8%)</td>
</tr>
<tr>
<td>Correct route (oral)*</td>
<td>810 (77.4%)</td>
<td>32 (3.4%)</td>
</tr>
<tr>
<td>Knows at least one potential symptom of misoprostol use*</td>
<td>230 (22.0%)</td>
<td>4 (0.4%)</td>
</tr>
</tbody>
</table>

*p<0.01

6.3. Feasibility: Coverage of Misoprostol Distribution through ANC

As noted above, reported ANC attendance was very high in both intervention and control areas. Of the women who attended ANC in the intervention area sample, approximately two thirds (62%) said they had been offered misoprostol during an ANC visit. However, significantly more women reported being offered misoprostol at ANC in Petauke, where 75% women who attended ANC and were offered misoprostol accepted the drug, compared to 45% of women in Kalomo (data not shown).

Very few women in control areas reported receiving misoprostol at ANC, as shown in Table 8 below.
Table 8: ANC attendance and misoprostol distribution

<table>
<thead>
<tr>
<th></th>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attended ANC*^</td>
<td>1,036 (99.0%)</td>
<td>930 (98.7%)</td>
</tr>
<tr>
<td>Took misoprostol home (of those attending ANC)*^^</td>
<td>642 (62.0%)</td>
<td>18 (1.9%)</td>
</tr>
</tbody>
</table>

*p<0.01
^No response in 7 clients in intervention areas and 9 clients in control areas
^^No response in 41 clients in intervention areas and 10 clients in control areas

6.4. Location and Attendant at Delivery
As Figure 8 shows, women in intervention areas were significantly more likely to deliver at a facility compared to women in control areas (54% vs. 40%). Facility deliveries were significantly higher in Petauke compared to Kalomo overall (54% vs. 39%) (data not shown).

Figure 8: Location of delivery^*

For women in both areas who delivered at facilities, over 80% received care from a trained attendant, compared with fewer than 20% at home deliveries (Table 9). Trained attendants include clinical officers, nurses and midwives, while untrained attendants include TBAs or friends/relatives. Based on the women surveyed in this evaluation, women in intervention areas delivered at facilities at a higher rate than women in control areas. In intervention areas where misoprostol was available for home births, women continued to deliver in facilities.
Table 9: Attendant at delivery by location

<table>
<thead>
<tr>
<th>Attendant at delivery</th>
<th>Intervention (N=1047)</th>
<th>Control (N=942)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trained</td>
<td>91 (19.0%)</td>
<td>86 (15.3%)</td>
</tr>
<tr>
<td>Untrained*</td>
<td>320 (67.0%)</td>
<td>423 (75.0%)</td>
</tr>
<tr>
<td>Alone*</td>
<td>62 (13.0%)</td>
<td>47 (8.3%)</td>
</tr>
<tr>
<td><strong>Facility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trained*</td>
<td>453 (80.3%)</td>
<td>340 (90.7%)</td>
</tr>
<tr>
<td>Untrained*</td>
<td>96 (17.0%)</td>
<td>25 (6.7%)</td>
</tr>
<tr>
<td>Alone</td>
<td>3 (0.5%)</td>
<td>1 (0.3%)</td>
</tr>
</tbody>
</table>

*p<0.01

^No response to location at delivery (5 in intervention areas; 3 in control areas)

^^No response on attendant at delivery (5 in intervention areas and 8 in control areas); Home includes 15 in intervention areas and 9 in control areas who delivered en route to health facility

^^^No response on attendant at delivery (12 in intervention areas and 9 in control areas)

6.5. Program Effectiveness: Overall Uterotonic Coverage and “Protected Births”

In order to prevent women from experiencing PPH, a uterotonic drug, such as oxytocin or misoprostol, should be administered immediately after delivery of the newborn. Coverage with a uterotonic drug at delivery for PPH prevention was much higher in the intervention areas for both home births and facility births (Table 10). Almost half (49%) of women in intervention areas delivering at home used misoprostol whereas almost all women delivering at home in control areas received no uterotonic for prevention of PPH (99%).

