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Saving Mothers, Giving Life

A Systems Approach to Reducing Maternal and Perinatal Deaths in Uganda and Zambia

Guest Editors: Marge Koblinsky, PhD; Claudia Morrissey Conlon, MD, MPH; Florina Serbanescu, MD, MPH



AMERICAN COLLEGE OF
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Cover caption: A mother waits with her daughter at the Saving Mothers, Giving Life-supported Lundazi Urban Health Centre, Zambia. © 2017 Amy Fowler/USAID.

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Lois Quam, Angeli Achrekar, Robert Clay

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SYNTHESIS

Saving Mothers, Giving Life: It Takes a System to Save a Mother

A multi-partner effort in Uganda and Zambia employed a districtwide health systems strengthening approach, with supply- and demand-side interventions, to address timely use of appropriate, quality maternity care. Between 2012 and 2016, maternal mortality declined by approximately 40% in both partnership-supported facilities and districts in each country. This experience has useful lessons for other low-resource settings.

Claudia Morrissey Conlon, Florina Serbanescu, Lawrence Marum, Jessica Healey, Jonathan LaBrecque, Reeti Hobson, Marta Levitt, Adeodata Kekitiinwa, Brenda Picho, Fatma Soud, Lauren Spigel, Mona Steffen, Jorge Velasco, Robert Cohen, William Weiss, on behalf of the Saving Mothers, Giving Life Working Group

Glob Health Sci Pract. 2019;7(suppl 1):S6–S26
<https://doi.org/10.9745/GHSP-D-18-00427>

ORIGINAL ARTICLES**Impact of the Saving Mothers, Giving Life Approach on Decreasing Maternal and Perinatal Deaths in Uganda and Zambia**

Through district system strengthening, integrated services, and community engagement interventions, the Saving Mothers, Giving Life initiative increased emergency obstetric care coverage and access to, and demand for, improved quality of care that led to rapid declines in district maternal and perinatal mortality. Significant reductions in intrapartum stillbirth rate and maternal mortality ratios around the time of birth attest to the success of the initiative.

Florina Serbanescu, Thomas A. Clark, Mary M. Goodwin, Lisa J. Nelson, Mary Adetinuke Boyd, Adeodata R. Kekitiinwa, Frank Kaharuza, Brenda Picho, Diane Morof, Curtis Blanton, Maybin Mumba, Patrick Komakech, Fernando Carlosama, Michelle M. Schmitz, Claudia Morrissey Conlon, on behalf of the Saving Mothers, Giving Life Working Group

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Addressing the First Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Approaches and Results for Increasing Demand for Facility Delivery Services

The Saving Mothers, Giving Life initiative used 3 coordinated approaches to reduce maternal deaths resulting from a delay in deciding to seek health care, known as the “first delay”: (1) promoting safe motherhood messages and facility delivery using radio, theater, and community engagement; (2) encouraging birth preparedness and increasing demand for facility delivery through community outreach worker visits; and (3) providing clean delivery kits and transportation vouchers to reduce financial barriers for facility delivery. These approaches can be adapted in other low-resource settings to reduce maternal and perinatal mortality.

Florina Serbanescu, Mary M. Goodwin, Susanna Binzen, Diane Morof, Alice R. Asiimwe, Laura Kelly, Christina Wakefield, Brenda Picho, Jessica Healey, Agnes Nalutaaya, Leoda Hamomba, Vincent Kamara, Gregory Opio, Frank Kaharuza, Curtis Blanton, Fredrick Luwaga, Mona Steffen, Claudia Morrissey Conlon, on behalf of the Saving Mothers, Giving Life Working Group

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Addressing the Second Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Reaching Appropriate Maternal Care in a Timely Manner

The Saving Mothers, Giving Life initiative employed 2 key strategies to improve the ability of pregnant women to reach maternal care: (1) increase the number of emergency obstetric and newborn care facilities, including upgrading existing health facilities, and (2) improve accessibility to such facilities by renovating and constructing maternity waiting homes, improving communication and transportation systems, and supporting community-based savings groups. These interventions can be adapted in low-resource settings to improve access to maternity care services.

Thandiwe Ngoma, Alice R. Asiimwe, Joseph Mukasa, Susanna Binzen, Florina Serbanescu, Elizabeth G. Henry, Davidson H. Hamer, Jody R. Lori, Michelle M. Schmitz, Lawrence Marum, Brenda Picho, Anne Naggayi, Gertrude Musonda, Claudia Morrissey Conlon, Patrick Komakech, Vincent Kamara, Nancy A. Scott, on behalf of the Saving Mothers, Giving Life Working Group

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Diane Morof, Florina Serbanescu, Mary M. Goodwin, Davidson H. Hamer, Alice R. Asiimwe, Leoda Hamomba, Masuka Musumali, Susanna Binzen, Adeodata Kekitiinwa, Brenda Picho, Frank Kaharuza, Phoebe Monalisa Namukanja, Dan Murokora, Vincent Kamara, Michelle Dynes, Curtis Blanton, Agnes Nalutaaya, Fredrick Luwaga, Michelle M. Schmitz, Jonathan LaBrecque, Claudia Morrissey Conlon, Brian McCarthy, Charlan Kroelinger, Thomas Clark, on behalf of the Saving Mothers, Giving Life Working Group

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<https://doi.org/10.9745/GHSP-D-18-00272>

The Costs and Cost-Effectiveness of a District-Strengthening Strategy to Mitigate the 3 Delays to Quality Maternal Health Care: Results From Uganda and Zambia

A comprehensive district-strengthening approach to address maternal and newborn health was estimated to cost US\$177 per life-year gained in Uganda and \$206 per life-year gained in Zambia. The approach represents a very cost-effective health investment compared to GDP per capita.

Benjamin Johns, Peter Hangoma, Lynn Atuyambe, Sophie Faye, Mark Tumwine, Collen Zulu, Marta Levitt, Tannia Tembo, Jessica Healey, Rui Li, Christine Mugasha, Florina Serbanescu, Claudia Morrissey Conlon, on behalf of the Saving Mothers, Giving Life Working Group

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Saving Lives Together: A Qualitative Evaluation of the Saving Mothers, Giving Life Public-Private Partnership

Overall, the Saving Mothers, Giving Life partnership was praised as a successful model for interagency coordination. Key strengths included diversity in partner expertise, high-quality monitoring and evaluation, strong leadership, and country ownership. Uncertainty about partner roles and responsibilities, perceived power inequities between partners, bureaucratic processes, and limited Ministry of Health representation in the governance structure were some challenges that, if addressed by similar public-private partnerships under development, may improve long-term partnership success.

Anne Palaia, Lauren Spigel, Marc Cunningham, Ann Yang, Taylor Hooks, Susan Ross, on behalf of the Saving Mothers, Giving Life Working Group

Glob Health Sci Pract. 2019;7(suppl 1):S123–S138
<https://doi.org/10.9745/GHSP-D-18-00264>

Community Perspectives of a 3-Delays Model Intervention: A Qualitative Evaluation of Saving Mothers, Giving Life in Zambia

While the Saving Mothers, Giving Life's health systems strengthening approach reduced maternal mortality, respondents still reported significant barriers accessing maternal health services. More research is needed to understand the necessary intervention package to affect system-wide change.

Alice Ngoma-Hazemba, Leoda Hamomba, Adam Silumbwe, Margarate Nzala Munakampe, Fatma Soud, on behalf of the Saving Mothers, Giving Life Working Group

Glob Health Sci Pract. 2019;7(suppl 1):S139–S150
<https://doi.org/10.9745/GHSP-D-18-00287>

Did Saving Mothers, Giving Life Expand Timely Access to Lifesaving Care in Uganda? A Spatial District-Level Analysis of Travel Time to Emergency Obstetric and Newborn Care

A spatial analysis of facility accessibility, taking into account road networks and environmental constraints on travel, suggests that the Saving Mothers, Giving Life (SMGL) initiative increased access to emergency obstetric and neonatal care in SMGL-supported districts in Uganda. Spatial travel-time analyses can inform policy and program efforts targeting underserved populations in conjunction with the geographic distribution of maternity services.

Michelle M. Schmitz, Florina Serbanescu, Vincent Kamara, Joan Marie Kraft, Marc Cunningham, Gregory Opio, Patrick Komakech, Claudia Morrissey Conlon, Mary M. Goodwin, on behalf of the Saving Mothers, Giving Life Working Group

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<https://doi.org/10.9745/GHSP-D-18-00366>

Saving Mothers, Giving Life Approach for Strengthening Health Systems to Reduce Maternal and Newborn Deaths in 7 Scale-up Districts in Northern Uganda

Saving Mothers, Giving Life (SMGL) strengthened the health system in 7 districts in Northern Uganda through a quality improvement approach. Quality improvement teams removed barriers to delivering maternal and newborn health services and improved emergency care, reducing preventable maternal and newborn deaths in a post-conflict, low-resource setting.

Simon Sensalire, Paul Isabirye, Esther Karamagi, John Byabagambi, Mirwais Rahimzai, Jacqueline Calnan, on behalf of the Saving Mothers, Giving Life Working Group

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Sustainability and Scale of the Saving Mothers, Giving Life Approach in Uganda and Zambia

The Saving Mothers, Giving Life district health systems strengthening approach provides a sustainable model for reducing maternal mortality at scale. Lessons from the learning districts demonstrated increased efficiency in allocation of resources for maternal and newborn health, better use of strategic information, improved management capacities, and increased community engagement.

Jessica Healey, Claudia Morrissey Conlon, Kennedy Malama, Reeti Hobson, Frank Kaharuza, Adeodata Kekitiinwa, Marta Levitt, Zulu Davy Wadula, Lawrence Marum, on behalf of the Saving Mothers, Giving Life Working Group

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Saving Mothers, Giving Life: A Systems Approach to Reducing Maternal and Perinatal Deaths in Uganda and Zambia

Lois Quam,^a Angeli Achrekar,^b Robert Clay^c

The 5-year public-private partnership boldly addressed maternal mortality in Uganda and Zambia using a systems approach at the district level to avoid delays in women seeking, reaching, and receiving timely, quality services. This supplement provides details on the Saving Mothers, Giving Life partnership and approach, including the model, impact, costs, and sustainability.

■ WHAT CHALLENGE DID WE FACE?

Despite all the gains of the last 30 years in global health and development, maternal mortality is often regarded as an intractable problem. Complications during pregnancy, childbirth, or in the 42 days after birth were the leading causes of death among women of reproductive age when Saving Mothers, Giving Life was initiated and remain so today Saving Mothers, Giving Life initiative and remain so today.¹ At the outset of Saving Mothers, nearly 30 women died every hour, 800 women died each day, and an estimated 287,000 women died each year due to pregnancy- and childbirth-related causes.¹ An additional 15–20 million women suffered debilitating infections and disabilities annually because of pregnancy.¹ Co-infection with HIV was increasingly one of the most common causes of pregnancy-associated deaths in Africa (ranging from 15% to 40%).¹ Yet mothers were dying for reasons that were well understood and almost always preventable, even in the poorest countries. Interventions to lower maternal mortality often focused on a single cause, delivered in a fragmented manner, or unsupported by evidence. Moreover, interventions utilized a facility-based approach alone where infrastructure was weak or not available. Despite having global champions for child survival, HIV/AIDS, malaria, and other health and development issues, maternal mortality had not risen to become an equal political priority.

■ WHAT WAS ATTEMPTED?

On June 1, 2012, the Saving Mothers, Giving Life initiative was launched. It was a concerted response by the U.S. Government through President Barack Obama's Global Health Initiative, with its focus on women and girls and integrated responses to global health challenges. Secretary Hillary Clinton emphasized these aims by focusing on accelerating the reduction of maternal mortality in countries where the United States had a significant global health investment and presence. Saving Mothers, Giving Life was a public-private partnership that engaged the entirety of the U.S. Government—particularly the U.S. Department of State and its Office of the U.S. Global AIDS Coordinator and Health Diplomacy, the United States Agency for International Development, and the U.S. Centers for Disease Control and Prevention. SMGL leveraged the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and maternal and child health platforms, expertise, partners, and infrastructure for maximizing efficiency and impact. In addition to the U.S. Government, the founding partners included the Government of Norway, Merck, the American College of Obstetricians and Gynecologists, Project C.U.R.E., and Every Mother Counts. The Governments of Uganda and Zambia, and later, Nigeria, were also central members of the partnership at the country level.

Saving Mothers, Giving Life was a bold attempt to show that maternal mortality could be reduced significantly in developing countries. It was inspired by the progress seen by other high-level initiatives (e.g., PEPFAR, the President's Malaria Initiative, Feed the Future) that modeled how high-level political leadership, focused attention, evidence-based interventions, clear outcome data, a broad coalition, and strong monitoring and evaluation could achieve impressive results in a short time.

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The initial goal of Saving Mothers, Giving Life was to support countries to reduce maternal deaths by up to 50% in targeted districts in Uganda and Zambia—particularly during the critical window during labor, delivery, and the first 24–48 hours postpartum when an estimated 2 of every 3 maternal deaths and 45% of newborn deaths occur.¹ An audacious goal, rather than an incremental goal, was established to engender new collaborative efforts between U.S. government agencies and the partnership.

To reach these goals, the Saving Mothers, Giving Life model employed a systems approach focused at the health district level to ensure that every pregnant woman had access to clean and safe normal delivery services and, in the event of an obstetric complication, lifesaving emergency care within 2 hours. The model served to strengthen the existing public and private health networks within each district to address the “Three Delays”: delay in seeking appropriate services, delay in reaching services, and delay in receiving timely, quality care at the facility. The Saving Mothers, Giving Life approach also integrated maternal and newborn health services with HIV services (e.g., HIV counseling and testing and prevention of mother-to-child transmission services).

The global partnership sought to leverage strengths, experience, methodologies, and resources of each partner in pursuit of the Saving Mothers, Giving Life goal. The effort used an integrated approach recognizing that a health care delivery system needed to function well in real time in order to prevent maternal death. The integrated systems approach focused on the following interventions: (1) skilled attendance at birth; (2) safe facilities and hospitals for delivery; (3) supplies and provision of basic and emergency obstetric services; (4) systems for communication, referral, and transportation available 24 hours a day, 7 days a week; and (5) quality data, surveillance, and response. Over the course of the 5-year partnership, the founding partners pledged more than US\$200 million in financial and in-kind resources to support the implementation of Saving Mothers, Giving Life.

■ WHAT WAS ACCOMPLISHED?

The results shared in this Saving Mothers, Giving Life journal supplement show that the initiative achieved tremendous impact in Uganda and Zambia. The initiative’s data-

driven approach clearly resulted in improved health outcomes, including declines in maternal mortality by 44% in target facilities in Uganda and 38% in target facilities in Zambia.² In addition, Uganda and Zambia both saw significant reductions in mothers dying across target districts: 44% in Uganda and 41% in Zambia.² This means Saving Mothers, Giving Life did not just reach women who made it to the facility but also improved the health of mothers across the community. Further results of Saving Mothers, Giving Life include:

- Increasing the number of women delivering in health facilities in Zambia by 44% and decreasing total stillbirths in the facility by 36%.
- Increasing the number of women who are treated to prevent mother-to-child transmission by 71% in target districts in Uganda.
- Expanding home visiting programs to reach more women and newborns during the critical first few days of life and broadening training and mentoring programs on sick newborn care to ensure all providers are equipped to save lives.²

In addition, Saving Mothers, Giving Life offers lessons on U.S. Government interagency models and the dynamics of a public-private partnership. Most significantly, the effort relied on the dedication, expertise, and entrepreneurship of Uganda and Zambia government medical and local civic leaders accompanied by equally dedicated and talented U.S. government teams with support from the U.S. ambassadors to Uganda and Zambia. Considerable problem solving, resource gathering, and resilience in the face of unexpected administrative and logistical challenges were required.

The 11 articles presented in this supplement provide extensive detail on the model, data, impact, costs, innovations, and sustainability of the Saving Mothers, Giving Life partnership and approach:

- **Article 1:** Saving Mothers, Giving Life: It Takes a System to Save a Mother.³
- **Article 2:** Impact of the Saving Mothers, Giving Life Approach on Decreasing Maternal and Perinatal Deaths in Uganda and Zambia.⁴
- **Article 3:** Addressing the First Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Approaches and Results for Increasing Demand for Facility Delivery Services.⁵

- **Article 4:** Addressing the Second Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Reaching Appropriate Maternal Care in a Timely Manner.⁶
- **Article 5:** Addressing the Third Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Ensuring Adequate and Appropriate Facility-Based Maternal and Perinatal Health Care.⁷
- **Article 6:** The Costs and Cost-Effectiveness of a District Strengthening Strategy to Mitigate the 3 Delays to Quality Maternal Health Care: Results From Uganda and Zambia.⁸
- **Article 7:** Saving Lives Together: A Qualitative Evaluation of the Saving Mothers, Giving Life Public-Private Partnership.⁹
- **Article 8:** Community Perceptions of a 3-Delays Model Intervention: A Qualitative Evaluation of Saving Mothers, Giving Life in Zambia.¹⁰
- **Article 9:** Did Saving Mothers, Giving Life Expand Timely Access to Lifesaving Care in Uganda? A Spatial District-Level Analysis of Travel Time to Emergency Obstetric and Newborn Care.¹¹
- **Article 10:** Saving Mothers, Giving Life Approach for Strengthening Health Systems to Reduce Maternal and Newborn Deaths in 7 Scale-up Districts in Northern Uganda.¹²
- **Article 11:** Sustainability and Scale of the Saving Mothers, Giving Life Approach in Uganda and Zambia.¹³

■ CONCLUSION

In conclusion, the Saving Mothers, Giving Life partnership and approach resulted in a focused, systematic, district-level program driven by data and results-orientation for reducing maternal mortality. The approach and subsequent impacts underscore the importance of investing in health systems to not only sustainably save mothers and newborns but also make systems more resilient so they can address other emerging health issues requiring an integrated approach, such as cardiovascular disease, diabetes, and motor vehicle crashes.

Although the 5-year partnership is coming to an end, key elements of the effort are still being sustained in country programming. As we look into the future, the journey remains long. We must sustain the momentum and work together as a global community to maintain the focus on reducing maternal mortality in a data-driven and

focused manner. As the African proverb states, “If you want to go fast, go alone. If you want to go far, go with others.” The long list of those involved in the Saving Mothers, Giving Life Working Group, in the acknowledgments below, confirms that the initiative’s goal was to mobilize many to go far. Ending preventable maternal and newborn deaths will require that we continue on this journey together until these tragic deaths are history.

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SYNTHESIS

Saving Mothers, Giving Life: It Takes a System to Save a Mother

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A multi-partner effort in Uganda and Zambia employed a districtwide health systems strengthening approach, with supply- and demand-side interventions, to address timely use of appropriate, quality maternity care. Between 2012 and 2016, maternal mortality declined by approximately 40% in both partnership-supported facilities and districts in each country. This experience has useful lessons for other low-resource settings.

■ ABSTRACT

Background: Ending preventable maternal and newborn deaths remains a global health imperative under United Nations Sustainable Development Goal targets 3.1 and 3.2. Saving Mothers, Giving Life (SMGL) was designed in 2011 within the Global Health Initiative as a public-private partnership between the U.S. government, Merck for Mothers, Every Mother Counts, the American College of Obstetricians and Gynecologists, the government of Norway, and Project C.U.R.E. SMGL's initial aim was to dramatically reduce maternal mortality in low-resource, high-burden sub-Saharan African countries. SMGL used a district health systems strengthening approach combining both supply- and demand-side interventions to address the 3 key delays to accessing effective maternity care in a timely manner: delays in seeking, reaching, and receiving quality obstetric services.

Implementation: The SMGL approach was piloted from June 2012 to December 2013 in 8 rural districts (4 each) in Uganda and Zambia with high levels of maternal deaths. Over the next 4 years, SMGL expanded to a total of 13 districts in Uganda and 18 in Zambia. SMGL built on existing host government and private maternal and child health platforms, and was aligned with and guided by Ugandan and Zambian maternal and newborn health policies and programs. A 35% reduction in the maternal mortality ratio (MMR) was achieved in SMGL-designated facilities in both countries during the first 12 months of implementation.

Results: Maternal health outcomes achieved after 5 years of implementation in the SMGL-designated pilot districts were substantial: a 44% reduction in both facility and districtwide MMR in Uganda, and a 38% decrease in facility and a 41% decline in districtwide MMR in Zambia. Facility deliveries increased by 47% (from 46% to 67%) in Uganda and by 44% (from 62% to 90%) in Zambia. Cesarean delivery rates also increased: by 71% in Uganda (from 5.3% to 9.0%) and by 79% in Zambia (from 2.7% to 4.8%). The average annual rate of reduction for maternal deaths in the SMGL-supported districts exceeded that found countrywide: 11.5% versus 3.5% in Uganda and 10.5% versus 2.8% in Zambia. The changes in stillbirth rates were significant (–13% in Uganda and –36% in Zambia) but those for pre-discharge neonatal mortality rates were not significant in either Uganda or Zambia.

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Conclusion: A district health systems strengthening approach to addressing the 3 delays to accessing timely, appropriate, high-quality care for pregnant women can save women's lives from preventable causes and reduce stillbirths. The approach appears not to significantly impact pre-discharge neonatal mortality.

■ INTRODUCTION

Despite a 45% drop in global maternal deaths between 1990 and 2015,¹ maternal mortality remains an intractable public health problem in many low-resource settings. Only 1 sub-Saharan African country, Rwanda, achieved the target for Millennium Development Goal 5 (reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio).^{1,2} Attempts have been made to bring high-level

visibility to the cause, but many countries have not directed sustained political attention or sufficient resources to eliminate preventable maternal mortality³—despite solid evidence of the profound effects a mother's death has on her family, her community, and on development in general.^{4,5} The situation is particularly dire in sub-Saharan African countries where 60% of global maternal deaths occur.^{1,5,6} In these countries, obstetrical risk is compounded by high fertility rates, raising the lifetime risk of death due to childbirth to 1 in 36, compared with 1 in 8,400 in the European Union.^{7–9}

Newborns fare no better. Globally, the reduction in newborn deaths has not kept pace with the reduction of deaths in children under age 5, with newborn deaths now contributing to nearly half of child mortality.¹ The average neonatal mortality rate is 27 deaths per 1,000 live births in low-income countries compared with 3 deaths per 1,000 live births in high-income countries. Eight of the 10 most dangerous places to be born are in sub-Saharan Africa.¹⁰

In 2011 the Office of the Global Health Initiative (GHI) within the U.S. Department of State was tasked with designing an endeavor that would bring public and private investment together with committed Ministry of Health (MOH), national, and district leaders to address maternal mortality in sub-Saharan Africa.^{11,12} It was felt that a highly visible, well-financed, bold initiative similar to the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), the President's Malaria Initiative, and Feed the Future was needed to inspire and recruit new public and private actors to the cause, while energizing and mobilizing the global health and development communities. The resulting initiative was Saving Mothers, Giving Life (SMGL), a public-private partnership. SMGL was composed of 6 U.S. agencies: GHI; the United States Agency for International Development (USAID) (which took over oversight of the partnership from GHI in July 2012 and responsibility as Secretariat from Merck for Mothers in 2014); the U.S. Centers for Disease Control and Prevention (CDC); the Office of the Global AIDS Coordinator (OGAC); Peace Corps; and the Department of Defense. It also included the Governments of Norway (became inactive in 2014), Uganda, Zambia, and Nigeria (joining in 2015 as the third SMGL country and slated to end in October 2019); Merck for Mothers; Every Mother Counts; the American College of Obstetricians and Gynecologists; and Project C.U.R.E (joined the

partnership in 2013). SMGL's initial goal was to decrease maternal mortality by 50% in 1 year in SMGL-designated districts in Uganda and Zambia, building on existing national public health platforms and systems, and aligning with country maternal health strategies and aspirations.^{13,14} At the end of the first phase of the partnership, the time frame for the goal was extended to the close of the initiative in 2017. An additional goal of reducing the neonatal mortality rate by 30% was added in 2013.

The Saving Mothers, Giving Life journal supplement consists of 11 articles on the SMGL initiative. The articles describe the formation and function of the partnership, the SMGL theory of change, programming approach and costs, and the results achieved in Uganda and Zambia where implementation ended in October 2017 (Table 1). It aims to answer key questions about the initiative and identify outstanding implementation issues. Results from Nigeria will be reported in 2019 after implementation in that country has ended.

SMGL's initial goal was to decrease maternal mortality by 50% in 1 year in selected districts in Uganda and Zambia.

■ THEORY OF CHANGE

The SMGL theory of change model was built on a district health systems strengthening approach. It was designed to surmount the critical demand-and supply-side delays that prevent women and newborns from receiving lifesaving care in a timely manner, while strengthening the capacity and resilience of the health care system (Figure 1).¹⁵

The SMGL theory of change was built on a district health systems strengthening approach.

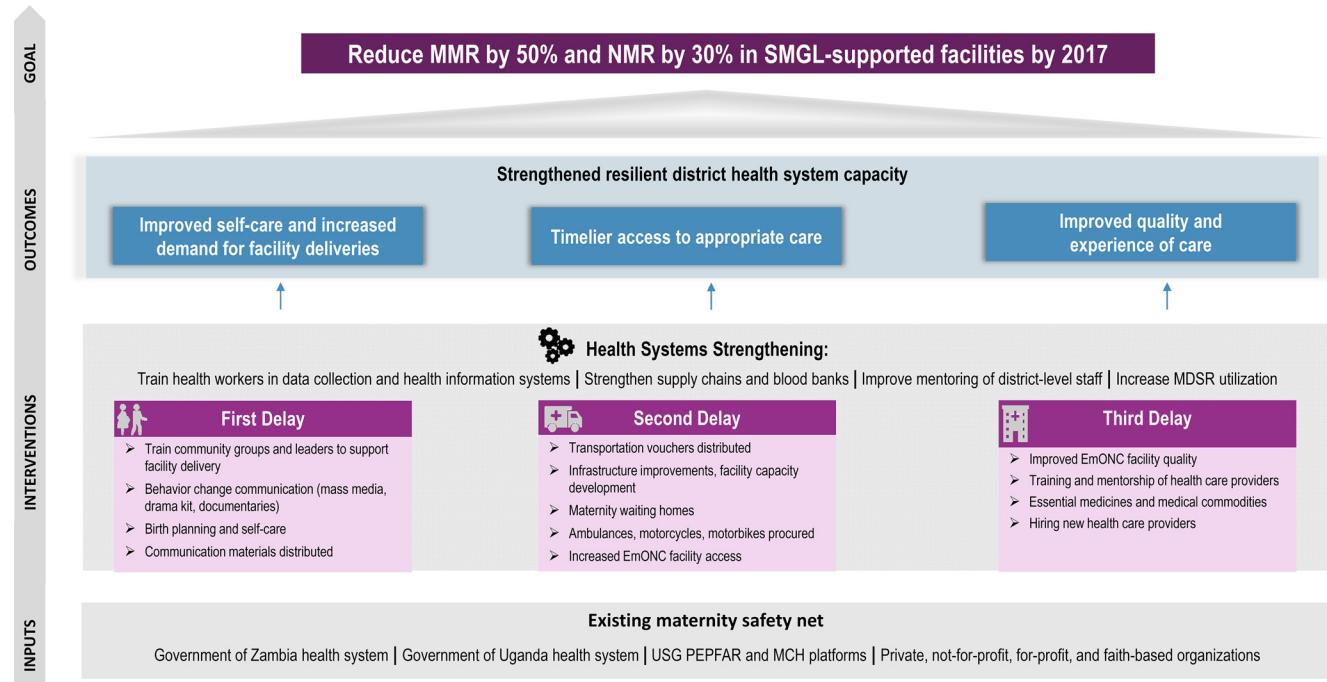
The governments of Uganda and Zambia, their public health systems, the PEPFAR- and USAID-supported maternal and child health platforms, and private for-profit and nonprofit providers were critical inputs and served as the foundation for SMGL's contributions to the district maternity care system. Evidence-based interventions were designed to address all key delays, be context-specific, and strengthen the capacity of the district health system. Four outcomes were anticipated: (1) increased use of services and improved self-care, (2) timelier access to appropriate care, (3) improved quality and experience of care, and (4) a more robust and resilient district health system. It was hypothesized that if these 4 outcomes were achieved together, SMGL-designated populations would see a substantial decrease in maternal and perinatal mortality.

Implementation of the SMGL theory of change followed 7 organizing principles:

TABLE 1. Saving Mothers, Giving Life Supplement Articles

Article No.	Article Title
1	Saving Mothers, Giving Life: it takes a system to save a mother
2	Impact of the Saving Mothers, Giving Life approach on decreasing maternal and perinatal deaths in Uganda and Zambia
3	Addressing the first delay in Saving Mothers, Giving Life districts in Uganda and Zambia: approaches and results for increasing demand for facility delivery services
4	Addressing the second delay in Saving Mothers, Giving Life districts in Uganda and Zambia: reaching appropriate maternal care in a timely manner
5	Addressing the third delay in Saving Mothers, Giving Life districts in Uganda and Zambia: ensuring adequate and appropriate facility-based maternal and perinatal health care
6	The costs and cost-effectiveness of a district-strengthening strategy to mitigate the 3 delays to quality maternal health care: results from Uganda and Zambia
7	Saving lives together: a qualitative evaluation of the Saving Mothers, Giving Life public-private partnership
8	Community perceptions of a 3-delays model intervention: a qualitative evaluation of Saving Mothers, Giving Life in Zambia
9	Did the Saving Mothers, Giving Life initiative expand timely access to lifesaving care in Uganda? A spatial district-level analysis of travel time to emergency obstetric and newborn care
10	Saving Mothers, Giving Life approach for strengthening health systems to reduce maternal and newborn deaths in 7 scale-up districts in northern Uganda
11	Sustainability and scale of the Saving Mothers, Giving Life approach in Uganda and Zambia

1. Reap system-level synergies by addressing all 3 delays to obtaining lifesaving maternal and newborn care concurrently: delays in seeking appropriate care, delays in reaching services in a timely manner, and delays in receiving quality care at a health facility with the capacity to perform 9 signal emergency obstetric and newborn care (EmONC) functions.¹⁶⁻²²
2. Recognize the district health system, which extends from community health workers to district hospitals (and to higher levels of care through referrals), as the primary unit for strengthening capacity.²³⁻²⁵ Potential interventions should be assessed in terms of their contributions to improving the functioning of the entire district-level system.
3. Apply a “whole market approach,” which requires identifying and including both public and private inputs (e.g., providers, delivery systems, stakeholders) in planning, execution, and evaluation in a designated district. Together they form the district maternity safety net.
4. Focus on improving services during the most vulnerable period for mothers and newborns—labor, delivery, and early postpartum. Interventions at this time have the possibility of saving the lives of mothers and newborns and preventing fresh stillbirths. The level of fresh stillbirths is often seen as an indicator of the quality of care during labor and delivery.
5. Strengthen the capacity of the health care system to provide comprehensive emergency obstetric and newborn care (CEmONC) within 2 hours of travel time from home or a delivery site for all pregnant women, approximately 15% of whom will experience a life-threatening complication, many without clear predictors.^{26,27}
6. Integrate maternal and newborn health (MNH) services with other reproductive health services, including (1) HIV counseling and testing services to maximize identification and treatment of seropositive pregnant women and prevent mother-to-child transmission, and (2) postpartum family planning for women wishing to delay their next pregnancy.
7. Count, analyze, and report all maternal and perinatal deaths along with the cause of

FIGURE 1. Saving Mothers, Giving Life Theory of Change Model

Abbreviations: EmONC, emergency obstetric and newborn care; MCH, maternal and child health; MPDSR, maternal and perinatal death surveillance and response; MMR, maternal mortality ratio; NMR, neonatal mortality rate; PEPFAR, U.S. President's Emergency Plan for AIDS Relief; SMGL, Saving Mothers, Giving Life; USG, U.S. Government.

Source: Adapted from Saving Mothers, Giving Life.⁵⁷

death; improve completion of facility records and registries; institutionalize maternal and perinatal death surveillance and response (MPDSR) in each district and foster high-level awareness of these reviews among traditional, religious, and political leadership to learn from each preventable death and promote necessary health system and cultural changes.

COUNTRY CONTEXT

In 2011, Uganda and Zambia were chosen as the first SMGL-supported countries based on (1) their interest to the Global Health Initiative; (2) high levels of maternal mortality—MMR of 420 in Uganda and 262 in Zambia in 2010¹; (3) solid MOH commitment to decreasing maternal and newborn mortality, as evidenced by their Roadmap to Accelerate Reduction of Maternal and Neonatal Mortality and Morbidity and

Campaign to Accelerate the Reduction of Maternal, Newborn, and Child Mortality in Africa plans; and (4) the existence of robust PEPFAR- and USAID-supported maternal and child health platforms.^{28–30} Direct causes of maternal deaths were similar in both countries, with postpartum hemorrhage being the leading cause followed by preeclampsia/eclampsia, sepsis, obstructed labor/ruptured uterus, and complications of unsafe abortions.¹ The most deadly indirect causes were malaria and HIV.^{29,31}

Inadequate skilled human resources for health were a major constraint to providing effective coverage in both countries.^{29,31} When SMGL began, the human resources vacancy rate at health facilities in SMGL-supported districts was 40% in both Uganda and Zambia.^{11,12,32–34} Uganda and Zambia also shared high HIV rates (7% and 12% among adults ages 15 to 49, respectively) and their total fertility rates were among the highest in the world (6.2 for both countries)

(Table 2). Less than half of births in Zambia, and 57% in Uganda, were attended by skilled birth attendants and the cesarean delivery rates were low at 5% in Uganda and 3% in Zambia. Neonatal mortality rates were 27 and 34 per 1,000 live births in Uganda and Zambia, respectively (Table 2).

■ PROJECT DESIGN, IMPLEMENTATION, AND ASSESSMENT

SMGL Learning Districts

Four districts each in Uganda and Zambia were selected for SMGL support by their MOH based on the large numbers of deliveries and maternal deaths, the availability of existing implementing partners working in the district, and national priorities. The 8 districts in total, designated as the SMGL learning districts, were mostly rural and poor.^{8,11,12,30,31} Figure 2 shows the learning districts and the scale-up districts. Over the life of the initiative, the 4 learning districts in each country were administratively split further to total 6 learning districts in each country.

In Zambia, the 4 initial learning districts were spread across the country with 2 in Eastern Province (Nyimba and Lundazi), 1 in Southern

Province (Kalomo), and 1 in Luapula Province (Mansa). The 4-district population was 880,000 with 46,157 deliveries in 2011. Throughout the initiative, 110 health facilities were engaged, 94% public and 6% private, including 16 health posts, 88 health centers, and 6 hospitals.^{11,35} Uganda's SMGL-supported districts (Kyenjojo, Kamwenge, Kabarole, and Kibaale, aka “the 4Ks”) were contiguous and located in Western Uganda. The population in the 4Ks was 1.75 million with 78,400 deliveries in 2011. Throughout the initiative, 105 delivering facilities, 61% public and 39% private (18 health centers II, 70 health centers III, 11 health centers IV, and 6 hospitals), were supported by SMGL.^{12,36}

SMGL Phases

The SMGL initiative was divided into 3 phases: Phase 0—design and startup (June 2011 to May 2012), Phase 1—proof of concept (June 2012 to December 2013), and Phase 2—scale-up and scale-out (January 2014 to October 2017).

Phase 0: Design and Startup

Initiative design. Design of the SMGL district health systems strengthening approach began in mid-2011 under the aegis of the Global Health

TABLE 2. Uganda and Zambia National-Level Indicators at the Start of the SMGL Initiative

Indicator	Uganda	Zambia
Maternal mortality ratio (per 100,000 live births)	420 ^a	262 ^a
Deliveries in facilities	57% ^b	48% ^c
Births by cesarean delivery	5% ^b	3% ^c
Birth attended by skilled birth attendant	57% ^b	47% ^c
Antenatal care coverage: at least 4 visits	48% ^b	60% ^c
HIV prevalence among adults 15–49	7% ^d	12% ^d
Pregnant women with HIV receiving antiretroviral therapy	61% ^d	93% ^d
Total fertility rate	6.2 ^b	6.2 ^c
Modern contraceptive prevalence rate among all women 15–49	21% ^b	25% ^c
Neonatal mortality rate (per 1,000 live births)	27 ^b	34 ^c

Abbreviation: SMGL, Saving Mothers, Giving Life.

^a 2010 data from *Trends in Maternal Mortality: 1990 to 2015. Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division* (<https://www.who.int/reproductivehealth/publications/monitoring/maternal-mortality-2015/en/>).

^b 2011 data from *Uganda Demographic and Health Survey 2011* (<https://dhsprogram.com/pubs/pdf/FR264/FR264.pdf>).

^c 2007 data from *Zambia Demographic and Health Survey 2007* (<https://dhsprogram.com/pubs/pdf/FR211/FR211/revised-05-12-2009.pdf>).

^d 2011 data from UNAIDS AIDSinfo (<http://aidsinfo.unaids.org/>).

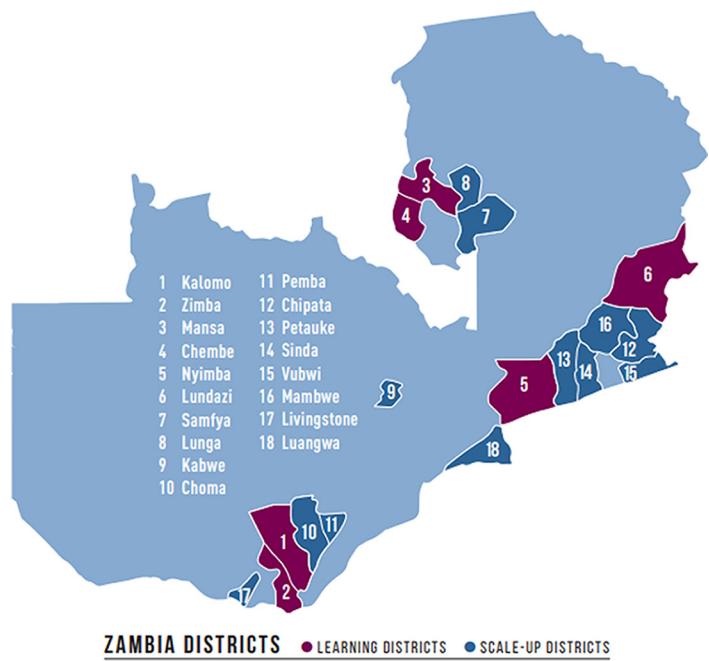
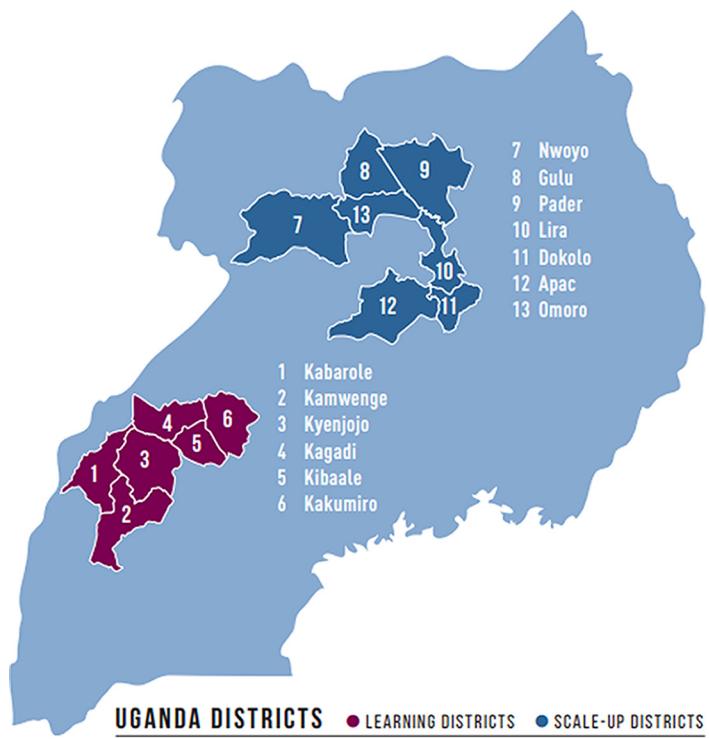
Initiative. The Global Health Initiative convened a design team of MNH and HIV technical experts in project development, implementation, costing, policy formulation, and monitoring and evaluation. The aim was to create a highly visible, bold initiative that would galvanize global action and financial support. A draft SMGL model was developed, guided by GHI principles and informed by extensive examination of the evidence base and modeling from the Lives Saved Tool (LiST). (Supplement 1) A goal was established to reduce maternal mortality in SMGL-supported facilities in Uganda and Zambia by 50% in 1 year and an implementation plan was formulated. A notable feature of the plan was that partner funding for SMGL implementation was only guaranteed for an initial 12-month period; if performance was deemed subpar, funding for SMGL could end.