The coverage with injectable uterotonic drugs was comparable at facilities in the control and intervention areas. However, an additional 35% of women were protected from PPH with misoprostol at facilities in the intervention areas. The majority of women who reported using misoprostol at facilities had received the tablets at an ANC visit and brought them when they went to the facility to deliver (80%; 159 of 199 women) (data not shown). Oxytocin stock-outs were noted during the intervention period and contributed to misoprostol use in facilities since providers gave misoprostol when injectable uterotonic drugs were not available. However, the increased uterotonic coverage in facilities in the intervention areas is directly due to misoprostol availability: 19% of women delivering in facilities in the intervention areas received no uterotonic compared to more than half of the women delivering in facilities in the control area (51%).
Table 10: Uterotonic coverage by location of delivery

<table>
<thead>
<tr>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
<th>Total (N=1,989)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=478</td>
<td>N=564</td>
<td>N=1,042</td>
</tr>
<tr>
<td>Misoprostol*</td>
<td>233 (48.7%)</td>
<td>5 (0.9%)</td>
</tr>
<tr>
<td>No Uterotonic*</td>
<td>245 (51.3%)</td>
<td>559 (99.1%)</td>
</tr>
<tr>
<td>FACILITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=564</td>
<td>N=375</td>
<td>N=939</td>
</tr>
<tr>
<td>Misoprostol only*</td>
<td>199 (35.3%)</td>
<td>10 (2.7%)</td>
</tr>
<tr>
<td>Injection only</td>
<td>250 (44.3%)</td>
<td>172 (45.9%)</td>
</tr>
<tr>
<td>Both misoprostol and injection</td>
<td>6 (1.1%)</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>No Uterotonic*</td>
<td>109 (19.3%)</td>
<td>192 (51.2%)</td>
</tr>
</tbody>
</table>

*p<0.01

No response (5) for delivery location in intervention areas: 4 received no uterotonic and 1 unknown treatment; No response (3) in control areas: 3 received no uterotonic

Any birth that occurred in this sample in which a woman received a uterotonic drug can be categorized as a “protected birth” because the mother received a medical intervention proven to reduce the likelihood of PPH and “protect” her from excessive bleeding. The contribution that misoprostol distribution makes to increasing “protected births” is an important indicator of the effectiveness of the intervention. As Table 11 shows, 66% of births in the intervention areas were protected by some uterotonic at delivery. Of all the women who delivered in intervention areas, 22% were protected from PPH by taking misoprostol at home delivery. While 34% of women in intervention areas received no uterotonic, over twice as many women (80%) in control areas received no uterotonic for prevention of PPH. In this sample, misoprostol provided “protection” from PPH during birth for over 40% of deliveries in the intervention areas; these births would otherwise not have benefited from uterotonic coverage, as evidenced by significantly more deliveries that did not receive a uterotonic in control areas.

Table 11: Uterotonic coverage and resulting protected births

<table>
<thead>
<tr>
<th>Uterotonic for PPH prevention</th>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
<th>Total (N=1,989)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection only*</td>
<td>250 (23.9%)</td>
<td>172 (18.3%)</td>
<td>422 (21.2%)</td>
</tr>
<tr>
<td>Both misoprostol and injection**</td>
<td>6 (0.6%)</td>
<td>1 (0.1%)</td>
<td>7 (0.4%)</td>
</tr>
<tr>
<td>Misoprostol at health facility*</td>
<td>199 (19.0%)</td>
<td>10 (1.1%)</td>
<td>209 (10.5%)</td>
</tr>
<tr>
<td>Misoprostol at home*</td>
<td>233 (22.3%)</td>
<td>5 (0.5%)</td>
<td>238 (12.0%)</td>
</tr>
<tr>
<td>No uterotonic*Y</td>
<td>358 (34.2%)</td>
<td>754 (80.0%)</td>
<td>1,112 (55.9%)</td>
</tr>
<tr>
<td>Births protected from PPH**</td>
<td>689^ (65.8%)</td>
<td>188 (20.0%)</td>
<td>877 (44.1%)</td>
</tr>
</tbody>
</table>

*p<0.01; **p<0.05

^Includes 7 women not included in previous table because of missing location of delivery

Any uterotonic given for PPH prevention

^Includes 1 client with unknown delivery location who used misoprostol
It is also important to note variation between the two intervention districts. Overall, the proportion of protected births was higher in Petauke: nearly 80% of deliveries were protected with a uterotonic at delivery compared to only half the deliveries in Kalomo.