After country and district selection, the U.S. ambassadors for Uganda and Zambia assigned coordination roles to U.S. agency heads (USAID mission director, CDC director, PEPFAR coordinator, Peace Corps lead, and Department of Defense liaison), and interagency working groups were formed. The working groups collaborated with national, provincial, and district MOH-designated SMGL leads (usually district health officers) and implementing partners, forming SMGL country teams. The country teams initially met weekly and then monthly to develop plans and leverage existing partner programs and capabilities. Country teams then created intensive 1-year workplans for the pilot districts in Uganda and Zambia based on addressing the 3 delays and strengthening the system.

The rapid design and execution of the initial SMGL 1-year plan required the participation of existing implementing partners working in SMGL-selected districts. Between Uganda and Zambia, 39 implementing partners were identified, most with set workplans and deliverables (Supplement 2). Under the leadership and supervision of MOH district health management teams and district health and medical officers, extant implementing partner workplans were adapted to support SMGL country and district plans.

Evaluation design. The ability to assess and report health outcomes resulting from SMGL efforts required robust evaluation. The headquarters monitoring and evaluation (M&E) committee, composed of specialists from CDC and USAID, developed an ambitious evaluation plan for Phase 1 that was endorsed by the ministries of health and implementing partner representatives in both countries.³⁷ The plan included ongoing

FIGURE 2. Saving Mothers, Giving Life-Designated Learning and Scale-Up Districts in Uganda and Zambia



Source: Adapted from Saving Mothers, Giving Life.⁵⁷

SMGL developed a robust evaluation plan that included ongoing enumeration of all maternal deaths with verbal autopsies to ascertain cause of death.

enumeration of all maternal deaths with verbal autopsies to ascertain cause of death. (See the article by Serbanescu and colleagues from the SMGL supplement.³⁸)

Thirty-one indicators were selected for monitoring care at all delivering facilities through quarterly record and registry reviews in SMGL-supported districts in Uganda and Zambia (**Supplement 3**). In Uganda, these data were collected through Pregnancy Outcomes Monitoring Studies; data were also gathered and displayed monthly at selected SMGL facilities in Uganda using a simple matrix referred to as “BABIES” (Birthweight by Age-at-Death Boxes for Intervention and Evaluation System), which provided short-loop feedback to improve newborn care. Formative special studies³⁷ included a qualitative study of women’s and communities’ perceptions of childbirth in Zambia and a 2-hour travel-time mapping study in Uganda.³⁹ (See the article by Schmitz and colleagues from the SMGL supplement.⁴⁰)

Baseline assessment. During Phase 0, baseline studies were undertaken in the 8 learning districts. MMRs were measured through a census with verbal autopsies of deaths among women of reproductive age in Zambia and a Reproductive Age Mortality Survey (RAMOS) in Uganda. (RAMOS uses a variety of sources to identify all deaths of women of reproductive age and decide which of these are maternal- or pregnancy-related.) Health facility assessments (HFAs) of capacity and readiness of the system to provide 9 lifesaving signal functions were undertaken in all public and private delivering facilities in the SMGL-supported districts (**Table 3**). This enabled planners and implementers to take stock of the existing availability of basic and comprehensive

emergency obstetric and newborn care. HFAs were carried out at 3 time points during SMGL: (1) at baseline, to inform SMGL planning and design and to identify needed investments; (2) at the end of the pilot year in 2013 to gauge progress and inform funding and operational decisions during subsequent years; and (3) at endline in 2017 to assess outcomes.

Common gaps identified from the baseline HFA included the following:

- **Delay 1: Demand.** The number of Government-established community health workers, village health teams (VHTs) in Uganda and Safe Motherhood Action Groups (SMAGs) in Zambia, was inadequate. Women booked late for antenatal care visits and attendance of 4 or more antenatal care visits was low (46% in Uganda).⁴¹
- **Delay 2: Access.** Women had limited access to comprehensive CEmONC facilities within 2 hours (only 51% to 55% of women were able to reach CEmONC within 2 hours using motorized vehicles) due to few operating theaters and blood banks, and lack of transport vehicles and referral protocols. Maternity waiting homes were often dilapidated and deserted.
- **Delay 3: Quality.** Many maternity blocks in hospitals and health centers were run-down and overcrowded, and they lacked water, electricity, and functioning toilets. Equipment was missing, inoperative, or insufficient for the client load. Facilities lacked 24-hour staffing of skilled birth attendants, anesthetists, and surgeons.
- **Health Systems Strengthening.** In the face of limited quality improvement activities, facilities experienced frequent drug and supply stock-outs and weak capture, analysis, and reporting of health outcome data.

TABLE 3. Emergency Obstetric and Newborn Care 9 Signal Functions

Basic Services	Comprehensive Services
1. Administer parenteral antibiotics	Perform signal functions 1 through 7 plus:
2. Administer uterotonic drugs (i.e., parenteral oxytocin, misoprostol)	8. Surgery (cesarean delivery)
3. Administer parenteral anticonvulsants for preeclampsia (i.e., magnesium sulfate)	9. Blood transfusion
4. Manually remove the placenta	
5. Remove retained products of conception (e.g., manual vacuum extraction, misoprostol, dilation and curettage)	
6. Perform assisted vaginal delivery (e.g., vacuum extraction, forceps delivery)	
7. Perform basic neonatal resuscitation (e.g., bag and mask)	

Source: WHO, UNFPA, UNICEF, and Mailman School of Public Health.²⁷

These gaps and other district-specific challenges were addressed in SMGL district workplans.

Startup. Startup activities began early in 2012. At the national level in Uganda and Zambia, routine meetings were held with the interagency working groups, MOH representatives, and implementing partners. Preparations for work with private providers through the Programme for Accessible Health Communication and Education (PACE) project and Marie Stopes International were initiated in Uganda. In Zambia, where the SMGL learning districts were spread out across the country, SMGL district coordinators—often retired midwives—were hired to harmonize all SMGL activities in their district with district health officers and district health management teams, and to serve as a link with implementing partners. During this phase, training commenced for providers and existing government-sponsored community health workers—SMAGs and VHTs. These health workers were recruited from the local community. Groups were a mix of men and women and often included former traditional birth attendants. SMGL provided these volunteers with resources such as gumboots, flashlights, T-shirts, and bicycles. In Zambia, Peace Corps volunteers were recruited and trained as community mobilizers to work with SMAGs to increase demand and organize community transport systems. By the end of the initiative, SMGL-dedicated Peace Corps volunteers were in all 18 SMGL-supported districts.

Phase 1: Proof of Concept

Results for Phase 1 are based on data for the 12-month period from June 2012 through May 2013. Analysis and write-up of lessons, however, continued through December 2013.

Interventions. District-level MOH staff led the implementation process working with implementing partners funded by PEPFAR, CDC, USAID, and Merck. In the learning districts, the following interventions were carried out to address the health system gaps identified in the Phase 0 HFAs, by delay, in accord with the SMGL theory of change.

- **Delay 1: Demand.** Tackling this delay required not only effecting change in individual behaviors but also influencing community norms. SMAGs and VHTs identified pregnant women and initiated antenatal home visits covering all villages across the 8 learning districts. They provided childbirth education and anticipatory guidance. Specific topics included: self-care and a healthy diet, attending antenatal

and postnatal care visits and delivering in a facility, family planning, recognition of maternal and newborn danger signs, being tested for HIV, and undertaking birth planning and saving to cover the costs of transport and medical care. Messages given during these family visits were reinforced by including husbands and household members, holding community sensitization meetings, and training traditional leaders to be “change champions.” Multimedia campaigns, which included community sensitization skits, radio announcements, community documentary screenings, and billboards, were also fielded in both countries. In Zambia, Peace Corps volunteers trained SMAGs on a home-visit protocol using the national SMAG curriculum. (See the article by Serbanescu and colleagues from the SMGL supplement.⁴¹)

- **Delay 2: Access.** A travel-time study in Uganda and HFA results from both countries confirmed that timely access to care was a major problem in all 8 SMGL-supported districts. SMGL programming addressed this problem in 3 ways: bringing lifesaving care closer to women, decreasing travel time to appropriate care, and bringing women closer to emergency services. Select maternity wards and surgical theaters were refurbished to upgrade facility capacity and optimize 2-hour access to CEmONC care. In Uganda, subsidized motorcycle transport vouchers and private-care vouchers, distributed by VHTs, were rapidly scaled up during Phase 1. In Zambia, where long distances to care are the norm, maternity waiting homes were refurbished or built next to EmONC facilities by the Department of Defense and the Merck-led Maternity Waiting Home Alliance. In both countries, SMGL ensured appropriate communication tools, such as cell phones and radios, and district-specific protocols to facilitate transfers. (See the article by Ngoma et al. from the SMGL supplement.⁴²)
- **Delay 3: Quality.** Baseline HFA results had revealed the need for significant improvements in the quality of services provided if women were to receive lifesaving care for complications; many aspects of the health system would need to be strengthened. Efforts to improve the quality of services engaged frontline health care providers and facility managers. SMGL hired strategically placed midwives, nurses, anesthetists, and doctors (147 providers in Uganda and 19 in Zambia). In both countries, many of the

To address barriers to timely access to care, SMGL brought lifesaving care closer to women, decreased travel time to appropriate care, and brought women closer to emergency services.

midwives hired were retired, seasoned health professionals. In Uganda, staff was hired with the understanding that their positions would be picked up by the MOH when SMGL funding ended. SMGL doctors received increases in their salaries to work in rural health center IVs rather than hospitals, an incentive that was subsequently adopted nationally by the MOH. Quality improvement committees were formed and the BABIES matrix was introduced into all EmONC facilities. Quality improvement committees were trained to sensitize providers on the importance of respectful care. Merck for Mothers worked through the PACE project to provide technical assistance to private providers in order to upgrade their skills.

Health care providers in both countries were trained by MOH trainers and routinely monitored on EmONC, Helping Babies Breathe, essential newborn care, uterine balloon tamponade (Zambia), maternal and perinatal death reviews, syphilis screening, prevention of mother-to-child transmission of HIV, infection prevention, and operative skills. Obstetricians and gynecologists associations in both countries provided clinical mentoring to district medical officers and district health officers in SMGL-designated districts and the professional societies were in turn strengthened with technical assistance from the American College of Obstetrics and Gynecology. Project C.U.R.E. supplied donated facility-specific, essential equipment and commodities (including hospital and delivery beds, surgical tables and lights, resuscitation supplies, sterilization equipment, sutures, and gloves), shipping 16 containers to Uganda and 20 to Zambia over the life of the initiative. (See the article by Morof et al. from the SMGL supplement.⁴³)

- Health systems strengthening activities included providing HIV-related diagnostics and treatment and integrated family planning services.**

the mother and prevent mother-to-child transmission. In select SMGL-supported districts, providers were trained to provide postpartum family planning. District medical and health officers and in-charges received instruction on drug logistics and forecasting to prevent chronic stock-outs of essential medicines. Facilities were equipped with rainwater catchment systems, solar panels, and functioning toilets. Maternal and perinatal deaths were reviewed through routine maternal and perinatal death surveillance and response efforts in facilities. The CDC provided capacity strengthening of district-level teams on monitoring and evaluation. SMGL staff supported monthly district-led data reviews of MNH indicators, quarterly provincial-level reviews, and strengthening of the District Health Information Management System (DHIS2), a free and open-source health management data platform. (See the article by Serbanescu and colleagues from the SMGL supplement.³⁸)

- Data collection activities.** After 12 months of Phase 1 implementation (June 2012 to May 2013), endline Phase 1 studies were conducted in the 8 learning districts to assess the status of the SMGL indicators and thus gauge progress at the end of year 1.¹⁷ In addition, a mixed-methods external implementation evaluation of Phase 1 was undertaken by Columbia University.²⁹ This evaluation examined the reach, extent, fidelity, and dynamic effects of the initiative in order to identify best practices and remaining barriers to reducing maternal mortality. Data from these evaluations were analyzed and results were reported at an SMGL global dissemination meeting in January 2014.^{44,45} (See Supplement 4.)

Phase 2: Scale-Up and Scale-Out

Early in 2014, the partners met to examine SMGL performance and to modify SMGL's approach, governance, assessment, and implementation for Phase 2. These adjustments are described in the following sections.

Initiative. The partners decided to maximize the return on initial investments in Uganda and Zambia by committing to operate in both countries until October 2017. SMGL would aim to achieve near-national coverage of the SMGL approach in Uganda and Zambia, defined by the partners as ≥70% population coverage, and would select 1 additional country for SMGL implementation. In 2015, Nigeria became the third and final

SMGL country.⁴⁶ There, the SMGL systems approach was rolled out across Cross River State (population 3.7 million) and will be supported until October 2019. The governing partners for SMGL Nigeria are USAID Washington, USAID Nigeria, Merck for Mothers, and Project C.U.R.E.

Governance. MOH representatives were invited to join the Leadership Council, SMGL's global governing body, and partners agreed to re-examine their resource pledges and submit quarterly contribution reports.

Scale-up district assessment. The SMGL partners agreed that due to the high cost and management burden of undertaking detailed information gathering, a limited number of M&E activities would take place in the scale-up districts of both countries. The focus of these efforts would be to guide program adjustments for quality improvement: HFAs at baseline to inform initial programming, quarterly record and registry data gathering at CEmONC facilities only, and Health Management Information System reporting on indicators of interest for all facilities on a quarterly basis. (See the article by Isabirye et al. from the SMGL supplement.⁴⁷)

Implementation. Interventions introduced in Phase 1 were largely maintained with a few exceptions: Mama Pack distribution in Zambia ended based on concerns about sustainability; repair or replacement of 2-way radios became unnecessary as the availability of cell phones increased; and ongoing enumeration of maternal deaths by Zambia SMAGs was discontinued after problems with data gathering during the proof-of-concept phase. VHTs in Uganda continued ongoing enumeration. The partners endorsed several context-specific programmatic changes for the learning districts and the scale-up districts. The SMGL time frame of interest was lengthened from intrapartum through 24 hours postpartum to 48 hours postpartum in Uganda and 72 hours postpartum in Zambia to conform to host country guidelines and enable greater focus on postpartum family planning and postnatal care. In the face of nonsignificant reductions in pre-discharge neonatal mortality in Uganda during Phase 1, SMGL increased programming for newborns. Additional interventions included: ensuring availability of newborn corners (flat surfaces for newborn resuscitation) in each delivery room; opening neonatal special care units, and Kangaroo Mother Care units in 8 health center IVs and 3 hospitals where stable low birth weight and premature newborns could be cared for; upgrading the existing neonatal intensive care unit at Fort Portal Regional

Referral Hospital; increasing training and drilling on newborn resuscitation and essential newborn care; and implementing the BABIES matrix in additional facilities. (See the article by Morof and colleagues from the SMGL supplement.⁴³)

In Zambia, where postpartum hemorrhage was the leading cause of maternal death and in the context of long distances to delivery care, 3 interventions were prioritized for Phase 2: (1) constructing and refurbishing maternity waiting homes, (2) introducing and institutionalizing uterine balloon tamponade, and (3) strengthening the national blood transfusion system. Maternity homes, located next to SMGL-supported EmONC facilities, were built or refurbished by the U.S. Department of Defense or under the Maternity Waiting Home Alliance. (See the article by Ngoma and colleagues from the SMGL supplement.⁴²) SMGL helped drive policy changes that allowed uterine balloons to be placed by nurses and midwives and for uterine balloon tamponade to be included in the national EmONC curriculum. Across the 18 Zambian SMGL districts, providers were trained in the assembly and use of uterine balloon tamponade. With funds from SMGL and the government of Zambia, several district blood bank hubs were established to provide 24-hour blood testing and availability of fresh-frozen blood and plasma.

Contextual changes. Important contextual changes occurred during Phase 2 at the district level. The 4 original learning districts in Uganda were divided into 6 districts—Kabarole, Kibaale, Kamwenge, Kyenjojo, Kakumiro, and Kagadi—and 7 new scale-up districts were added in the north—Nwoya, Gulu, Omolo, Pader, Lira, Apac, and Dokolo. All were selected by the MOH. Due to a change in the implementing partner for the new SMGL Uganda northern districts, full execution of the SMGL approach did not begin until 2015 and ended 2 years later. (Project description and results can be found in the article by Isabirye and colleagues from the SMGL supplement.⁴⁷) In Zambia, the 4 learning districts were divided into 6 districts through an administrative re-districting process—Nyimba, Lundazi, Kalomo, Zimba, Mansa, and Chembe—and 12 additional districts were added across the country—Samfya, Lunga, Kabwe, Choma, Pemba, Chipata, Petauke, Sinda, Vubwi, Mumbwa, Livingstone, and Luangwa (Figure 2).

SMGL increased programming for newborns during the second phase, including opening neonatal special care units and increasing training on newborn resuscitation.

Endline evaluation studies. After the Phase 1 endline studies showed a 35% reduction in facility maternal mortality and positive results for process and quality indicators in the SMGL-supported learning districts in both countries, a summative

evaluation plan was developed by the M&E committee and the SMGL Secretariat. The plan was endorsed by the SMGL Leadership Council members who also pledged funding for executing the plan. Using 2016 as the index year for SMGL final results, end-of-initiative studies were undertaken in 2017 to establish outcomes in the learning districts: (1) a census in Zambia and a RAMOS in Uganda,^{38,48} (2) repeat HFAs in all delivering facilities in the learning districts,³⁸ (3) a cost-effectiveness study addressing the 3 delays,⁷ (4) a secondary analysis comparing SMGL district outcomes with findings from the Uganda Demographic and Health Survey (DHS) in comparison districts and nationally,³¹ (5) a follow-on qualitative study of community perspectives on childbearing in Zambia,⁴⁹ and (6) a repeat travel-time mapping study in Uganda to gauge if the SMGL initiative resulted in greater access to care.⁵⁰

■ RESULTS

Key Health Facility and Population-Based Assessment Results

Select results from Phase 1 have previously been reported.^{7,17,29,39,51–53} What follows is an overview of key results at baseline and 2016 endline for the SMGL-supported learning districts. Table 4 compares selected baseline and endline indicators by type. A description of data collection methods, indicators, and baseline and endline results are included in the article by Serbanescu and colleagues from the SMGL supplement.³⁸ A comparison of SMGL outcomes with those from DHS and UN maternal mortality estimates is presented in Supplement 5.

Demand

The chances of surviving childbirth are improved when a woman gives birth in a facility, attended by a skilled birth attendant.^{54–56} Over the life of SMGL, the institutional delivery rate, or the proportion of births occurring in delivery facilities, increased from 46% to 67% in Uganda (a 47% increase) and from 63% to 90% (a 44% increase) in Zambia SMGL-supported facilities.

Timely Access

SMGL prioritized bolstering the system's capacity to provide timely lifesaving emergency care. The number of facilities that performed all 7 signal functions that constitute basic emergency obstetric and newborn care (BEmONC) increased from 3 to 9 in Uganda (200%) and from 3 to 8 in Zambia

(167%). Similarly, the number of CEmONC facilities increased from 7 to 17 (143%) in Uganda and from 4 to 5 (25%) in Zambia.

In 3 SMGL-supported districts in Uganda, transportation vouchers enhanced women's access to essential and emergency health services by covering the cost of motorcycle rides to facilities for delivery, 4 antenatal care visits, and 1 postnatal care visit. In 2016, almost 1 out of 4 women who delivered in SMGL facilities used transportation vouchers to reach care. In Zambia where motorcycle transport is not generally available, maternity waiting homes were built or upgraded to provide mothers a safe place to stay near an EmONC facility during the last weeks of pregnancy. The proportion of SMGL facilities that reported having an associated maternity waiting home increased significantly from 29% at baseline to 49% at endline (a 69% increase).

Quality

The range of interventions that SMGL implemented to enhance quality of care largely proved effective:

- Population-based cesarean delivery rates increased by 71% (from 5.3% to 9.0%) in Uganda and 79% (from 2.7% to 4.8%) in Zambia in SMGL-supported districts. The rates achieved are still below the World Health Organization (WHO) recommended rates of 10% to 15%. (Regardless of the rate, cesarean deliveries should be performed only when medically indicated).
- The percentage of facilities reporting having performed newborn resuscitation in the last 3 months increased by 155% (from 34% to 88%) in Uganda and by 173% (from 27% to 75%) in Zambia.
- The percentage of all SMGL-supported facilities in Uganda that reported active management of the third stage of labor increased by 28% (from 75% to 96%). In Zambia, the change from baseline was 33% (72% to 96%).
- Having at least 1 long-acting reversible family planning method in SMGL-supported facilities increased in both countries. In Uganda, availability increased by 51% (from 63% to 94%) of facilities. In Zambia, it improved by 50% (from 50% to 75%) of facilities.
- The percentage of hospitals conducting maternal death audits tripled in Uganda (from

Cesarean delivery rates increased by 71% in SMGL-supported districts in Uganda and by 79% in Zambia.

The institutional delivery rate increased by 47% in SMGL-supported facilities in Uganda and by 44% in Zambia.

TABLE 4. Key Results at Baseline and Phase 2 Endline in the SMGL Learning Districts

SMGL Indicator	Uganda				Zambia			
	2012 Baseline	2016 Phase 2 Endline	% Change Baseline to Phase 2	Significance ^a	2012 Baseline	2016 Phase 2 Endline	% Change Baseline to Phase 2	Significance ^a
GOAL								
Institutional MMR (per 100,000 live births)	534	300	-44	***	370	231	-37.6	***
Community MMR (per 100,000 live births)	452	255	-44	***	480	284	-40.8	***
Pre-discharge neonatal mortality rate (per 1,000 live births)	8.4	7.6	-10	NS	7.7	8.7	+14	NS
Institutional perinatal mortality rate (per 1,000 births)	39.3	34.4	-13	***	37.9	28.2	-26	***
Institutional total stillbirth rate (per 1,000 births)	31.2	27.0	-13	***	30.5	19.6	-36	***
DEMAND								
Health facilities that report having a VHT (Uganda) or SMAG (Zambia) (%)	18	92	+400	***	64	93	+46	***
Institutional delivery rate (%)	46	67	+47	***	63	90	+44	***
Deliveries in EmONC facilities (%)	28	41	+45	***	26	29	+12	***
Deliveries in lower-level facilities (health center II, III) (%)	17	26	+48	***	37	61	+67	***
ACCESS								
Facilities that report having an associated mother's shelter (%)	0	4	NA	NA	29	49	+69	***
Institutional deliveries supported by transport vouchers (%)	6	24	+277	***	Vouchers not provided in Zambia			
Number of BEmONC facilities where the 7 signal functions were performed in last 3 months	3	9	+200	NA	3	8	+167	NA
Number of CEmONC facilities where the 9 signal functions were performed in last 3 months	7	17	+143	NA	4	5	+25	NA
24/7 services at health centers (%)	75	89	+18	NS	65	96	+41	***
QUALITY OF CARE								
Facilities reporting having performed newborn resuscitation in the previous 3 months (%)	34	88	+155	***	27	75	+173	***
Facilities providing active management of the third stage of labor (%)	75	96	+28	***	72	96	+33	***
Population-based cesarean delivery rate (%)	5.3	9.0	+71	***	2.7	4.8	+79	***
Hospitals that currently have at least 1 long-acting family planning method (%)	63	94	+51	**	50	75	+50	NS
Number of women receiving PMTCT treatment	1262	2155	+71	NA	930	1036	+11	NA
HEALTH SYSTEMS STRENGTHENING								
Hospitals conducting maternal death audits or reviews (%)	31	94	+201	***	50	100	+100	NA
Health facilities that did not experience stock-outs of oxytocin in the last 12 months (%)	56	82	+46	***	75	75	-0.4	NS
Health facilities that did not experience stock-outs of magnesium sulfate in the last 12 months (%)	48	64	+34	***	20	43	+115	***

Abbreviations: EmONC, emergency obstetric and newborn care; BEmONC, basic emergency obstetric and newborn care; CEmONC, comprehensive emergency obstetric and newborn care; MMR, maternal mortality ratio; NA, not applicable; NS, nonsignificant; SMAG, Safe Motherhood Action Group; VHT, Village Health Team; PMTCT, prevention of mother-to-child transmission of HIV.

^a *** P < .01; ** P < .05; * P < .10. NA in cases where significance testing was not warranted.

Source: Serbanescu et al.³⁸

31% to 94%) and doubled in Zambia (from 50% to 100%).

- The number of HIV-seropositive women who received prophylaxis or treatment for the prevention of mother-to-child transmission increased by 71% in Uganda, from 1,262 to 2,155 women, and by 11% in Zambia, from 930 to 1,036 women (denominators not available).

Health Systems Strengthening

Access to medications was positive but uneven. While SMGL funds were not used to procure medicines in Phase 2, providers were trained in supply chain management. The proportion of all health facilities that did *not* experience stock-outs of oxytocin in the last 12 months increased by 46% (from 56% to 82%) in Uganda but did not change in Zambia (from 75% to 75%). The proportion of all health facilities that did *not* experience stock-outs of magnesium sulfate in the last 12 months increased significantly in both countries, by 34% (from 48% to 64%) in Uganda and by 115% in Zambia (from 20% to 43%).

Impact

The MMR declined significantly in both SMGL-supported facilities and districts in Uganda and Zambia.

From baseline to endline (2012–2016), the MMR declined by 44% in both facilities and districtwide in Uganda (from 534 to 300 per 100,000 live births in facilities and from 452 to 255 in the community). MMR declined by 38% in SMGL-supported facilities in Zambia (from 370 to 231) and by 41% districtwide (from 480 to 284). All declines were statistically significant.

In Uganda, the perinatal mortality rate declined by 13% in SMGL-supported facilities (from 39.3 to 34.4 perinatal deaths per 1,000 births). The

total institutional stillbirth rate also declined by 13% (from 31.2 to 27.0 per 1,000 births). Both values are statistically significant. The pre-discharge neonatal mortality rate fell by 10% (from 8.4 to 7.6 per 1,000 live births); however, this was a nonsignificant change. In Zambia, the institutional perinatal mortality rate declined by 26% in SMGL-supported facilities (from 37.9 to 28.2) and the institutional stillbirth rate declined by 36% (from 30.5 to 19.6). Both declines were significant. The change in the pre-discharge neonatal mortality rate was not significant at +14% (from 7.7 to 8.7).

Public and Private Health Care Facilities

In Uganda, where 40% of facilities receiving SMGL support were private, the endline evaluation explored in a separate analysis whether any differences existed in the impact indicators by the type of sector providing delivery care (Table 5). The majority of SMGL facility deliveries occurred in public facilities (83.4% public vs. 16.6% private). The proportion of women who delivered by cesarean delivery was slightly lower in public-sector facilities compared with the private sector (13.0% vs. 15.7%, respectively) (data not shown). Generally, no significant differences existed in the occurrence of adverse pregnancy outcomes among women delivering in the private and public sectors in 2016 in Uganda, with the exception of the intrapartum stillbirth rate, which was higher in private facilities than in public facilities (17.0 vs. 13.8 per 1,000 births, respectively). See Supplement 6 for more information about private-sector activities in Uganda.

TABLE 5. Select Indicators by Delivery Care Service Sector in Uganda, 2016

Indicator	Public-Sector Facilities	Private-Sector Facilities	Significance ^a
Maternal mortality ratio (per 100,000 live births)	301	295	NS
Direct case fatality rate	1.8	1.5	NS
Perinatal mortality rate (per 1,000 births)	34.0	36.4	NS
Intrapartum stillbirth rate (per 1,000 births)	13.8	17.0	**
Total stillbirth rate (per 1,000 births)	26.6	28.7	NS
Pre-discharge neonatal mortality rate (per 1,000 live births)	7.6	7.9	NS

Abbreviation: NS, nonsignificant.

^a ** $P < .05$.

Source: Serbanescu et al.³⁸

■ DISCUSSION

The positive results from the SMGL Phase 2 end-line evaluation studies (2016 data) in the learning districts in Uganda and Zambia are substantial. However, SMGL's non-randomized, before-and-after design makes it challenging to attribute the outcomes documented after nearly 5 years of implementation solely to the SMGL health systems strengthening approach. The Columbia University implementation evaluation of SMGL's proof-of-concept year did include comparison districts, but there was no randomization. Still, the MMR declined significantly faster in the SMGL-supported learning districts compared with national-level declines. Over a 5-year span the average annual rate of reduction in Uganda learning districts was 11.5% compared with the national rate of 3.5% using DHS values. The difference-in-differences between the drop in MMR in SMGL areas compared with the drop in the MMR nationally is statistically significant ($P = .02$) (Supplement 5).

The findings for Zambia are similar although the timing of the DHS did not allow use of DHS data for comparison. Instead, the UN maternal mortality estimates for Zambia for the period 2011–2015 were used. The average annual rate of reduction in SMGL districts in Zambia was 10.5% vs. a national rate of 2.8%.¹ These more rapid declines in MMR in SMGL program areas compared with national levels in both countries over a 5-year period suggest that SMGL outcomes are not solely due to secular trends (Supplement 5).

The results of the SMGL evaluation provide answers to some questions that are critical to ending preventable maternal and newborn deaths, while leaving other questions unresolved.

Why Does the SMGL Theory of Change Focus on All Pregnant Women Rather Than Only Those Experiencing a Complication?

The 3-delays model, introduced by Thaddeus and Maine in 1994 in their seminal article,¹⁶ provided a conceptual framework for programming to surmount the key barriers faced by women with obstetric complications. In the SMGL theory of change, we focused on all pregnant women within the SMGL-supported districts because many maternal complications are difficult to predict and prevent, can arise quickly, and can result in a maternal death in a short period of time. The SMGL systems approach aimed to provide access to emergency care within 2 hours from home or a lower-level

health facility for all pregnant women in SMGL-supported districts.

Can a District Health Systems Strengthening Approach Addressing the 3 Delays Contribute to Maternal Mortality Reductions in High-Burden, Low-Resource Countries?

The data show significant reductions in the MMR in the learning districts in both Uganda and Zambia after nearly 5 years of SMGL implementation. The contribution of SMGL to these changes is plausible given the greater rate of reduction in program areas compared with national rates in both countries (Supplement 5). In Uganda, 70% of the total MMR reduction, from baseline to endline Phase 2, occurred during Phase 1, suggesting that once inputs were in place, the systems approach was successful in sustaining the reduced MMR. This is particularly instructive as after Phase 1, in the context of erratic funding flows, implementation was uneven. In spite of these lapses, reductions were sustained over the life of SMGL, based on robust analysis of the SMGL routine quarterly indicators and Pregnancy Outcomes Monitoring Studies values.⁵⁷

The MMR declined significantly faster in the SMGL-supported districts than nationally.

What About Newborn Deaths and Stillbirths?

Decreases in institutional perinatal deaths were statistically significant in Uganda and Zambia at 13% (31.2 to 27.0) and 26% (37.9 to 28.2), respectively. The declines in the total stillbirth rate (fresh and macerated stillbirths) were also significant in both countries (13% in Uganda and 36% in Zambia).³⁸ However, changes in pre-discharge neonatal mortality rates were nonsignificant. Further analysis is needed to understand why the SMGL approach was able to decrease stillbirths but not newborn deaths. We hypothesize that, in the past, newborns who were not breathing at birth were laid aside and categorized as stillbirths but that after HBB training some were successfully resuscitated. A portion of these now breathing newborns potentially succumbed to fatal complications. It is also unclear if the public-private differences seen in intrapartum stillbirth rates in Uganda reflect differences in health care provision or in clinical risk factors. (See the article by Serbanescu and colleagues from the SMGL supplement.³⁸)

Results from a modeling exercise support the SMGL theory of change that an integrated systems approach addressing both demand- and supply-side barriers is more impactful than individual interventions.

What Is the Minimum Package of Interventions Needed to Reduce Maternal and Neonatal Mortality?

The SMGL theory of change posits that an integrated systems approach addressing both demand-

and supply-side barriers is more impactful than individual and/or uncoordinated interventions, especially for a complex and multifaceted problem such as maternal mortality. The results of the Qualitative Comparative Analysis (QCA) modeling from Uganda support this hypothesis.⁵⁸ The QCA examined the relative power of varied *bundles of interventions* to replicate the Phase 1, first-year achievement of reducing *community* maternal mortality in SMGL-supported districts in Uganda by 30% (*facility* deaths were reduced by 35%). The results suggest that the most powerful bundle of interventions (most effective at lowest cost) was comprised of 4 interventions: VHTs (*demand*); transportation vouchers (*access*); availability of staff (*quality*); and availability of medicines (*health systems strengthening*). If run individually, none of these interventions achieved the 30% MMR reduction, and if the results from these individual interventions were then added together, the sum did not achieve the reduction of the optimal bundle. It appears that it is not only these critical interventions but the synergy created by addressing both supply- and demand-side barriers that accelerates change.⁶⁰ It would be instructive to undertake a QCA study in Zambia to see if similar results are found.

What About Cost?

SMGL's achievements are often tempered by concerns that the SMGL approach was too expensive for replication. In order to rigorously examine this critical consideration and establish the relative value for money, it is necessary to compare the cost of SMGL implementation with other initiatives that have achieved equivalent health outcomes. Unfortunately, few MNH projects are comparable to SMGL in terms of complexity, robust capture of both facility and districtwide health outcomes (MMR, perinatal mortality rate, neonatal mortality rates, cause of death), and commitment to tallying expenditures.^{29,60} Even when examining the cost-effectiveness of individual MNH interventions, there is a paucity of high-quality cost-effectiveness studies.^{61–64} These features have left evaluators without ideal counterfactuals.^{65–67}

To better understand relevant SMGL cost outlays over the life of the initiative, 3 costing studies were undertaken (Supplement 4). All 3 studies projected that after investing in essential capital improvements and streamlining operations, running costs would decrease substantially. Those predictions proved accurate. By design, external

funding tranches for SMGL implementation in Uganda and Zambia were decreased yearly while the number of SMGL districts increased, resulting in substantial reductions in funding per learning district over Phase 2. During that same period, maternal health outcomes in the learning districts continued to show improvement.

The endline 3-delays costing study looked at the cost in 2016 of addressing all 3 delays: demand generation, accelerating access to appropriate care including referral, and improving the quality of care at the facility. The expenditure per maternal and perinatal life-year gained was found to be US\$177 in Uganda and US\$206 in Zambia. These values are inclusive of startup and capital costs—both expressed as annual equivalents. The authors conclude that the SMGL approach is cost-effective, with the cost per life-year gained in Uganda at 25.6% of gross domestic product (GDP) per capita and at 16.4% of GDP per capita in Zambia. Both values are less than 50% of GDP per capita, a benchmark for cost-effectiveness. In terms of affordability, the additional (incremental) costs associated with the SMGL approach would add less than 0.5% to the health spending from GDP in both countries (from 7.3% to 7.5% in Uganda and from 5.4% to 5.8% in Zambia). Recent models suggest that, at a minimum, an additional US\$11 per capita per year is necessary to meet the full needs of MNH care in sub-Saharan Africa.⁶⁸ The incremental costs of the SMGL initiative of US\$1.36 per person per year in Uganda and US\$4.85 per person per year in Zambia are far less than these modeled estimates, and much less than that spent on antiretrovirals per person treated per year, which stood at an average of US\$136.80 in 2015.⁶⁹ (See the article by Johns and colleagues from the SMGL supplement.⁷⁰)

What About Sustainability?

In Uganda and Zambia there is both increased MOH commitment to the health systems strengthening approach and heightened societal awareness that most maternal and newborn deaths can and should be prevented.²⁹ Yet, it is likely that ongoing donor funding and technical assistance will be required in the short term to maintain the positive results achieved during SMGL implementation. Below, we look at country capacity and ownership as 2 important domains to gauge the likelihood that key elements of the SMGL health systems strengthening approach will be sustained.

Country capacity. Capacity building of district-level medical and public health staff

included clinical training, monthly on-site mentoring, and management; data gathering, analysis, reporting, and response; quality improvement; drug logistics; and budget development. Physicians in both Uganda and Zambia were trained (for the first time) on International Classification of Diseases (ICD) 10 Maternal Mortality coding of deaths, a prerequisite skill for a functioning maternal death surveillance and response system and a civil registration and vital statistics system. In both countries, the initiative led to improvements in tracking routine service delivery indicators as part of the national health management and information systems. In 2011, the governments of Uganda and Zambia began using DHIS2 as an electronic platform for aggregated health service data. In both countries, the SMGL-supported districts piloted DHIS2 implementation to collect, store, and analyze data on maternal and reproductive health. The improvements were scaled up to the national level by the end of 2012. Another important activity in Zambia was training SMGL district doctors and nurses in blood transfusion safety. Hospital Transfusion Committees were established to improve monitoring of blood supplies through the use of short message services (SMS or texts) for forecasting and planning to avert shortages. When donor funding recently decreased for blood-safety programs, the government of Zambia increased its health budget to ensure an adequate supply of blood for its citizens. (See the article by Healey et al. from the SMGL supplement.⁷¹)

Beyond training, SMGL country technical leads were supported to assume leadership positions within SMGL and to provide technical assistance to other SMGL countries. A team of Uganda SMGL leads traveled to Nigeria to provide technical assistance to the Nigeria SMGL team to carry out HFAs in Cross River State health care facilities, public and private, and also to Zambia to support HFAs in Phase 2 scale-up districts. A Zambia SMGL lead traveled to Afghanistan and assisted the USAID Mission to incorporate lessons learned from the SMGL approach into their MNH strategic plan. SMGL country staff prepared posters and presented at the yearly SMGL team-building meetings, and staff members were encouraged to submit abstracts and present at global MNH meetings.

Country ownership. District health leaders in Uganda reported high levels of ownership of SMGL and cited the addition of key inputs as strategic: filling human resource gaps; strengthening referral systems; expanding the number of

CEmONC facilities; improving the supply of blood for transfusion; mentoring health personnel; and increasing demand and access through VHTs, transportation vouchers, and community champions. SMGL also influenced national planning and budgeting for maternal health: the Wage Bill included allowances to support doctors working at health center IVs located in rural areas based on SMGL's remuneration approach; nearly 75% of the midwives hired by SMGL were picked up by the MOH; additional midwifery training was provided for enrolled nurses; and the voucher program laid the groundwork for a national program.²⁹ Lessons learned from the SMGL approach were incorporated into the Global Financing Facility Investment Case,⁷² the WHO Quality, Equity, Dignity initiative country plan, and USAID requests for assistance and contracts. Between these initiatives, over half of the Ugandan population will be covered by a district health systems strengthening approach by 2020. (See the articles by Healey et al.⁷¹ and Palaia et al.⁷³ from the SMGL supplement.)

In Zambia, preexisting CDC cooperative agreements with provinces and district-support from CDC and USAID implementing partners enabled early leveraging of funds and increased district ownership of SMGL. SMGL worked with other donors, the Swedish International Development Cooperation Agency (SIDA) and the UK Department for International Development, to carry out direct government-to-government funding to provincial and district public health systems through the Reproductive, Maternal, Newborn, Adolescent Health and Nutrition Continuum of Care Program, blanketing 6 of 10 provinces. With this partnership alone, over 50% of the Zambian population is covered by projects informed by the SMGL systems approach.¹⁷ (See the article by Healey et al. from the SMGL supplement.⁷¹)

In both Uganda and Zambia, SMGL led to improvements in tracking routine service delivery indicators as part of the national health management and information systems.

What Were the Main Challenges?

The initial 1-year time frame. Frustration was generated when SMGL funding was guaranteed for only 1 year with subsequent support based on achievement of unprecedented reductions in maternal mortality within a highly compressed time frame. At the end of Phase 1 implementation (June 2013) and before results from the Phase 1 endline studies were available (December 2013), host countries and implementing partners were without SMGL funds. Yet they were expected to continue with interventions while a

Future systems approaches focused on maternal and newborn mortality reduction should commit to a minimum of 5 years of support.

decision on continuation was made. This 6-month period from July to December 2013 was chaotic. Any future systems approach focused on maternal and newborn mortality reduction should commit to a minimum of 5 years of support from the outset.²⁹ (See the article by Palaia et al. from the SMGL supplement.⁷³)

The heavy management burden. SMGL was a partnership (all U.S. government) within a partnership (countries, a global corporation, non-governmental organizations, and a professional society). Each partner had a different bottom line, constituency, funding timeline, requirements, and restrictions that all needed to be forged into a dynamic force for change. The positive driver was the ongoing commitment of all partners and stakeholders to dramatically reduce maternal deaths. When the SMGL Leadership Council was recruiting additional countries for SMGL at the end of Phase 1, “management burden” was cited by USAID Mission directors and CDC country office directors as their main concern and rationale for not engaging. A simpler management structure where partnerships provide direct-to-government support with appropriate oversight and ample technical assistance might produce similar results; it might also accelerate country self-sufficiency and increase value for money by decreasing implementing partner overhead charges. At the same time, the diversity of SMGL partners encouraged innovation and enabled access to a wide array of expertise and experience.