The proportion of births protected by an injection at the facility (26% in Petauke vs. 21% in Kalomo) or misoprostol at home (24% in Petauke vs. 20% in Kalomo) was similar in the two districts. However, the additional use of misoprostol at facility births accounts for the larger proportion of protected births seen in Petauke (Figure 9).

Figure 9: Uterotonic coverage in intervention areas in Petauke and Kalomo

6.6. Use of Misoprostol at Home Deliveries
A key indicator for determining the program effectiveness of this intervention is the proportion of women that received misoprostol through ANC and subsequently used it correctly at home delivery. Of the 478 home deliveries reported in the intervention areas, 60% of women reported receiving misoprostol during an ANC visit.

As Table 12 shows, of those who received misoprostol at ANC and delivered at home (N=281), the majority used misoprostol at delivery (83%). For the women in intervention areas who attended ANC, took misoprostol home, and subsequently delivered at home, misoprostol use at delivery was very high. Women in intervention areas in Petauke who delivered at home were much more likely to have received misoprostol at ANC (80% vs. 43% in Kalomo) and following from that, more likely to have taken misoprostol at home (69% vs. 34%) (data not shown).
Table 12: Coverage of misoprostol at home births

<table>
<thead>
<tr>
<th>Home births</th>
<th>Intervention (N=478)</th>
<th>Control (N=564)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attended ANC</strong>^</td>
<td>469 (98.1%)</td>
<td>557 (98.8%)</td>
</tr>
<tr>
<td>Received misoprostol during ANC</td>
<td>281 (59.9%)</td>
<td>9 (1.6%)</td>
</tr>
<tr>
<td>Used misoprostol at home delivery (of those who received misoprostol during ANC)</td>
<td>233 (82.9%)</td>
<td>5 (55.6%)</td>
</tr>
</tbody>
</table>

^Non response (5 clients in intervention areas and 5 clients in control areas)

Most women who used misoprostol at home delivery said they took the drug to prevent bleeding (84%). The most common reasons that women did not use misoprostol at home deliveries were that they did not have the misoprostol tablets with them at the time of delivery (45 women) or they did not have any information about it (40 women). Few women (16) cited a fear of symptoms associated with misoprostol use as a reason for not taking the tablets (data not shown).

### 6.7. Safety: Correct Use of Misoprostol

Most women who received misoprostol at an ANC visit and delivered at home reported using the drug correctly. Of the women who responded to the questions on timing and route (88%; 205 of 233), all said that they took misoprostol immediately after delivery, taking the tablets orally. While most women indicated that they took the correct dose of three tablets, thirteen (6%) said they took only two tablets (Table 13).

Table 13: Misoprostol use at home deliveries in intervention areas

<table>
<thead>
<tr>
<th></th>
<th>Intervention (N=233)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timing</strong></td>
<td></td>
</tr>
<tr>
<td>Took immediately after delivery</td>
<td>205 (88.0%)</td>
</tr>
<tr>
<td>No data</td>
<td>28 (12.0%)</td>
</tr>
<tr>
<td><strong>Number of tablets</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>13 (5.6%)</td>
</tr>
<tr>
<td>3</td>
<td>187 (80.3%)</td>
</tr>
<tr>
<td>No data</td>
<td>33 (14.2%)</td>
</tr>
<tr>
<td><strong>Route</strong></td>
<td></td>
</tr>
<tr>
<td>Oral</td>
<td>204 (87.6%)</td>
</tr>
<tr>
<td>No data</td>
<td>29 (12.5%)</td>
</tr>
</tbody>
</table>

### 6.8. Women’s Self-Report of Postpartum Blood Loss

Postpartum blood loss can be difficult to measure accurately, especially in rural and home delivery settings. For those reasons, women were asked if they felt they had experienced more or less bleeding during their most recent delivery, compared with past deliveries. Women in intervention areas reported significantly less bleeding in their most recent delivery (69% vs. 55% respectively). In addition, women using misoprostol or oxytocin at the time of delivery reported significantly less bleeding compared to previous deliveries (data not shown).
Table 14: Reported bleeding in most recent delivery compared to previous delivery^  