Erratic funding. Because of the complexity of the partnership and its myriad resource streams, funding to the implementing partners in both countries was profoundly delayed for several periods during Phase 2. These lapses in funding were the result of prolonged U.S. government procurement processes, changes in funding mechanisms, and delays in disbursements from agency headquarters to country offices. If public-private partnerships are increasingly used to advance the goals of U.S. government agencies, streamlining funding for these endeavors will be needed to increase flexibility and responsiveness and to preserve momentum. Smaller amounts of reliable funding are easier to manage than larger tranches of unpredictable financial support.

What Were Some of the Unexpected Effects?

Having a range of stakeholders participating in SMGL created a think-tank atmosphere that brought together people with varied talents:

obstetricians, midwives, nurses, communications specialists, epidemiologists, and district medical and health officers. It also led to collective yearly planning and country budget creation. In many of the routine implementing partner meetings, organizations would share tasks as well as ideas that crossed bureaucratic and competitive barriers. The bold goal of a rapid 50% reduction in maternal mortality fostered a collaborative “all hands on deck” spirit that inspired district leadership and partners alike.

SMGL’s insistence on capturing, analyzing, and reporting all maternal deaths resulted in strengthened data gathering and interpretation by district teams. District-level data were presented and critically reviewed by district M&E staff at routine provincial and regional epidemiological meetings. Results were compared within the provinces and among the different project sites, and served as a motivating factor for good performers and as a call for improvement among less successful districts. The heightened appreciation of the need for quality mortality data accelerated the rollout and practice of maternal and perinatal death surveillance and response in both countries. In Zambia, the district commissioner, as the chair of the audit committee, was made responsible for reporting surveillance and response results locally and at the provincial level. This high-level ownership of data was immediately replicated on a national basis and had the effect of positioning maternal mortality not just as a health concern but also as a broader social issue, bringing in other sectors of government and traditional leaders to grapple with and be accountable for preventing maternal mortality.

Better birth planning, involvement of men, and increased community demand for facility deliveries required leaders to raise awareness and address community concerns in order to change cultural norms. Involvement of chiefs and traditional leaders in Zambia and local councils and religious leaders in Uganda created “change champions” who took on these challenges. However, qualitative research by Greeson et al.⁷⁴ identified punitive actions by Zambian village chiefs and headmen, such as fining a husband a goat if he did not provide a sufficient reason for why his wife delivered at home. Researchers suggested that negative unintended consequences are possible by-products of a “big push” endeavor where pressure to succeed is high.⁷⁴ These “disciplinary” actions were not endorsed by SMGL or the MOH, but they do represent a traditional approach by cultural leaders to induce social change in their communities.

What Are the Main Recommendations Coming Out of the SMGL Experience?

Given the complexity of the SMGL initiative, extracting lessons learned and turning them into a few salient recommendations is challenging. The following points are put forward in support of SMGL's theory of change and organizing principles:

1. Create a culture of zero tolerance for preventable maternal and newborn deaths at all strata of society including parliamentarians and their constituents.
2. Follow key organizing principles by addressing all 3 delays with interventions that are context-specific and time-bound (e.g., setting a 2-hour 'time-to-service' limit for complications and focusing on labor, delivery, and 72 hours postpartum).
3. Assess the gaps in the existing maternity care safety net, created by both public and private providers, in the public health catchment area of interest (e.g., district, woreda, county, local government area).
4. Ensure district-level capacity building around planning, execution, and evaluation; consider working in contiguous areas to achieve economies of scale, reduce management burden, and facilitate greater coordination.
5. Support the local health system; work across the district or relevant administrative units to reinforce the system from communities to health centers to hospitals in order to provide equitable lifesaving care and support for mothers and newborns, and by extension, other community members.
6. Sensitize and mobilize community change agents to accelerate normative change but be aware of potential unintended consequences of a "big push" effort.
7. Count, analyze, and report all maternal and perinatal deaths and cause of death.

CONCLUSIONS

While a 50% reduction in maternal deaths was not achieved during the initiative, the 44% decrease in MMR in Ugandan SMGL-supported facilities and districts, the 38% decrease in Zambian SMGL-supported facilities, and the 41% decrease in Zambian SMGL districts were substantial. There was a marked increase in facility deliveries in both countries and also in population cesarean delivery

rates: a 71% increase (5.3% to 9.0%) in Uganda and a 79% increase (2.7% to 4.8%) in Zambia. Perinatal health outcomes were small but significant: the perinatal mortality rate was reduced by 13% in SMGL-supported facilities in Uganda and by 26% in Zambia. The SMGL goal for reduction of newborn deaths (30%) was not achieved in Zambia or Uganda.

Still at question is whether the SMGL health systems strengthening approach to addressing the 3 delays will be adopted or adapted to other country contexts and implemented by MOHs, donors, and multilaterals. Clearly, the level of management burden is high, and partners, especially bilateral donors, are traditionally not structured to be nimble, proactive, or inventive. Yet several global endeavors could benefit from endorsing the SMGL approach. For example, with expansion of the number of Global Financing Facility countries and GFF emphasis on results-based financing, having a ready approach to improving effective coverage (range plus quality) could accelerate GFF impact. Similarly, the district health systems strengthening approach dovetails closely with the objectives and goals of the WHO Quality, Equity, and Dignity initiative.

SMGL was a bold attempt to show that maternal mortality could be reduced significantly in developing countries over a few years of strategic, synergistic programming. It was inspired by the progress achieved by other U.S. government global initiatives that showed how high-level political leadership, focused public attention, evidence-based demand- and supply-side interventions, a broad coalition of stakeholders, and strong M&E could achieve impressive results in a short time. For many, it was an opportunity to change the narrative around the serious problems pregnant women face in the developing world.

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Several global endeavors, such as the Global Financing Facility and the WHO Quality, Equity, and Dignity initiative, could benefit from endorsing the SMGL district health systems strengthening approach.

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ORIGINAL ARTICLE

Impact of the Saving Mothers, Giving Life Approach on Decreasing Maternal and Perinatal Deaths in Uganda and Zambia

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Through district system strengthening, integrated services, and community engagement interventions, the Saving Mothers, Giving Life initiative increased emergency obstetric care coverage and access to, and demand for, improved quality of care that led to rapid declines in district maternal and perinatal mortality. Significant reductions in intrapartum stillbirth rate and maternal mortality ratios around the time of birth attest to the success of the initiative.

ABSTRACT

Background: Maternal and perinatal mortality is a global development priority that continues to present major challenges in sub-Saharan Africa. Saving Mothers, Giving Life (SMGL) was a multipartner initiative implemented from 2012 to 2017 with the goal of improving maternal and perinatal health in high-mortality settings. The initiative accomplished this by reducing delays to timely and appropriate obstetric care through the introduction and support of community and facility evidence-based and district-wide health systems strengthening interventions.

Methods: SMGL-designated pilot districts in Uganda and Zambia documented baseline and endline maternal and perinatal health outcomes using multiple approaches. These included health facility assessments, pregnancy outcome monitoring, enhanced maternal mortality detection in facilities, and district population-based identification and investigation of maternal deaths in communities.

Results: Over the course of the 5-year SMGL initiative, population-based estimates documented a 44% reduction in the SMGL-supported district-wide maternal mortality ratio (MMR) in Uganda (from 452 to 255 maternal deaths per 100,000 live births) and a 41% reduction in Zambia (from 480 to 284 maternal deaths per 100,000 live births). The MMR in SMGL-supported health facilities declined by 44% in Uganda and by 38% in Zambia. The institutional delivery rate increased by 47% in Uganda (from 45.5% to 66.8% of district births) and by 44% in Zambia (from 62.6% to 90.2% of district births). The number of facilities providing emergency obstetric and newborn care (EmONC) rose from 10 to 26 in Uganda and from 7 to 13 in Zambia, and lower- and mid-level facilities increased the number of EmONC signal functions performed. Cesarean delivery rates increased by more than 70% in both countries, reaching 9% and 5% of all births in Uganda and Zambia districts, respectively. Maternal deaths in facilities due to obstetric hemorrhage declined by 42% in Uganda and 65% in Zambia. Overall, perinatal mortality rates declined, largely due to reductions in stillbirths in both countries; however, no statistically significant changes were found in predischarge neonatal death rates in either country.

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Conclusions: MMRs fell significantly in Uganda and Zambia following the introduction of the SMGL interventions, and SMGL's comprehensive district systems-strengthening approach successfully improved coverage and quality of care for mothers and newborns. The lessons learned from the initiative can inform policy makers and program managers in other low- and middle-income settings where similar approaches could be used to rapidly reduce preventable maternal and newborn deaths.

INTRODUCTION

Globally, more than 300,000 maternal deaths due to complications of pregnancy and childbirth occurred

in 2015, 201,000 of which occurred in sub-Saharan Africa.¹ Additionally, of the approximately 2.7 million neonatal deaths that occurred and 2.6 million babies who were stillborn in 2015, about 1 million neonatal deaths² and 1 million stillbirths occurred in sub-Saharan Africa.^{3,4} Roughly, 30% of neonatal deaths and 50% of the stillbirths in sub-Saharan Africa were due to intrapartum complications.²⁻⁴ Reductions in maternal and neonatal mortality and stillbirths have been prioritized in the United Nations Sustainable Development Goals (SDGs) 3.1 and 3.2 that promote targets of fewer than 70 maternal deaths per 100,000 live births, 12 or fewer neonatal deaths per 1,000 live births, and 12 or fewer stillbirths per 1,000 births by 2030.⁵ These targets are echoed in the updated World Health Organization (WHO) Global Strategy for Women's, Children's and Adolescents' Health (2016–2030) to advance progress toward reaching the SDGs.⁶

Despite an annual reduction of 2.5% per year from 1990 to 2015, the maternal mortality ratio (MMR) of 546 maternal deaths per 100,000 in sub-Saharan Africa remains the highest regional MMR in the world.¹ Similarly, the neonatal mortality rate of 28 neonatal deaths per 1,000 live births is the highest globally and its 2% annual decline rate is the lowest.⁷ A large proportion of women and infants die because they do not receive appropriate routine care and do not have support to address the “3 delays”: (1) delayed recognition of a pregnancy complication and decision to go to a facility, (2) delays in reaching an emergency obstetric care facility, and (3) delays in receiving adequate and appropriate obstetric and neonatal care at a health care facility.⁸

Maternal and neonatal deaths at the time of delivery and postpartum are largely preventable using the 9 evidence-based lifesaving interventions, called “signal functions,” which comprise emergency obstetric and neonatal care (EmONC) services.⁹ Basic EmONC (BEmONC) facilities provide 7 of the signal functions: (1) administer parenteral antibiotics, (2) administer uterotonic drugs for active management of the third stage of labor and prevention of postpartum hemorrhage, (3) use parenteral anticonvulsants for the management of preeclampsia/eclampsia, (4) perform manual removal of placenta, (5) perform removal of retained products, (6) perform assisted vaginal delivery, and (7) perform basic neonatal resuscitation. Comprehensive EmONC (CEmONC) facilities perform the 7 basic signal functions, plus 2 more: cesarean delivery and blood transfusion.¹⁰ Access to EmONC remains a global challenge,

with only 1 in 5 pregnant women experiencing pregnancy complications receiving emergency obstetric care.¹¹

Since obstetric complications are often unpredictable, WHO proposed a 2-hour travel time to the nearest facility with surgical capacity as the benchmark of access; 2 hours is the estimated interval from onset of bleeding to death if a woman with obstetric hemorrhage does not receive adequate treatment.^{10,12} More broadly, experts have recommended that at least 80% of the entire population should have access to emergency surgical care within 2 hours.¹³

Saving Mothers, Giving Life (SMGL) was a multipartner initiative designed to reduce deaths stemming from complications of pregnancy and childbirth through proven interventions that increase access to, use of, and quality of facility delivery and EmONC services, including improved newborn care.¹⁴ SMGL simultaneously implemented multiple interventions to target the 3 delays by applying a comprehensive approach to strengthen district health systems (Table 1). SMGL sought to ensure that every pregnant woman is aware of the benefits of facility-based care and has access to, and uses, quality obstetric services. The initiative established an ambitious target of achieving a 50% decline in the MMR in the pilot districts to accelerate progress toward global goals and commitments.

SMGL focused on a district health systems-strengthening strategy that was implemented in close collaboration with the national, district, and local governments of Uganda and Zambia and implementing partners, which included the U.S. Centers for Disease Control and Prevention, U.S. Agency for International Development, U.S. Peace Corps, U.S. Department of Defense, U.S. Office of the Global AIDS Coordinator, the American College of Obstetricians and Gynecologists, Every Mother Counts, Merck for Mothers, the Government of Norway, and the Project C.U.R.E.

The SMGL theory of change, goals, and objectives have been described in detail elsewhere.¹⁵ SMGL interventions in Uganda and Zambia were accompanied by intensive monitoring and evaluation (M&E) efforts that drew upon the experience of existing global initiatives designed to standardize data-collection methods for monitoring interventions, making decisions, and developing health policies related to maternal and neonatal outcomes and care.¹⁶ To ensure that M&E efforts were aligned with the country's existing data needs and priorities and that existing data systems were utilized to the greatest extent

Access to EmONC remains a global challenge, with only 20% of pregnant women experiencing pregnancy complications receiving emergency obstetric care.

TABLE 1. SMGL Strategies and Interventions Implemented in Uganda and Zambia to Reduce the 3 Delays, 2012–2017

Strategy	Approach/Intervention	Primary Delay Addressed ^a
Promote community engagement and empowerment for improved maternal and newborn health	<ul style="list-style-type: none"> Implement community-based communication and education messages on safe motherhood via mass media and community events, which includes displaying SMGL messages in public places to promote safe motherhood, broadcasting radio messages and programs, developing a documentary in Zambia, and supporting local drama groups in performing skits and traditional songs Build stronger partnerships between communities and facilities, which includes supervision and support provided by facility health workers to community volunteers Engage communities in monitoring and evaluation, which includes participation of VHTs in the SMGL baseline and endline evaluation of population maternal mortality ratio and MDSR (Uganda) 	1
Increase birth preparedness, demand for facility delivery, and use of preventive health care services	<ul style="list-style-type: none"> Assist with community activities aimed to increase birth preparedness, knowledge of pregnancy danger signs, and use of antenatal care, facility-based delivery, and postnatal care services Extend the delivery system of preventive services by using mobile and community outreach clinics to provide antenatal care, HIV counseling and testing, immunization, and postpartum family planning; ensuring provision of postpartum home care for mothers and newborns; distributing commodities through Mama Ambassadors (Uganda); and distributing birth plans through community volunteers and change champions (Zambia) 	1
Decrease financial and logistic barriers to accessing facility delivery care	<ul style="list-style-type: none"> Market and distribute clean delivery kits Market and distribute transport vouchers to subsidize access to facility delivery, antenatal, and postnatal care services Promote community-based loans to increase use of facility delivery care services 	1 and 2
Decrease distance to facility-based delivery services by increasing the number of EmONC facilities	<ul style="list-style-type: none"> Establish additional EmONC facilities and strengthen existing ones to provide: clean and safe basic delivery services; quality HIV counseling and testing; management of routine and complicated deliveries; essential and specialized newborn care; and timely referrals Implement interventions to improve facility renovations, including building operation theaters and maternity waiting homes; expanding/upgrading maternity wards, neonatal special care units, and laboratories and pharmacies; purchasing equipment, supplies, and essential medicines; and hiring and training nurses, midwives, doctors, and anesthetists in EmONC 	2 and 3
Improve the accessibility of EmONC facilities	<ul style="list-style-type: none"> Create a 24 hour a day/7 day a week communication/transportation system that is consultative, protocol-driven, quality-assured, and integrated (public and private) to ensure that women with complications reach emergency services within 2 hours Implement interventions such as purchasing ambulances and other motorized vehicles; supporting operating costs of transport, such as maintenance, insurance, and petrol; setting up district transportation committees to improve coordination of ambulances; and renovating and building maternity waiting homes 	2
Ensure facilities providing delivery care have adequate infrastructure	<ul style="list-style-type: none"> Support uninterrupted access to electricity and water Implement interventions such as procuring solar panels and generators and ensuring safe water systems in maternity wards (water tanks and provision of piped water) Support expansions, renovations, and facility enhancements to accommodate additional deliveries (including renovating and building operation theaters, expanding labor rooms, and adding postpartum wards) 	3

Continued

TABLE 1 Continued

Strategy	Approach/Intervention	Primary Delay Addressed ^a
	<ul style="list-style-type: none"> Support facility enhancements to improve neonatal survival, including renovating infrastructure to provide space for KMC and neonatal special care units and procuring special equipment (incubators, infant warmers, and phototherapy lamps) 	
Ensure sufficient medical supplies, equipment, and essential medicines	<ul style="list-style-type: none"> Strengthen supply chains for essential supplies and medicines Strengthen availability of blood supplies and surgical equipment, including the opening of new blood banks 	3
Ensure sufficient well-trained health care providers at facilities	<ul style="list-style-type: none"> Recruit new medical doctors and nurse-midwives through a joint hiring process with the districts Conduct trainings and refresher courses including: basic EmONC trainings, surgical skills course for medical officers, management of postpartum hemorrhage using uterine balloon tamponade, essential newborn care and neonatal resuscitation, and KMC Provide mentoring and supportive supervision to newly hired and existing personnel 	3
Improve quality of care and ensure care is evidence-based	<ul style="list-style-type: none"> Implement quality effective interventions, such as partograph use, active management of the third stage of labor, KMC, improved infection control practices, and management of obstetric complications protocols to prevent and treat obstetric and newborn complications Ensure reliable delivery of quality essential and emergency maternal and newborn care, which includes interventions such as the training of midwives in respectful maternity care and the use of facility-generated data to review quality of care and implement practice changes Develop guidelines and policies, and ensure protocol adherence through activities such as the introduction of clinical guidelines and protocols for diagnosing and managing most common obstetric emergencies, delivery checklists, and a tool to prevent perinatal deaths by using data to guide actions (BABIES matrix) 	3
Ensure referral capacity exists to support transfers to higher level of care	<ul style="list-style-type: none"> Improve referral communication systems through increased communication capacity and introduction of referral protocols and forms Ensure timely referrals through purchase of motorized vehicles, support of operating costs of transport, and promotion of district-level coordination 	3
Strengthen health management information system and maternal and perinatal death surveillance	<ul style="list-style-type: none"> Set up pregnancy outcomes monitoring surveillance in health facilities and train health providers and health monitoring officers in data recording, data abstraction, data entry, and data file management Strengthen maternal and perinatal death surveillance in health facilities, including the development of national standards for MDSR Train medical doctors in assigning causes of maternal death using ICD-MM Train health personnel in conducting maternal and perinatal death reviews at facility and district levels Introduce a community MDSR system using the VHTs and other district personnel and develop protocols and tools, including an electronic data monitoring system 	1,2,3

Abbreviations: BABIES, birthweight group age-at-death boxes for an intervention and evaluation system; EmONC, emergency obstetric and newborn care; ICD-MM, International Classification of Diseases—Maternal Mortality; KMC, kangaroo mother care; MDSR, maternal death surveillance and response; SMGL, Saving Mothers, Giving Life; VHTs, village health teams.

Note: Detailed information about SMGL country-specific interventions targeting each of the 3 delays are included elsewhere in this supplement.

^aPrimary delay addressed refers to which of the 3 delays the interventions are assumed to primarily address, since some of the interventions may address more than one delay. 1=First Delay; 2=Second Delay; 3=Third Delay.

possible, common guiding principles for M&E frameworks, and indicators were adopted.¹⁶ Data systems that documented maternal and neonatal health outcomes accurately and completely were needed to measure changes in key outcomes. Since the necessary data systems to document these outcomes were only partially in place at the outset of SMGL, intensive efforts were made to scale up or establish community- and facility-based data collection systems.

This article describes the methods employed in Uganda and Zambia to document SMGL results and presents an overview of the changes in intermediate results and health outcomes at the conclusion of the 5-year SMGL initiative. The specific strategies and interventions used in each country to address these goals are described in other articles in this supplement.^{15,17–19}

METHODS

SMGL Implementation Areas

Uganda and Zambia were selected for the SMGL initiative because of their high number of maternal deaths and elevated MMRs, average or below average use of maternal health services (especially around the time of delivery) compared with other countries in the region, government commitments to improving maternal and neonatal survival, and ability to leverage existing U.S. government platforms to promote maternal health and reduce HIV transmission. Before the SMGL initiative, Uganda and Zambia had estimated national MMRs of 438 and 398 maternal deaths per 100,000 live births, respectively.^{20,21} In Uganda alone, an estimated 4,700 maternal deaths and 35,000 neonatal deaths occurred every year.

Four SMGL-supported districts were designated as 'learning districts' in both Uganda and Zambia. Just prior to implementation of SMGL in 2011, Uganda SMGL-supported districts had a combined population of 1.75 million, with approximately 330,776 women of reproductive age (WRA; women aged 15–49 years) and an estimated 78,000 live births annually (Table 2).²² Zambia SMGL-supported districts had a smaller combined population of 925,000, with approximately 194,000 WRA and 37,000 annual live births. Whereas the 4 learning districts in Uganda were contiguous and densely populated, the 4 learning districts in Zambia were geographically dispersed and comprised a much larger, but more sparsely populated, geographic area. At SMGL baseline, Uganda learning districts had more

hospitals and high-level health centers (HC IVs) with surgical capacity per capita than the learning districts in Zambia.^{23,24} Hospitals in SMGL-supported districts in both countries are predominantly government-owned, with a few private, faith-based facilities. Both countries had a regional hospital (Fort Portal Regional Referral Hospital in Uganda and Mansa General Hospital in Zambia) that was part of the SMGL initiative, with catchment areas that extended to neighboring non-SMGL-supported districts. Health centers III in Uganda and all health centers in Zambia were mid-level facilities that provide basic maternity and newborn care and limited emergency obstetric care including some, but not all, of the 7 BEmONC signal functions. Assisted vaginal delivery, in particular, was often not performed in mid-level facilities due to concerns about possible adverse events. Health centers II in Uganda and health posts in Zambia are lower-level primary care facilities that provide antenatal, delivery, and postpartum care and refer complicated births to higher-level facilities.

The SMGL initiative was implemented in phases: Phase 0 (pre-implementation planning in 2011–2012), Phase 1 (June 2012 to December 2013), and Phase 2 (January 2014 to October 2017). Phase 1 consisted of rapidly scaled-up facility and community interventions ("the big push") to address the 3 delays.¹⁵ Phase 2 aimed to continue and consolidate successful interventions introduced in Phase 1; improve quality of care, including care for sick and small newborns; and further refine M&E methods and surveillance activities in the learning districts. Additional districts in both countries adopted the SMGL model, except for the M&E approaches.¹⁵ To evaluate SMGL's impact, comparisons of maternal and perinatal outcomes in the learning districts were made between the 12-month baseline period (June 2011 to May 2012) prior to SMGL implementation and the endline period (January to December 2016).

The baseline and endline evaluations used similar M&E approaches to measure progress and outcomes: health facility assessments (HFAs), facility pregnancy outcome monitoring with enhanced identification of maternal deaths, and, at the SMGL-supported district population level, community-based maternal death identification with Reproductive Age Mortality Studies (RAMOS) in Uganda and censuses in Zambia, which included verbal autopsies for suspected maternal deaths (Table 3). Each of the M&E data collection and analytic approaches is described in greater detail below.

Intensive efforts were made to scale up or establish community- and facility-based data collection to document maternal and neonatal health outcomes.

Each country's baseline and endline evaluations used similar M&E approaches to measure progress and outcomes.

TABLE 2. Baseline SMGL-Supported District Characteristics

Characteristic	Uganda	Zambia
Area (sq. km)	10,851	49,468
Population (2011) ^a	1,750,000	925,198
% of population in rural areas	84%	61%
Number of women of reproductive age (in 2011) ^a	330,776	193,515
Number of expected live births (in 2011) ^b	78,261	37,267
Number of health care facilities, by type (in 2011)		
Health posts	19	16
Health centers without surgical care	72	91
Health centers with surgical care	8	0
District hospitals	7	5
Regional hospital ^c	1	1
Number of facilities, by ownership (in 2011)		
Government	65	106
Private for profit	11	0
Private not-for-profit	31	7
Number of EmONC facilities (in 2011) ^d		
Basic EmONC	3	3
Comprehensive EmONC	7	4

Abbreviations: CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; SMGL, Saving Mothers, Giving Life.

^aBased on the 2013 4-district population census in Uganda and the Population and Housing Census 2010 in Zambia projected to 2011 for the 4 SMGL districts.

^bIn Uganda, expected births were estimated by multiplying the number of women of reproductive age from the 2013 4-district census by age-specific fertility rates from the 2011 Demographic and Health Survey; in Zambia, expected births were derived from the 2010 census crude birth rates.

^cFort Portal Regional Referral Hospital is a 351-bed level-3 referral hospital located in Kabarole district and serving 3 SMGL-supported districts (Kabarole, Kyenjojo, and Kamwenge) and 4 non-SMGL districts (Kasese, Ntoroko, Kyegegwaa, and Bundibugyo); Mansa General Hospital is a 352-bed level-2 referral hospital providing care to Luapula province, which, in 2011, included 1 SMGL-supported district (Mansa) and 5 nonsupported districts.

^dFacilities were classified based on whether they had, within the previous 3 months, performed the signal functions associated with each level of EmONC care. Because assisted vaginal delivery—using either forceps or vacuum extractor—is relatively uncommon in both Uganda and Zambia, some facilities were classified as fully providing EmONC care even if they did not perform assisted vaginal deliveries within the past 3 months (EmONC-1). In Uganda, district and regional hospitals and health centers with surgical capacity (health centers IV) are designated as CEmONC facilities, able to perform each of the 9 signal functions and serving about 100,000 population; in Zambia, only district and higher-level hospitals are designated to provide CEmONC care.

HFA results documented baseline status and program needs and informed the distribution of human and financial resources to strengthen infrastructure and other facility capacities.

Health Facility Assessments

At SMGL baseline and endline, each country conducted health facility assessments (HFAs) in all facilities that provided childbirth care in the SMGL-supported districts, using a modified version of the standard EmONC HFA questionnaire originally developed by the Averting Maternal Death and Disability program at Columbia University.²⁵ The HFAs gathered data on maternity care infrastructure, human resources, and adherence to safe motherhood protocols and practices, drugs, equipment, and supplies. The HFAs also characterized facility EmONC status—defined as performance of 7 BEmONC or 9 CEmONC

signal functions in the 3 months prior to the HFAs—and assessed capacity and use of transport for emergency referrals. The number of health facilities performing deliveries varied in each country over the 5-year initiative. The HFA results presented here were compiled only from those facilities that maintained delivery capacity from baseline to endline (105 in Uganda and 110 in Zambia).

The HFA baseline results were used to document baseline status and identify programmatic needs for SMGL. The results also informed the distribution of human and financial resources to strengthen infrastructure and other facility

Table 3. SMGL Indicator Baseline and Endline Data Sources in Uganda and Zambia SMGL-Supported Districts

Period and Indicator	Uganda			Zambia	
	Community	Health Center IV and Hospitals	Health Centers III and II	Community	Health Centers and Hospitals
Baseline (June 2011–May 2012)					
Routine and emergency obstetric care indicators	–	HFA	HFA	–	HFA
Institutional deliveries (vaginal and cesarean deliveries)	–	Individual outcome data and triangulation of facility registers (POMS)	Facility aggregate outcome data	–	HFA and facility aggregate outcome data
Direct obstetric complications prevalence rates	–	POMS and RAPID	Facility aggregate outcome data	–	HFA and facility aggregate outcome data
Stillbirth and predischarge neonatal mortality rates	–	POMS and RAPID	Facility aggregate outcome data	–	HFA and facility aggregate outcome data
Cause-specific maternal mortality and case fatality rates	–	POMS and RAPID triangulated with RAMOS	Facility aggregate outcome data	–	Facility aggregate outcome data triangulated with census-identified maternal deaths
Population maternal mortality ratios	RAMOS	–	–	4-district census ^a	–
Endline (January–December 2016)					
Routine and emergency obstetric care indicators	–	HFA	HFA	–	HFA
Institutional deliveries (vaginal and cesarean deliveries)	–	POMS	POMS	–	HFA and facility aggregate outcome data
Direct obstetric complications prevalence rates	–	POMS and RAPID	POMS and RAPID	–	HFA and facility aggregate outcome data
Stillbirth and predischarge neonatal mortality rates	–	POMS and RAPID	POMS and RAPID	–	HFA and facility aggregate outcome data
Cause-specific maternal mortality and case fatality rates in facilities	–	POMS and RAPID triangulated with RAMOS	POMS and RAPID triangulated with RAMOS	–	Facility MDSR; individual cases triangulated with census-identified maternal deaths
Population maternal mortality ratios	RAMOS	–	–	4-district census ^a	–

Abbreviations: HFA, health facility assessment; MDSR, maternal death surveillance and response; POMS, Pregnancy Outcome Monitoring System; RAPID, Rapid Ascertainment Process for Institutional Deaths; RAMOS, Reproductive Age Mortality Studies.

^aConducted in 2012 and 2017 for the previous 18 months; 12-month pre-census population maternal mortality ratios were estimated after adjustments for underreporting of population and births.

capacities, particularly during Phase 1 of the initiative.²⁶ The results of the endline HFAs, conducted in November 2016, were used to assess changes in infrastructure and capacity at the end of the initiative and to guide planning for post-SMGL sustainability. Baseline and endline indicators of changes in health care facility infrastructure, availability of medications and supplies, and EmONC functions and labor management were calculated as the percentages of all facilities that reported positive

responses on the HFA indicators, with the exception of indicators that are reported as complete enumerations.

Facility Pregnancy Outcome Monitoring

Individual and aggregated retrospective pregnancy outcome data, including identification of maternal deaths in facilities, were collected periodically by trained health facility staff and SMGL M&E personnel in both countries using enhanced

data collection tools. In 2011, Uganda and Zambia had just started to use an electronic aggregated health service data platform (District Health Information System, version 2), which did not cover all health facilities. To address this, SMGL M&E teams developed standard abstraction forms and operation procedures for ongoing data collection of health service and outcome indicators. SMGL-supported facility monitoring led to improvements in tracking routine service delivery indicators as part of the newly established district data platform.

In Uganda, SMGL-supported facilities provided CEmONC implemented individual-level Pregnancy Outcome Monitoring Surveillance (POMS) data collection on maternal and newborn outcomes, including information on obstetric surgeries. As part of POMS, a package of standard tools was developed and used to obtain comprehensive maternal and reproductive health information: (1) electronic abstraction of all individual pregnancy outcomes found in labor and delivery registers, (2) abstraction forms to triangulate data on complications and obstetric surgeries from multiple sources, and (3) standard operation procedures to perform data abstraction and data entry. Because SMGL-supported facilities used ward-specific log books rather than centralized health records, POMS data from hospitals and HC IVs were triangulated with patient logs from various sources—such as labor and delivery, post-partum, female ward, surgical, admission/discharge registers, and hospital morgues—within each health facility.²⁷ Trained SMGL M&E and clinical staff collected information on maternal characteristics, type of delivery, pregnancy outcomes, and up to 3 maternal complications at the time of each delivery. The most immediately life-threatening complication was used to analyze maternal morbidities and calculate case fatality rates (CFRs) from direct obstetric causes. Although data on early pregnancy outcomes—spontaneous and induced abortions and ectopic pregnancies—were also individually collected, they were not included in the calculation of the severe direct obstetric complications and CFRs unless they led to maternal demise. This approach was used to ensure that only severely complicated early pregnancy outcomes are examined and yield conservative estimates of met need for obstetric complications and CFRs.

In lower-level delivery facilities in Uganda, aggregated outcome data from maternity registers were collected at baseline. By Phase 2 of SMGL, the individual-level POMS approach was expanded to all delivery facilities and individual

delivery and pregnancy loss data were collected every 3 months using a Microsoft Access-based electronic data management system. Starting in 2013, the Ugandan Ministry of Health, in collaboration with the implementing partners, introduced an ongoing maternal death surveillance and response (MDSR) system in SMGL-supported health facilities and communities, with the goal of more accurately identifying and ascertaining maternal deaths.

In Uganda, detection of facility maternal deaths was enhanced using the Rapid Ascertainment Process for Institutional Deaths (RAPID) methodology,²⁸ in which all health facility records related to deaths among WRA were reviewed. RAPID data collection was conducted periodically in hospitals and HC IVs by Ugandan and U.S. Centers for Disease Control and Prevention obstetricians, and collected data were cross-checked with POMS data. While conducted separately, RAPID enhanced the capacity of facility-based MDSR to identify and review additional facility maternal deaths.

In Zambia, aggregate facility maternal and perinatal outcome data were collected at baseline by SMGL M&E teams from each implementing partner in conjunction with the baseline HFA data collection. After SMGL interventions were introduced, monthly collection of aggregated facility outcomes data continued through the end of Phase 1 (December 2013). Facility data abstraction forms were used to compile aggregated data primarily from maternity registers. However, data abstraction forms and the completeness of case detection varied among implementing partners. In Phase 2, the periodicity of data abstraction changed from monthly to quarterly and a unified electronic data abstraction tool was implemented.

Starting in mid-2015, enhanced case detection and an audit of each maternal death became mandatory in all Zambian health facilities as part of newly implemented national maternal mortality surveillance. SMGL monitoring included audited maternal deaths in the estimation of endline facility maternal mortality.

In both countries, and in accordance with the global MDSR guidance,²⁹ baseline and endline measurements of maternal deaths in SMGL-supported facilities were derived by cross-checking multiple facility and community data sources (as further described) in order to capture a complete list of maternal deaths. Maternal deaths captured in these sources include those due to direct and indirect obstetric causes. Direct, indirect, and cause-specific MMRs in facilities

In Uganda, SMGL-supported facilities triangulated POMS data and patient logs within each facility.

In Zambia, facility data abstraction forms were used to compile aggregated data primarily from maternity registers.

were calculated as the number of cause-specific maternal deaths per 100,000 live births. WHO guidelines for using the 10th revision of the International Classification of Diseases to the classification of maternal mortality (ICD-MM) were applied to determine the underlying cause of death.³⁰ However, this was complicated by the inclusion of the deaths of pregnant or postpartum women who lived outside SMGL-supported districts—and, thus, were not exposed to the SMGL interventions—in the count of maternal deaths in the SMGL-supported facilities.

Facility-based pregnancy outcome data were used to estimate other standard indicators of monitoring emergency obstetric care, such as the cesarean delivery rate, met need for emergency obstetric care, the direct obstetric CFR, and the facility MMR.^{5,10} The cesarean delivery rate was defined as the proportion of deliveries by cesarean delivery of total district births. Met need for emergency obstetric care in all facilities was defined as the proportion of all women expected to have developed severe obstetric complications (estimated at 15%)¹⁰ who were treated in any health facility, and the met need for emergency obstetric care in EmONC facilities was represented by the proportion of expected severe obstetric complications that were treated in a fully functioning EmONC facility. The direct obstetric CFR was defined as the proportion of all women admitted to all facilities and to EmONC facilities with a given severe complication who died before discharge. The facility MMR was calculated as the number of maternal deaths per 100,000 live births in SMGL-supported facilities.

Throughout the SMGL initiative, the number of stillbirths and predischarge neonatal deaths among babies weighing ≥ 1000 grams were monitored from information recorded in facility maternity registers. In contrast to the monitoring of maternal deaths for SMGL, identification of perinatal deaths was not enhanced through triangulation of multiple data sources, audits were less widespread, and underlying medical and non-medical causes were not consistently available. Individual-level data on maternal and delivery characteristics, Apgar scores, and birthweight were available only in Uganda; similar data were collected as aggregate counts in Zambia. Although facility HFAs reported whether they had performed neonatal resuscitation, information about successful neonatal resuscitation was not available for either country.

The facility perinatal mortality rate was calculated as the number of stillbirths and predischarge

neonatal deaths among births delivered in facilities divided by the total number of births (live births and stillbirths) in SMGL-supported facilities. Similarly, the total facility stillbirth rate (SBR) was calculated as the total number of facility stillbirths per 1,000 facility births. In Uganda, where timing of fetal death was captured, it was possible to calculate the intrapartum SBR as the number of intrapartum stillbirths (those occurring after the onset of labor but before birth) divided by the total number of births per 1,000 births. Finally, the predischarge neonatal mortality rate (NMR) was calculated as the number of facility neonatal deaths divided by the total number of facility live births per 1,000 live births.

Community-Based Maternal Death Identification

In Uganda, retrospective RAMOS were conducted in SMGL-supported districts to capture community-level maternal deaths at baseline, end of Phase 1, and endline. At baseline, trained village health teams used community registers to identify and compile lists of WRA deaths in the prior 18-month period. Deaths were investigated using a 1-page screening tool to identify WRA who had been pregnant during the 2 months preceding death. Caretakers of women who died while pregnant or postpartum were interviewed using a standardized verbal autopsy protocol, which explores circumstances and potential causes of maternal death.^{29,31} At the end of Phase 2, the trained interviewers used an expanded RAMOS questionnaire that collected data on household composition, lifetime and recent pregnancy events among all WRA residing in the household, and all deaths in the household since January 2016. Households that reported WRA deaths were further asked to identify if deaths occurred during pregnancy, delivery, or postpartum using the baseline 1-page screening tool. Verbal autopsy teams conducted interviews with caregivers to women whose deaths were associated with pregnancy. At both baseline and endline, verbal autopsy data were analyzed independently by 2 physicians trained to assign underlying cause of death, with a third physician opinion sought when no consensus on cause of death could be reached. They then issued a consensus standard WHO death certificate for each verbal autopsy. Only maternal deaths that occurred during the baseline and endline periods were included in the analyses.

In Zambia, community-level maternal mortality data were collected using household population censuses conducted in 2012 and 2017. The

In Uganda, retrospective RAMOS were conducted in SMGL-supported districts to capture community-level maternal deaths at baseline, end of Phase 1, and endline.

Population-based MMRs were computed using information collected through verbal autopsies in Uganda and Zambia at baseline and endline.

primary aim of the censuses was to assess the baseline mortality for WRA—including maternal mortality—and the change between the 2 time points. To enable calculation of maternal mortality rates and ratios, the household census data provided the number of WRA, the number of WRA deaths, and the number of live births in the population within the 12-month period before each census. For the 2012 census, the recent period used for WRA deaths and births was March 2011–February 2012; for the 2017 census, the recent period was July 2016–June 2017. A series of questions was asked about each person who was a usual member of the household and had died recently (since October 1, 2010, for the 2012 census and since January 1, 2016, for the 2017 census), including the age, sex, and dates of birth and of death. For each death of a woman aged 12 to 49 years, additional questions were asked about whether the woman had died when pregnant, during childbirth, or within 2 months after the end of a pregnancy.

For each death of women aged 12 to 49 years, a verbal autopsy interview was conducted with a member of the household to record information about the circumstances, signs, and symptoms experienced by the deceased before she died. Teams of trained physicians reviewed the verbal autopsy interview responses and coded them to assign causes of death within both the baseline and endline censuses. To compensate for underreporting of deaths in reported numbers of all deaths of women aged 15 to 49 years and on maternal deaths from the baseline and endline censuses, standard adjustments to the data were made.

We compared census-based measurements of population, births, and deaths in the 4 SMGL-supported districts with external sources and assessed that they were incomplete, particularly at baseline.^{20,21,32–34} We adjusted the 4 district mortality completeness using the General Growth Balance method.³⁵ The adjustment factors were derived from fitting a line to a series of observed and predicted mortality rates for different age groups using the most recent national censuses and the United Nations Census Pregnancy-Related Mortality (CensusPRM) workbook for estimating maternal mortality from census data.³⁶

The proportion of deaths among women of reproductive age that are due to maternal causes was estimated using the verbal autopsy data and applied to adjusted numbers of deaths to WRA to obtain the estimated number of maternal deaths. Likewise, the proportions of maternal deaths due to specific causes were applied to the estimated

number of all maternal deaths in a reporting period to estimate the number of maternal deaths by cause.

In order to establish a more comprehensive count of maternal deaths in facilities, community maternal death data in both countries were cross-checked with deaths reported through facility monitoring. A probabilistic match between information from verbal autopsies and from facility monitoring using place, cause, and month of death was completed. If a facility death was reported in a verbal autopsy but was not matched to a death recorded in the facility's monthly monitoring statistics, the death was classified as an additional facility-based death and added to the facility count of maternal deaths.

Population-based MMRs were computed using information collected through verbal autopsies in Uganda and Zambia at baseline and endline. Total and cause-specific MMRs were calculated after classifying causes of maternal death in accordance with ICD-MM.²⁹ Zambia baseline verbal autopsy data were reclassified at the endline using ICD-MM, which was initially only used at endline. This resulted in an increase in the counts of Zambia maternal deaths identified in the baseline census and a corresponding increase in the baseline facility-based maternal mortality previously published.¹⁶ Direct, indirect, and cause-specific population MMRs were calculated as the number of cause-specific deaths in the SMGL-supported districts per 100,000 live births to WRA in these districts. The annual rate of SMGL MMR reduction (ARR) was calculated as: $ARR = \log(MMR_{endline}/MMR_{baseline})/5*100$. This is consistent with WHO methodology to estimate MMR ARRs both globally and at the country level.¹

Response rates for verbal autopsies were very high in both countries. In Uganda, only 6 suspected maternal deaths identified in the baseline RAMOS and 2 deaths in the endline were not followed by an interview due to household dissolution or relocation. There were no refusals to participate in the baseline and endline RAMOS studies. In Zambia, several suspected maternal deaths were not followed by verbal autopsies (11 at baseline and 18 at endline). Refusals were encountered from 2 and 5 households, respectively. However, population maternal mortality data from Zambia are adjusted estimates based on the application of the General Growth Balance method to compensate for underreporting of WRA deaths and the estimated proportion of deaths among WRA that are due to maternal causes to derive maternal deaths.

Population Denominators

Calculation of population MMRs and selected EmONC indicators requires external population data. District-wide censuses in Zambia (2012 and 2017) and Uganda (2013 and 2017) were conducted by SMGL to enumerate households, population, and WRA. Enumerations were projected back to estimate the 2011 population using the inverse growth coefficient derived from the intercensal population growth rate provided by the countries' national statistics bureaus.^{32,33} The baseline number of live births in Zambia districts was estimated by applying crude birth rates to the baseline district populations—directly derived from the 2010 national census. The endline live births were estimated by applying district-specific facility delivery rates calculated from the 2017 SMGL census to the endline district population. In Uganda, the number of live births was estimated by applying age-specific fertility rates among WRA enumerated in 2013 and 2017 in Uganda districts. For both countries, we calculated MMRs in facilities using the number of live births in facilities as the denominator and population-based MMRs using the estimated number of live births in the SMGL-supported districts.

Statistical Analyses

The results shown here were based on 4 district data analyses performed for each country. They were based on the total population and total number of health facilities in the SMGL-supported districts in each country. They were not a sample and are not representative of a larger population in the country. The pregnancy outcomes in facilities, including institutional mortality rates and ratios, were based on complete enumeration of deaths identified in facilities, so they were not subject to sampling error. However, the rates and ratios may be affected by random variation and changes in case detection.³⁷ The following statistical tests were used when testing the difference between the Phase 0 and Phase 2 results. For the mortality rates and ratios, the error was modeled assuming deaths and births to be distributed according to a Poisson distribution. A z statistic, $z = \sqrt{SE(MMR_{baseline})^2 + SE(MMR_{endline})^2}$,² was used to calculate the P value of the difference between the baseline and endline MMRs, both in facilities and when comparing population MMRs.³⁸ Similarly, changes in other core indicators, based on complete counts of events

during the 2 periods, were also estimated using z statistics for significance testing. Finally, for the indicators that capture facility functionality, infrastructure, and availability of supplies, the McNemar's test, which is appropriate for dichotomous responses for matched pairs of data collected at different time points, was used to test for significant differences.³⁹ Results were considered significant if $P < .05$.

District-wide censuses in Zambia and Uganda were conducted by SMGL to enumerate households, population, and WRA to facilitate calculation of population MMRs.

Ethical Considerations

The study protocol was approved by, and complied with, Uganda and Zambia Ministries of Health procedures for protecting human rights in research, and was deemed nonresearch by the U.S. Centers for Disease Control and Prevention Human Research Protection Office of the Center for Global Health. Written informed consent was obtained for respondents in all households and among women for the census and RAMOS interviews. For the verbal autopsies, written consent among the caregivers of the deceased subjects was obtained after informing the caregivers about the purpose and public health importance of the research, selection procedures, voluntary participation, and confidentiality. Interviews were scheduled no sooner than 6 weeks after the death occurred.

RESULTS

Each country's SMGL-supported districts achieved improvements in numerous aspects of facility infrastructure and provision of delivery care (Table 4). By the end of the initiative, the proportion of delivery facilities that provided delivery care 24 hours a day/7 days a week had increased significantly by 41% in Zambia (from 68.2% to 96.4%) but had not increased significantly in Uganda, where the baseline 80% of facilities providing care 24 hours a day/7 days a week was already comparatively high. The proportion of facilities with uninterrupted electricity increased significantly in both countries, from 57.1% to 96.2% in Uganda and from 55.5% to 96.2% in Zambia. Virtually all SMGL-supported facilities in both countries had running water and functional communications systems by the end of the initiative. In Zambia, where distances to facilities were greatest, transport capacity at the facility level increased by 31%, from 55.5% to 72.7%. Facility obstetric capacity—defined as having a sufficient number of beds so obstetric patients do not share beds—increased significantly in Uganda (from 35.2% to 91.4%) but remained insufficient at endline in Zambia, where about one-quarter of

Virtually all SMGL-supported facilities in both countries had running water and functional communications systems by the end of the initiative.

TABLE 4. Selected Facility Characteristics and Interventions at Baseline and Endline in Uganda and Zambia SMGL-Supported Districts

Facility Characteristic/Intervention	Uganda (n=105 facilities)			Zambia (n=110 facilities)			Sig. Level ^d
	Baseline ^{a,b}	Endline ^{a,b}	% Change ^c	Baseline ^{a,b}	Endline ^{a,b}	% Change ^c	
Facility infrastructure							
Availability of delivery services 24 hours a day/ 7 days a week	80.0	87.6	+10	NS	68.2	96.4	+41 ***
Uninterrupted electricity available	57.1	96.2	+69	***	55.5	92.7	+67 ***
Running water available	76.2	100.0	+31	N/A	90.0	97.3	+8 **
Functional communications available ^e	93.3	99.0	+6	**	44.6	100.0	+124 N/A
Transportation available ^f	61.0	59.0	-3	NS	55.5	72.7	+31 ***
Sufficient number of obstetric beds	35.2	91.4	+160	***	62.7	73.6	+17 NS
Women do not deliver on the floor	85.7	91.4	+7	NS	71.3	83.8	+18 NS
Mother shelter present	0	3.9	NA	N/A	28.8	48.8	+69 ***
Availability of medications and supplies							
No stock-out in last 12 months: magnesium sulfate ^g	47.6	63.8	+34	***	20.0	43.0	+115 ***
No stock-out in last 12 months: oxytocin ^g	56.2	81.9	+46	***	75.3	75.0	-0.4 NS
HIV rapid test kits currently available ^{g,h}	70.5	79.0	+12	NS	82.5	93.8	+14 **
At least 1 long-acting reversible family planning method currently available	41.0	55.2	+35	***	20.0	71.3	+257 ***
EmONC functions and labor management							
Number of functioning CEmONC facilities	7	17	+143	N/A	4	5	+25 N/A
Number of functioning BEmONC facilities	3	9	+200	N/A	3	8	+167 N/A
Number of facilities with partial BEmONC ⁱ	19	34	+79	N/A	22	29	+32 N/A
Use of partograph to monitor labor	33.3	92.4	+178	***	NA	92.7	NA NA
Active management of third stage of labor	75.2	96.2	+28	***	71.8	95.5	+33 ***
Use of parenteral antibiotics in last 3 months	85.7	92.4	+8	NS	79.1	73.6	-7 NS
Use of parenteral oxytocin in last 3 months	69.5	98.1	+41	***	90.9	95.5	+5 NS
Use of parenteral anticonvulsants in last 3 months	48.6	34.3	-29	**	44.6	40.0	-10 NS
Perform newborn resuscitation in last 3 months	34.3	87.6	+155	***	27.3	74.6	+173 ***
Perform manual removal of placenta in last 3 months	28.6	54.3	+90	***	39.1	30.0	-23 NS
Remove retained products in last 3 months	19.0	61.9	+226	***	17.3	49.1	+184 ***
Perform assisted vaginal delivery in last 3 months	4.8	10.5	+119	NS	10.0	15.5	+55 NS
Perform surgery (cesarean delivery) (HC IV or higher) in last 3 months	7.6	16.2	+113	***	3.6	4.6	+28 NS
Perform blood transfusion (HC IV or higher) in last 3 months	8.6	16.2	+88	***	5.5	4.6	-16 NS
Perform maternal death reviews ^j	6.7	32.4	+384	***	42.5	75.0	+76 **

Continued

TABLE 4. Continued

Facility Characteristic/Intervention	Uganda (n=105 facilities)			Zambia (n=110 facilities)			Sig. Level ^d
	Baseline ^{a,b}	Endline ^{a,b}	% Change ^c	Baseline ^{a,b}	Endline ^{a,b}	% Change ^c	
Health facility has associated community volunteers	18.3	91.5	+400	***	63.8	96.3	+51 ***

Abbreviations: BEmONC, basic emergency obstetric and newborn care; CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; HC, health center; Sig., significance.

Note: All data reported as percentages unless otherwise noted.

^aBaseline period is June 2011–May 2012; endline period is January–December 2016.

^bBaseline and endline results are percentages of all facilities, unless otherwise noted.

^cPercent change calculations based on unrounded numbers.

^dAsterisks indicate significance level of the difference between baseline and endline outcomes using McNemar's exact test, as follows:

***P<.01, **P<.05, NS = not significant. NA = data not available. N/A = not applicable.

^eUganda: facility-owned landline, cell, two-way radio, or individual had cell phone; Zambia: two-way radio, landline, or cell phone with service.

^fUganda: available and functional motorized vehicle with fuel today and funds generally available; Zambia: motor vehicle, motorcycle, or bicycle.

^gZambia: Kalomo facilities did not collect the information and were excluded from the analysis.

^hUganda: Rapid HIV test was used in maternity ward in the last 3 months (does not indicate current availability).

ⁱPercentage of health centers that performed 4 to 5 basic emergency obstetric care interventions in the past 3 months.

facilities reported that obstetric patients have to share beds.

Availability of lifesaving medications and supplies improved, with significant increases in the percent of facilities in both countries reporting no stock-outs of magnesium sulfate (Table 4). Despite the significant increase, however, at endline only 63.8% of facilities in Uganda and 43.0% in Zambia reported no magnesium sulfate stock-outs. The availability of oxytocin also improved in Uganda, where the percent of facilities reporting no stock-outs increased significantly from 56.2% to 81.9%. The percent of facilities having no stock-outs of oxytocin in Zambia, however, did not change significantly. Because the availability of HIV rapid test kits in facilities was already over 70% in Uganda and over 83% in Zambia at SMGL baseline, no significant increase of their availability was reported in either country. However, the availability of long-acting reversible family planning methods did increase significantly in both countries over the course of SMGL.

Both countries' SMGL-supported districts documented increases in the number of health care facilities that reported having provided CEmONC and BEmONC signal functions in the 3 months prior to the baseline and endline HFAs. Additionally, a larger number of non-EmONC facilities were able to perform 4 to 5 of the 7 basic EmONC signal functions. At endline, more than 92% of facilities in both countries reported

routine partograph use to monitor labor, with partograph use almost tripling in Uganda (from 33.3% to 92.4%, a significant increase). The practice of active management of the third stage of labor also increased significantly and was nearly universal in both counties at endline (96.2% in Uganda and 95.5% in Zambia). Use of parenteral antibiotics did not increase significantly in either country; however, use of parenteral oxytocin increased significantly in Uganda but not in Zambia. Use of parenteral magnesium sulfate remained low in both countries, with use declining slightly but significantly in Uganda. In both countries, SMGL-supported facilities reported significant increases in performance of neonatal resuscitation—from 34.3% to 87.6% in Uganda and from 27.3% to 74.6% in Zambia. In Uganda, significant increases were seen in the percentage of facilities that reported having performed manual removal of the placenta, removal of retained products, cesarean deliveries, and blood transfusions. In Zambia, significant increases were only found in performance of removal of retained products. The proportion of health facilities conducting maternal death reviews, as mandated by government health policies in both countries since 2009, increased significantly from 6.7% to 32.4% (from 7 to 34 facilities) in Uganda and from 42.5% to 75.0% (from 47 to 82 facilities) in Zambia.

SMGL-supported facilities in both countries documented significant improvement over the

**In both countries,
SMGL-supported
facilities reported
significant
increases in
performance of
neonatal
resuscitation.**

TABLE 5. Maternal Health Outcomes in Facilities at Baseline and Endline in Uganda and Zambia SMGL-Supported Districts

Maternal Health Outcomes	Uganda				Zambia			
	Baseline	Endline	% Change	Sig. Level ^a	Baseline	Endline	% Change	Sig. Level ^a
Number of live births – all facilities	33,492	57,355	+71	N/A	21,914	38,174	+74	N/A
Institutional delivery rate – all facilities (%)	45.5	66.8	+47	***	62.6	90.2	+44	***
Institutional delivery rate – EmONC facilities (%)	28.2	41.0	+45	***	26.0	29.1	+12	***
Number of obstetric complications treated ^b	5,256	8,458	+61	N/A	1,844	1,979	+7	N/A
Cesarean delivery rate as a proportion of all births (%)	5.3	9.0	+71	***	2.7	4.8	+79	***
Met need for emergency obstetric care – all facilities (%)	46.3	64.7	+40	***	34.1	30.6	-10	***
Met need for emergency obstetric care – EmONC facilities (%)	39.2	62.1	+58	***	25.8	23.1	-11	***
Direct obstetric case fatality rate – all facilities (%)	2.6	1.7	-37	***	3.7	3.2	-12	NS
Direct obstetric case fatality rate – EmONC facilities (%)	2.9	1.6	-45	***	2.9	3.8	+31	NS
Facility MMR, overall (per 100,000 live births)	534	300	-44	***	370	231	-38	***
Direct obstetric causes MMR	415	244	-41	***	310	168	-46	***
Obstetric hemorrhage MMR ^c	131	77	-42	***	119	42	-65	***
Puerperal infection/sepsis MMR ^d	75	47	-37	NS	NA	NA	N/A	N/A
Obstructed labor MMR ^e	72	56	-22	NS	59	31	-47	NS
Abortion-related MMR ^f	63	23	-64	***	NA	NA	N/A	N/A
Preeclampsia/eclampsia MMR	45	26	-42	NS	NA	NA	N/A	N/A
Other major direct obstetric causes MMR ^g	30	16	-47	NS	132	94	-29	NS
Indirect obstetric causes MMR ^h	119	56	-53	***	59	63	+6	NS
Facility perinatal mortality (per 1,000 births)	39.3	34.4	-13	***	37.9	28.2	-26	***
Total stillbirth rate (per 1,000 births)	31.2	27.0	-13	***	30.5	19.6	-36	***
Intrapartum stillbirth rate (per 1,000 births)	22.4	14.3	-36	***	NA	NA	N/A	N/A
Predischarge neonatal mortality rate (per 1,000 live births)	8.4	7.6	-10	NS	7.7	8.7	+14	NS

Abbreviations: EmONC, emergency obstetric and newborn care; MMR, maternal mortality ratio; Sig., significance.

^aAsterisks indicate significance level of the difference between baseline and endline outcomes for all facilities combined, using a z statistic to calculate the P value of the difference, as follows:

***P<.01, **P<.05, NS = not significant. NA = data not available. N/A = not applicable.

^bExcludes early pregnancy complications (e.g., abortion-related complications and ectopic pregnancy).

^cIncludes antepartum, intrapartum, and postpartum hemorrhage.

^dInfection of the genital tract occurring at any time between the onset of the rupture of membranes or labor and the day of death in facility; in Zambia, these maternal deaths were classified as deaths due to “other major direct complication.”

^eObstructed and prolonged labor including rupture of the uterus.

^fDeaths after induced and spontaneous abortions.

^gIn Uganda, it includes deaths due to embolism, anesthesia, and ruptured ectopic pregnancy; in Zambia, it includes these conditions plus deaths due to puerperal infections, eclampsia/preeclampsia, and abortion.

^hIncludes HIV-, TB-, and malaria-related maternal deaths and those due to other medical conditions aggravated by pregnancy or postpartum.

course of the SMGL initiative in numerous health outcome-related indicators (**Table 5**). For example, the volume of facility deliveries increased by 71% in Uganda and by 74% in Zambia and facility delivery rates increased significantly, with a 47% increase in facility

deliveries in Uganda (from 45.5% to 66.8% of district births) and a 44% increase in Zambia (from 62.6% to 90.2% of district births). Delivery rates in EmONC facilities also increased significantly, by 45% in Uganda and 12% in Zambia.

The number of major direct obstetric complications treated in facilities also increased in both countries, including reported facility cases of obstetric hemorrhage, prolonged or obstructed labor, ruptured uterus, sepsis, preeclampsia/eclampsia, and other severe direct obstetric complications (data not shown). The met need for EmONC in all facilities—meaning the proportion of all women with major direct obstetric complications in the population treated in health facilities—increased by 40% in Uganda (from 46.3% to 64.7%) but declined by 10% in Zambia (from 34.1% to 30.6%). Similarly, the met need in EmONC facilities—meaning the proportion of all women with major direct obstetric complications in the population treated in EmONC facilities—increased by 58% in Uganda but declined slightly in Zambia. Cesarean delivery rates in the SMGL-supported districts increased by 71% in Uganda (from 5% to 9%) and 79% in Zambia (from 3% to 5%).

Facility MMRs declined significantly in both countries, from 534 to 300 maternal deaths per 100,000 live births in Uganda facilities (a 44% decline) and from 370 to 231 per 100,000 live births in Zambia (a 38% decline) (Table 5). In all, facility maternal mortality due to direct obstetric causes declined by 41% in Uganda and 46% in Zambia. The facility MMR for obstetric hemorrhage decreased from 131 to 77 maternal deaths per 100,000 in Uganda (a 42% decline) and from 119 to 42 maternal deaths per 100,000 in Zambia (a 65% decline). In addition, maternal mortality due to postabortion complications fell significantly in Uganda facilities from 63 to 23 maternal deaths per 100,000 (a 64% decline). Although the direct obstetric CFR in all facilities declined from 2.6% to 1.7% in Uganda (a significant 37% decline), it did not change significantly in Zambia. At endline, neither country's direct obstetric CFR reached the 1% upper limit established by WHO¹⁰; Zambia's direct obstetric CFR remained especially high at 3.2%.

In Uganda, the facility perinatal mortality rate declined significantly from 39.3 to 34.4 perinatal deaths per 1,000 births, a 13% decline. The total SBR in Uganda declined by 13%, from 31.2 to 27.0 stillbirths per 1,000 births, due to reduction in the intrapartum SBR, which declined by 36% (from 22.4 to 14.3 intrapartum stillbirths per 1,000 births); antepartum SBR increased from 8.8 to 12.7 antepartum stillbirths per 1,000 births. In Zambia, the facility perinatal mortality rate declined significantly from 37.9 to 28.2 perinatal deaths per 1,000 births, a 26% decline, and the total SBR declined from 30.5 to 19.6 stillbirths per

1,000 live births. Neither country achieved a significant decline in the predischARGE NMR, with final rates of 7.6 neonatal deaths per 1,000 live births in Uganda and 8.7 neonatal deaths per 1,000 live births in Zambia.

At the district population level, the total number of maternal deaths in Uganda dropped from 342 at baseline to 222 at endline (Table 6). The associated Uganda SMGL population-based MMR declined significantly—from 452 to 255 maternal deaths per 100,000 live births, a reduction of 44% (Table 6). This corresponds with an ARR of 11.5% per year. In the Zambia SMGL-supported districts, the adjusted number of maternal deaths decreased from 200 to 135 maternal deaths, corresponding to a reduction in the MMR from 480 to 284 deaths per 100,000 live births, a 41% decline, and an ARR of 10.5%. In SMGL-supported districts, the reduction in maternal mortality was largely driven by declines in direct obstetric causes, with population-level direct obstetric MMRs declining significantly in Uganda (49%) and Zambia (40%). Significant declines in cause-specific mortality were observed in Uganda for obstetric hemorrhage (a 45% decline), obstructed labor (a 36% decline), eclampsia (a 51% decline), postabortion complications (a 67% decline), and other direct causes (a 67% decline). In Zambia, district maternal deaths due to obstetric hemorrhage declined significantly (a 66% decline) as did deaths due to obstructed labor (an 87% decline). Documented changes in indirect obstetric MMRs were not significant in either country. Maternal mortality fell significantly during the intrapartum period and up to 24 hours postpartum in both countries (by 72% in Uganda and 46% in Zambia). Declines in antepartum mortality—before the onset of labor—and greater than 24 hours postpartum were not statistically significant.

In SMGL-supported districts, the reduction in maternal mortality was largely driven by declines in direct obstetric causes.

In Uganda and Zambia SMGL-supported districts, declines in maternal mortality were significant during delivery and immediately postpartum, when SMGL interventions that focused on the intrapartum period would be expected to have their greatest impact.

■ DISCUSSION

Over a 5-year period, the SMGL initiative implemented a comprehensive health systems strengthening approach that focused on making rapid improvement in availability of, and access to, facility delivery and EmONC services. The increase in availability of services, together with community-level demand generation, was associated with a greater proportion of facility deliveries and improvement in health outcomes. The respective 44% and 41% declines in population-based maternal mortality in Uganda and Zambia learning districts attest to the success of the SMGL initiative in achieving its central goal. The magnitude of the

TABLE 6. Changes in District-Wide Numbers of Maternal Deaths and Maternal Mortality Ratios (per 100,000 Live Births) in Uganda and Zambia SMGL-Supported Districts, by Cause and Timing of Death

	Uganda				Zambia			
	Baseline	Endline	% Change	Sig. Level ^a	Baseline	Endline	% Change	Sig. Level ^a
Number of maternal deaths	342	222	N/A	N/A	200	135	N/A	N/A
Total MMR ^{b,c}	452	255	-44	***	480	284	-41	***
Cause of death (MMRs) ^d								
Direct obstetric causes	382	195	-49	***	364	220	-40	***
Obstetric hemorrhage	128	70	-45	***	131	45	-66	***
Obstructed labor (including uterine rupture)	71	46	-36	**	44	6	-87	**
Preeclampsia/eclampsia	58	29	-51	***	36	22	-39	NS
Puerperal infection/sepsis	33	21	-37	NS	29	42	+44	NS
Abortion-related	42	14	-67	***	66	64	-2	NS
Other direct obstetric causes	49	16	-67	***	58	42	-28	NS
Indirect obstetric causes	70	60	-15	NS	116	64	-45	NS
Timing of death (MMRs) ^e								
Antepartum	66	53	-20	NS	109	59	-46	NS
Intrapartum and immediate postpartum (up to 24 hours)	224	62	-72	***	196	106	-46	**
>24 hours–42 days postpartum	161	140	-13	NS	175	120	-31	NS

Abbreviations: MMR, maternal mortality ratio; P/F, parity/fertility; Sig., significance.

^a Asterisks indicate significance level of the difference between baseline and 2016 MMRs, using a z statistic to calculate the P value of the difference, as follows:

***P<.01, **P<.05, NS = not significant. N/A = not applicable.

^b Uganda MMRs are direct estimates for the baseline (June 2011–May 2012) and endline (2016): baseline MMR=342 maternal deaths/75,675 live births* 100,000; 2016 MMR=222 maternal deaths/87,094 live births* 100,000.

^c Zambia MMRs are adjusted estimates using General Growth Balance method for compensating underreporting of all deaths to WRA in the previous 12 months and applying the proportion of deaths among WRA that are due to maternal causes to derive maternal deaths; population live births were adjusted using P/F ratios estimated from the lifetime fertility of women of reproductive age. Adjusted baseline MMR=200 maternal deaths/41,665 live births; adjusted endline MMR=135/47,509 live births.

^d Uganda cause-specific MMRs are direct estimates using population maternal deaths of a specific cause divided by total number of population live births. Zambia cause-specific MMRs are adjusted estimates using General Growth Balance method for adjusting all deaths to WRA and applying the proportion of deaths among WRA that are due to maternal causes to derive maternal deaths; crude percent distribution by cause is applied to the adjusted maternal deaths to derive adjusted cause-specific MMRs.

^e Uganda time-of-death MMRs are direct estimates using population maternal deaths while pregnant (antepartum), during delivery or first 24 hours postpartum, and up to 42 days postpartum divided by total number of population live births. Zambia MMRs are adjusted estimates using General Growth Balance method for adjusting all deaths to WRA and applying the proportion of deaths among WRA that are due to maternal causes to derive maternal death; crude percent distribution by timing of death is applied to the adjusted maternal deaths to derive adjusted cause-specific MMRs.

reductions in maternal mortality within SMGL-supported districts during the short 5-year period was unprecedented in sub-Saharan Africa and is comparable with the decline achieved globally in 25 years.¹ Between 2012 to 2016, the average annual decline in MMR in the project-supported districts was approximately 11% per year, compared with WHO's estimated annual reduction rate of 2.5% per year for sub-Saharan Africa and reductions of approximately 3% per year at the national levels documented in both countries' Demographic and Health Surveys.^{21,40}

In both Uganda and Zambia SMGL-supported districts, declines in maternal mortality were significant during delivery and immediately postpartum (down by 72% in Uganda and 46% in Zambia), when SMGL interventions that focused on the intrapartum period would be expected to have their greatest impact. Evidence from Uganda, where population data were collected at the end of Phase 1, shows that two-thirds of the decline in maternal mortality in the SMGL-supported districts was achieved after the first “proof-of-concept” year, during which SMGL

interventions were rapidly scaled up and implemented most intensively.⁴¹ Smaller but sustained declines in the subsequent 4 years demonstrate that Uganda SMGL-supported districts expanded the gains in maternal mortality reduction during Phase 2.

In addition to the reductions achieved in population-level maternal mortality, substantial gains were found for most other maternal and perinatal health indicators. This was likely related to the facility delivery rates increasing substantially and at a similar magnitude in Uganda and Zambia (47% and 44%, respectively). Nevertheless, Uganda's endline institutional delivery rate of 66.8% still leaves considerable room for continued improvement, with almost a third of deliveries still taking place outside a health facility. Models estimating potential lives saved indicate that about half of maternal and neonatal deaths and a third of stillbirths could be averted through scaling up maternal and newborn health interventions.^{9,42} In both countries, the number of CEmONC facilities increased, as did the delivery rates in higher-level EmONC facilities and the number of major direct obstetric complications treated. Both countries reported a significant increase in the population cesarean delivery rate. Uganda's cesarean delivery rate increased to 9%, which was well within the 5% to 15% range recommended by WHO. Although Zambia's cesarean delivery rate improved to 4.8%, still below the WHO recommendation, it had increased by 79% from SMGL baseline rate of 2.7%, indicating further improvement was possible. Greater utilization of adequately staffed and equipped health facilities in SMGL-supported districts and improved access to lifesaving interventions for mothers and their infants undoubtedly were instrumental in achieving and maintaining lower facility MMRs.

Intervention-specific data were not available to assess the individual impact of SMGL interventions. However, population-level data indicated that maternal deaths due to obstetric hemorrhage and obstructed labor, in general, declined significantly in both countries, as did obstetric hemorrhage at the facility level in both countries. These findings are consistent with the reported increase in use of active management of the third stage of labor, manual removal of placenta, removal of retained products, availability of blood transfusions, and obstetric surgery.

SMGL interventions were also associated with improved perinatal outcomes. The increase in the number of deliveries in EmONC facilities in both countries means that more obstetric and neonatal emergencies received appropriate care

in a well-equipped facility where providers had been trained in and applied neonatal resuscitation techniques. SMGL facilities reported large increases in performance of neonatal resuscitation in the 3 months prior to each HFA (about 2.5-fold increase between baseline and endline). Other SMGL interventions that improved newborn outcomes included support for essential newborn care, early and exclusive breastfeeding, infection control practices, thermal care around the time of birth for all neonates, and kangaroo mother care for preterm babies.

Over the course of the SMGL initiative, facility perinatal mortality declined significantly, from 22.4 to 14.3 per 1,000 births in Uganda and from 37.9 to 28.2 per 1,000 births in Zambia. These reductions were driven by declines in the SBR, a finding that is consistent with the reported improved monitoring and care during labor and delivery; improved case management of obstetric complications; better access to emergency obstetric care, including obstetric surgeries; and increased focus on newborn care at birth, including neonatal resuscitation. In Uganda, where stillbirths that occurred during labor and delivery were enumerated separately, the intrapartum SBR reduction of 36% was the biggest driver of overall declines in the total SBR. Significant declines in the total SBR were documented in Zambia (36% by the end of the initiative) as well, although data could not be disaggregated by timing of stillbirth. Given the generally slow global progress toward reducing perinatal mortality and the particular lack of visibility of the burden of stillbirths,⁴³ the reductions documented by SMGL represent an important achievement.

However, predischarge NMRs measured by the SMGL facility monitoring did not change significantly in either country. The risk of neonatal death occurring during the early neonatal period—within approximately 24 to 48 hours of delivery—is very high across a range of countries, with an estimated 36% of neonatal deaths occurring on the first day of birth.⁴⁴ In both Uganda and Zambia, predischarge NMRs remained unchanged and relatively high at SMGL endline—7.6 per 1,000 live births in Uganda and 8.7 per 1,000 live births in Zambia. The lack of NMR reduction indicates a compelling need for further investments in basic equipment and supplies for supportive care, such as oxygen, nasogastric feeding, and intravenous fluids; neonatal special or intensive care units; and training of clinical staff to help vulnerable babies survive adverse neonatal health conditions and/or complicated

In both Uganda and Zambia, predischarge NMRs remained unchanged and relatively high at SMGL endline.

In both countries, the number of CEmONC facilities increased, as did the delivery rates in higher-level EmONC facilities and the number of major direct obstetric complications treated.

In Uganda, where stillbirths that occurred during labor and delivery were enumerated separately, the intrapartum SBR reduction of 36% was the biggest driver of overall declines in the total SBR.

deliveries. It is possible that changes in reporting may have played a role in lack of change in the predischarge NMR, as increased training on neonatal resuscitation—conducted as part of the SMGL initiative—may have sensitized facility staff to a common misclassification of newborns as stillbirths if they did not initiate spontaneous breathing.⁴⁵

Similar to improving maternal survival, targeting interventions to increase early neonatal survival requires adequate documentation of the number and rates of perinatal deaths as well as a systematic review of this information, including causes and contextual factors that may have contributed to these deaths. Because we were unable to obtain this level of documentation from SMGL facility registers, making it impossible to track changes in cause-specific mortality, we could not determine whether the SMGL initiative was associated with reduction in any specific underlying causes. For example, it is possible that individual causes such as birth asphyxia, a cause that was particularly targeted through training and mentoring of delivery providers, could have declined significantly in Uganda even if the overall 10% decline in the NMR did not reach statistical significance. Nevertheless, it remains clear that SMGL efforts to reduce neonatal mortality did not have the desired level of impact and that further efforts targeting neonatal survival need to be accelerated in the SMGL-supported districts. Future efforts to rapidly reduce maternal and neonatal mortality may be better positioned to address this continuing problem by taking stock of the lessons learned from the SMGL clinical interventions and using the findings to improve newborn care and by continuing to document perinatal outcomes with the new monitoring tools and procedures that were introduced in SMGL-supported facilities.

The introduction of MDSR in Uganda and facility-based MDSR in Zambia greatly improved identification and reporting of maternal deaths in communities and facilities.

Limitations

Limitations of the SMGL approaches in communities and facilities generally stemmed from: (1) the potential for increased demand for facility delivery to outpace the district health systems' capacity to deliver quality facility services, despite intense efforts to improve and expand facilities and staffing; (2) uneven distribution and coverage of EmONC services, resulting in continued disparities in access to services; (3) remaining gaps in quality of care in facilities; and (4) a rapid launch and ramping up of activities with gaps in funding availability, particularly after SMGL's intensive Phase 1. This proved challenging for the

coordination, continuity, and sustainability of SMGL intervention and evaluation approaches.

Although extensive, the monitoring and evaluation methods implemented for tracking SMGL outcomes also had important limitations. In general, data quality and completeness of facility- and population-based data increased in both countries since one of the goals of the initiative was to improve health information systems and data-driven decision making at the district level. The SMGL initiative used several strategies to ensure data quality: (1) training and mentoring of facility staff to improve quality of information recorded in source registers; (2) recruitment of SMGL M&E officers and training in data collection, data entry, reviewing, and submitting data; and (3) development and use of data collection instructions, training manuals, and indicator reference sheets. While these measures generally ensured consistency in data quality during the initiative, the more accurate indicators were not strictly comparable with those measured during the baseline period. There are also differences in measurements between Uganda and Zambia, as each country used existing data systems and infrastructure to devise its own independent data-collection approach, making cross-country comparisons more difficult.

Ascertainment of the numbers and causes of maternal deaths before SMGL implementation was particularly challenging in both countries, which may have resulted in an underestimation of the MMR decline. The introduction of MDSR in Uganda in 2013 greatly improved reporting of maternal deaths in communities and facilities afterward. Similarly, the facility-based MDSR, introduced in 2015 in Zambia, led to increased detection and a higher MMR in the following year. The SMGL census population, birth, and mortality data in Zambia, in particular, were heavily underreported at baseline, when compared to external sources, and required complex adjustment factors.^{21,34} As a result, the maternal mortality at baseline may have been higher and MMR declines in both countries may be underestimated.

Facility-based maternal and neonatal mortality rates are also prone to selection bias, as they include only a subset of the population who accessed obstetric care services and may not necessarily reside in the districts where these facilities are located. In large referral hospitals, such as Fort Portal Regional Referral Hospital in Uganda and Mansa General Hospital in Zambia, for example, about one-third of maternal deaths

in 2016 were among patients referred from districts outside SMGL coverage.

Throughout the SMGL initiative, the number and rates of stillbirths and predischarge neonatal deaths among babies weighing ≥ 1000 grams were monitored from data recorded in maternity registers. In contrast to SMGL's monitoring of maternal deaths, identification of perinatal deaths was not enhanced through triangulation of multiple data sources, audits were less widespread, and underlying causes were not consistently reported. Additionally, individual-level maternal and delivery characteristics, Apgar scores, and birthweight were available only in Uganda, whereas only aggregate numbers of deaths were available in Zambia. Individual-level data on outcomes of neonatal resuscitation were not available in either country.

Despite the limitations in SMGL approaches and M&E methods, significant improvements occurred in most outcomes in both countries. However, the main effects of the SMGL initiative were captured by comparing outcomes in the pilot districts before and after SMGL implementation, without a control group in nonintervention districts. This was due, in part, to the rapid launch of SMGL interventions (within a couple of months) throughout the pilot districts and the inability of the team to establish an appropriate control group within that time period. Each country implemented district-level interventions with varying scope, intensity, and M&E methods. As the interventions were not evaluated independently, it is impossible to determine the relative impact of any individual intervention. The before-and-after evaluation approach also introduced inherent limitations in the ability to attribute positive health outcomes to the SMGL interventions.

CONCLUSIONS

Following the introduction of the SMGL model, maternal mortality declined significantly in 8 learning districts in Uganda and Zambia. This decline is likely due to parallel improvements of supply and demand for obstetric and newborn services coupled with improved quality of care at health facilities and improved coordination and health management throughout the districts. Although the implementation and emphasis of SMGL interventions were not identical in each district, maternal health outcomes in SMGL-supported districts and facilities improved in both countries.

The 44% and 41% declines in maternal mortality in SMGL-supported districts in Uganda and Zambia, respectively, and the more modest but significant decreases in perinatal mortality, were accomplished through a comprehensive district systems strengthening approach that led to reductions in the 3 delays that contribute to maternal and neonatal deaths. Maternal mortality reductions of this magnitude over a 5-year period demonstrate that it is possible to greatly accelerate progress in saving mothers' lives. Newborn lives, however, continue to require more sustained attention. The lessons learned from the SMGL initiative can inform policy makers and program managers in other low- and middle-income settings, where similar approaches can be used to rapidly reduce maternal and perinatal mortality.

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ORIGINAL ARTICLE

Addressing the First Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Approaches and Results for Increasing Demand for Facility Delivery Services

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The Saving Mothers, Giving Life initiative used 3 coordinated approaches to reduce maternal deaths resulting from a delay in deciding to seek health care, known as the “first delay”: (1) promoting safe motherhood messages and facility delivery using radio, theater, and community engagement; (2) encouraging birth preparedness and increasing demand for facility delivery through community outreach worker visits; and (3) providing clean delivery kits and transportation vouchers to reduce financial barriers for facility delivery. These approaches can be adapted in other low-resource settings to reduce maternal and perinatal mortality.

ABSTRACT

Saving Mothers, Giving Life (SMGL), a 5-year initiative implemented in selected districts in Uganda and Zambia, was designed to reduce deaths related to pregnancy and childbirth by targeting the 3 delays to receiving appropriate care at birth. While originally the “Three Delays” model was designed to focus on curative services that encompass emergency obstetric care, SMGL expanded its application to primary and secondary prevention of obstetric complications. Prevention of the “first delay” focused on addressing factors influencing the decision to seek delivery care at a health facility. Numerous factors can contribute to the first delay, including a lack of birth planning, unfamiliarity with pregnancy danger signs, poor perceptions of facility care, and financial or geographic barriers. SMGL addressed these barriers through community engagement on safe motherhood, public health outreach, community workers who identified pregnant women and encouraged facility delivery, and incentives to deliver in a health facility. SMGL used qualitative and quantitative methods to describe intervention strategies, intervention outcomes, and health impacts. Partner reports, health facility assessments (HFAs), facility and community surveillance, and population-based mortality studies were used to document activities and measure health outcomes in SMGL-supported districts. SMGL’s approach led to unprecedented community outreach on safe motherhood issues in SMGL districts. About 3,800 community health care workers in Uganda and 1,558 in Zambia were engaged. HFAs indicated that facility deliveries rose significantly in SMGL districts. In Uganda, the proportion of births that took place in facilities rose from 45.5% to 66.8% (47% increase); similarly, in Zambia SMGL districts, facility deliveries increased from 62.6% to 90.2% (44% increase). In both countries, the proportion of women

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delivering in facilities equipped to provide emergency obstetric and newborn care also increased (from 28.2% to 41.0% in Uganda and from 26.0% to 29.1% in Zambia). The districts documented declines in the number of maternal deaths due to not accessing facility care during pregnancy, delivery, and the post-partum period in both countries. This reduction played a significant role in the decline of the maternal mortality ratio in SMGL-supported districts in Uganda but not in Zambia. Further work is needed to sustain gains and to eliminate preventable maternal and perinatal deaths.