<table>
<thead>
<tr>
<th></th>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More bleeding than previous delivery**</td>
<td>258 (24.6%)</td>
<td>391 (41.5%)</td>
</tr>
<tr>
<td>Less bleeding than previous delivery**</td>
<td>720 (68.8%)</td>
<td>513 (54.5%)</td>
</tr>
<tr>
<td>First delivery/don’t know</td>
<td>32 (3.1%)</td>
<td>19 (2.0%)</td>
</tr>
</tbody>
</table>

^No response in 37 clients in intervention areas and 19 clients in control areas  
**p<0.05

6.9. Bleeding-related Referrals and Need for Additional Interventions
While more women in the intervention area reported being referred (8% vs. 5%)(Table 15), bleeding-related referrals were lower among women in the intervention areas (39% vs. 55% of all referrals). A number of women reported they referred themselves to a facility for normal delivery, knowing the importance of delivering in a health facility, and were not included in Table 15 below.

Table 15: Rate of referral and reason for referrals

<table>
<thead>
<tr>
<th>Reasons for referral</th>
<th>Intervention areas (N=1,047)</th>
<th>Control areas (N=942)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # women referred*</td>
<td>88 (8.4%)</td>
<td>42 (4.5%)</td>
</tr>
<tr>
<td>Excessive bleeding</td>
<td>34 (38.6%)</td>
<td>23 (54.8%)</td>
</tr>
<tr>
<td>Retained placenta</td>
<td>3 (3.4%)</td>
<td>4 (9.5%)</td>
</tr>
<tr>
<td>Ruptured uterus</td>
<td>2 (2.3%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Prolonged labor¹</td>
<td>41 (46.6%)</td>
<td>16 (38.1%)</td>
</tr>
<tr>
<td>Other referrals²</td>
<td>8 (9.1%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

*p<0.01; **p<0.05  
¹Women who were referred during labor or their labor lasted more than 24 hours.  
²Includes Caesarean sections and malaria

6.10. Misoprostol Use and Postpartum Symptoms
Participants’ self-reports of symptoms experienced after delivery are presented in Table 16. Almost half of all women did not experience any symptoms during the postpartum period (48% in intervention areas and 42% in control areas). Women in the intervention areas were significantly more likely to report experiencing no symptoms.
According to women’s self-reports, the most common symptoms experienced were shivering (31%), high temperature (12%), and fainting/dizziness (28%). Women in intervention areas were not any more likely to report these symptoms compared to women in control areas.

As Figure 10 illustrates, symptoms experienced by women varied by the type of uterotonic they received at delivery. Almost half of all women experienced no symptoms. Compared to women who received injectable uterotonics or no uterotonic, women who received misoprostol reported experiencing fainting, dizziness or nausea with significantly less frequency, and shivering significantly more often. The other symptoms experienced were comparable across all groups. Report of multiple symptoms was slightly more common amongst those who did not use misoprostol (26% of those who received an injection or no uterotonic vs. 22% of misoprostol users). Symptoms resolved within two hours for almost all participants.
6.11. Acceptability: Women’s Perspectives on Misoprostol Use

Women reported high acceptability of misoprostol. Nearly 90% of women interviewed in intervention areas reported they would use misoprostol during their next delivery. Almost 90% of women in intervention areas also reported that they would recommend misoprostol to others, and 80% would purchase misoprostol. Of those willing to pay for misoprostol in the intervention areas, the average amount was just over 7,500 Zambian kwacha (approximately $1.60 USD).

Acceptability was also high in the control areas, despite most women hearing about misoprostol for the first time during this evaluation. Most women in the control area said they would like to use misoprostol during their next pregnancy. Almost 70% of women in control areas said they would purchase misoprostol. Although significantly fewer women in the control areas indicated they were willing to purchase misoprostol than in the intervention areas, the amount women said they would pay was significantly higher: over 11,500 kwacha (approximately $2.50 USD) on average.
Table 17: Acceptability and willingness to pay for misoprostol