INTRODUCTION

Three Delays That Contribute to Maternal Mortality

Globally, more than 300,000 women die each year due to complications of pregnancy and childbirth,

with 99% of these deaths occurring in developing countries.¹ Approximately 2 million newborns die during their first week of life each year, and an additional 2.6 million are stillborn from complications during pregnancy or delivery.^{2,3} Effective interventions exist to prevent the majority of these deaths; however, these interventions are often unavailable or inaccessible in many countries in sub-Saharan Africa where the greatest burden lies.^{4–6}

Ending preventable maternal and perinatal deaths while ensuring health and well-being and enabling environments (i.e., survive, thrive, and transform) are the main priorities for the United Nations' Sustainable Development Goals and Global Strategy for Women's, Children's, and Adolescent's Health (2016–2030).^{7,8} However, equitable access to emergency obstetric and newborn care (EmONC) remains a challenge in many countries, particularly where fertility and mortality levels are high. In low- and middle-income countries, only 1 in 5 pregnant women who experiences pregnancy complications receives EmONC.⁹ Since pregnancy complications are often unpredictable, timely access to quality EmONC is essential to reducing maternal and perinatal deaths.^{10,11}

Although pregnancy complications constitute the diagnosable conditions that lead to maternal deaths, underlying non-medical factors are also important contributors to maternal mortality in developing countries. A large proportion of women die because of (1) delayed recognition of a pregnancy complication and decision to go to a facility, (2) delays in reaching an emergency obstetric care facility, and (3) lack of receipt of timely, adequate, and appropriate obstetric care at a health care facility. Strategies designed to reduce the burden of each of these 3 delays that contribute to maternal deaths can help improve maternal and infant survival. The “Three Delays” model is a useful conceptual and practical framework that can help identify where and when maternal deaths occur and the most appropriate actions on the pathway to preventing future maternal and infant deaths.¹²

Originally designed to analyze barriers to EmONC, the 3-Delays model used by the Saving Mothers, Giving Life (SMGL) initiative was applied more broadly to select interventions aimed at reducing barriers to (1) seeking facility-based care during pregnancy, birth, and the postpartum period; (2) reaching facility-based care for routine and complicated births; and (3) receiving timely quality preventive and curative interventions included in facility-based delivery care. Delays in deciding to seek care, including timely recognition of complications (first delay) and in identifying and

reaching a health facility (second delay) relate directly to problems with access to care, encompassing factors at the individual, household, community, and health systems level. Contributors to the first and second delays include financial barriers, reluctance to seek care because of demeaning or perceived low quality care, geographic distance from a health care facility, road quality, and lack of transport availability. These factors have been widely recognized as contributing to high levels of maternal and neonatal mortality.^{12–14} Once a woman has reached a health facility, the delay in receiving adequate and timely care (third delay) relates to factors in the health care facility that are also critical for programs to address. If health facilities cannot provide timely emergency care (i.e., open 24 hours per day/7 days per week, well-staffed, well-equipped, and able to provide an array of lifesaving interventions), addressing the first 2 delays does not improve survival, and in fact may negatively affect perceptions of facility care and demand for health services.

Studies based on maternal death reviews with verbal autopsies differ in their conclusions about which of the 3 delays contributes most to maternal deaths and have found that often a single maternal death may be the result of multiple delays. They also suggest that the relative contribution of the delays may differ according to the study setting and sociocultural, geographic, and health systems context. Although programmatic evaluations in Haiti, Malawi, and Zambia using the Three Delays model suggest that the first and third delays contributed most to preventable maternal and newborn deaths,^{14–16} other studies have found that the first,¹⁷ second,¹⁸ or third delays,¹⁹ respectively, contribute most to maternal and newborn deaths. Thus, while the predominance of a certain type of delay may differ across health systems and country contexts, assessing and addressing all 3 delays is critical in designing and implementing comprehensive safe motherhood strategies. In addition, factors related to experiencing the 3 delays are often interrelated, overlapping, and complex, with rural, poor, and less educated women often experiencing all 3 delays.¹⁴

The Three Delays model can help identify where and when maternal deaths occur and the most appropriate actions to prevent future maternal and infant deaths.

The Saving Mothers, Giving Life Initiative and the Three Delays Model

The SMGL initiative is an innovative model that brought together diverse public- and private-sector partners in a collaborative effort to dramatically and rapidly reduce the number of maternal and newborn deaths that occur during childbirth

and in the period immediately following in selected districts of Uganda and Zambia. Nigeria Cross River State joined SMGL in 2015 (results not included in this analysis).²⁰

SMGL simultaneously implemented multiple interventions to target all 3 delays by applying a comprehensive approach to strengthen district health systems. The goal of the SMGL interventions was to ensure that every pregnant woman has access to and uses safe, basic delivery services and, in the event of an obstetric complication, can reach lifesaving EmONC within 2 hours.

Beginning in 2012, SMGL introduced interventions in communities and health facilities (public and private) in 4 pilot “learning” districts each in Uganda and Zambia. SMGL approaches included: (1) generating demand for antenatal, facility delivery, and postpartum care; (2) raising awareness and facilitating action on birth planning, understanding pregnancy danger signs, HIV testing and treatment, family planning services, and postpartum check-ups; (3) upgrading and equipping health care facilities with necessary medical commodities and supplies, including safe blood; (4) hiring, training, and mentoring mid- and high-level staff to increase the number and geographic distribution of quality basic and comprehensive EmONC services with 24 hour coverage; (5) strengthening linkages between communities and facilities through integrated communications and transportation systems and opening of new maternity waiting homes; and (6) increasing capacity of district health systems and personnel to manage and use health management information systems.²¹

For the purposes of reporting the major SMGL intervention strategies, intervention outcomes, and health impacts, we have organized findings according to the Three Delays model in 3 separate articles (this article plus 2 companion articles published in this SMGL supplement). However, it is important to recognize that there is a great deal of overlap among the delays and that the underlying contributors to delayed or inadequate maternal care are often cross-cutting and complex.

The first delay encompasses numerous barriers that can affect a woman and her family's awareness of a serious complication or timely decision to seek health care.

Effective Interventions to Reduce the First Delay

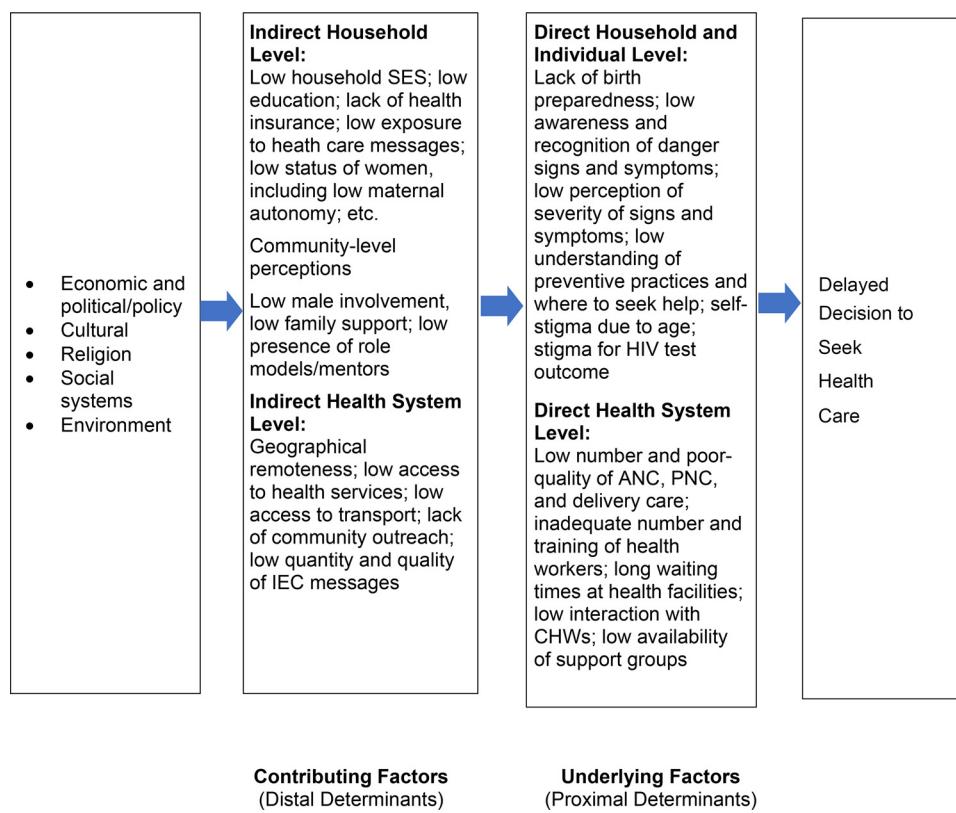
The first delay encompasses numerous barriers that can affect a woman and her family's awareness of a serious complication or timely decision to seek health care. These include broad environmental factors; indirect community, household, and health systems factors; and direct factors related to the

household or individual's ability to recognize the need for health care, have a plan in place, and initiate action to reach care, or related to the availability and quality of the health system (Figure 1). Interventions to reduce the first delay address many of these barriers, including individuals' and households' ability to recognize the need for health care, having a birth plan in place, and having adequate financial and logistic resources to access care.

Literature on barriers to accessing delivery care indicates that individual experiences, financial and decision-making autonomy, and community and societal norms play a major role in women's decisions.^{22–24} Past negative experiences and perceived poor quality of care at facilities, including the perceptions that facilities are under-equipped or that clinic staff are disrespectful, can discourage women and their families from seeking a facility delivery.^{25–27} Other studies suggest that community and family support are also important drivers of seeking facility care, sometimes superseding negative attitudes about quality of care in the decision to go to a facility.^{22,23}

Community outreach and engagement, through deployment of community health workers (CHWs), can be effective means to increase facility deliveries and use of maternal and child health services.^{28–30} CHWs can provide linkages between the community and health care facilities along the continuum of care, utilize existing community networks to identify and communicate with pregnant women, engage with local leaders, and promote health messages to increase birth planning, awareness of pregnancy danger signs, and facility delivery.^{28–30} Facility- and community-level interventions that promote birth preparedness, recognition of complications, and referrals from CHWs to facilities are associated with increased facility-based births.³¹ CHWs can also promote preventive health services. Birth planning and preparedness, as well as identification of underlying maternal risk factors and health conditions, often begin during antenatal care (ANC) visits. ANC provides an ideal opportunity to educate pregnant women about the danger signs of a pregnancy complication and the need to have a birth plan (e.g., saving money, identifying a birth location, arranging and planning for transportation).

Financial and geographic barriers are also important drivers of decisions to seek facility care. Financial barriers that deter seeking facility delivery services are associated with the cost of the delivery itself but also include affordability of transportation to the facility and purchasing medical supplies that must be brought to the health care facility at the time of delivery. Strategies such

FIGURE 1. Conceptual Framework to Explain the First Delay in Deciding to Seek Care

Abbreviations: ANC, antenatal care; CHW, community health worker; IEC, information, education, and communication messages; PNC, postnatal care; SES, socioeconomic status.

as voucher incentives and distributing clean delivery kits (CDKs) have been shown to increase facility-based delivery rates.^{32,33} Finally, accessibility barriers also include geographic distance to a health facility. In Kenya, researchers found that women who live within 2 kilometers of an obstetric facility were more likely to deliver in a facility.³⁴

SMGL recognized from the start the critical reality that in Africa women's male partners, extended families, and communities play a crucial role in mothers' health-seeking behaviors. Thus, women in Africa are not always able to make health decisions on their own. The SMGL initiative sought to improve access to safe delivery in health facilities by supporting communities to become more engaged, encouraging families to have a birth plan, providing pregnant women and their partners with information about the danger signs during pregnancy and birth, and addressing social, cultural, and gender barriers to appropriate care. Community outreach activities by community health volunteers (Village

Health Teams [VHTs] in Uganda and Safe Motherhood Action Groups [SMAGs] in Zambia) advocated for birth preparedness, promoted health practices, and encouraged ANC visits, facility delivery, and postpartum care. They were also crucial in the distribution of birth plans (Zambia); marketing CDKs containing supplies necessary for birth and newborn care to women who came to deliver in facilities (Uganda and Zambia); and distribution of transport subsidies to increase health care facility use (Uganda).²⁰ These activities were supplemented with radio and print media campaigns, community drama groups, and community advocacy through "Mama Ambassadors" in Uganda and "Change Champions" in Zambia.

National and SMGL-Supported District Contexts in Uganda and Zambia in Relation to the First Delay

At the outset of the SMGL initiative, the 2011 Uganda Demographic and Health Survey (DHS) revealed

that almost all (95%) pregnant women in the country received at least some antenatal care, including 48% who attended 4 or more visits.³⁵ Nationally, 50% reported having received information during ANC visits on pregnancy danger signs. Overall, 57% of Ugandan women delivered in health facilities, including 52% of women in rural areas who reported a facility delivery. Most women of reproductive age (65%) reported that they have serious problems in accessing health care, including 49% who said that getting money for treatment was a problem and 41% who said that distance to care is an important barrier.

The 2013–2014 DHS in Zambia reported that among women who recently gave birth, almost all (96%) attended ANC, including 56% who attended 4 or more visits during their most recent pregnancy.³⁶ The majority of women reported that during ANC they received information about danger signs of pregnancy complications (88%), and that they either discussed a birth plan with a health care provider (91%) or had used a birth plan (88%). Two-thirds (67%) of women delivered in health facilities, but only 56% of rural women reported a facility-based delivery at their last birth. The main reasons for not delivering in health facilities included the facility was too far away or they did not have transportation (32%), followed by labor being unexpected or too short (27%). Two-thirds of women reported receiving postnatal care within 2 days of delivery.

Lack of transportation was identified as a major barrier to timely access to facility-based care.

Prior to SMGL, Uganda and Zambia had already taken important steps to identify and implement community health strategies and programs. The Roadmap for Accelerating the Reduction of Maternal and Neonatal Mortality and Morbidity in Uganda (2007–2015)³⁷ highlighted the central roles of VHTs and community leaders in ensuring community involvement in health promotion. The roadmap also acknowledged that women's access to preventive health care services can be heavily influenced by husbands or relatives and cultural norms. A woman who has a potential pregnancy complication may not be the one making decisions about her care; rather, societal and familial expectations often take precedence. In addition, because pregnancy and childbirth are seen as normal occurrences, women who deliver without medical assistance may be more highly regarded than those who receive skilled birth assistance.³⁷ These cultural factors may contribute to delays in deciding how and when medical care is needed and sought, and highlight the need to conduct community outreach not only for women but

also for men and family members. As such, a family and community-centered approach to health promotion is preferable to activities targeting women only.

In Zambia, the Ministry of Health established SMAGs in 2003 to increase the utilization of maternal and newborn health care services.³⁸ SMAGs are community-based volunteer groups that aim to deliver essential information on safe motherhood and health prevention practices to men and women. Zambia's Countdown to Millennium Development Goals on maternal and child health prioritized key community health interventions, including expanding the number and scope of SMAGs to be undertaken by 2015 to foster community engagement in safe motherhood.³⁹

In both countries, SMGL partners carried out formative research to understand existing district contexts and identify specific factors that influence behaviors before, during, and after delivery. In Uganda, consultative meetings with community, political, religious, and district leaders and postpartum women were conducted to identify barriers to institutional delivery care and best strategies to overcome them. The groups prioritized lack of transportation as a major barrier to timely access to facility-based care, which resulted in the development of a subsidized transport vouchers program. In Zambia, the Communications Support for Health (CSH) project, funded by the United States Agency for International Development (USAID), carried out a qualitative study in selected SMGL districts to better understand the context in which women made care-seeking decisions.⁴⁰ The study found that women knew about antenatal care and the necessity of planning for birth, and they were familiar with pregnancy danger signs; however, only 60% attended 4 or more ANC visits due to difficulty paying for transportation, long wait times, the belief that ANC is only for managing complicated pregnancies, and not seeing the benefit of multiple ANC visits. A 2013 ethnographic study of maternal health-seeking behavior conducted for SMGL in Zambian districts identified cultural beliefs and practices that prevented some women from going to health facilities for care.⁴¹ The study indicated that some women did not seek antenatal care early in their pregnancy, as is recommended, because they feared bad pregnancy outcomes if they disclosed the pregnancy before it had been announced by an older female relative. The study also found that some women do not deliver in health facilities because they wish to use traditional herbs to promote short labor and reduce

bleeding and are not comfortable disclosing this to a health care provider.

This article examines how the SMGL initiative focused its efforts to address the first delay and integrated its interventions within the district health systems in the learning districts in Uganda and Zambia. We describe the main interventions and approaches within the context of the 3 broad strategies that SMGL implemented to improve care-seeking behaviors:

1. Promote community engagement and empowerment for improved maternal and newborn health.
2. Increase birth preparedness, demand for facility delivery, and use of preventive health care services.
3. Decrease financial and logistic barriers to accessing facility delivery care.

The article also examines process and outcome indicators influenced by community interventions that took place in the SMGL-supported districts including changes in the institutional delivery rate and in antenatal and postpartum care; proportion of health facilities with affiliated CHWs; and maternal mortality due to the first delay.

METHODS

SMGL used both qualitative and quantitative methods to document intervention strategies, outcomes, and health impacts. To evaluate the impact of the SMGL initiative overall, we compared data collected during the baseline (the 12 months prior to the onset of the initiative; June 2011–May 2012), with data collected during the endline monitoring period (January–December 2016). Programmatic interventions are described as occurring during Phase 1 (June 2012–December 2013) and Phase 2 (January 2014–October 2017) of the SMGL initiative. Further details on the content of the phases is described elsewhere.²⁰

Qualitative Data and Analytic Methods

Qualitative data sources included Phase 1 and Phase 2 project reports and documents submitted by SMGL implementing partners, who collected programmatic data to describe interventions and results. Information on Uganda's inputs came from VHT data and from program reports on Integrated Community Clinic Outreach, community dialogue activities, the "Mama Ambassador" program, "Mama Kit" distribution logs, and radio

station invoices and activity reports. Data for Zambia activities were derived from annual performance reports to USAID, Communications Support for Health's final report, and the "Mothers Alive Campaign" Change Champions assessment. Programmatic interventions detailed here generally occurred during Phase 1 and continued into Phase 2. Program data were also derived from reports published by the Columbia University Mailman School of Public Health, which conducted an external evaluation of SMGL at the conclusion of Phase 1.⁴²

Quantitative Data and Analytic Methods

Quantitative sources to assess the results of community-based interventions included data from health facility assessments (HFAs) and the District Health Information System 2 (DHIS2) platforms, as well as population-based data to identify and investigate deaths to women of reproductive age, including those due to maternal causes. Approaches and methods for each of these data sources are fully described elsewhere.⁴³ For our study, we compared maternal data collected during the baseline and endline periods.

Health Facility Assessments

The SMGL partners implemented HFAs in SMGL-supported learning districts to assess changes in facility infrastructure, functionality, and use.⁴³ A total of 105 facilities in Uganda and 110 facilities in Zambia supported throughout the initiative were assessed at baseline and endline. Indicators derived from the HFAs used in this analysis include numbers of deliveries that took place in facilities and the percentage of facilities that reported having affiliated community health outreach workers.

Facility assessments were conducted in virtually all facilities that provide maternity care in SMGL-supported districts. We considered data complete counts rather than a sample and reported indicators as percentages, not subject to sampling error. We calculated the *z* score using the McNemar test for dichotomous responses for matched pairs of data at baseline and endline.

District Health Information Systems

In Uganda, SMGL used the Ministry of Health's recently updated DHIS2 to track changes in use of preventive services. The indicators that were used include the proportion of pregnant women in SMGL districts who received 4 or more ANC visits and the proportion of women with at least

1 postpartum visit within 48 hours after delivery in a health facility. Methods for DHIS2 data collection and analysis are described elsewhere.⁴³

Maternal Mortality Data

To evaluate changes in maternal mortality in SMGL districts, household population data were collected in 2012 and 2017 (through the SMGL Reproductive Age Mortality Study [RAMOS] in Uganda and SMGL District Census in Zambia)⁴³ to identify and investigate deaths to women of reproductive age. As part of data collection efforts in both countries, retrospective verbal autopsies were conducted on deaths using the World Health Organization's (WHO's) Maternal Death Surveillance and Response (MDSR) verbal autopsy tool⁴⁴ to identify maternal deaths and their circumstances. Verbal autopsies also provide a better understanding of the social circumstances and decision-making processes preceding a maternal death, and they include qualitative narratives about the pathway from awareness of the onset of a deceased mother's illness or complication to informal or formal treatment received.

Women who experience a first delay may have never attempted to seek health care or may have sought care too late. These 2 groups may differ in their background characteristics, motivations, and decision-making barriers and facilitators. Using verbal autopsies, we examined changes in the proportion of maternal deaths in these 2 groups.

Maternal mortality ratios (MMRs), defined as maternal deaths per 100,000 live births, are based on complete enumeration of deaths identified in communities, so they are not subject to sampling error. The rates are affected by random variation and errors in case detection.⁴⁵ Similarly, percentages were assumed to have some variation or error in measurement. Three different statistical tests were used when comparing the baseline to the endline results. For the mortality ratios, the error was modeled using a Poisson distribution and a *z* score was used to calculate *P* values for significance testing.⁴⁶ For the population percentages, *z* scores based on the normal approximation to the binomial distribution were used to calculate *P* values. The number of maternal deaths and the MMR among women who died of a maternal cause without seeking any health care were also calculated to examine changes in the first delay between baseline and endline.

MMRs and the proportion of deliveries that occurred in facilities rely on the estimated number

of live births as the denominator. In Uganda, for both baseline and endline, population statistics were derived from the district-wide SMGL censuses and RAMOS studies, conducted in 2013 and 2017.⁴³ In Zambia, at baseline, district-specific population and crude birth rates from the 2010 national census were used to estimate live births for the SMGL-supported districts. At endline, the number of live births was determined by applying district-specific facility delivery rates calculated from the 2017 SMGL census to the district population.⁴³ We calculated relative change in indicators by subtracting the baseline value from the endline value and dividing by the baseline.^{45,46}

Ethics

The study protocol was reviewed and approved by the U.S. Centers for Disease Control and Prevention (CDC) Human Research Protection Office of the Center for Global Health and by the Ugandan and Zambian Ministries of Health. Written informed consent was obtained for all respondents to the census and verbal autopsy interviews.

■ STRATEGIES, INTERVENTIONS, AND RESULTS

Strategy 1. Promote Community Engagement and Empowerment for Improved Maternal and Newborn Health

Uganda and Zambia SMGL districts employed community-based communication and education strategies to promote safe motherhood messages, increase community awareness of enhanced delivery services in facilities, and engage community leaders and "Change Champions" in promoting the SMGL initiative (Table 1). In Uganda, SMGL used radio programming to broadcast safe motherhood messages from 6 local radio stations about 10 times per day throughout the life of the SMGL initiative (broadcasted 36,146 times during SMGL Phase 1).⁴² It also conducted radio talk shows that included panels of local leaders and technical experts discussing the importance of facility delivery for improving maternal and neonatal health outcomes. In Zambia, radio "spots" emphasized the advantages of facility delivery and encouraged family members to support pregnant women in seeking facility care. Radio messages in Zambia were primarily broadcast during SMGL Phase 1, when approximately 4,000 radio spots were aired.⁴⁰

In Uganda and Zambia, SMGL used radio programming to broadcast safe motherhood messages.

TABLE 1. Saving Mothers, Giving Life Interventions to Reduce the First Delay, 2012–2017

SMGL Strategies and Approaches	Country-Specific Interventions		
	Uganda	Zambia	
Strategy 1: Promote community engagement and empowerment for improved maternal and newborn health			
Approach 1.1: Implement community-based communication and education messages on safe motherhood via mass media and community events	<ul style="list-style-type: none"> Displayed posters with SMGL messages in public places to promote safe motherhood Held talk shows on local radio stations with technical experts and local leaders (political and religious local leaders, local safe motherhood champions) Supported local drama groups to perform skits and traditional songs on safe motherhood, raise awareness of danger signs in pregnancy, and promote facility delivery 	<ul style="list-style-type: none"> Broadcasted targeted radio messages, including spots directed specifically to encourage men to actively support their pregnant partners in seeking care Conducted drama performances to increase knowledge about and demand for delivery services and access to care Created and screened a documentary film “Journey to Becoming a Parent” 	
Approach 1.2: Build stronger partnerships between communities and facilities	<ul style="list-style-type: none"> Ensured that all SMGL-supported facilities have VHTs trained in accordance to the national training curriculum Mobilized health facility staff, including district coordinators, to supervise the implementation of activities performed by VHTs 	<ul style="list-style-type: none"> Ensured all SMGL-supported facilities had trained SMAGs Mobilized health facility staff, including district coordinators, to supervise the implementation of activities performed by SMAGs 	
Approach 1.3: Engage communities in monitoring and evaluation and accountability	<ul style="list-style-type: none"> Trained VHTs to conduct RAMOS data collection in 2012, 2013, and 2017 Trained VHTs to conduct maternal and perinatal death surveillance in their communities 	<ul style="list-style-type: none"> Ensured that SMAGs reported to health facilities on community events (pregnancies, home births, maternal deaths, and stillbirths) 	
Strategy 2: Increase birth preparedness, demand for facility delivery, and use of preventive health care services			
Approach 2.1: Assist with community activities aimed to increase:	<ul style="list-style-type: none"> Birth preparedness and knowledge of pregnancy danger signs Use of ANC and PNC services Awareness and use of facility-based delivery services 	<ul style="list-style-type: none"> Trained SMAGs to provide health education on birth preparedness and pregnancy danger signs Trained SMAGs to encourage women to start ANC early, attend at least 4 ANC visits, deliver in a health facility, and use PNC services Supported SMAGs to escort women to deliver in a health facility Trained health facility workers to conduct community dialogue meetings, including meetings that sensitized TBAs about danger signs of obstetric complications, and engaged them in emergency facility referrals 	
Approach 2.2: Extend the delivery system of preventive services:	<ul style="list-style-type: none"> ANC visits HIV counseling and testing Postpartum home care for mothers and newborns Postpartum family planning 	<ul style="list-style-type: none"> Trained SMAGs to conduct follow-up postnatal visits for mothers and newborns, identify women and newborns with danger signs, and conduct referrals to health facilities when danger signs are identified Organized clinic community outreach to provide ANC, health education, HIV counseling and testing, immunizations, and male involvement education sessions Selected religious, political, and cultural leaders became champions for promoting utilization of maternal and newborn health services Trained “Mama Ambassadors” to set up community dialogue meetings, give health education talks, distribute health commodities, and provide support to midwives 	<ul style="list-style-type: none"> Trained SMAGs to conduct follow-up postnatal visits for mothers and newborns, identify women and newborns with danger signs, and conduct referrals to health facilities when danger signs are identified Distributed birth plans to help pregnant women plan for social support, transport, nutrition, ANC, and PNC Selected religious, political, and cultural leaders became champions for promoting utilization of maternal and newborn health services Trained community “Change Champions” to promote safe motherhood and HIV prevention practices

Continued

TABLE 1. Continued

SMGL Strategies and Approaches	Country-Specific Interventions	
	Uganda	Zambia
Strategy 3: Decrease financial and logistic barriers to accessing facility delivery care		
Approach 3.1: Market and distribute CDKs	<ul style="list-style-type: none"> VHTs marketed CDKs as part of the promotion of institutional deliveries Facility health workers distributed “Mama Kits” to women who delivered in facilities 	<ul style="list-style-type: none"> SMAGs and nurses in SMGL facilities marketed and distributed “Mama Packs” containing diapers, soap, and baby clothes to women who came to a facility for delivery
Approach 3.2: Market and distribute vouchers to subsidize access to facility delivery care services, ANC, and PNC	<ul style="list-style-type: none"> VHTs promoted and distributed transport vouchers; health facility workers from private facilities marketed and distributed private vouchers The “Boda for mothers” voucher program to transport women by motorcycle for delivery or obstetric emergencies in 3 districts. During Phase 2, “Boda for mothers” was extended to cover transport for 4 ANC visits and 1 postpartum visit, in addition to transport for delivery care Marie Stopes subsidized vouchers for care in private facilities in all districts (“private vouchers”) (Phase 1 only) 	<ul style="list-style-type: none"> No vouchers or subsidies implemented in Zambia
Approach 3.3: Promote community-based loans to increase utilization of facility delivery care services	<ul style="list-style-type: none"> Established revolving funds for Village Saving Schemes (Phase 1 only) 	<ul style="list-style-type: none"> Community revolving funds were not implemented in Zambia

Abbreviations: ANC, antenatal care; CDKs, clean delivery kits; PNC, postnatal care; RAMOS, Reproductive Age Mortality Study; SMAGs, Safe Motherhood Action Groups; SMGL, Saving Mothers, Giving Life; TBAs, traditional birth attendants; VHTs, Village Health Teams.

Both countries used local theater groups and visual media to conduct community outreach about safe motherhood practices in SMGL districts. In Uganda, SMGL used a community-based drama group during Phase 1 to perform during community dialogue meetings (701 drama skits conducted).⁴² Performances dramatized safe motherhood health messages, which were then discussed during community stakeholder meetings. In Zambia, drama skits were conducted in one district in Phase 1. CSH created a documentary film entitled *Journey to Becoming a Parent* for viewing in SMGL districts.

Although data were not systematically captured to measure the reach of these activities throughout the 5-year SMGL initiative, an external evaluation conducted at the conclusion of SMGL Phase 1 (November 2012–August 2013) by the Columbia University Mailman School of Public Health found that nearly 90% of women delivering at SMGL facilities in Uganda and about 50% in Zambia had heard of SMGL. Respondents in Uganda cited radio as the most common source

of information about SMGL (45%), and in Zambia, SMAGs were the most frequently cited source (47%).⁴²

SMGL fostered stronger partnerships between communities and health facilities in both countries. Uganda mobilized, expanded, and trained existing VHTs, which represent the most basic level of the national health system. Established in 2000 and affiliated with health facilities, VHTs are community resident volunteers who are trained to provide health education to improve health behaviors and increase the uptake of health services. They are also trained to perform home visits, accompany women to health facilities, and report community health events to the health information system.⁴⁷ Similarly, in Zambia, SMAGs were established in 2003 with donor support and scaled up nationally in 2008. They are tasked to educate communities in health prevention practices (including reduction of HIV transmission) and improve access to maternal and newborn health care services.³⁸ Both VHTs and SMAGs operate under the supervision of health

personnel in governmental health centers. Previous evaluations conducted in Uganda and Zambia demonstrated an increase in facility-based care in communities where these cadres were functional.^{38,48}

The formation, training, and deployment of VHTs in Uganda and SMAGs in Zambia during Phase 1 involved large-scale mobilization efforts and trainings (both initial and refresher trainings), and were among the most extensively implemented aspects of the initiative.⁴² In Uganda, almost 4,000 VHTs were engaged and trained, covering almost every village in the 4 SMGL districts. Baseline 5-day trainings of up to 40 VHTs and parish coordinators and 2 trainers per training were conducted in mid-2012, followed by 2 one-day long refresher trainings (including one for the 2016 RAMOS that used a census-like questionnaire). Training was conducted using the Ministry of Health training curriculum.⁴⁹ Monthly or quarterly meetings between VHTs and parish coordinators were also used as avenues for refreshing knowledge on any observed gaps. To develop and maintain the VHTs' skills and motivation, SMGL trainers and project staff held approximately 2,400 mentorship meetings over the duration of the initiative. In Zambia, more than 1,500 SMAGs were mobilized and trained during a 5-day training (without refreshers). Trainings used an adaptation of the home-based lifesaving skills curriculum originally developed by the American College of Nurse-Midwives in 1998 to promote safe motherhood outcomes. The curriculum was designed to fit Zambia's national goal of promoting facility-based births for all women. It focused on birth preparedness, complication recognition, and lifesaving interventions that should be initiated while waiting for transport to a health facility in the event that an obstetric complication occurs.

Both countries used a cascading training approach beginning with master trainers from the Ministry of Health. They trained district VHT/SMAG trainers, including project staff, who in turn trained the VHTs/SMAGs in trainings organized at the sub-county level. In Zambia, Peace Corps Volunteers also assisted with SMAG training. Each VHT/SMAG received non-monetary incentives at the onset of the initiative (a bicycle with monthly maintenance allowance, a T-shirt with logo, a pair of gumboots, a bag or backpack, an umbrella, and a raincoat). In Uganda, each VHT also received a phone (on closed user group services with the health facility staff). In Uganda, VHTs received a per-diem during RAMOS data collection activities in 2012, 2013, and 2016.

The SMGL initiative significantly increased the number and expanded the functions of the VHTs and SMAGs in all SMGL-supported districts. In both countries, SMGL capitalized on existing national guidelines for recruiting and training community volunteers. Recruitment of women and men as community health volunteers was done through input from community leaders and neighborhood health committees. Traditional birth attendants (TBAs) were given the opportunity to be trained in becoming VHTs and SMAGs or to become "referral agents" to facility delivery, since both governments have policies in place that actively discourage home delivery. Recognizing that TBA-assisted deliveries were a barrier to facility-based care, the SMGL initiative in Uganda prioritized community sensitization about the dangers of unskilled birth attendance through radio talk shows and skits performed by drama groups. Additionally, the implementing partners used geo-mapping to identify hot spots where community deliveries were predominant that were targeted for community dialogue meetings and site visits. Training curricula in both countries included safe motherhood knowledge and skills, specifically for raising awareness of birth planning, pregnancy danger signs, promoting antenatal care, delivery in a health facility with a skilled provider, and conducting postnatal home visits and essential neonatal care. Volunteers were also trained in reporting to health facilities on community events (home births, maternal and perinatal deaths). Refresher trainings, mentorship, job aids, reporting and reference materials, and transportation means (bicycles) were provided by the implementing partners to support these activities.

The 2016 Uganda HFA documented that the percentage of facilities with affiliated VHTs increased from 18.3% to 91.5% ([Table 2](#)). Uganda SMGL facilities with affiliated VHTs reported that the VHTs were engaged in convening community workshops (55%), school- (53%) and church-based (47%) education activities, and conducting outreach to community leaders and TBAs (45%) ([Figure 2](#)). Similarly, the 2016 endline HFA in Zambia documented that the percentage of facilities having associated SMAGs increased from 63.8% to 96.3% over the course of SMGL ([Table 2](#)). HFA respondents indicated that SMAGs were engaged in outreach activities with community leaders and TBAs (74%), convening community workshops (64%), supporting drama groups (52%), organizing mass media announcements (40%), and conducting school- (39%) or church-based (39%) education activities ([Figure 2](#)).

TABLE 2. SMGL Outcomes Associated With Strategies to Reduce the First Delay, by Country, 2011–2016

Outcomes	Baseline (Jun 2011–May 2012)	Endline (Jan–Dec 2016)	% Relative Change ^a	Significance Level
Uganda				
Facilities that reported having an associated VHT (%) ^b	18.3	91.5	+400	***
Institutional delivery rate, all facilities (%) ^b	45.5	66.8	+47	***
Institutional delivery rate, EmONC facilities (%) ^b	28.2	41.0	+45	***
Institutional delivery rate, non-EmONC facilities (%) ^b	17.3	25.8	+49	***
Pregnant women who had 4 or more ANC visits (%) ^c	46.1	56.7	+23	***
Women who had a postpartum care visit within 48 hours (%) ^{c,d}	15.3	17.7	+16	***
Zambia				
Facilities that reported having an associated SMAG (%) ^b	63.8	96.3	+51	***
Institutional delivery rate, all facilities (%) ^b	62.6	90.2	+44	***
Institutional delivery rate, EmONC facilities (%) ^b	26.0	29.1	+12	***
Institutional delivery rate, non-EmONC facilities (%) ^b	36.7	61.1	+67	***

Abbreviations: ANC, antenatal care; DHIS2, District Health Information System 2; EmONC, emergency obstetric and newborn care; HFA, health facility assessment; PNC, postnatal care; SMAG, Safe Motherhood Action Group; SMGL, Saving Mothers, Giving Life; VHT, Village Health Team.

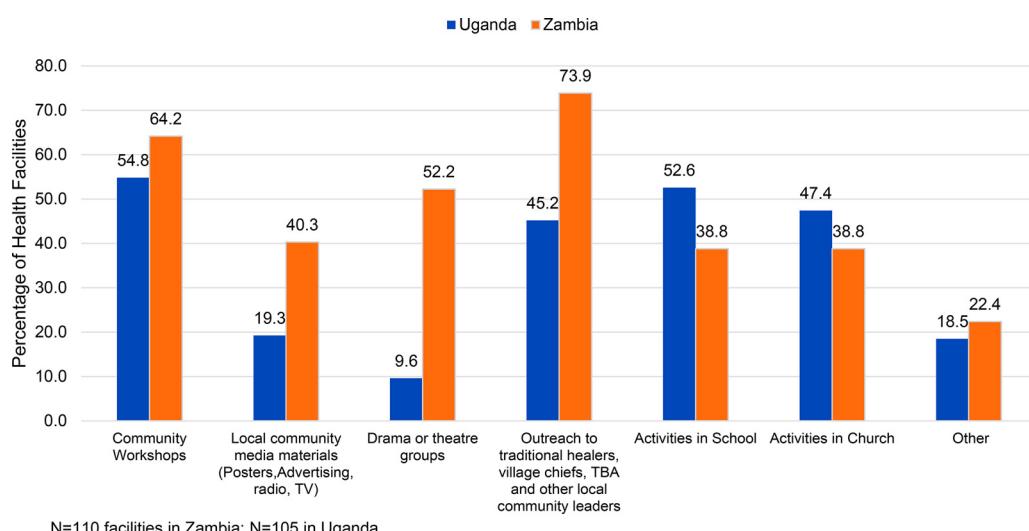
*** $P < .01$.

^aPercentage change calculations are based on unrounded numbers.

^bHFA data (Uganda N=105 facilities; Zambia N=110 facilities).

^cDHIS2 data, using estimated live births as denominator.

^dBaseline data include PNC visits beyond the first 48 hours, so the percentage increase is conservative.

FIGURE 2. Activities Performed by VHTs/SMAGs in SMGL Districts in Uganda and Zambia, 2016

Abbreviations: SMAGs, Safe Motherhood Action Groups; SMGL, Saving Mothers, Giving Life; TBA, traditional birth attendant; VHTs, Village Health Teams.

In Uganda, VHTs are actively engaged in the health management and information system and submit monthly reports on selected community health events.⁴⁷ The SMGL partners and the CDC Division of Reproductive Health built on this platform to create a comprehensive maternal and neonatal death surveillance and response system at the village level. They trained and monitored approximately 3,800 VHTs to identify deaths among women of reproductive age and report them to sub-district health coordinators monthly. Households with deaths among women of reproductive age were visited by a trained verbal autopsy team. If the death occurred during pregnancy or delivery or within 2 months of a delivery, the team collected information about the circumstances of death and contributing factors, using the verbal autopsy tool.⁴⁴ Beginning in 2015, Uganda VHTs supported the integration of neonatal deaths surveillance into the MDSR system, following procedures recommended by WHO.⁵¹

Strategy 2. Increase Birth Preparedness, Demand for Facility Delivery, and Use of Preventive Health Care Services

SMGL partners engaged existing cadres of community public health workers to conduct outreach to SMGL districts and communities to encourage birth preparedness and knowledge of pregnancy danger signs, encourage use of ANC and postnatal care services, and increase awareness and use of facility delivery services. In both Uganda and Zambia, cultural norms place importance on the role of the woman's partner, family, and even community in making health decisions during pregnancy and childbirth. SMGL sought to address gender, social, and cultural barriers to facility-based care by encouraging families and communities to recognize the importance of having a birth plan, attending ANC, and delivering in a health care facility.

VHTs and SMAGs delivered an array of interventions aimed at women's education on birth preparedness and referral to health facilities for skilled maternal and newborn health services. In both countries, these community volunteers identified pregnant women in their communities, informed them about birth planning and pregnancy danger signs, promoted ANC visits, and often accompanied women for delivery in a health facility. A minimum of 4 ANC visits were heavily promoted in order to get women connected early in pregnancy to a health care facility, increase the identification of high-risk pregnancies, and

encourage facility deliveries. In Zambia, SMAGs distributed birth plan documents to remind pregnant women of the steps they need to take to have a healthy pregnancy and delivery, including information about nutrition, ANC, pregnancy danger signs, birth planning, and postnatal care. Stocks of birth plans were distributed at clinics in SMGL-supported districts, with approximately 400,000 provided over the course of the project. SMAGs distributed these birth plans continuously, with approximately 70% of pregnant women receiving and using the birth plan.⁵²

VHTs and SMAGs were also trained to perform follow-up postnatal home visits for mothers and newborns, identify mothers and newborns with danger signs, and conduct referrals to health facilities when danger signs were identified. In Uganda, the work performed by community volunteers was aided by health facility workers, who periodically organized community dialogue meetings, including meetings with community TBAs to sensitize them about danger signs of obstetric complications and engage them in facility referrals.

The SMGL initiative also placed emphasis on postpartum family planning and increased identification and treatment of pregnant women and newborns with HIV infection to prevent mother-to-child transmission of HIV/AIDS. VHTs, SMAGs, community champions, and SMGL health care facility workers included promotion of these topics in their community outreach and education activities. In Uganda, health facility workers provided community outreach services related to blood pressure screening and other focused ANC services, health education, HIV counseling, testing and referrals, immunizations, and male involvement education sessions.

In both countries, the implementing partners engaged traditional and local government leaders, as well as religious leaders, to increase community engagement and access to maternal and newborn health services. They partnered with influential community members to assess the needs of their communities; identify local priorities, opportunities, and challenges; and develop approaches for recruitment, training, and retention of volunteers. Further, community leaders were actively engaged in community dialogues, health promotion activities, and the facilitation of volunteers' work (recruitment, motivation, oversight, and accountability).

The SMGL initiative promoted women champions to talk about ways in which mothers should address their own health and their children's health. This has been proven a successful health

Community outreach workers in both Uganda and Zambia delivered an array of interventions to educate women about birth preparedness and encourage delivery in a health facility.

SMGL distributed clean delivery kits with items that women are often required to purchase and bring with them to a facility delivery, such as a plastic sheet, gauze, disposable gloves, and soap.

Facility deliveries rose significantly in SMGL districts in both Uganda and Zambia during the first phase of the initiative, and the increased levels were either maintained or continued to increase during the second phase.

promotion strategy that empowers women at the same time.²⁸ In Uganda, SMGL recruited and trained a cadre of “Mama Ambassadors,” women community leaders who reinforced maternal health messages at community dialogue meetings, led clinic outreach events, provided health education to mothers at ANC visits in health facilities, and participated in radio talk shows. This cadre also provided non-technical support in antenatal and postpartum care to midwives during busy clinic days. During Phase 1, 78 women served as Mama Ambassadors, and the number increased slightly to 87 during Phase 2. In Zambia, SMGL trained and deployed 350 community leaders to be “Mothers Alive Campaign Change Champions.” Change Champions were often traditional leaders in chiefdoms tasked with tracking and reporting maternal deaths and promoting safe motherhood. Change Champion leaders identified and addressed specific challenges to meet their community needs, such as soliciting and receiving an ambulance from the Ministry of Health, initiating a garden and food safety net to improve maternal nutrition, soliciting local business contributions to build a mother’s waiting shelter, and constructing a new rural health center.

HFA and pregnancy outcome monitoring data indicate that the promotion of maternal and newborn health services was effective; facility deliveries rose significantly in SMGL districts in both Uganda and Zambia during Phase 1, and the increased levels were maintained or continued to increase over the course of Phase 2.⁵¹ In Uganda, the proportion of all births that took place in facilities rose from 45.5% to 66.8% (47% increase) over the 5-year SMGL initiative (Table 2). Increases in facility deliveries occurred both in facilities that were equipped to perform a full range of EmONC functions (45% increase) and in facilities that provided delivery services but were not categorized as EmONC facilities (49% increase). Likewise, in Zambia facility deliveries in the SMGL-supported districts increased from 62.6% to 90.2% (a 44% increase), with a 12% increase in deliveries in EmONC facilities and a 66% increase in non-EmONC facilities.

Between baseline and endline assessments of the SMGL initiative in Uganda, the proportion of pregnant women in SMGL districts who had 4 or more ANC visits increased by 23% (from 46.1% to 56.7% of pregnant women) (Table 2). A comparison of baseline and end of Phase 1 national DHIS2 data determined that the proportion of women with 4 or more ANC visits was consistently higher in SMGL districts than in neighboring districts in Western

Uganda.⁵³ The proportion of Ugandan women with a postpartum care visit within 48 hours of delivery, though much lower, also increased significantly during SMGL implementation (from 15.3% to 17.7%). Comparable data were not available for Zambia.

Strategy 3: Decrease Financial and Logistic Barriers to Accessing Facility Delivery Care

Women and families’ reasons for not seeking facility care or for delaying the decision to go to a facility also include financial barriers. In both Uganda and Zambia, the SMGL initiative distributed CDKs at facilities to provide incentives for facility delivery. To encourage women to deliver in facilities and to facilitate sanitary births, SMGL Uganda distributed “Mama Kits” to pregnant women who came to a facility. Mama Kits contained items that women are often required to purchase and bring with them to a facility delivery, including a plastic sheet, gauze, razors, syringes, disposable gloves, eye ointment, and soap. Each kit also included baby sheets, a baby shawl, and a child growth card. SMGL Uganda provided Mama Kits to 15,655 women in the 4 learning districts during Phase 1. Similar “Mama Packs” were made available in 2 SMGL districts in Zambia at health facilities to women who came to deliver.⁴² During Phase 1, about 2,000 Mama Packs were distributed in the 2 districts, but due to concerns about sustainability Mama Packs were discontinued during Phase 2. The Columbia University evaluation of Phase 1 found that, in exit interviews with women who had delivered in a facility, the kits allowed families to save money that could help pay for other necessities, such as transportation.⁴² The evaluation also found the kits were popular, with 25% of the women who participated in an exit interview in Uganda SMGL districts reporting having used the kit for their recent delivery.⁴²

In Uganda, physical and economic accessibility were enhanced through a voucher system that provided access to motorcycles (“boda for mothers”) and subsidized the cost of transportation to delivery services. In 3 Uganda districts where Baylor College of Medicine implemented the SMGL initiative (Kabarole, Kamwenge, and Kyenjojo), transport vouchers substantially enhanced women’s access to facility-based births during Phase 1. In addition, vouchers for transport to and use of services in nongovernmental facilities offering childbirth care (including cesarean deliveries) were subsidized and rapidly scaled up by Marie Stopes International during Phase 1. Beginning in

2012, pregnant women were able to buy both vouchers at a minimal cost during ANC or directly from VHTs in their communities. Altogether, the percentage of voucher-supported deliveries in the Baylor implementation districts increased from 15% in April 2012 to 79% 12 months later. Use of boda-for-mothers vouchers increased dramatically (from 3% to 47%), and use of vouchers for accessing and receiving delivery care in non-governmental facilities almost tripled (from 12% to 32%). During SMGL Phase 2, voucher supply was inconsistent due, in part, to the discontinuation of the vouchers for nongovernmental facilities. However, boda-for-mothers vouchers were expanded during Phase 2 to provide transport not only for reaching delivery care in facilities but also for 4 ANC visits and 1 postnatal care visit. In 2016, nearly 1 out of 4 women who delivered in any health facility in the 3 Ugandan districts used transport vouchers to reach delivery care.

Baylor Uganda complemented the voucher program with the provision of small community grants given to start community-based revolving funds. However, it was not clearly documented how many users benefited from such loans, whether the initial grants generated substantial community contributions, and which members of the community were expected to contribute.

Maternal Mortality in SMGL-Supported Districts

Over the 5 years of SMGL implementation, the district-wide MMR in Uganda declined from 452 to 255 maternal deaths per 100,000 live births, and in Zambia, from 480 to 284 maternal deaths per 100,000 live births.⁴³

In Uganda SMGL-supported districts, 342 women died of a maternal cause between June 2012 and May 2013, compared with 222 women between January and December 2016.⁴¹ At baseline, care-seeking information collected through verbal autopsies was available for 322 women who died of a maternal cause; of these, 86 women (26.7%) did not seek any care outside the home—including care from a health facility or from a TBA, a traditional healer, or a pharmacist/drug seller. At endline, of 222 women who died of a maternal cause, only 21 (9.5%) did not seek any care outside the home. Applying the baseline proportion of maternal deaths for which no care was sought (26.7%) to the observed endline number of 222 maternal deaths, we would have expected 59 deaths to women who did not seek care to have occurred during the endline

period under baseline care-seeking patterns. Since only 21 women died without seeking care at the endline, we infer that 38 deaths were averted through interventions that increased care seeking outside the home. This number of deaths averted accounts for a 23% decline in the overall MMR (from 452 to 349 deaths per 100,000), or about half of the overall 44% MMR decline.

Among women who died of a maternal cause who sought or attempted to seek any care outside the home, the median duration of the delay from the onset of complications to seeking any health care was 5 hours at baseline and 3 hours at endline (data not shown). Almost 4 times more women who died had sought or attempted to seek care within the first hour of symptom onset at endline compared with baseline (26.9% vs. 7.2%, respectively).

In Zambia SMGL districts, 200 women died of a maternal cause during the 12 months preceding the baseline census, compared with 135 during the 12 months preceding the endline census. Of those, 42 women (21%) who died of a maternal cause did not seek any care outside the home at baseline, compared with 30 (22%) at endline. Applying the baseline proportion of 21% of maternal deaths for which women did not seek care to the number of deaths at endline (135), we would have expected 29 maternal deaths to have occurred if baseline care seeking had not changed. Since this is similar to the documented number of 30 women who died without seeking care, we infer that the increase in seeking care was not a substantial contributor to the MMR decline in Zambia.

At baseline, among the 158 women who died of a maternal cause despite the fact they sought or attempted to seek care prior to their death, the median delay to seek care was 24 hours. At endline, the same median duration of delay in seeking care was reported for the 105 mothers who died after they sought or attempted to seek care. The proportion who sought any care within the first hour from onset of symptoms also changed little (21.1% at baseline and 17.7% at endline) (data not shown).

Verbal autopsy narratives illustrate the circumstances and barriers encountered in seeking care among women who died of maternal causes. In the case vignette in the Box, Hellen's mother-in-law describes the factors that affected Hellen's decision not to seek facility delivery. Her delay in seeking care was influenced by past personal experiences and wanting to avoid a third cesarean delivery, advice from a friend and a religious

Over the 5-year initiative, the district-wide MMR in Uganda declined from 452 to 255 maternal deaths per 100,000 live births; about half of this decline was associated with increased care seeking for obstetric complications.

BOX. Verbal Autopsy Case Example of the First Delay: Hellen's Story

Hellen, a 24-year-old woman from Uganda, died giving birth to her third child after 2 previous cesarean deliveries. The transcript below comes from a verbal autopsy interview with her mother-in-law. Details have been added in brackets to clarify meaning; names of persons, places, and dates have been changed to protect confidentiality.

Hellen felt labor pains but kept quiet and did not tell anyone for 2 days. After 2 days, the labor pains disappeared at night, but Hellen asked her husband not to tell anyone about it because she was afraid to go to the hospital as she thought they would operate on her again. She left the house and went to talk to a friend who had earlier advised her that it was possible for her to push [deliver] the baby on her own and had taken her to the traditional birth attendant. The traditional birth attendant had assured her that she could deliver at home even though her last 2 births had been by cesarean delivery. Hellen and her friend went to the pastor who prayed and gave Hellen herbs to take to aid the delivery. Again, Hellen was assured by the pastor and her friend that she could push [deliver] the baby. Hellen went back to her own house but started bleeding. She then called her mother and told her that she was becoming weak. Hellen's mother called a vehicle to take her to the hospital. As soon as the vehicle came, Hellen was carried to it, but before they could even leave, they realized she was dead.

leader, and other sociocultural factors. At each step of her decision-making process, these factors delayed Hellen and her family's recognition of the seriousness of her condition and added more barriers to receiving emergency health care interventions that could have saved Hellen's life. A better understanding of her high-risk status associated with prior cesarean deliveries could have been part of a birth plan for Hellen.

■ DISCUSSION

The SMGL approaches to addressing the first delay were predicated on the assumption that increased utilization of maternal and newborn health services and improved health outcomes cannot be achieved without community engagement and empowerment. The SMGL initiative focused heavily on allocating resources to promote community engagement, increase birth preparedness, educate communities about the benefits of facility delivery, increase supply of and demand for newly expanded facility resources, and reduce barriers to accessing health services.

The initiative recognized that engaging community members as active participants in addressing their own communities' health issues is critical. Activities were designed to raise individual and community awareness on safe motherhood and the benefits of facility delivery, build partnerships between communities and health facilities, and deliver health education and selected preventive services outside health facilities through community health volunteers, community champions, and outreach clinics. In Uganda, engaging communities and community volunteers in the process of identifying and assessing causes of maternal and newborn deaths and in measuring changes in mortality over time helped government efforts to promote accountability in accordance with their global commitments.

**Engaging
community
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participants in
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critical.**

SMGL interventions also sought to reduce financial barriers to facility care with the distribution of CDKs in both countries and voucher systems in Uganda. Dramatic increases in facility deliveries in SMGL districts, as well as use of CDKs and vouchers, provide evidence that these strategies were likely effective in promoting greater awareness of and access to facility care.

SMGL's Successes

The barriers addressed by SMGL in communities covered major known contributors to not seeking facility care, including lack of knowledge of the danger signs of pregnancy complications, mistrust or poor perception of facility care, and lack of material resources for transportation or birth supplies. During Phase 1, the Columbia University external evaluation reported that improved facility care in SMGL-supported districts fostered greater community recognition of the value of and need for receiving maternity care in facilities and increased the likelihood that women would seek facility delivery. As women's confidence and trust in providers and in the quality of health services grew, they began returning to the facilities with their children for general maternal and child health services and for future births.⁴⁰

Implementing partners conducted community outreach on safe motherhood issues in SMGL-supported districts. They engaged with and expanded existing Ministry of Health community cadres—Village Health Teams (Uganda), Safe Motherhood Action Groups (Zambia), newly trained women champions (Mama Ambassadors in Uganda and community Change Champions in Zambia)—and mobilized health facility workers to promote and support community activities. VHTs and SMAGs formed the backbone of SMGL's community engagement efforts by raising community awareness of safe motherhood, distributing birth

plans and vouchers, escorting women to facilities or maternity waiting homes, performing home visits, and collecting and reporting data for the initiative. These community cadres became trusted sources of information, respected for their dedication to and passion about preventive practices, birth companionship to delivery care, and postpartum home visits. In Uganda, monthly reports from VHTs strengthened monitoring and evaluation of SMGL efforts and laid the foundation of a national model for maternal and neonatal death community surveillance.

Implementing partners utilized multiple forms of communication to reach the community with messages about safe motherhood and the benefits of facility delivery. By using many avenues (face-to-face visits by VHTs and SMAGs, radio programs, community meetings, drama groups, health education by health care providers), SMGL ensured broad segments of the community, including pregnant women, their families, men, and elders, received information. SMGL's approach of extending the information, education, and communication activities to the whole community increased the possibility of shifting community norms to promote long-term change in attitudes and behaviors that support facility-based pregnancy and delivery care.

Financial incentives, through CDKs (in both countries) and transport and service vouchers (in Uganda), provided women and their families with tangible ways to overcome monetary barriers to accessing facility care. The voucher program in Uganda reduced the impediments of distance to care and the cost of transportation. The Mama Kits and Mama Packs provided women with some of the supplies needed during facility delivery. These strategies were generally popular in the SMGL districts that supported them. Subsidies, incentives, and community health worker outreach supported by SMGL were identified as “active ingredients” of the SMGL initiative at the conclusion of Phase 1.⁴⁰

Both countries demonstrated clear commitments to improve health and well-being by strengthening community health systems, as reflected in the national policies and domestic funding issued prior to the SMGL initiative. In collaboration with national and district stakeholders, SMGL implemented evidenced-based strategies^{28–30} that were country-defined and driven, extensive, and adequately funded. Although not all activities are financially sustainable without continued donor assistance, the SMGL accomplishments demonstrate that

countries can rapidly promote and expand access to health at the community level with additional funding. These successes could also inform identification of community health priorities within the national strategy, as the new Uganda community health roadmap suggests.⁵⁵

The accomplishments of the initiative in relation to health outcomes were documented through extensive monitoring and evaluation activities, including population-based measurement of maternal mortality. Data yielded from these efforts indicate that the SMGL-supported districts experienced significant increases in facility deliveries and declines in maternal mortality. Moreover, care-seeking behaviors among Ugandan women who died of maternal causes improved substantially and the median time between the onset of women's symptoms and the decision to seek care declined, even though these women ultimately did not survive. We estimated that the reduction in the number of maternal deaths among women who did not seek care contributed to about half of the overall MMR decline in Uganda. In Zambia, where institutional delivery rates were high at the outset of SMGL and fewer women did not seek care prior to death, the impact of changes in care-seeking behaviors was negligible.

Although SMGL did not use a comparison group, the independent evaluation in Uganda and Zambia at the conclusion of Phase 1 and a separate study in Kalomo district in Zambia showed greater community awareness, demand for facility-based delivery care, and satisfaction with the services received in SMGL districts when compared with other districts nearby.^{40,53}

Limitations of the SMGL Approach and Monitoring and Evaluation Methods

Despite SMGL's success in increasing facility deliveries and reducing maternal deaths, the initiative faced notable challenges. Large investments in education messages via mass media and community events could not be carried out beyond Phase 1. Rapid expansion of the activities performed by community health volunteers may not be sustainable, though it is aligned with government priorities.⁵⁴ CDK incentives and transport subsidies for facility delivery were periodically depleted, according to the Phase 1 external evaluation.⁴⁰ Funding delays and changes in implementing partner contracts occurred periodically over the life of the SMGL initiative, causing resource depletion or temporary interruption of community outreach activities.

In some areas, increased demand for facility services exceeded facilities' capacity.

There is strong evidence that maternal mortality in SMGL-supported districts dropped at a higher pace than the rest of the country.

Other limitations stemmed from the increased demand for SMGL facility services outpacing the supply. In certain areas, SMGL's work to encourage facility delivery led to a rapid increase in numbers of women seeking services that exceeded the facilities' capacity, despite intense efforts to improve and expand facilities and staffing. This sometimes led to facility congestion and over-worked health care providers, as well as to the increased possibility that the quality of facility care could be compromised.

SMGL was launched rapidly in separate countries and districts and relied heavily on the organizational structure and capacity of different implementing partners to mobilize quickly. This proved challenging for the coordination, intensity, and continuity of SMGL intervention and evaluation approaches across districts and countries. Although general strategies and approaches were shared across the initiative, as shown in Table 1, specific approaches varied according to location. In some instances, approaches were unique to an implementing partner and district context, as is the case of the voucher system implemented in 3 districts in Uganda.

Different intervention approaches and varied resources across implementing partners, districts, and countries, as well as the lack of process evaluations of specific community-based interventions, resulted in an inability to attribute specific community-based messaging or interventions to the successful increases in facility deliveries and improved health outcomes. Although all implementing partners collected data on their level of efforts related to community health activities, they did not use a set of unified indicators nor did they collect these data continuously. Community-based data that may have explained the strength of association between community engagement and improved health outcomes were not collected at endline and hence were not included in the final evaluation. Only the Phase 1 evaluation using exit interviews and focus groups⁴⁰ captured important information on community perceptions, women's attitudes about SMGL services, and use of transport arranged through community mobilization and transport vouchers; comparable data were not collected during Phase 2.

Although extensive monitoring and evaluation activities were implemented for SMGL, these methods focused heavily on measuring effects on health outcomes and much less on process documentation of various programmatic approaches. When process indicators were monitored, they mostly documented Strategies 2 and 3 aimed at

increasing facility delivery and use of preventive health services. Systematic data were not collected to directly link inputs and processes of SMGL communications strategies (Strategy 1), community birth planning activities (Strategy 2), or financial incentives (Strategy 3) with health outcomes.

The evidence of SMGL successes in reducing maternal mortality at a higher pace than the rest of the country is strong.⁴¹ Documenting the role of reducing the first delay in maternal mortality is challenging in the absence of a comparison group that would allow examination of whether there were significant socio-demographic, medical, or other delay-related differences between deceased women and women with obstetric complications who survived. However, verbal autopsy studies often have no comparison group and the effect of SMGL interventions should have been accessible to all pregnant and postpartum women. Since the verbal autopsy respondents were the main caregivers of the deceased women, it is possible that the information about delay in seeking health care may have been affected by personal biases, poor recall of events, or lack of precise reporting of symptoms or timing. Further, the decision to seek care stems from an awareness about the severity of the mother's condition and that health care was needed. Verbal autopsy questions on awareness and decision making may have been interpreted differently by caregivers of women with or without evident obstetric complications prior to deciding to seek care outside the home.

Addressing the First Delay Within the Context of a Systems Approach

Reducing and ultimately eliminating barriers that contribute to the first delay in accessing health care services is critical to achieve continued reductions in preventable maternal and neonatal mortality. Individual and community engagement aided by political support, program integration, and partnerships are critical drivers of change to improve survival, promote health and well-being, and ensure enabling environments.^{7,8} The SMGL experience provided valuable lessons and insights into how increased community engagement combined with health systems strengthening within the context of existing national policies and in partnership with national, district, and local stakeholders can be instrumental in achieving mortality decline.

In collaboration with the Ministries of Health in Uganda and Zambia, SMGL implemented a broad array of community health interventions (covering

over 90% of communities in the learning districts), that were context-specific, coordinated, integrated along the continuum of care, and aligned with country-defined priorities. SMGL strategies coalesced national efforts to define a comprehensive community health agenda (as illustrated by the new community health roadmap in Uganda) with district-driven priorities both centered on increased community ownership and engagement.

SMGL community health strategies and activities helped stimulate demand for facility delivery care. Facility delivery rates increased, including in those facilities able to provide the complete range of lifesaving interventions that constitute EmONC. Although maternal deaths associated with the first delay declined in the learning districts, recognizing a serious complication and making a timely decision to seek health care in a facility is only the first step of the journey to a safe facility delivery. Deaths associated with the second or third delays remain a serious threat if women have waited too long to seek care, face insurmountable barriers getting to a facility, or receive inadequate care once they arrive at a health care facility. Thus, SMGL's systems approach to addressing all 3 delays is critical, so that programs designed to increase demand for facility maternity care are also able to ensure readily available transport to a facility and an adequate supply of quality facility care. Sustainability for maternal mortality reduction initiatives include building a robust community health system within which community members are aware of and actively engaged in their health care and ensuring that the supply of high-quality care can meet increased demand.

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ORIGINAL ARTICLE

Addressing the Second Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Reaching Appropriate Maternal Care in a Timely Manner

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The Saving Mothers, Giving Life initiative employed 2 key strategies to improve the ability of pregnant women to reach maternal care: (1) increase the number of emergency obstetric and newborn care facilities, including upgrading existing health facilities, and (2) improve accessibility to such facilities by renovating and constructing maternity waiting homes, improving communication and transportation systems, and supporting community-based savings groups. These interventions can be adapted in low-resource settings to improve access to maternity care services.

ABSTRACT

Background: Between June 2011 and December 2016, the Saving Mothers, Giving Life (SMGL) initiative in Uganda and Zambia implemented a comprehensive approach targeting the persistent barriers that impact a woman's decision to seek care (first delay), ability to reach care (second delay), and ability to receive adequate care (third delay). This article addresses how SMGL partners implemented strategies specifically targeting the second delay, including decreasing the distance to facilities capable of managing emergency obstetric and newborn complications, ensuring sufficient numbers of skilled birth attendants, and addressing transportation challenges.

Methods: Both quantitative and qualitative data collected by SMGL implementing partners for the purpose of monitoring and evaluation were used to document the intervention strategies and to describe the change in outputs and outcomes related to the second delay. Quantitative data sources included pregnancy outcome monitoring data in facilities, health facility assessments, and population-based surveys. Qualitative data were derived from population-level verbal autopsy narratives, programmatic reports and SMGL-related publications, and partner-specific evaluations that include focus group discussions and in-depth interviews.

Results: The proportion of deliveries in any health facility or hospital increased from 46% to 67% in Uganda and from 63% to 90% in Zambia between baseline and endline. Distance to health facilities was reduced by increasing the number of health facilities capable of providing basic emergency obstetric and newborn care services in both Uganda and Zambia—a 200% and 167% increase, respectively. Access to facilities improved through integrated transportation and communication services efforts. In Uganda there was a 6% increase in the number of health facilities with communication equipment and a 258% increase in facility deliveries supported by transportation vouchers. In Zambia, there was a 31% increase in health facilities with available transportation, and the renovation and construction of maternity waiting homes resulted in a 69% increase in the number of health facilities with associated maternity waiting homes.

Conclusion: The collective SMGL strategies addressing the second delay resulted in increased access to delivery services as seen by the increase in the proportion of facility deliveries in SMGL districts, improved communication and transportation services, and an increase in the number of facilities with associated maternity waiting homes. Sustaining and improving on these efforts will need to be ongoing to continue to address the second delay in Uganda and Zambia.

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INTRODUCTION

Global guidelines developed by the World Health Organization (WHO) recommend that women deliver at facilities with the capacity to manage

emergency obstetric and newborn care (EmONC) as a strategy to improve maternal and newborn mortality.¹ WHO identified a set of medical interventions or signal functions that address the direct causes of maternal death, with 7 of these interventions defining basic emergency obstetric and newborn care (BEmONC).² However, despite the recommendation, persistent barriers affect a woman's decision to seek care (first delay), ability to reach care (second delay), and ability to receive adequate maternal health services (third delay), as outlined in the Three Delays Model developed in 1994 by Thaddeus and Maine.³ While this conceptual framework was first developed to understand health care decision making and access to care for complications during delivery, it has been adapted to understanding decision making and access around location of normal delivery as well.⁴

The second delay—the delay in the ability to reach care—is fueled by factors that both directly and indirectly influence a woman's ability to reach care, including long distance to facilities, geographical barriers, poor road infrastructure, lack of transportation options, poor communication, and costs associated with delivery such as transportation and supplies (Figure 1).^{5,6} In rural Ghana, a recent study indicated that travel time was inversely associated with facility delivery even when facilities had improved their capacity to handle obstetric emergencies.^{7,8} Other barriers include high costs of available transportation or supplies,⁴ lack of a clear birth plan⁹ or not departing for the facility with sufficient time before labor,¹⁰⁻¹² and limited access to financial resources.¹³

Interventions to Reduce the Second Delay

Intervention approaches to address these barriers include those that target the health system (supply side) and those targeting pregnant women (demand side).¹⁴ Known interventions designed to address health system barriers include strengthening referral systems and transportation, improving communication tools, establishing maternity waiting homes, and developing or strengthening community-based systems to escort women to facilities.^{15,16} Activities targeting pregnant women include community-based linkages to health facilities, financing mechanisms to prepare for facility delivery, and birth preparedness. Demand-side financing mechanisms, such as cash transfers and vouchers, have been introduced in several countries and have been effective in increasing the utilization of

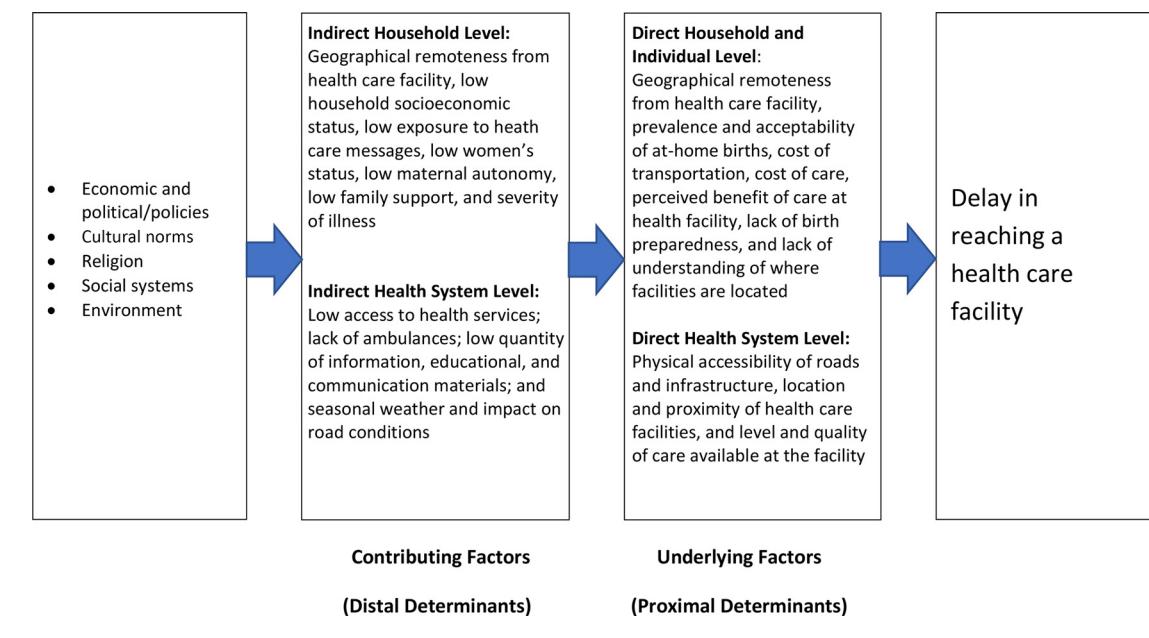
maternity care.^{17,18} A recent review of cash transfers and vouchers found the strongest effect for birth with a skilled birth attendant was observed for those who used vouchers for maternity services.¹⁹ However, reflecting the significance of supply-side barriers, women who lived long distances from facilities and had poor access to transportation still faced challenges to accessing services.

SMGL Context

According to the 2011 Uganda Demographic Health Survey, 58% of births in the previous 5 years took place in a health facility.²⁰ The 2013–2014 Zambia Demographic Health Survey found that 67% of deliveries in the previous 5 years were in a health facility. Health facilities being too far and a lack of transportation were cited as reasons for home delivery by 1 in 3 women who delivered at home.²¹ In both Uganda and Zambia, women from urban areas were more likely to deliver at a health facility compared with those in rural areas. In Uganda, 89% of women in urban areas and 53% of women in rural areas delivered at a facility. In Zambia, 89% of women in urban areas delivered at a facility compared with 56% in rural areas.

As part of its comprehensive strategy to address maternal mortality, the Saving Mothers, Giving Life (SMGL) initiative,²² in partnership with the governments of Uganda and Zambia, implemented a package of interventions specifically targeting the second delay. A mix of interventions was implemented under 2 broad strategies: (1) increasing the number of EmONC facilities and (2) improving the accessibility of EmONC facilities (Table 1). For each intervention, implementing partners monitored and evaluated their efforts to contribute to the collective understanding of the overall impact of the SMGL initiative. This article provides an overview of the SMGL interventions that focused on the second delay in Uganda and Zambia, and uses programmatic data to describe the outputs and outcomes of these interventions.

The SMGL initiative in both Uganda and Zambia operated within 3 phases: Phase 0—design and start-up (June 2011 to May 2012); Phase 1—proof of concept (June 2012 to December 2013); and Phase 2—scale-up and scale-out (January 2014 to October 2017). During Phase 2, SMGL expanded its presence in Uganda from 4 districts to 13 districts (Figure 2), and in Zambia from 6 to 18 districts (Figure 3). For this article, we focused

FIGURE 1. Second Delay: Timely Access to Health Care

on the initial districts selected in Phase 0 (before the Phase 2 expansion) from June 2011 to December 2017. Implementing districts were contiguous in Uganda, whereas the Zambian districts were spread out across 3 provinces, with 2 in Eastern Province, 1 in Southern Province, and 1 in Luapula Province in the northern region.

In both Uganda and Zambia, all SMGL implementing districts were predominantly rural, with geographic distance and mountainous terrain playing a major role in the accessibility of EmONC services. Most roads were packed dirt, with only a handful of paved roads primarily between main towns and the district capitals. Dense forest coverage and low population density characterized large portions of the implementation districts in both countries. Further details on the scope of the program and district and facility characteristics have been described elsewhere.²³

METHODS

We reviewed both quantitative and qualitative data to describe the implementation of SMGL interventions targeting the second delay and to evaluate collective outcomes. Partners collected program-specific data as well as indicators that were harmonized across a broader SMGL

monitoring and evaluation strategy. In both countries, the U.S. Centers for Disease Control and Prevention country office oversaw partner-specific data collection and evaluation activities and each implementing partner had data quality control measures in place for data collection and data entry. We also reviewed partner-specific programmatic data and data from systematic evaluations. In both countries, SMGL partners carried out formative research to understand the country context and determine which specific factors influenced the practice of key behaviors before, during, and after delivery.

Quantitative Data and Analytic Methods

Pregnancy outcome monitoring data in facilities, health facility assessments, and population-based data were the primary quantitative data sources used to assess programmatic outcomes related to strategies addressing the second delay across all SMGL-supported districts. Details on data collection methods have been published elsewhere.²⁴

Pregnancy Outcomes Monitoring Data

Implementing partners collected routine data on 31 SMGL indicators from the labor and delivery and other in-patient registers in facilities in

TABLE 1. Saving Mothers, Giving Life Strategies and Interventions to Reduce the Second Delay, 2011–2016

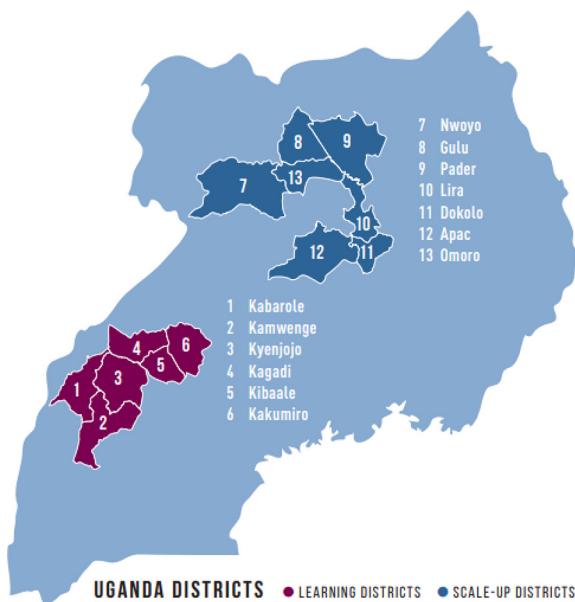
SMGL Strategies and Approaches	Country-Specific Interventions	
	Uganda	Zambia
Strategy 1. Decrease distance to skilled birth attendance by increasing the number of EmONC facilities		
Establish additional EmONC facilities and strengthen existing facilities to provide the following services 24 hours per day, 7 days a week, for all pregnant women in the district:	<ul style="list-style-type: none"> Upgraded infrastructure to a sufficient number of public and private facilities in appropriate geographic locations and provided necessary equipment and commodities for EmONC service delivery Hired midwives, medical officers, and anesthetists Trained medical officers, anesthetists, midwives, and nurses in EmONC Provided on-site mentorship of health facility teams using protocols 	<ul style="list-style-type: none"> Upgraded infrastructure and provided necessary equipment to provide services for pregnant women in public and private facilities in appropriate geographic locations Hired a sufficient number of skilled birth attendants and midwives Trained doctors, midwives, and anesthetists in EmONC and the Electronic Logistic Management Information System Provided on-site mentorship of health facility staff using protocols, forms, and drills
Strategy 2. Improve accessibility of EmONC facilities		
Create a communication and transportation referral system that operates 24 hours per day, 7 day per week, and:	<ul style="list-style-type: none"> Created district transportation committees to improve coordination of ambulances for referrals Provided service and transportation vouchers to women for transportation to facilities nearest to them and access to antenatal care, delivery, and postnatal care services at the facilities Trained village health teams to encourage birth preparedness and escort women to the facility Procured ambulances to facilitate transportation for referral Renovated maternity waiting homes 	<ul style="list-style-type: none"> Repaired and procured 2-way radios where needed Procured ambulances and motorcycle ambulances; strengthened district transportation committees; and ensured strategic placement of ambulances Renovated and constructed maternity waiting homes Strengthened district transportation committees to improve coordination of ambulance services Trained Safe Motherhood Action Groups to encourage birth preparedness and escort women to the facility Established village-level savings programs for pregnant women to encourage better planning for delivery

Abbreviations: EmONC, emergency obstetric and newborn care; SMGL, Saving Mothers, Giving Life.

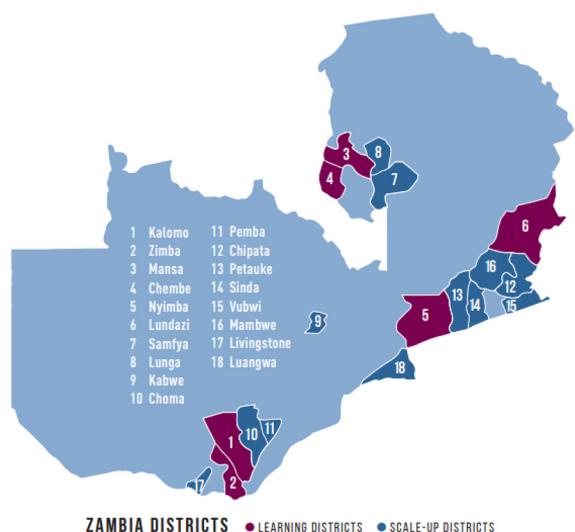
SMGL-supported districts. Baseline indicators were calculated from data collected during Phase 0 between June 2011 and May 2012, and endline indicators were calculated from data collected between January and December 2016. We then calculated the relative change between the baseline and endline indicators. To compare the baseline and endline results for significant differences, we used the McNemar's test, which is appropriate for dichotomous responses for matched pairs of data at different time points.

Health Facility Assessments

Health facility assessments were conducted at baseline (late 2011 in Zambia and early 2012 in Uganda) and at endline (2017) in all health facilities in SMGL-supported districts. We used these data to document the status of health facilities and their availability of lifesaving emergency obstetric interventions at the time of the assessment. In this article, we present results compiled from facilities that maintained delivery capacity from baseline to endline—105 in Uganda and 110 in Zambia. The assessments were aligned

FIGURE 2. SMGL Learning and Scale-Up Districts in Uganda

Source: Adapted from Saving Mothers, Giving Life. Results of a Five-Year Partnership to Reduce Maternal and Newborn Mortality: Final Report 2018. <http://www.savingmothersgivinglife.org/docs/smgl-final-report.pdf>. Accessed December 18, 2018.

FIGURE 3. SMGL Learning and Scale-Up Districts in Zambia

Source: Adapted from Saving Mothers, Giving Life. Results of a Five-Year Partnership to Reduce Maternal and Newborn Mortality: Final Report 2018. <http://www.savingmothersgivinglife.org/docs/smgl-final-report.pdf>. Accessed December 18, 2018.

with the WHO criteria for basic (BEmONC) and comprehensive emergency obstetric and newborn care (CEmONC)² and included questions about facility infrastructure, staffing, ability to perform signal functions,² stock-outs of key medications required for the management of complications, and referral system components including transportation and communication.

We classified facilities as EmONC if, in the previous 3 months, they performed all 7 of the signal functions for BEmONC and all 9 for CEmONC at the time of the assessment, and non-EmONC if they were not capable of performing all of the BEmONC signal functions.

Population-Based Data

Population-level household surveys (Reproductive Age Mortality Study in Uganda and SMGL Census in Zambia) were conducted in 2012 and 2017.²⁴ We combined household data with the health facility routine monitoring data and health facility assessment data, to calculate the proportion of facility deliveries, stratified by EmONC capacity, at baseline and endline. The facility delivery rate was calculated using the number of deliveries verified to have occurred in an SMGL-affiliated facility divided by the estimated number of live births in the SMGL districts at each time point. The number of births was estimated by applying crude birth rates (derived from the age-specific fertility rates among women of reproductive age enumerated in 2013 in Uganda districts, and derived from the 2010 national census in Zambia) to the baseline and endline district population. We calculated the relative change in facility deliveries between baseline and endline, assuming some variation in error or measurement. To test for significance, *z* scores based on the normal approximation to the binomial distribution were used to calculate *P* values.

Qualitative Data and Analytic Methods

We derived qualitative data primarily from population-level verbal autopsy narratives, programmatic reports and SMGL-related publications, and partner-specific evaluations that included focus group discussions and in-depth interviews.

Verbal Autopsy Narratives

Following the population-based household surveys, retrospective verbal autopsies were conducted and used to measure the medical causes and delay-associated factors of maternal deaths. An open-ended narrative was captured, detailing

the experiences of women prior to maternal death and offering context to health facility results.

Programmatic Reports and Publications

We reviewed implementation partner reports and SMGL-related publications and evaluations primarily to describe the intervention activities that occurred under each strategy.^{25,26} When necessary, we contacted implementing partners for clarification to resolve discrepancies and to provide more in-depth descriptions of program activities. Data were used to outline SMGL activities and contextualize findings related to the second delay.

Partner-Specific Systematic Evaluations

Partners provided data from focus group discussions with community groups and in-depth interviews with health systems staff at the district and health facility levels to understand the perceived impact of interventions. We analyzed focus group discussions and in-depth interviews using content analysis.

From these qualitative data sources, we gathered information on the (1) description of strategies, (2) methods of implementation, (3) outputs (i.e., direct results of activities), and (4) outcomes (i.e., changes in knowledge or behaviors of the pregnant women/target population). Data were triangulated with the quantitative data to assess the implementation of strategies related to the second delay in the context of the SMGL initiative.

Ethics

The study protocol was reviewed and approved by the ministries of health in Uganda and Zambia and deemed non-research by the Human Research Protection Office of the Center for Global Health at the U.S. Centers for Disease Control and Prevention. Written informed consent was obtained for respondents in all households and among women for the census, Reproductive Age Mortality Study interviews, focus group discussions, and in-depth interviews.