<table>
<thead>
<tr>
<th>Intervention (N=1,047)</th>
<th>Control (N=942)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Would use misoprostol at next delivery</strong></td>
<td>939 (89.7%)</td>
</tr>
<tr>
<td><strong>Would recommend misoprostol to others</strong></td>
<td>922 (88.1%)</td>
</tr>
<tr>
<td><strong>Willing to pay for misoprostol</strong></td>
<td>839 (80.1%)</td>
</tr>
<tr>
<td><strong>Average amount willing to pay for one dose of misoprostol in Kwacha (range)</strong></td>
<td>7,586 (100-150,000)</td>
</tr>
</tbody>
</table>

*p<0.01; **p<0.05

ˆNo response in 43 clients in intervention areas and 29 clients in control areas

ˆˆNo response in 13 clients in intervention areas and 11 clients in control areas

ˆˆˆNo response in 32 clients in intervention areas and 31 clients in control areas

7. **Acceptability: Provider Perspectives**

Of the five providers interviewed, four had received their first training on the use of misoprostol for prevention of postpartum hemorrhage as part of this pilot project. Oxytocin was available more than half of the time at three of the four facilities, and since the pilot project began, misoprostol had also been available consistently at three of the facilities surveyed. Three of the five providers reported always giving oxytocin at deliveries, and the other two providers said the reason for not always offering oxytocin is that it is not always available. The majority of the providers reported that they only give misoprostol at the time of delivery if oxytocin is out of stock.

Three of the five providers reported that they prefer to use oxytocin for management of PPH, stating it works quickly, is more effective in managing bleeding, and has fewer symptoms associated with its use. The providers who prefer misoprostol reported so because sometimes oxytocin is out of stock. In addition, one clinical officer reported, “giving an injection is very hard to do within one minute. It can also be painful for women.”

Though all providers recognized that oxytocin is the recommended first-choice drug for management of PPH, they all reported that they felt misoprostol reduces the need for referral to other health facilities, while also reducing the risk of maternal death due to bleeding. All of the providers would recommend use of misoprostol. In addition, none of the providers had ever had to refer any women for symptoms associated with misoprostol use.

8. **Maternal Deaths**

Supervisors working on the evaluation benefited from the SMAGs’ and TBAs’ knowledge and assistance in the catchment area around their health centers in identifying all potential maternal deaths that had occurred in the past 15 months (i.e. since misoprostol had been available in intervention areas). Using the local guides, Field Supervisors conducted interviews with family members or neighbors using the **Verbal Autopsy** tool to determine the potential cause of death, and thereby whether the death could be categorized as a maternal death.
As Table 18 shows, more deaths were reported in the control areas than in the intervention areas (6 vs. 4). The majority of deaths in the control areas were at home, while most deaths reported in the intervention areas were in facilities. While no death in the intervention area was due to bleeding-related causes, most of the deaths in the control area were reported as bleeding-related or exacerbated by anemia. Four of the maternal deaths in the control areas came from one health center’s catchment area. At the time of the evaluation, this health center had not had a trained health care provider for over a year.

In intervention areas, where misoprostol was available both at facilities and through ANC, fewer maternal deaths were identified. In addition, the deaths were more likely to occur at a health facility and less likely to be bleeding-related.

### Table 18: Maternal deaths identified in catchment areas of health centers in past year

<table>
<thead>
<tr>
<th>No.</th>
<th>Intervention/Control</th>
<th>Age</th>
<th>Parity</th>
<th>Place of Death</th>
<th>Probable Cause of Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Control</td>
<td>35</td>
<td>8</td>
<td>Health Facility</td>
<td>Excessive bleeding; retained placenta; potential eclampsia</td>
</tr>
<tr>
<td>2.</td>
<td>Control</td>
<td>41</td>
<td>8</td>
<td>Home</td>
<td>Excessive bleeding</td>
</tr>
<tr>
<td>3.</td>
<td>Control</td>
<td>30</td>
<td>4</td>
<td>Health Facility</td>
<td>Anemia</td>
</tr>
<tr>
<td>4.</td>
<td>Control</td>
<td>42</td>
<td>8</td>
<td>Home</td>
<td>Potential malaria; dehydration</td>
</tr>
<tr>
<td>5.</td>
<td>Control</td>
<td>40</td>
<td>7</td>
<td>Home</td>
<td>Anemia; excessive bleeding</td>
</tr>
<tr>
<td>6.</td>
<td>Control</td>
<td>30</td>
<td>3</td>
<td>Home</td>
<td>Excessive bleeding before delivery; Placenta previa/abruption</td>
</tr>
<tr>
<td>7.</td>
<td>Intervention</td>
<td>35</td>
<td>8</td>
<td>Health Facility</td>
<td>Complications/Infection from C-section</td>
</tr>
<tr>
<td>8.</td>
<td>Intervention</td>
<td>40</td>
<td>5</td>
<td>Health Facility</td>
<td>Anemia; died while pregnant; potential heart failure</td>
</tr>
<tr>
<td>9.</td>
<td>Intervention</td>
<td>29</td>
<td>2</td>
<td>Health Facility</td>
<td>Obstructed labor</td>
</tr>
<tr>
<td>10.</td>
<td>Intervention</td>
<td>&lt;18</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unsafe abortion</td>
</tr>
</tbody>
</table>

### 9. Conclusions

This report presents the results of the misoprostol pilot project, from both the intervention and evaluation phases, to assess the feasibility, program effectiveness, safety and acceptability of misoprostol distribution via ANC visits to prevent PPH at home births. There was high coverage of misoprostol distribution to women who attended ANC (94%) during the intervention phase of the pilot.

Almost 2,000 women participated in the evaluation and were interviewed about their experiences during their previous delivery, providing important results about location of delivery, excessive bleeding after delivery, knowledge about misoprostol, use of misoprostol at home deliveries, overall uterotonic coverage, and acceptability of the intervention, leading to the following conclusions.
ANC attendance is high in Zambia and an important location to reach women with misoprostol

Women interviewed during the evaluation had very high ANC attendance rates (over 98% of women in both intervention and control areas). In addition, the majority of women (over 80%) reported attending three or more ANC visits during their last pregnancy. Since ANC attendance is high in many areas in Zambia, ANC visits are an opportune moment for reaching pregnant women with information about PPH and misoprostol. The evaluation found that two in three women in the intervention areas took misoprostol home with them from ANC.

High coverage and comprehension of campaign messages

Knowledge about misoprostol was high in intervention areas. Health facilities and ANC providers were the most cited sources of information on PPH and misoprostol by women in the intervention areas. While all women attending ANC in intervention areas should have received information on PPH and misoprostol, the importance that participants placed on the health facility for this information demonstrates the vital role health facilities and their staff play in educating women. This finding suggests that the facility-based education sessions may be the most critical means for education about misoprostol and should be prioritized.

In addition, a third of women (33%) in the intervention area recognized SMAGs as important sources of information about misoprostol. The inclusion of SMAGs in this project was very important to raising initial awareness about PPH and misoprostol among women and communities, as well as for reiterating messages heard at ANC and other health facilities.

Women continue to attend ANC and deliver in health facilities when misoprostol is available for home births

Distributing misoprostol through ANC did not lead to more women delivering at home in the intervention areas. In fact, significantly more women in intervention areas where misoprostol was available delivered at facilities compared to control areas. Since an important component of this pilot project was the facility- and community-based education on birth preparedness and PPH prevention, the higher rate of facility delivery seen in the intervention areas could be the result of additional messages on the safety of delivering in the facility shared by ANC providers and SMAGs. Making misoprostol available at ANC visits did not, according to the evaluation, encourage more women to deliver at home.

Misoprostol increased the number of births protected from PPH

Uterotonic coverage was greater in the intervention areas than in the control areas, both at home births and at facility births. Almost half of the women delivering at home in the intervention areas were protected from PPH with misoprostol (49%); whereas fewer than 1% of women in control areas reported uterotonic use at home deliveries. In addition, having misoprostol available at facilities meant that an additional 20% of women in intervention areas were protected from PPH with a uterotonic. While 66% of women in intervention areas received some type of uterotonic regardless of their location of delivery, only 20% of women in control areas received a uterotonic at delivery for prevention of PPH.
Near universal correct use of misoprostol at home
Correct use of misoprostol by women who delivered at home was very high, with 88% of women taking it immediately after delivery and orally, and over 80% reporting that they took the proper prevention dose of three tablets. For those women who did not use the misoprostol tablets at home, the most common reasons were that they did not have information about the drug or they did not have the tablets.