RESULTS

This evaluation includes program data from multiple implementation partners that addressed the second delay to care within the context of the SMGL initiative. In this section, we first present the overall statistics for the change in rate of facility delivery within the SMGL districts by country. We then

provide a brief description of the interventions under each SMGL strategy (*Table 1*) and their results.

The facility delivery rate at all facilities providing delivery services increased by 47% in Uganda and 44% in Zambia during the evaluation period (2011–2016). The increase in the facility delivery rate in Uganda was due to increased use of both facilities that met the EmONC requirements (45% increase) and of non-EmONC delivery facilities (49% increase) (*Table 2*). By contrast, the change in Zambia was primarily driven by increased use of non-EmONC delivery facilities (67% increase). The proportion of births in EmONC facilities increased to a lesser degree (12% increase) (*Table 3*). Facilities that did not meet BEmONC requirements may have had some, but not all, of the 7 interventions defining BEmONC.²

The facility delivery rate at all facilities providing delivery services increased by 47% in Uganda and 44% in Zambia during the evaluation period.

Strategy 1: Decrease Distance to Skilled Birth Attendance by Increasing the Number of EmONC Facilities

Decreasing the distance to skilled birth attendance was addressed by upgrading a sufficient number of existing health facilities to meet BEmONC criteria in appropriate geographic positions (*Table 1*). One BEmONC criterion is to remain open 24 hours a day, 7 days a week with skilled staff present; this was a key element of the SMGL initiative to encourage and enable women to deliver in health facilities.²⁷ Also critical for an EmONC facility is ensuring the availability of sufficient numbers of skilled birth attendants capable of managing complications (*Table 1*). During both Phase 1 and 2 of SMGL implementation, partners worked with ministries of health in both Uganda and Zambia to ensure facilities had staff capable of providing EmONC services.

Uganda

To address a shortage of health centers adequately equipped to handle deliveries, an implementing partner worked with districts to identify facilities that would benefit from additional support to enable them to provide BEmONC services in geographic areas lacking these services. Facilities previously offering only outpatient services, but which had adequate space, were supported with the necessary equipment and supplies to conduct delivery services, and skilled midwives were redeployed to work there. To ensure the availability of a sufficient number of skilled staff, medical officers, anesthetists, midwives, and nurses were hired and retrained in EmONC.

During the period of implementation, 12 health center II facilities (which are generally outpatient facilities) in hard-to-reach areas were strengthened to provide delivery services capable of managing basic complications. The number of EmONC facilities increased between baseline and endline by more than double—from 10 (3 BEmONC and 7 CEmONC) to 26 (9 BEmONC and 17 CEmONC), with a 200% increase in the number of health facilities capable of providing BEmONC services (Table 2). Though not statistically significant, Uganda saw a

10% relative increase in the proportion of health facilities offering services 24 hours a day, 7 days a week. At baseline, all SMGL facilities had at least 1 doctor, nurse, or midwife on duty and this remained the same at endline (Table 2).

An analysis of the changes in estimated travel time to reach EmONC facilities across SMGL time points in Uganda found that geographic access to BEmONC and CEmONC increased significantly ($P<.01$) within the 4 SMGL study districts between 2012 and 2016.²⁸

TABLE 2. Changes in Outputs and Outcomes Related to Activities Conducted Under SMGL Strategies Addressing the Second Delay in SMGL-Supported Districts, Uganda

	Baseline June 2012 (105 facilities)	Endline Dec 2016 (105 facilities)	% Relative change ^a	Significance level ^b
Service delivery outcomes^c				
Deliveries in all facilities	45.5%	66.8%	+47%	$P<.01$
Deliveries in EmONC facilities	28.2%	41.0%	+45%	$P<.01$
Deliveries in non-EmONC facilities	17.3%	25.8%	+49%	$P<.01$
Strategy 1: Decrease distance to skilled birth attendance by increasing the number of EmONC facilities^d				
Facilities offering services 24 hours a day, 7 days a week	80.0%	87.6%	+10%	NS
Facilities with electricity	57.1%	96.2%	+69%	$P<.01$
Facilities with running water	76.2%	100.0%	+31%	$P<.01$
Number of BEmONC facilities	3	9	+200%	NA
Number of CEmONC facilities	7	17	+143%	NA
Number of pregnant women who received antiretroviral therapy for the prevention of mother-to-child-transmission of HIV/AIDS	1,262	6,837	+442%	NA
Number of HIV-exposed infants receiving HIV prophylaxis	1,117	3,245	+191%	NA
Health facilities reporting that at least 1 doctor, nurse, or midwife is on staff	100.0%	100.0%	0%	NS
Strategy 2: Improve the accessibility of EmONC facilities^d				
Institutional deliveries supported by Baylor transportation vouchers ^e	0.9%	23.8%	+258%	$P<.01$
Health facilities that reported having available transportation (motor vehicle or motorcycle)	61.0%	59.0%	-3%	NS
Health facilities that reported having communication equipment (including 2-way radio, landline, or cell phone with service)	93.3%	99.0%	+6%	$P<.05$

Abbreviations: BEmONC, basic emergency obstetric and newborn care; CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; NA, not applicable; NS, not significant; SMGL, Saving Mothers, Giving Life.

^aPercentage of change calculations are based on unrounded numbers.

^bTo test for significance, z scores based on the normal approximation to the binomial distribution were used to calculate P values.

^cThe number of facility deliveries was collected through the Pregnancy Outcome Monitoring data collection. The number of live births was estimated by applying crude birth rates (derived from the age-specific fertility rates among women of reproductive age enumerated in 2013 in the SMGL Uganda districts) to the baseline and endline district populations.

^dThe number of health facilities performing deliveries varied over the 5-year initiative. Health facility assessments results for Uganda were compiled from only the 105 facilities that maintained delivery capacity from baseline to endline.

^eTransportation vouchers were introduced in April 2012 in the 3 Baylor districts; the system was rapidly scaled up with SMGL support.

TABLE 3. Changes in Outputs and Outcomes Related to Activities Conducted Under SMGL Strategies Addressing the Second Delay in SMGL-Supported Districts, Zambia

	Baseline June 2012 (110 facilities)	Endline Dec 2016 (110 facilities)	% Relative change ^a	Significance level ^b
Service delivery outcomes^c				
Deliveries in all facilities	62.6%	90.2%	+44%	P<.01
Deliveries in EmONC facilities	26.0%	29.1%	+12%	P<.01
Deliveries in non-EmONC facilities	36.7%	61.1%	+67%	P<.01
Strategy 1: Decrease distance to skilled birth attendance by increasing the number of EmONC facilities^d				
Facilities offering services 24 hours a day, 7 days a week	68.2%	96.4%	+41%	P<.01
Facilities with electricity	55.5%	92.7%	+67%	P<.01
Facilities with running water	90.0%	97.3%	+8%	P<.05
Number of BEmONC facilities	3	8	+167%	NA
Number of CEmONC facilities	4	5	+25%	NA
Number of pregnant women who received antiretroviral therapy for the prevention of mother-to-child transmission of HIV/AIDS	930	1,036	+11%	NA
Number of HIV-exposed infant receiving HIV prophylaxis	523	1,030	+97%	NA
Number of health providers hired	—	89	—	NA
Health facilities reporting that at least 1 doctor, nurse, or midwife is on staff	90.0%	98.8%	+10%	P<.05
Strategy 2: Improve the accessibility of EmONC facilities^d				
Health facilities that reported having available transportation (motor vehicle or motorcycle)	55.5%	72.7%	+31%	P<.01
Health facilities that reported having communications equipment (including 2-way radio, landline, or cell phone with service)	44.6%	100.0%	+124%	NA
Health facilities that reported having an associated maternity waiting home	28.8%	48.8%	+69%	P<.01
Health facilities that reported having an associated Safe Motherhood Action Group	63.8%	96.3%	+51%	P<.01

Abbreviations: BEmONC, basic emergency obstetric and newborn care; CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; NA, not applicable; NS, not significant; SMGL, Saving Mothers, Giving Life.

^aPercentage of change calculations are based on unrounded numbers.

^bTo test for significance, z scores based on the normal approximation to the binomial distribution were used to calculate P values.

^cThe number of facility deliveries was collected through the Pregnancy Outcome Monitoring data collection. The number of live births was estimated by applying crude birth rates (derived from 2010 national census in Zambia) to the baseline and endline district populations.

^dThe number of health facilities performing deliveries varied over the 5-year initiative. Health facility assessments results for Zambia were compiled from only the 110 facilities that maintained delivery capacity from baseline to endline.

Zambia

In Zambia, partners implemented a range of interventions including purchasing essential equipment, supplies, and medications necessary for EmONC, both basic and comprehensive; hiring additional midwives to fill existing vacancies; training doctors, midwives, and anesthetists in EmONC; and renovating health facility infrastructure, including making improvements to

water source and provision of solar power when electricity was not available. Recently retired midwives were recruited to return to active service. In addition, implementing partners and district staff conducted monthly on-site mentorship of health facility staff using protocols, forms, and drills.

The number of EmONC facilities increased from 7 (3 BEmONC and 4 CEmONC) to 13 (8 BEmONC and 5 CEmONC). Zambia saw a 41% increase in

Zambia saw a 41% increase in the number of facilities offering services 24 hours a day, 7 days a week.

the number of facilities offering services 24 hours a day, 7 days a week, and the proportion of health facilities reporting at least 1 doctor, nurse, or midwife on staff at the end of the project in 2016 improved significantly ($P<.05$) (Table 3). Specifics about health facility staff hires and trainings have been provided elsewhere.²⁷

Strategy 2: Improve the Accessibility of EmONC Facilities

As illustrated by an excerpt from a verbal autopsy (Box 1), the challenges of distance and transportation are substantial.

In both Uganda and Zambia, a number of approaches were taken to improve access to EmONC services by establishing strong referral systems inclusive of communication and transportation. These approaches, detailed in the sections below, included strengthening maternity waiting homes, reinforcing communication and transportation systems, establishing community linkages to the health system, and facilitating better savings in preparation for delivery (Table 1).

Renovation and Construction of Maternity Waiting Homes

To increase access to EmONC services for women in need, partners renovated and constructed maternity waiting homes—residential lodging near facilities where women can stay while awaiting delivery—in both Uganda and Zambia. The temporary lodging spaces provided by maternity waiting homes enable health facilities with EmONC services to better accommodate mothers from hard-to-reach or distant communities who may otherwise experience transportation challenges at the time of delivery.

Uganda

Newly renovated maternity waiting homes in Uganda accommodated approximately 10% of all mothers who delivered at the associated health facilities in Phase 1 and Phase 2 of the initiative.

In one district, a partner renovated maternity waiting homes at CEmONC hospitals, creating a waiting space for women at sites that were capable of providing comprehensive care services without needing to be referred elsewhere. During SMGL Phase 1, 4 maternity waiting homes were refurbished at 1 district hospital and 3 at EmONC-capable health center IVs (health centers that function as mini-hospitals). Newly renovated maternity waiting homes in Uganda accommodated approximately 10% of all mothers who delivered at the associated health facilities during Phase 1 and Phase 2 of the initiative.

Zambia

In Zambia, some partners either constructed or renovated existing maternity waiting homes. As part of the Maternity Homes Alliance, other partners conducted formative research to design a community-informed maternity waiting home model during the end of SMGL Phase 1 and beginning of SMGL Phase 2 (2013–2014).^{9,29–31} During SMGL Phase 2 (July 2015), partners then refined the model with the government and constructed 24 maternity waiting homes in 7 SMGL districts across 3 provinces (Eastern, Luapula, and Southern) at sites where distance, physical geography, and terrain played a major role in determining access to EmONC services. Partners worked with health system staff, Safe Motherhood Action Group members, and traditional leaders to generate demand for maternity waiting homes. Beginning in SMGL Phase 2, partners began evaluating the impact of maternity waiting homes³² and assessing them for acceptability and sustainability.

During SMGL Phases 1 and 2, 211 maternity waiting home were either renovated (n=171) or newly constructed (n=40). Utilization data for all homes are not available, but in the 24 maternity waiting homes newly constructed by the Maternity Homes Alliance operating for the last 6 months of SMGL Phase 2, 1,123 women had used them before December 2016, approximately 49% of those delivering at the affiliated health facilities. Preliminary qualitative results from Zambia indicate that maternity waiting homes are acceptable to community members and that health facility staff perceive an increase in facility attendance for delivery and postnatal services (Box 2).

Communication and Transportation Services

A key element of the SMGL initiative was the creation of an integrated communication and transportation system that functions 24 hours a day, 7 days a week, to encourage and enable pregnant women to access delivery care facilities. Both Uganda and Zambia led several efforts to facilitate transportation to and between facilities.

Uganda

In Uganda, partners collaborated with the Ministry of Health to establish guidelines and referral procedures, which did not exist before Phase 1. The referral system consisted of 5 critical components (Box 3). A transportation committee was established in each SMGL-supported district that comprised the district health officer, assistant district

health officer for maternal and child health, hospital superintendents, health center IV in-charges, ambulance drivers, and a project mentor midwife. These committees met monthly to review referrals and quarterly to review maternal and child health outcomes. The ambulance and referral systems were jointly coordinated by SMGL project staff and the district health office. To facilitate coordination, fixed phones were procured, enabling facilities to better communicate referrals with the district health office. The district staff communicated with the ambulance driver closest to the health facility, with clear instructions of the name of the facility needing the service and the name of the facility where the client was being taken. By phone, the district health office staff also provided mentorship on how to handle the patient as they waited on the ambulance to reach them.

Secondly, partners in Uganda procured and distributed at least 1 ambulance to each SMGL district to supplement existing ambulances or fill a gap in districts with none. Large 4x4 vehicles were procured for areas with the most difficult terrain to navigate, smaller vehicles were procured for distant but easily navigable destinations, and motorized tricycle ambulances for areas that were nearer and had good terrain. The motorized tricycle ambulances were placed at the health sub-district or sub-county levels and the vehicles at the district level. This allowed the closest ambulance to the emergency to be assigned for timely referral of mothers and newborns with complications. SMGL partners supported existing ambulances within the districts with vehicle maintenance and repairs and by hiring and paying ambulance drivers' salaries and allowances. Program-based data included individual-level data such as the status of the patient, diagnosis, time of arrival, and reason for referral. These data were collected through referral forms completed at the destination health facility.

To facilitate transportation for women from the community to health facilities, Uganda implemented a "boda-for-mother" voucher program in 3 districts. This was guided by results from a health systems needs assessment conducted in April 2012, which indicated that *boda-bodas* (local motorcycles) were acceptable for transportation and could improve access to skilled birth attendance. Boda-bodas were engaged to facilitate the transportation of pregnant women from their villages to the nearest health facility providing EmONC as part of the voucher program. Transportation vouchers were distributed within the communities by village health team members to ensure women's access to health facilities and

BOX 1. Vignette Illustrating Challenges Related to Delay in Reaching Care, From a Verbal Autopsy

Sylvia was a 23-year-old Ugandan woman who died giving birth to her third child, having had 2 previous births by cesarean delivery. Sylvia's father was interviewed during a verbal autopsy. The interview was transcribed and is summarized below. Details have been added in brackets to clarify meaning; names of people, places, and dates have been changed to protect confidentiality.

At 5:00 a.m., Sylvia's father was called and told that his daughter needed help; she was in labor, which had started some hours earlier. He found her in serious pain and went to look for a motorcycle [to take her to a health facility]. By the time he got a motorcycle, Sylvia could not manage to sit on it. It had already started raining heavily. Sylvia's father contacted somebody who had a vehicle, but the driver told him he couldn't manage the trip because the road was impossible. The father contacted a second person with a vehicle and was again told the trip was not possible because of the poor condition of the road. Their village was about 10.5 km from the main road. The rain continued and at 11:00 a.m. Sylvia's brother came with a vehicle. By that time, the drug shop seller had put Sylvia on a drip [intravenous infusion] to stimulate contractions. While they were on the way to the health center number IV, or mini-hospital, the baby started bringing the head [crowning]. After they had been traveling for approximately 1 hour, Sylvia died before reaching the health center. They contacted the doctor to remove the fetus, but it had already died. The doctor told them that the uterus ruptured, which had caused Sylvia's death.

to reach upper-level referral facilities in the event of a delivery-related emergency. Village health teams are community volunteers affiliated with health facilities and engage during health promotion activities at the community level.³³ The transportation vouchers were expanded during Phase 2 to provide transportation not only for delivery but also for 4 antenatal care visits and 1 postnatal care visit. Thirty percent of transportation vouchers were redeemed, resulting in a 258% increase ($P<.0001$) in the proportion of deliveries supported by boda-for-mother transportation vouchers (Table 2).

Although the percentage of facilities reporting the availability of motor vehicle transportation was stable in Uganda (61% at baseline and 59% at endline), there was a 6% increase ($P<.05$) in the percentage of health facilities that reported having communications equipment (Table 2).

Zambia

Zambia had existing referral guidelines and procedures before Phase 1, consisting of triplicate Ministry of Health referral forms or books that logged the time the transportation was called, time of patient pickup, time of arrival to hospital, outcome of mother and baby, and feedback to the referring facility. SMGL partners strengthened the use of existing referral procedure guidelines and

BOX 2. Stakeholder Perceptions of Maternity Waiting Homes in Zambia

“It’s always good to go and wait in the [maternity waiting home]. The doctors are always available and in case you have a complication, they always know fast. So that’s why it’s good to go and wait in the [maternity waiting home].”

—Focus group discussion with recently delivered or pregnant women

“We are very happy because it used to be a problem for our children when they become pregnant; we would be very worried on where to take our children in case of delivery. But now that they have built a [maternity waiting home] which is very good and clean, we will be very free and happy to come and live here with our children.”

—Focus group discussion with community elders

“I think the appearance of the [maternity waiting home] is very good. The way I saw it . . . it really helps our women because everything is there. For a woman who is very pregnant, it’s a very good thing.”

—Focus group discussion with men

“The success is that we no longer have mothers delivering from outside the facility, giving reasons that they were unable to come because they are coming from very far. Most of the mothers coming from distant places usually are admitted in our [maternity waiting home]. We have reduced on people having the excuse of delivery at home because of distance.”

—In-depth interview with health facility staff

“From the time the [maternity waiting home] was opened, we have seen that the number of women who are coming for deliveries has risen and the standard of the [maternity waiting home], which has been built now, is of high quality than the one we used to have, which was just a simple house and some women would not even want to stay in it.”

—Focus group discussion with Safe Motherhood Action Group members

supported printing of the triplicate referral forms and log books. Over time, support for the printing of log books was withdrawn and districts took on the printing of referral logs for their facilities. Technical committees met monthly to review transportation coordination, patient referrals, partner coordination, and other maternal health issues. Program-based data included referral forms and logs in each facility and at the district level. A pilot program in Kalomo District conducted in 2012–2013 used a transportation checklist to help stabilize pregnant women before moving them to a higher-level facility for emergency procedures or surgery; this strategy was not scaled up beyond Kalomo and was not rigorously evaluated.

Similar to Uganda, ambulances were procured in Zambia to supplement existing ambulances in SMGL districts. The need for ambulances was identified through updates at provincial and district-level monthly meetings, and districts (through SMGL partner organizations) procured ambulances to fill the identified gaps. The strategic placement of ambulances within the districts was dependent on availability and the most efficient distribution. Ambulances were coordinated by district transportation committees. In Lundazi District, for example, where travel time from facilities to the district hospital is about 6 hours during the rainy season, the district positioned ambulances at strategic health facilities, so they would need to go only in one direction when referral to the hospital was needed. In Mansa District, on the other hand, the placement of ambulances was zonal. Mansa District is divided into 5 zones and each zone has a central “zonal” health facility (with higher-level

services) that serves all health centers within that zone. The 3 ambulances procured under the SMGL initiative were placed in 3 of the 5 zones that did not already have an ambulance. The district transportation committees (a subset of the district technical committee) were responsible for the coordination of ambulance services. To request an ambulance, health facilities communicated with committee members by phone or radio messaging.

Bicycle ambulances (*Zambulances*) and motorcycle ambulances were procured in Zambia to provide transportation for pregnant women from the community to the health facilities. In some instances, the motorcycle ambulances were used for transportation of referral cases from health facilities to higher-level facilities or hospitals, filling the gap of unavailable motor vehicle ambulances. Safe Motherhood Action Group members were trained as motorcycle riders and worked as volunteers.

Lastly, to facilitate transportation between facilities, radios were repaired, and, where needed, cell phones or talk time were provided to enable communication between facilities and districts to improve coordination of ambulance services.

The availability of motor vehicle transportation improved significantly ($P<.01$) in Zambia, and there was a 124% increase in facilities that reported having communication equipment (Table 3). SMGL partners procured and distributed 1,500 bicycle ambulances; however, partner reports indicate this intervention was not successful because the bicycle-drawn carriage was an uncomfortable mode of transportation for pregnant women.

The availability of motor vehicle transportation improved significantly in Zambia, and there was a 124% increase in facilities that reported having communication equipment.

BOX 3. Details of the Ambulance Coordination Efforts in Uganda**Ambulance Coordination and Communication**

- Positioned tricycle and vehicle ambulances at strategic facilities for prompt referral
- Trained drivers in first aid and emergency care and provided first aid kits containing gloves and plastic sheets, surgical blades, cotton, and ligatures
- Availed contact lists for ambulance drivers at each health facility; these were networked with health facility and village health teams for toll-free calls (closed user group) to facilitate timely referral
- Referral calls received by a district health officer or senior midwife, including from private hospitals
- Monthly and quarterly committee meetings to review the number of referrals and outcomes, respectively, for quality improvement:
 - A total of 3,180 women in Phase 1 and 14,871 women in Phase 2 were transported by the ambulances for referral between facilities
 - When needed, senior midwives met with private and nonprofit hospitals to coordinate ambulances

Ambulance Maintenance

- Senior driver regularly checked fuel, tires, brakes, oxygen, and emergency supplies

Human and Financial Resources

- Around-the-clock (24 hours a day, 7 days a week) duty schedule and on-call sleep room for drivers at district hospitals
- Ambulance team included nurse-midwives, doctors, and emergency responders; picked up by drivers at night for emergency referrals
- Drivers hired by the Saving Mothers, Giving Life initiative who performed well were transitioned to government positions, as available

Guidelines for Transport and Infection Control

- Washing and disinfection of vehicles

Referral Guidelines

- Referral log book in triplicate: copy at referring site, copy at receiving site signed by attending midwife, and third copy in ambulance book
- Key vital signs recorded in log book
- Outcomes discussed in quarterly meetings

Community-Based Linkages to the Health Facility

In addition to the transportation schemes, some programs facilitated community health facility linkages in both Uganda and Zambia.

Uganda

In Uganda, using the Ministry of Health CHW training manual, village health team members were trained on maternal and newborn health issues. Within the communities, the village health teams distributed transportation vouchers and facilitated communication with the ambulance coordination team to transport women who had complicated pregnancies to health facilities. In addition, during Phase 2 only, in response to requests from the community, portable stretchers were procured and distributed to communities with terrain inaccessible by both vehicles and motorcycles. These were used to transport pregnant women or sick people to pickup points (by either the boda or ambulance vehicles) or health facilities.

Zambia

In Zambia, a cadre of non-clinical, community-based Safe Motherhood Action Group volunteers was expanded and trained extensively in safe motherhood strategies. This group had been supported initially on a pilot basis by a few non-governmental organizations to help facilitate access to skilled deliveries. Safe Motherhood Action Group members were trained to educate women and their families about the risks associated with giving birth at home and with labor complications, and encourage them to develop birth plans, attend antenatal care, and give birth in a facility. In addition to the role they served addressing the first delay, the members also escorted women to the facility for delivery and in some instances called facilities to facilitate transportation of women from the community to the facility.³⁴ Working in the community with direct links to the health facility, Safe Motherhood Action Group members were provided with mobile phone minutes or “air-time” to call the facility or call for transportation in an emergency. The proportion of health facilities

that reported having an associated Safe Motherhood Action Group increased by 51% ($P<.01$) in Zambia (Table 3).³³

Savings for Delivery as Part of Birth Preparedness

Zambia

To address costs associated with access to delivery service, even when the delivery service itself is free of charge, different models of saving for birth preparedness were implemented at the community level in Zambia during the latter part of SMGL Phase 2. One partner tested a variety of savings groups approaches across villages in Choma and Kalomo districts, to assess the most effective model of community savings using a training-of-trainers approach. Safe Motherhood Action Groups were trained on the savings models and they in turn worked with the community savings groups to guide selection of a savings model and provide oversight for the groups. Another partner working in Mansa, Chembe (Chembe District was part of Mansa District during Phase 1), and Lundazi districts worked with Savings and Internal Lending Community (SILC) groups, which were developed as a strategy to provide low-income people, especially women, access to resources for income-generation opportunities through loans from self-managed savings.³⁵ With a membership of 15 to 20 people, each person saved an equivalent of US\$5 in a general pool, from which members borrowed loans at an interest rate of 10% to 25% per loan or per month, depending on what was set out in the group constitution. Members also contributed to a social fund from which women drew money for costs associated with access to delivery services such as transportation to the health facility, baby clothes, and supplies needed for delivery. Women of reproductive age were mobilized into the SILC groups as a mode of saving for delivery.

Saving for delivery has been integrated into home-based counseling for birth preparedness in Zambia, and village savings groups have helped enable women to save for costs associated with delivery.

Preliminary results show that through the training-of-trainers model, savings have been integrated into home-based counseling for birth preparedness, and village savings groups have incorporated new mechanisms into their savings group constitution to enable women to save for the costs associated with delivery, such as transportation to a health facility, delivery supplies, and baby clothes.⁹ Nearly all (96%) of the savings groups are offering loans to pregnant women at reduced interest rates (median 5% for pregnant women and 20% for other group members), 10% are offering 0% interest loans for pregnant

women, 87% have a provision to offer a bonus (median US\$2) to pregnant women who demonstrate preparedness for delivery, 50% have a maternity fund focusing specifically on maternal services, and 100% have a provision for pregnant women to store their money in the group's lockbox.

The 319 SILC groups supported in Mansa, Chembe, and Lundazi had a total of 6,862 members. Of group members, 74% were women of reproductive age. Members of the SILC groups feel more prepared for delivery, as explained by a member of the group:

Through SILC I managed to buy all necessities for my baby and myself. I went and delivered a bouncing baby girl at the health center. Through SILC, I was able to prepare for transport to take me to the health facility on time. —SILC member, recently delivered woman

■ DISCUSSION

In Uganda and Zambia, SMGL employed 2 key strategies to improve a woman's ability to reach EmONC services and ultimately improve maternal and newborn outcomes. These strategies addressed the known causes of delays in reaching care including distance, geography, accessibility, lack of transportation and communication, and costs associated with delivery.^{5,6,36} Under each strategy, a set of interventions was implemented to address the second delay. Strategy 1—interventions to increase the number of EmONC facilities—primarily included upgrading strategically positioned health facilities to be capable of providing EmONC services and providing EmONC trainings and in-service mentorship for health staff. Strategy 2—interventions to improve the accessibility of EmONC facilities—included renovations and construction of maternity waiting homes, creation of integrated communication and transportation systems, establishment of community-based linkages to the health facility, and programs to encourage savings for delivery as part of birth preparedness. Though it is difficult to disentangle the effects of each intervention within the context of complex, multilevel programs, it is reasonable to conclude that collectively, these interventions addressed challenges associated with the delay in reaching care in both Uganda and Zambia.

SMGL's Successes

SMGL's comprehensive approach of targeting all 3 delays is likely more programmatically meaningful than tackling interventions focusing solely on a single delay. In both countries, the proportion of

facility deliveries between 2012 and 2016 in SMGL-supported districts increased significantly. An analysis of delivery location among women living in remote Zambia found that those living in districts unexposed to the SMGL initiative were 3 times more likely to deliver at home compared with those living in SMGL districts—offering additional evidence to support the benefits of this initiative.¹² In a separate analysis of household-level data on women's reported place of birth in 1 district in Zambia between 2011 and 2013, women in SMGL districts had a 45% increase in the odds of facility delivery after the program was implemented relative to a comparison group within the same province with no SMGL exposure,³⁷ suggesting that the rapid increase was not attributable solely to other contextual factors.

SMGL second-delay interventions in both countries related to communication and transportation focused on key elements of referral systems, including decreasing distance to skilled birth attendance, improving transportation, strengthening facility capacity to manage complications (e.g., EmONC), and establishing community linkages. Referral and transportation strategies alone have been estimated to account for an 80% reduction in maternal mortality.³⁸ A systematic review of the referral-based interventions that were addressed in the second delay generally found that most interventions improved utilization of maternity care.³⁹ Another review of referral systems in maternity care cited the need for appropriate communication and transportation, both of which were addressed by the SMGL initiative's second-delay strategies, as well as for appropriate protocols and monitoring of staff performance.⁴⁰ Recent studies have also demonstrated the effectiveness of having community health workers use mobile phones to reduce delays in seeking and accessing care, improving health education and promotion, and facilitating timely referrals,⁴¹ a strategy similar to that employed by SMGL's community-based linkages interventions.

The provision of transportation vouchers for maternity care has also gained traction recently; this approach was a pillar of SMGL work in Uganda and is being replicated as a national program. The use of transportation vouchers in Uganda as a mechanism for improving transportation of mothers from the community to the health facility was key to increasing facility deliveries.⁴² In general, voucher programs have been shown to be effective at improving utilization of health care services, though there remains little to no evidence of improvement of quality of care or health

outcomes.¹⁸ Previous research from SMGL Phase 0 indicated that engaging private-sector transportation providers was an important feature and that the availability of transportation made a large difference in increasing access for maternity care.⁴³ SMGL interventions aimed to tackle equity through vouchers in Uganda and availability of transportation in both Uganda and Zambia.

As part of its strategy to improve the accessibility of EmONC facilities, SMGL implementing partners and collaborators refurbished or constructed maternity waiting homes in both countries. Though there is limited rigorous data, evidence suggests that higher-quality maternity waiting homes are associated with higher rates of facility deliveries.⁴⁴ Additionally, a qualitative analysis across 17 countries found that barriers to utilization of maternity waiting homes included a lack of knowledge, poor structures, and too little space; the SMGL collaborators implemented maternity waiting homes that were designed with community input as part of a health system intervention.⁴⁵ Maternity waiting homes represent a promising strategy to address the second-delay barriers and are being more comprehensively evaluated in this context.

SMGL interventions included strengthening a cadre of community-based health workers in each country—village health teams in Uganda and Safe Motherhood Action Groups in Zambia. In addition to helping address the first-delay challenges,³³ these cadres played critical roles by supporting the referral system, distributing vouchers, and escorting women to facilities. A Cochrane review evaluating the effectiveness of community-based programs on maternal and newborn health found that community health workers can have positive impacts on increased facility-based delivery.⁴⁶ Additionally, a qualitative study in Zambia found that Safe Motherhood Action Group members are perceived to have a positive impact on facility delivery and utilization of maternity waiting homes.³⁴

Lastly, the savings for delivery strategies, implemented primarily in Zambia, may be effective interventions for reducing delays in accessing care. Better planning for delivery has been shown to increase uptake of antenatal care services and facility delivery in Tanzania.⁴⁷ Additionally, as part of birth preparedness, savings for delivery may empower women to overcome distance, transportation, and supply challenges.⁴⁸

Though it is challenging to isolate the specific contribution of individual programmatic elements, taken together, the intensive, multifaceted strategies of the SMGL initiative tackled many of the factors

fueling the second delay and thereby contributed to an increase in facility delivery rates in both Uganda and Zambia. These efforts alone may not necessarily have improved health outcomes; however, combined with the SMGL efforts targeting the first and third delays, SMGL efforts can be deduced to have contributed to both increasing maternity care utilization and improving key health outcomes.^{23,24}

Limitations

There were several limitations to understanding the effects of the SMGL initiative in both Uganda and Zambia. First, there was no comparison with non-implementing districts, thus making it difficult to assess the overall impact of the initiative. Second, within the SMGL districts during Phase 1, routine data collection systems were not harmonized across partner organizations, making it difficult to aggregate indicators to allow assessment of the impact of interventions. A more coordinated and systematic program evaluation effort integrated from program inception would have allowed for a better assessment of program effects.

In addition to the challenges around evaluation, 2 notable implementation limitations may impact program sustainability. First, increasing the availability of ambulances to facilitate referrals was undoubtedly key for improving access to health facilities. However, high costs including providing 24-hour driver coverage and fuel may limit the availability of ambulance services after SMGL. In some cases these high costs led to the transfer of fuel costs to women and their families who were often not able to cover the cost. Second, it was not always possible for a health facility staff member to accompany and monitor women during the referral journey. Finally, in Uganda, a high demand for transportation vouchers meant the vouchers were not always available to women in need. Village health teams who sold the vouchers did not always adhere to eligibility criteria, and some boda-boda drivers procured vouchers for resale at higher prices, often resulting in inequitable distribution of vouchers.

CONCLUSION

Approaches outlined in this article to address the second delay (ability to reach care) can be adapted in low-resources settings to improve access to maternity care services and aim to reduce maternal and perinatal death. Through the SMGL initiative, multiple strategies were implemented to address the second delay, including increasing the number of BEmONC-equipped

facilities and improving access to EmONC through improved systems of transportation and communication, temporary lodging in maternity waiting homes, and community-based savings groups. Collectively, these strategies resulted in increased access to skilled delivery services. There is a need to sustain and improve on these efforts to maintain and further address factors that influence a woman's ability to reach care in Uganda and Zambia.

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ORIGINAL ARTICLE

Addressing the Third Delay in Saving Mothers, Giving Life Districts in Uganda and Zambia: Ensuring Adequate and Appropriate Facility-Based Maternal and Perinatal Health Care

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Saving Mothers, Giving Life used 6 strategies to address the third delay—receiving adequate health care after reaching a facility—in maternal and newborn health care. The intervention approaches can be adapted in low-resource settings to improve facility-based care and reduce maternal and perinatal mortality.

ABSTRACT

Background: Saving Mothers, Giving Life (SMGL) is a 5-year initiative implemented in participating districts in Uganda and Zambia that aimed to reduce deaths related to pregnancy and childbirth by targeting the 3 delays to receiving appropriate care: seeking, reaching, and receiving. Approaches to addressing the third delay included adequate health facility infrastructure, specifically sufficient equipment and medications; trained providers to provide quality evidence-based care; support for referrals to higher-level care; and effective maternal and perinatal death surveillance and response.

Methods: SMGL used a mixed-methods approach to describe intervention strategies, outcomes, and health impacts. Programmatic and monitoring and evaluation data—health facility assessments, facility and community surveillance, and population-based mortality studies—were used to document the effectiveness of intervention components.

Results: During the SMGL initiative, the proportion of facilities providing emergency obstetric and newborn care (EmONC) increased from 10% to 25% in Uganda and from 6% to 12% in Zambia. Correspondingly, the delivery rate occurring in EmONC facilities increased from 28.2% to 41.0% in Uganda and from 26.0% to 29.1% in Zambia. Nearly all facilities had at least one trained provider on staff by the

endline evaluation. Staffing increases allowed a higher proportion of health centers to provide care 24 hours a day/7 days a week by endline—from 74.6% to 82.9% in Uganda and from 64.8% to 95.5% in Zambia. During this period, referral communication improved from 93.3% to 99.0% in Uganda and from 44.6% to 100% in Zambia, and data systems to identify and analyze causes of maternal and perinatal deaths were established and strengthened.

Conclusion: SMGL's approach was associated with improvements in facility infrastructure, equipment, medication, access to skilled staff, and referral mechanisms and led to declines in facility maternal and perinatal mortality rates. Further work is needed to sustain these gains and to eliminate preventable maternal and perinatal deaths.

INTRODUCTION

Saving Mothers, Giving Life (SMGL) is a 5-year initiative designed to reduce deaths related to pregnancy and childbirth. SMGL used a coordinated approach targeting the 3 delays—seeking, reaching, and receiving

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adequate care—that contribute to maternal deaths.¹ This article focuses on maternal and perinatal deaths due to the third delay, the lack of receipt of timely, adequate, and appropriate obstetric care at a health care facility (Figure).² An estimated 75% of maternal deaths globally result from direct obstetric causes, with more than half attributed to hemorrhage, hypertensive disorders, and sepsis.³ Moreover, approximately 29% of newborn deaths in sub-Saharan Africa are attributed to intrapartum-related events.⁴ Facility-based maternal and newborn care, including access to skilled providers and neonatal resuscitation, improves the likelihood of maternal and infant survival.^{5,6} Although multiple socio-economic and environmental factors affect maternal and neonatal survival, reducing the delay in receiving adequate and appropriate care at a health facility is key to improving health outcomes.⁷

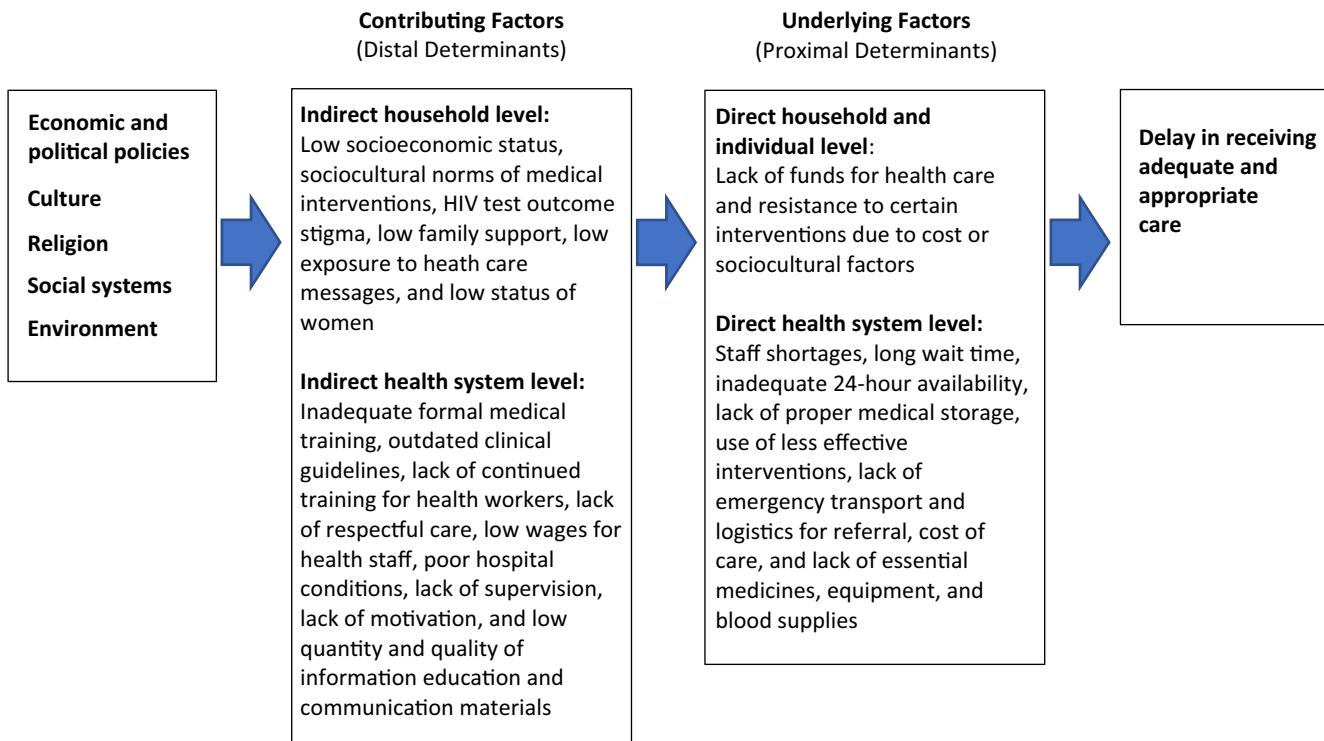
Reducing deaths related to the third delay requires overcoming barriers to timely, adequate, and appropriate obstetric and neonatal care in facilities.^{7–9} Many deaths are largely preventable if providers and facilities use the 9 evidence-based

medical interventions termed ‘signal functions’ that comprise emergency obstetric and newborn care (EmONC).¹⁰ Facilities may be classified as providing basic EmONC (BEmONC) if they are able to (1) administer parenteral antibiotics, (2) administer uterotonic drugs for active management of the third stage of labor and prevention and management of postpartum hemorrhage, (3) use parenteral anticonvulsants for the prevention and management of pre-eclampsia/eclampsia, (4) perform manual removal of placenta, (5) perform removal of retained products, (6) perform assisted vaginal delivery, and (7) perform neonatal resuscitation; and classified as providing comprehensive EmONC (CEmONC) if they are able to perform the 7 basic signal functions plus being able to perform a (8) cesarean section and (9) blood transfusion.^{6,10}

Barriers and Interventions to Improve the Third Delay

Interventions to address the third delay and ensure timely access to the 9 signal functions

FIGURE. Context of Quality of Health Services for the Third Delay



have concentrated primarily on health facility care during the critical period of labor, delivery, and first 24 hours postpartum when most maternal deaths and about half of newborn deaths occur.^{11,12} Effective interventions ensure the availability of skilled health providers, sufficient and appropriate medical commodities and equipment, accessible high-quality obstetric care, and high-functioning inter-facility referral and receiving processes.^{7,13}

Human resource shortage is the most frequently cited factor associated with lack of appropriate care in health facilities; it encompasses inadequate training, lack of access to continuing education, staffing shortages, lack of motivation due to poor working conditions and low pay, and lack of optimal supervision and management.^{7,14} Lack of appropriate medical commodities and equipment is the second most commonly referenced challenge to reducing the third delay, with inadequate drug supply, lack of equipment, and lack of blood cited as common problems.¹⁵

Low demand for facility deliveries and other obstetric services may occur for many reasons, including in low population density areas where there is a need to invest in the availability and accessibility of obstetric care.¹⁶ Prior negative experiences with unclean, unsafe, or disrespectful care; a lack of competent providers; real or perceived high costs of health care; and cultural beliefs and practices can also contribute to low facility use.^{17–22} While, the third delay is most directly associated with facility characteristics and quality of care, certain aspects of individual and household barriers, including the negative experiences described above, may contribute to delays in receiving appropriate facility care. Additionally, while delays associated with poor referral practices directly contribute to the second delay, they also contribute to the third delay when facilities delay referral to higher levels or incorrectly refer patients to facilities that cannot provide the level of care needed. Finally, delays in receiving care after arrival at the health care facility contribute to the third delay.^{23–25} When health facilities have sufficient beds, essential drugs, medical equipment, robust infrastructure, skilled care, and consistent operating hours, women and newborns are more likely to receive appropriate facility care.^{26,27}

SMGL Context in Relation to the Third Delay

In Uganda, at the beginning of the SMGL initiative in 2011, 57% of all births occurred in a health

facility.²⁸ Facility births were more common in urban areas (90%) than in rural areas (52%), as were cesarean deliveries (13.7% of urban births, 3.9% of rural births).²⁸ The 4 contiguous SMGL districts—Kabarole, Kibaale, Kamwenge, and Kyenjojo—were predominantly rural, with an average population density of 26.2 women of reproductive age per square kilometer and a facility delivery rate of 45.5%, which was slightly lower than the national average of 55%.²⁸ At the time the initiative began, national reports found that most health centers in the SMGL Uganda districts had inadequate infrastructure for maternity units, too few functional operating theatres, insufficient numbers of skilled providers, poorly documented health care services and outcomes, and low-functioning referral and communication systems.²⁹

In Zambia, 67% of births in 2013 took place in health facilities.³⁰ In contrast to Uganda, the Zambia SMGL districts were more sparsely populated, with 3.9 women of reproductive age per square kilometer, requiring longer-distance travel to care.³⁰ Cesarean section rates were low in all 3 provinces—3.7% in Eastern Province, 2.9% in Southern Province, and 3.0% in Luapula—reflecting lower rates in rural (3.0%) compared with urban areas (7.2%).³⁰ In 2010, 2 of the 3 SMGL districts in Luapula and Eastern provinces were among the 5 provinces with the highest maternal mortality rates and the 3 provinces with the highest child mortality rates.³¹ Poor coverage of maternal and neonatal health services in Zambia was attributed, in part, to weak referral systems, the absence of systems to handle obstetric and neonatal health emergencies, and poor logistics to manage essential drugs.³¹

This article highlights SMGL interventions related to reducing the third delay by ensuring that women and newborns received adequate and appropriate care once at a health care facility. We describe intervention approaches and results in 6 areas in health care facilities necessary to address the third delay:

1. Adequate infrastructure to provide EmONC
2. Sufficient medical supplies, equipment, and medications
3. Sufficient trained health care providers at facilities
4. Improved quality of care and care that is evidence-based
5. Referral capacity to support transfers to higher-level care

Human resource shortage is the most frequently cited factor associated with lack of appropriate care in health facilities.