Reduced bleeding-related referrals in the intervention area
While the overall reported rate of referral was higher in interventions areas, this may be indicative of increased awareness of risk factors and danger signs around excessive bleeding and pregnancy in general. In addition, while this evaluation was not able to determine causality, bleeding-related referrals were lower in the intervention areas where misoprostol was available for home and facility deliveries (39% vs. 55% of total referrals). This may be as a result of the role of misoprostol in reducing excessive bleeding at delivery as well as the subsequent need for referrals.

High acceptability of misoprostol by users and providers
Finally, acceptability of misoprostol was extremely high among women in intervention areas. The majority of women would recommend the drug to a friend (88%), use it in a subsequent delivery (90%), or be willing to purchase the drug (80%). By the end of the survey, women in control areas demonstrated willingness to use the drug in the future. Women in control areas even reported willingness to pay a higher amount for misoprostol than those in the intervention areas, indicating that demand develops for misoprostol among women once they gain knowledge of the drug and its benefits. Providers interviewed expressed their belief that the availability of misoprostol had reduced the need for referrals, as well as reduced maternal deaths due to bleeding.

Like all studies, this evaluation had limitations. The sampling of women was done according to a referral design, which was the most feasible in the context. Due to cost and time limitations, independent validation of the randomness of the sample was not possible. However, geographic sampling and use of numerous informants ensured that the populations in the samples were statistically comparable.

Coverage of misoprostol distribution and use at home births can vary by district
The frequency at which women were offered misoprostol varied between the two intervention areas surveyed. In Petauke district, approximately 75% of women surveyed had been offered misoprostol, either at an ANC visit or at the facility at the time of delivery. In Kalomo, only 45% of women surveyed reported being offered misoprostol.

This may be due to the reduced accessibility to health centers in Kalomo district, with some catchment areas of health centers being as far as 25 kilometers away on poor roads. Transportation and accessibility are still challenges in some districts in Zambia, both to obtaining ANC care and misoprostol, as well as to delivering at a facility with trained professionals.
10. Recommendations

The findings from the intervention and evaluation of the misoprostol pilot program in Zambia indicate that distributing misoprostol during ANC visits increases the proportion of women protected from PPH. Protection from PPH at home deliveries is substantially higher when misoprostol is available and the availability of misoprostol in facilities can lead to increased uterotonic coverage at facility deliveries. Distribution of misoprostol tablets at ANC visits does not appear to discourage women from returning to health facilities for subsequent ANC visits or delivery. Furthermore, women can safely self-administer misoprostol after being educated on its use during ANC. For those women who are not able to reach a facility to deliver, for whatever reason, misoprostol is a key intervention to prevent excessive bleeding and potential bleeding-related maternal death.

Therefore, these results strongly support making misoprostol available at all government and private facilities where deliveries are conducted, as well as making misoprostol available to women directly in the event they cannot reach a facility to deliver. Given the positive findings of this evaluation, we recommend to policy makers and key stakeholders to begin planning for scale-up of misoprostol distribution at ANC nationwide in Zambia.

In conjunction with misoprostol distribution, education through ANC and community-level agents, such as SMAGs, is necessary to ensure continued emphasis on health facility delivery and correct use of misoprostol at home births if women are unable to reach facilities to deliver. Scale-up of the SMAG program to support facilities, especially in rural areas, will help bolster dissemination of safe delivery messages in these communities. Future SMAG orientations should include how to educate women about the importance of delivering in a health facility, the consequences of PPH, how to estimate postpartum blood loss, that misoprostol can prevent PPH, and that misoprostol is available at the nearest health facility.

Efforts to scale up distribution of misoprostol need to take into account the differences between districts in terms of geography and infrastructure. The variation seen between the two evaluation districts is illustrative of the diversity of Zambia and the unique challenges that each district faces. The large distances between women’s homes and facilities as well as poor roads in districts such as Kalomo can make it difficult for women to receive care and also pose challenges to providers and community groups in reaching these populations. In these settings, utilization of community-based agents, such as SMAGs, may be even more essential to educating women and communities.

We strongly recommend that misoprostol be made available both at the community level for women who cannot reach facilities to deliver and at facilities as an additional uterotonic option when oxytocin and other uterotonic drugs are not consistently available. Scale-up of access to misoprostol at ANC can make a large contribution to increasing the number of women who receive a uterotonic at home or facility deliveries, and thereby can reduce the burden of PPH and unnecessary bleeding-related maternal mortality in Zambia for years to come.
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Appendix
Evaluation Facility Selection and Sampling Design

In order to obtain 98% power for inference across intervention status, a sample size of 1,780 respondents (890 in intervention areas and 890 in control areas) was required. Using MOH, Zambia demographic data from these catchment areas, the number of potential respondents available (women who had experienced a delivery between January 2009 and March 2010) was estimated in each catchment population. This was well within the estimated number of expected deliveries in both Petauke and Kalomo districts (see Table 1).

Like the facilities participating in the intervention phase of the pilot project, the control health facilities for the evaluation were not randomly selected. Each was recommended by District Maternal and Child Health Coordinators as being similar to one of the four pilot facilities in terms of geography, demographics, and facility size and type. Concerns about patient crossover from control to intervention clinics ruled out facilities within 10 kilometers of a participating clinic. Table 19 lists the facilities included in the evaluation.

Table 19: Health centers included in the evaluation by district

<table>
<thead>
<tr>
<th>Study Area</th>
<th>District</th>
<th>Health Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Petauke</td>
<td>Kakwiya, Matambazi, Mwajawanthu, Ukwimi B</td>
</tr>
<tr>
<td>Control</td>
<td>Petauke</td>
<td>Chataika, Chipungu, Manyane, Ukwimi A</td>
</tr>
<tr>
<td>Intervention</td>
<td>Kalomo</td>
<td>Chilala, Naluja, Mapatizya</td>
</tr>
<tr>
<td>Control</td>
<td>Kalomo</td>
<td>Siamafumba, Siachitema, Kanchele</td>
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</tbody>
</table>

Health center catchment areas are further divided into geographically distinct neighborhood health committee areas (NHCs). Each NHC includes a handful of distinct settlements or small villages scattered through the landscape. The boundaries of both catchment areas and NHCs are understood approximately and conventionally, as opposed to being formally determined by land survey. Maps of catchment areas used by health facility staff are hand-drawn, showing villages, clinics and landmarks such as roads, rivers and bridges. However, each village is officially assigned to a catchment area (that of the nearest health facility) and to an NHC. Therefore, the catchment area population is uniquely partitioned for our purposes, even though land demarcation is somewhat informal.

Sampling in both intervention and control areas took advantage of the NHC substructure within catchment areas in the following ways. First, health facility personnel determined the population of each NHC and of the catchment area as a whole. Survey teams then computed a target number of respondents for each NHC proportional to that NHC’s contribution to the total population. This approach ensured that our sample was geographically representative of the catchment area as a whole.
The help of local residents with knowledge of births in their areas was necessary because reliable vital registration of births and maternal deaths is often unavailable for rural populations. In view of this, survey teams employed SMAGs (in intervention areas) and traditional birth attendants (TBAs) (in control areas) as guides to identify and locate the target number of recently-delivered mothers in each NHC, as well as all known recent maternal deaths. As many local guides as possible were employed in each catchment area in order to minimize the possibility of excluding any delivery from the sampling frame (60 to 80 TBAs/Community Health Workers/SMAGs were used in each district). This method, known as referral sampling, can be thought of as sampling from the combined social networks of all local informants.

Training and Implementation

Training for the interviewers consisted of background to the project, instruction in sampling methodology, and an exhaustive review of the survey tools in both English and the most commonly spoken language in the district (Nyanja in Petauke and Tonga in Kalomo).

Following the training, each survey team (one supervisor and five to seven interviewers) was transported to its assigned health center for a four- to six-day period of data collection. As survey teams finished data collection in one catchment area, they were redeployed until all catchment areas had been covered. Each survey team was provided with three bicycles in order to cover the long distances between health facilities and distant NHCs. The VSI Evaluation Team was in daily phone contact with each Field Supervisor, and conducted at least one monitoring visit to each survey team to check the survey protocol and provide other assistance as needed. Monitoring visits were also used to help survey teams reach the most distant NHCs with the help of a vehicle.