SMGL interventions related to reducing the third delay addressed 6 key areas for improvement: infrastructure, medical supplies and medication, health care provider training, evidence-based care, referrals, and maternal and perinatal surveillance.

6. Effective maternal and perinatal health surveillance

Although specific programmatic interventions, detailed in **Table 1**, varied by location, the overall approaches were aligned.

METHODS

SMGL used both quantitative and qualitative methods to describe implementation of intervention strategies, outcomes, and health impacts. SMGL implementing partners collected programmatic data throughout the initiative. Partners increased efforts during the initiative to coordinate monitoring and evaluation and harmonize data collection to understand which intervention components were effective. Programmatic interventions detailed here principally occurred in Phase 1 and continued into Phase 2, further details on the content of the phases are described elsewhere.³² To evaluate the overall impact of the SMGL initiative, we compared data collected at baseline—the 12 months prior to the onset of the initiative, June 2011 to May 2012—with data collected at the endline, January to December 2016. We collected supplemental qualitative data to describe the influence of specific maternal and perinatal interventions on improving appropriate facility-based care.

Quantitative Data and Analytic Methods

We used health facility assessments (HFAs), facility-based outcome monitoring, and community-based surveillance to capture key intervention outcomes and health impacts. Approaches and methods for each of these data sources are described in depth.³² For our study, we compared maternal and perinatal data collected at baseline and endline.

Health Facility Assessments

SMGL partners implemented HFAs in SMGL districts³⁵ to assess changes in facility functionality, including facility infrastructure; transportation and communications referral practices; capacity to perform EmONC; equipment and supplies, including essential medicines; staffing, training, and 24-hour availability of medical staff in health facilities; and selected aspects of respectful care. A total of 105 and 110 facilities were assessed at baseline and endline in Uganda and Zambia, respectively. Indicators derived from HFAs that were used in this analysis include basic facility infrastructure and staffing, promotion of protocols and guidelines, availability of essential drugs, performance of EmONC signal functions, and

performance of maternal death reviews. Definitions and descriptions of indicators of interest are included in **Box 1**.

Facility-Based Outcome Data

Facility-based pregnancy outcome data collection captured clinical data on procedures, complications, and health outcomes. This analysis uses percent of deliveries in EmONC facilities derived from the facility-based data sources.

Population-Based Data

We calculated the proportion of deliveries in EmONC facilities with number of live births as the denominator. In Zambia, at baseline, district-specific population from the 2010 national census, external district-specific growth rates, and crude birth rates were used to estimate the number of live births in the SMGL districts.^{33,34} At endline, the number of live births was determined by applying district-specific facility delivery rates calculated from the 2017 SMGL census.³² In Uganda, for both baseline and endline, population statistics were derived from district-wide SMGL household enumerations conducted in 2012 and 2017 in conjunction with the Reproductive Age Mortality Survey studies.³²

HFAs and pregnancy outcomes monitoring were conducted in virtually all facilities that provide maternity care in SMGL districts. Because we considered data to be complete counts rather than a sample and reported indicators as percentages, our data were not subject to sampling error. We calculated the z-statistic using the McNemar's test for dichotomous responses for matched pairs of data at baseline and endline periods, and calculated relative change in indicators by subtracting the baseline value from endline value and dividing by the baseline value.

Qualitative Data and Analytic Methods

Qualitative data sources included Phase 1 and Phase 2 project reports, documents submitted by SMGL implementing partners, and special qualitative studies focused on determining the effectiveness of the interventions.

In November 2017, we conducted 16 individual or small group (up to 3 people) in-depth interviews with 28 maternal and newborn health providers from 15 health centers and hospitals in SMGL districts in Uganda. In most cases, the head of maternity identified the most appropriate individuals to participate based on their experience with the Birth Weight and Age-at-Death Boxes for Interv-

In November 2017, 16 in-depth interviews were conducted with 28 maternal and newborn health providers from 15 health centers and hospitals in SMGL districts in Uganda.

TABLE 1. SMGL Interventions to Reduce the Third Delay, 2011–2016

Strategies and Approaches	Country-Specific Interventions ^a	
	Uganda	Zambia
Strategy 1. Ensure facilities have adequate infrastructure to provide EmONC		
Approach 1.1: Support expansion and renovation of operating theaters and facility enhancements to accommodate additional deliveries	<ul style="list-style-type: none"> Renovated and upgraded operating theaters Increased the size of labor rooms Provided additional delivery beds to allow more women to deliver in facilities and stay longer postpartum 	<ul style="list-style-type: none"> Supported renovation of birthing centers, delivery rooms, and maternity annexes Provided additional delivery beds to allow more women to deliver in facilities and stay longer postpartum
Approach 1.2: Support facility enhancements to improve neonatal survival	<ul style="list-style-type: none"> Procured incubators, infant warmers, and phototherapy lamps Renovated infrastructure to have designated space for KMC and to create NICUs 	<ul style="list-style-type: none"> Refurbished dedicated KMC rooms at hospitals
Approach 1.3: Support improved access to electricity and water	<ul style="list-style-type: none"> Provided safe water systems at health facilities Provided solar panels at facilities to improve continuity of access to electricity and light 	<ul style="list-style-type: none"> Improved lighting systems for delivery rooms Improved piped water to maternity annexes
Strategy 2. Ensure sufficient medical supplies, equipment, and medications		
Approach 2.1: Strengthen supply chains for essential supplies and medicines	<ul style="list-style-type: none"> Procured essential medication and backup supply of commodities for all sites on the SMGL project Redistributed supplies between health facilities to reduce stock-outs Implemented SMS reminder system to ensure timely drug ordering Equipped health centers with BEmONC equipment and supplies 	<ul style="list-style-type: none"> Procured essential emergency medications and supplies with backup Trained staff in eLMIS Equipped health centers with BEmONC equipment and supplies Assembled and distributed uterine balloon tamponade kits, and CPAP machines
Approach 2.2: Strengthen availability of blood supplies and surgical equipment	<ul style="list-style-type: none"> Strengthened and maintained the blood supply system in CEmONC sites and supported new regional blood bank Provided new blood refrigerators Procured and distributed new surgical equipment to facilities 	<ul style="list-style-type: none"> Procured and distributed centrifuges, refrigerators, and freezers to support blood bank Procured and distributed new surgical equipment to facilities
Strategy 3. Ensure sufficient trained health care providers at facilities		
Approach 3.1: Recruited staff	<ul style="list-style-type: none"> Recruited new medical doctors and nurse/midwives through a joint hiring process with the districts 	<ul style="list-style-type: none"> Recruited new nurse/midwives
Approach 3.2: Trained health professionals in emergency obstetric care, including obstetric surgeries	<ul style="list-style-type: none"> Trained medical officers, anesthetic officers, and midwives/nurses in CEmONC Conducted surgical skills course for medical officers, including decision making and caesarean section Trained providers on neonatal resuscitation/HBB and used drills to reinforce lessons 	<ul style="list-style-type: none"> Trained doctors, nurses, midwives, and anesthetists in EmONC, clinical decision making, obstetric complications, hemorrhage management with uterine balloon tamponade, early HBB, and CPAP Limited rotation of trained providers to different wards Supported capacity building of laboratory staff for blood services

Continued

TABLE 1. Continued

Strategies and Approaches	Country-Specific Interventions ^a	
	Uganda	Zambia
<u>Approach 3.3:</u> Provided mentoring and supportive supervision to newly hired and existing personnel	<ul style="list-style-type: none"> Conducted individual clinical mentorship sessions Provided selected nurses with intensive hands-on clinical skills placement to expand NICU skills 	<ul style="list-style-type: none"> Trained district mentorship teams who then held monthly on site health facility staff training and mentorship visits on normal delivery and partograph use, EmONC, and HBB
Strategy 4. Improve quality of care and ensure care is evidence-based		
<u>Approach 4.1:</u> Implemented quality, effective interventions to prevent and treat obstetric and newborn complications	<ul style="list-style-type: none"> Provided quality improvement practice to increase partograph use Implemented KMC 	<ul style="list-style-type: none"> Introduced emergency kits and logs/registers to facilitate quick access to emergency supplies Implemented partograph use by facility staff Enhanced infection prevention practices
<u>Approach 4.2:</u> Introduced sound managerial practices using 'short-loop' data feedback and response to ensure reliable delivery of quality essential and emergency maternal and newborn care	<ul style="list-style-type: none"> Incorporated concepts related to respectful maternity care into customer care training of midwives Used facility-generated data to review quality of care and implement practice changes 	<ul style="list-style-type: none"> Incorporated respectful maternity care into EmONC and early newborn care and supported it through mentorship
<u>Approach 4.3:</u> Developed guidelines and policies, and ensured protocol adherence	<ul style="list-style-type: none"> Developed national standards for MDSR that were informed by SMGL processes Implemented BABIES matrix to prevent perinatal deaths by using data to guide actions 	<ul style="list-style-type: none"> Developed clinical guidelines and protocols for diagnosing and managing most common obstetric emergencies Contributed to the development of the newborn health framework and guidelines Created standardized clinical forms to guide providers in recognizing danger signs and diagnosing the most common obstetric emergencies Introduced laminated checklists for quick reference in delivery rooms
Strategy 5. Ensure referral capacity exists to support transfers to higher-level care		
<u>Approach 5.1:</u> Improved referral communication systems	<ul style="list-style-type: none"> Introduced ambulance referral forms to better track referrals Set up and supported district ambulance committees to work on referral-related issues Procured and maintained landline phones for facilities and mobile phones for village health workers 	<ul style="list-style-type: none"> Used referral forms to improve communication between health centers and hospitals Set up and supported district ambulance committees to work on referral-related issues. Repaired and maintained 2-way radios at health facilities. Improved communications through the SMS and Remind-mi mHealth program (local communication programs)
<u>Approach 5.2:</u> Support increased transportation between facilities with motor vehicles or ambulances	<ul style="list-style-type: none"> Procured ambulances (vehicle and tricycle) 	<ul style="list-style-type: none"> Procured ambulances (vehicle and motorcycle)

Continued

TABLE 1. Continued

Strategies and Approaches	Country-Specific Interventions ^a	
	Uganda	Zambia
Strategy 6. Support effective maternal and perinatal health surveillance		
<u>Approach 6.1:</u> Strengthen maternal and perinatal mortality surveillance in facilities and communities	<ul style="list-style-type: none"> Trained providers on MPDSR Set up MPDSR system, including committees to identify and understand maternal and newborn mortality at facilities and in communities Strengthened prospective health facility surveillance through the MOH DHIS2 Set up POMS and RAPID to understand facility maternal and perinatal mortality Developed national standards for MDSR that were informed by SMGL processes 	<ul style="list-style-type: none"> Established MDSR including verbal autopsies at facilities with a community component Conducted MDR trainings for the district medical officer and health facility staff Supported MDR at facilities
<u>Approach 6.2:</u> Promote a government-owned HMIS data-gathering system to accurately record every birth outcome, obstetric and newborn complication, and treatment at facilities	<ul style="list-style-type: none"> Trained providers and implemented BABIES matrix Strengthened prospective health facility surveillance through the MOH DHIS2 Set up POMS 	<ul style="list-style-type: none"> Supported national MDSR processes and expansion of MDSR to SMGL districts

^aThis list is not exhaustive and activities noted may apply to more than one approach.

Abbreviations: BABIES, birth weight and age-at-death boxes for an intervention and evaluation system; BEmONC, basic emergency obstetric and newborn care; CEmONC, comprehensive emergency obstetric and newborn care; CPAP, continuous positive airway pressure; DHIS2, District Health Information System 2; eLMIS, Electronic Logistic Management Information System; EmONC, emergency obstetric and newborn care; HBB, Helping Babies Breathe; HMIS, Health Management Information System; KMC, kangaroo mother care; MDR, maternal death review; MDSR, maternal death surveillance and response; MOH, ministry of health; MPDSR, maternal and perinatal death surveillance and response; NICU, neonatal intensive care unit; NSCU, neonatal special care units; POMS, pregnancy outcome monitoring surveillance; RAPID, Rapid Ascertainment Process for Institutional Deaths; SMGL, Saving Mothers, Giving Life; SMS, short message service.

ention and Evaluation System (BABIES) matrix. Interviews were conducted to understand the patterns of the matrix's use, its perceived value, and behavior change that resulted from its use. All interviews were conducted in English, audio recorded, and transcribed verbatim, after which common themes were identified from the transcripts.

SMGL introduced BABIES through district workshops, facility-based mentorship, and international conferences. The BABIES report card and storyboards were used to identify 'trigger' cells for the BABIES matrix (Box 2). The report card provides a listing of at least 70 indicators that can be calculated from the matrix. SMGL nested the BABIES data within the pregnancy outcome monitoring surveillance database in a multidimensional table to evaluate the third delay using indicators to assess the performance of the system.

Verbal autopsies collected in the context of baseline and endline population mortality measurement studies captured the causes and circumstances of maternal deaths in both Uganda and

Zambia. Questionnaires administered to family members about the women's experiences during the days leading up to a maternal death were used to discern both medical and nonmedical causes of death, such as sociocultural and behavioral factors. Each interview included an open narrative where respondents provided an unprompted account of events preceding the death. Narrative data excerpts were used as a case vignette to illustrate certain barriers to appropriate facility care (Box 3).

Ethics

The study protocol was reviewed and approved by the Ugandan and Zambian Ministries of Health and deemed nonresearch by the U.S. Centers for Disease Control and Prevention Human Research Protection Office of the Center for Global Health. Written informed consent was obtained for respondents in all households and among women for the census, Reproductive Age Mortality Survey study interviews, and verbal autopsies.

BOX 1. Definitions and Descriptions of Indicators of Interest for SMGL Monitoring and Evaluation

Indicator	Description
Performance of EmONC signal functions	<p>Basic Services:</p> <ul style="list-style-type: none"> • Administer parenteral antibiotics • Administer uterotonic drugs (e.g., parenteral oxytocin) • Administer parenteral anticonvulsants for pre-eclampsia and eclampsia (e.g., magnesium sulfate) • Manual removal of placenta • Remove retained products (e.g., manual vacuum aspiration, dilation and curettage) • Perform assisted vaginal delivery (e.g., vacuum extraction, forceps delivery) • Perform basic neonatal resuscitation (e.g., bag and mask) <p>Comprehensive Services:</p> <ul style="list-style-type: none"> • Perform surgery (e.g., caesarean section) • Perform blood transfusion
Basic facility infrastructure	<ul style="list-style-type: none"> • Electricity • Regular water supply • Functional communications systems • Motorized vehicles available • Services available 24 hours a day
Promotion of protocols and guidelines	<p>Facilities with protocols available and displayed on the following topics:</p> <ul style="list-style-type: none"> • Obstetric and newborn complications • Postpartum hemorrhage • Active management of the third stage of labor • Helping Babies Breathe or kangaroo mother care • Early newborn care
Availability of essential drugs	<ul style="list-style-type: none"> • Oxytocin, magnesium sulfate, gentamycin

Abbreviation: EmONC, emergency obstetric and newborn care.

■ RESULTS

Strategies, Interventions, and Selected Quantitative Results

The 6 strategies implemented through SMGL are summarized in [Table 1](#) and described below. Outcomes resulting from the implementation of these strategies are presented in [Table 2](#) (Uganda) and [Table 3](#) (Zambia) with selected outcomes highlighted below.

Strategy 1. Ensure Facilities Have Adequate Infrastructure to Provide EmONC

Adequate infrastructure is needed to provide safe delivery care and implement EmONC functions. In both countries, SMGL sought to improve basic facility infrastructure and enhance the facilities' ability to provide safe deliveries 24 hours a day/ 7 days a week (24/7) ([Table 1](#)). In Uganda, SMGL supported renovation and upgrading of operating

In both Uganda and Zambia, the total number of BEmONC facilities more than doubled between baseline and endline.

theatres and made facility infrastructure changes to enlarge labor rooms, to create neonatal special care units and to provide spaces for kangaroo mother care, a program that has been shown to reduce neonatal mortality by promoting early skin-to-skin contact and improving thermoregulation in low birth weight and preterm newborns. In Zambia, SMGL increased the number of delivery beds and refurbished rooms to enable increased volume of facility deliveries, longer postpartum stays, and kangaroo mother care. Both countries focused on improving facility availability of electricity and water.

In Uganda, the total number of BEmONC and CEmONC facilities more than doubled between baseline and endline (BEmONC from 3 to 8 and CEmONC from 7 to 17) ([Table 2](#)). In Zambia, the number of BEmONC facilities more than doubled (from 3 to 8) and CEmONC facilities increased by 25% (from 4 to 5) ([Table 3](#)). This expansion of EmONC facilities is reflected in a corresponding

BOX 2. Information and Feedback on the BABIES Matrix**Simplest BABIES Matrix**

	Ante-partum	Intra-partum	Pre-discharge	Post-discharge	Alive	Total	
	0-1499 g	1500-2499 g	2500+ g				BWSMRs Denominators
	1	2	3	4	17	18	
B - birthweight	5	6	7	8	19	20	
A - age at death	9	10	11	12	21	22	
B - oxes for an							
I - interventions							
E - evaluation							
S - system							
Total	13	14	15	16	23	24	BWPMRs Denominator

Saving Mothers, Giving Life (SMGL) used the Birth Weight and Age-at-Death Boxes for Intervention and Evaluation System (BABIES)³⁵ matrix as a basic surveillance tool to link maternal and perinatal outcomes with evidenced-based interventions. The BABIES matrix is a simple, expandable, and adaptable table that displays stillbirths and newborn deaths by birthweight and time of death. The matrix accounts for every mother and stillbirth/newborn pair in a facility. Its indicators empower facility staff to monitor and evaluate coverage, equity, and quality-of-care indicators for their patients.

In its simplest form, completion of the BABIES matrix allows facilities to calculate 2 types of mortality indicators. First, birthweight proportionate mortality rates (BWPMRs) help to answer the question “Have we chosen the right thing to do?” Second, birthweight specific mortality rates (BWSMRs) help to answer the question “Are we doing these things right?”

statistically significant increase in the proportion of deliveries occurring in EmONC facilities between baseline and endline for both countries (Uganda from 28.2% to 41.0%; Zambia from 26.0% to 29.1%). The availability of facility electricity increased significantly in both countries (by 69% in Uganda and 67% in Zambia), and water availability in facilities improved (Uganda from 76.2% to 100%; Zambia from 90.0% to 97.3%).

Strategy 2. Ensure Sufficient Medical Supplies, Equipment, and Medications

In Uganda, SMGL procured essential equipment, including surgical equipment, EmONC supplies, and commodities; strengthened supply chains for essential medicines; upgraded BEmONC facilities; and strengthened the blood supply system in CEmONC sites (Table 1). In Zambia, SMGL supported the procurement of essential medications and implemented logistics management systems to reduce or eliminate stock-outs or supply

depletion. Specialized equipment for surgeries, treatment of postpartum hemorrhage, and neonatal resuscitation were obtained for higher-level care along with additional supplies for BEmONC sites. Project C.U.R.E supplied donated facility-specific, essential equipment and commodities shipping 16 containers to Uganda and 20 to Zambia over the life of the initiative.

The proportion of facilities with no stock-outs of oxytocin significantly increased between baseline and endline in Uganda, from 56.2% to 81.9%, but did not change in Zambia. The proportion of facilities with no stock-outs of magnesium sulfate significantly increased in both countries: Uganda increased from 46.7% to 63.8% and Zambia increased from 20.0% to 43.0%. In some cases, however, the availability of essential drugs was unchanged or even declined between baseline and endline. For example, the current availability of gentamicin in Zambia decreased from 67.3% to 48.2%, but remained stable in Uganda

BOX 3. Verbal Autopsy Case Example From SMGL District Verbal Autopsy Case Example of the Third Delay: Sarah's Story

Sarah was a 17-year-old from Uganda who died after giving birth to her first child. The respondent during the verbal autopsy interview was Sarah's mother-in-law. The interview was transcribed and summarized below. The names of persons and places and the dates have been changed to protect confidentiality.

Labor pains started on October 14, 2016 at 8 am. Sarah [the pregnant woman] noted some blood coming from her vagina. She told me what was happening, and I told her to go the hospital if the situation worsened. Instead, Sarah went to work in the garden since the pains were not strong. Early in the morning on the following day, the labor pains increased, and Sarah's husband took us to the hospital on a motorcycle, a 25-minute drive away. Upon reaching the labor ward, Sarah was attended to immediately and soon gave birth. However, shortly after giving birth, she started bleeding heavily, and the midwife started 'scooping' blood from the bed and gave Sarah an injection to stop the bleeding. The midwife called the doctor who came immediately. The doctor took Sarah to the operating theatre to establish the cause of the bleeding and told me to go and buy two sachets of blood. I rushed to the health center where I found only one sachet remaining. By the time I purchased the sachet and Sarah was transfused, it was almost 4 pm. I checked on Sarah and found blood coming from her nose; she was unconscious. The nurse told me that they would refer her to a higher level hospital, but I said no, seeing my daughter-in-law in a passing (unconscious) state. Just before 5 pm, right after I completed that statement, Sarah died. The baby remained alive. According to my feeling, the death could not be avoided; it was her time to die—the day that God had planned.

at 90.5% at baseline and 88.6% at endline (**Table 2** and **Table 3**).

In both Uganda and Zambia, SMGL supported recruitment of health care staff in order to meet national standards for CEmONC facilities.

In Zambia, guidelines, protocols, mini-emergency kits, clinical forms, and checklists were introduced or standardized to manage emergencies and improve provider and delivery room safety.

were trained to mentor others followed by monthly on site training that included drills and clinical mentorship visits.

In Uganda, the increase in 24/7 care from 74.6% to 82.9% was not significant (**Table 2**) but, in Zambia, staffing increases contributed to a higher proportion of health centers providing 24/7 care at endline compared with baseline (from 64.8% to 95.5%) (**Table 3**). Facilities in Uganda reported improvements in the performance of several EmONC signal functions in the 3 months prior to the HFAs, including administration of parenteral oxytocin (from 69.5% to 98.1%), manual removal of placenta (from 28.6% to 54.3%), removal of retained products (from 19.0% to 61.9%), and newborn resuscitation (from 34.3% to 87.6%) (**Table 2**). There was either a nonsignificant change or reduction in the proportion of facilities performing the remaining signal functions at endline compared with baseline. In Zambia, a significant increase in the proportion of facilities performing 2 signal functions was observed—for removal of retained products (from 17.3% to 49.1%) and newborn resuscitation (from 27.3% to 74.6%)—with no significant change in other signal functions (**Table 3**).

Strategy 4. Improve Quality of Care and Ensure Care is Evidence-Based

Overall, SMGL focused on providing tools to help strengthen provider practices, developing guidelines and policies, and ensuring protocol adherence (**Table 1**). In Uganda, the project implemented kangaroo mother care in SMGL facilities and trained providers on simplified basic resuscitation, using the Helping Babies Breathe

TABLE 2. Monitoring and Evaluation Outcomes Associated With Strategies to Reduce the Third Delay in Uganda, 2011–2016 (N=105 facilities)

Indicators	Baseline ^a Value	Endline ^a Value	% Relative Change ^b	Sig. Level ^c
Strategy 1: Ensure facilities have adequate infrastructure to provide EmONC				
Total number of EMONC facilities	10	25	150.0	N/A
Number of CEmONC facilities	7	17	142.9	N/A
Number of BEmONC facilities	3	8	166.7	N/A
Deliveries in EmONC facilities	28.2%	41.0%	45.4	***
Hospitals/health center IVs that perform blood transfusions ^d	56.3%	100.0%	77.6	N/A
Hospitals/health center IVs that have capacity to perform surgery (caesarean-section) ^d	50.0%	100.0%	100.0	N/A
Facilities with electricity	57.1%	96.2%	68.5	***
Facilities with water	76.2%	100.0%	31.2	N/A
Strategy 2: Ensure sufficient medical supplies and medications				
Facilities experiencing no stock-out of oxytocin in the past 12 months	56.2%	81.9%	45.7	***
Facilities experiencing no stock-out of magnesium sulfate in the past 12 months	47.6%	63.8%	34.0	***
Facilities reporting gentamycin antibiotic currently available	90.5%	88.6%	-2.1	NS
Strategy 3: Ensure sufficient trained health care providers at facilities				
Facilities reporting at least 1 doctor, nurse, or midwife is on staff	100.0%	100.0%	0.0	NS
Health center IIIIs that are open 24/7 ^e	74.6%	82.9%	11.1	NS
Facilities reporting EmONC lifesaving interventions performed in the past 3 months ^f				
Parenteral antibiotics	85.7%	92.4%	7.8	NS
Parenteral oxytocin	69.5%	98.1%	41.2	***
Parenteral anticonvulsants	48.6%	34.3%	-29.4	**
Manual removal of placenta	28.6%	54.3%	89.9	***
Remove retained products	19.0%	61.9%	225.8	***
Assisted vaginal delivery	4.8%	10.5%	118.8	NS
Newborn resuscitation	34.3%	87.6%	155.4	***
Strategy 4: Improve quality of care and ensure care is evidence-based				
Facilities with protocols and guidelines available and displayed on EmONC lifesaving interventions				
AMTSI	39.0%	58.1%	49.0	***
Postpartum hemorrhage	15.2%	85.7%	463.8	***
Eclampsia or magnesium sulfate use	8.6%	74.3%	764.0	***
Obstetric and newborn complications	26.7%	61.0%	128.5	***
Immediate newborn care	30.5%	79.0%	159.0	***
Facilities that report routine practice of partograph	33.3%	92.4%	177.5	***
Facilities that report routine practice of AMTSI	75.2%	96.2%	27.9	***
Facilities reporting that obstetric patients never share beds	35.2%	91.4%	159.7	***
Facilities reporting that women never deliver on the floor	85.7%	91.4%	6.7	NS

Continued

TABLE 2. Continued

Indicators	Baseline ^a Value	Endline ^a Value	% Relative Change ^b	Sig. Level ^c
Strategy 5: Ensure referral capacity to support transfers to higher-level care				
Facilities with at least 1 method of communication for referrals ^g	93.3%	99.0%	6.1	**
Facilities that reported having available transportation (motor vehicle or motorcycle) ^h	61.0%	59.0%	-3.3	NS
Strategy 6: Support effective maternal and perinatal health surveillance				
Facilities with maternal death reviews performed	6.7%	32.4%	383.6	***
Hospital and health center IVs that performed maternal death reviews ^d	31.3%	94.1%	200.6	***

^aBaseline period was June 2011 to May 2012; endline period was January to December 2016.

^bPercentage change calculations are based on unrounded numbers.

^cAsterisks indicate significance levels calculated with a z-statistic using McNemar's as follows: *** = $P < .01$, ** = $P < .05$, NS = not significant. In cases where significance testing is not warranted, this is denoted as N/A.

^dHospital and health center IV was n=16 at baseline and n=17 at endline of HFA.

^eHealth center III was n=71 at baseline and n=70 at endline of HFA.

^fPerformance during the previous 3 months preceding the assessment.

^gIncludes facility owned landline, mobile phone, 2-way radio, or individual had a mobile phone.

^hIncludes available and functional motorized vehicle with fuel today and funds generally available.

Abbreviations: AMSTL, active management of the third stage of labor; BEmONC, basic emergency obstetric and newborn care; CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; HFA, health facility assessments; N/A, not applicable; NS, not significant; Sig, significance.

curriculum,³⁷ and categorizing infant outcomes by birthweight and age at delivery, using the BABIES clinical tool.³⁸ In Zambia, guidelines, protocols, and mini-emergency kits were developed to manage common EmONC emergencies, clinical forms were standardized to guide providers to recognize obstetric danger signs, and checklists were introduced for reference in delivery rooms. Respectful maternity care concepts were introduced into midwife trainings in both countries. Additionally, in both countries, maternal death surveillance and response guidelines were developed and implemented to systematize and strengthen maternal death reviews.

In Uganda, the proportion of facilities with available and displayed protocols and guidelines for lifesaving interventions increased significantly for active management of third stage of labor for prevention of postpartum hemorrhage, management of postpartum hemorrhage, eclampsia treatment, management of obstetric and newborn complications, and immediate newborn care. In Zambia, the proportion of facilities with guidelines displayed was not captured at either baseline or endline.

With regard to the implementation of protocols and practices, in Uganda, the proportion of facilities reporting routine partograph use also

increased significantly between baseline and endline (from 33.3% to 92.4%), whereas data were not available in Zambia at both time periods. Partograph use was visually verified by surveyor. The proportion of facilities reporting routine practice of active management of third stage of labor increased significantly in both Uganda (from 75.2% to 96.2%) and Zambia (from 71.8% to 95.5%). The proportion of facilities that reported women never shared beds increased significantly in Uganda (from 35.2% to 91.4%), but not in Zambia (from 62.7% to 73.6%) (**Table 2** and **Table 3**).

In Uganda and Zambia, referral forms were introduced, ambulances were procured to assist in transport to and between facilities, and district ambulance committees were formed to strengthen referrals.

Strategy 5. Ensure Referral Capacity to Support Transfers to Higher-Level Care

SMGL supported improved referral communication systems and invested in improving transportation between facilities by acquiring additional motor vehicles or ambulances (**Table 1**). In Uganda and Zambia, referral forms were introduced, ambulances—motor vehicles, motor bikes/tricycles—were procured to assist transportation to and between facilities, and district ambulance committees were formed to strengthen referrals.

TABLE 3. Monitoring and Evaluation Outcomes Associated With Strategies to Reduce the Third Delay in Zambia, 2011–2016 (N=110 facilities)

Indicators	Baseline ^a Value	Endline ^a Value	%Relative Change ^b	Sig. Level ^c
Strategy 1: Ensure facilities have adequate infrastructure to provide EmONC				
Total number of EMONC facilities	7	13	85.7	N/A
Number of CEmONC facilities	4	5	25.0	N/A
Number of BEmONC facilities	3	8	166.7	N/A
Deliveries in EmONC facilities	26.0%	29.1%	12.2	***
Hospitals that perform blood transfusions ^d	100.0%	83.3%	-16.7	N/A
Hospitals that have capacity to perform surgery (caesarean section) ^d	83.3%	83.3%	0.0	NS
Facilities with electricity	55.5%	92.7%	67.0	***
Facilities with water	90.0%	97.3%	8.1	**
Strategy 2: Ensure sufficient medical supplies and medications				
Facilities experiencing no stock out of oxytocin in the past 12 months ^e	75.3%	75.0%	-0.4	NS
Facilities experiencing no stock out of magnesium sulfate in the past 12 months ^e	20.0%	43.0%	115.0	***
Facilities reporting gentamycin antibiotic currently available ^e	67.3%	48.2%	-28.4	***
Strategy 3: Ensure sufficient trained health care providers at facilities				
Facilities reporting that at least one doctor, nurse, or midwife is on staff	90.0%	98.8%	9.8	**
Health centers that are open 24/7 ^f	64.8%	95.5%	47.4	***
Facilities reporting EmONC lifesaving interventions performed in the past 3 months ^g				
Parenteral antibiotics	79.1%	73.6%	-7.0	NS
Parenteral oxytocin	90.9%	95.5%	5.1	NS
Parenteral anticonvulsants	44.6%	40.0%	-10.3	NS
Manual removal of placenta	39.1%	30.0%	-23.3	NS
Remove retained products	17.3%	49.1%	183.8	***
Assisted vaginal delivery	10.0%	15.5%	55.0	NS
Newborn resuscitation	27.3%	74.6%	173.3	***
Strategy 4: Improve quality of care and ensure care is evidence-based				
Facilities that report routine practice of AMTSI	71.8%	95.5%	33.0	***
Facilities reporting that obstetric patients never share beds	62.7%	73.6%	17.4	NS
Facilities reporting that women never deliver on the floor	71.3%	83.8%	17.5	NS
Strategy 5: Ensure referral capacity to support transfers to higher-level care				
Facilities with at least 1 method of communication for referrals ^h	44.6%	100.0%	124.2	N/A
Facilities that reported having available transportation (motor vehicle or motorcycle) ⁱ	55.5%	72.7%	31.0	***

Continued

TABLE 3. Continued

Indicators	Baseline ^a Value	Endline ^a Value	%Relative Change ^b	Sig. Level ^c
Strategy 6: Support effective maternal and perinatal health surveillance				
Facilities with maternal death reviews performed	42.5%	75.0%	76.5	**
Hospitals that performed maternal death reviews ^d	50.0%	100.0%	100.0	N/A

^aBaseline period was June 2011 to May 2012; endline period was January to December 2016.

^bPercentage change calculations are based on unrounded numbers.

^cAsterisks indicate significance levels calculated with a z-statistic using McNemar's as follows: *** = $P < .01$, ** = $P < .05$, NS = not significant. In cases where significance testing is not warranted, this is denoted with N/A.

^dHospitals (n=6) included in the HFA.

^eData were not collected in Kalomo facilities so they were excluded from the analysis.

^fHealth centers (n=88) included in the HFA.

^gPerformance during the previous 3 months preceding the assessment.

^hIncludes two-way radio or mobile phone with service.

ⁱIncludes motor vehicle, motorcycle, or bicycle.

Abbreviations: AMSTL, active management of the third stage of labor; BEmONC, basic emergency obstetric and newborn care; CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; HFA, health facility assessments; N/A, not applicable; NS, not significant; Sig., significance.

In Uganda, the data showed a significant increase in the proportion of facilities that reported at least 1 method of communication (e.g., telephones and radios) for referral (from 93.3% to 99.0%), but there was no noted improvement in transport availability (from 61.0% to 59.0%) (Table 2). In Zambia, 100% reported having at least 1 method of communication at endline (up from 44.6% at baseline), and the proportion of facilities with available transportation significantly increased (from 55.5% to 72.7%) (Table 3).

Significant increases in the proportion of facilities conducting maternal death reviews were observed in Uganda (from 6.7% to 32.4%) and Zambia (from 42.5% to 75.0%). In Uganda, a significantly higher proportion of hospitals and health center IVs reported performing maternal death reviews at endline compared with baseline (from 31.3% to 94.1%). Similarly, in Zambia, 100% of hospitals reported performing maternal death reviews at endline (up from 50.0% at baseline) (Table 2 and Table 3).

Strategy 6. Support Effective Maternal and Perinatal Health Surveillance

In both countries, SMGL strengthened maternal and perinatal mortality surveillance in facilities and communities and supported government-managed data processes (Table 1). In Uganda, SMGL helped establish maternal and perinatal death surveillance and response committees, enhanced facility surveillance processes and systems to capture more refined health facility and outcome data, and strengthened the national health management information system. In Zambia, SMGL established the maternal death surveillance and response, including the use of verbal autopsies at facilities and in communities; maternal death review trainings for district and health facility staff; and implementation of death reviews.

The daily visibility of the matrix in the ward was important for increasing awareness and effectiveness.

Qualitative Results

The BABIES matrix, implemented in select facilities in Uganda, provided a simple, systematic approach to monitor and evaluate staffing coverage, equity, and quality of care for facility service populations (Box 2).

The aim of the 16 in-depth interviews conducted in November 2017 in Uganda was to better understand the patterns of BABIES matrix use, its perceived value, and behavior change that resulted from its use. Providers described use of the BABIES matrix on a primarily monthly basis during maternity and all-staff meetings and perceived that the matrix was highly valuable, with nearly all providers reporting that it instilled a strong sense of accountability for perinatal deaths that simply had not existed previously. One doctor said, "the first time we ever projected the information, it was an eye-opener. . . . Oh! It's just not

numbers, it's real figures that can influence outcome." The daily visibility of the matrix in the ward to providers, clients, and visitors alike played an important role in increasing its effectiveness as a tool for awareness.

Providers shared numerous examples of how the BABIES matrix has led to positive changes in the facility, including improved labor monitoring and management, use of the partograph, more honest intercadre communication, better communication and outreach with lower-level facilities, and more complete and accurate documentation, all of which they believe contributed to improved quality of care. When asked if the BABIES matrix will continue to be used after SMGL ends, nearly all providers reported they believed it would. One midwife said, "Yes, whether the SMGL continues, or whether it stops, the BABIES matrix board has to continue. Because whatever we are doing, we are not doing it for SMGL, we are doing it for the better management of our mothers and babies!"

Verbal autopsy narratives give context to the facility results by providing descriptions of women's experiences prior to a maternal death. The vignette in Box 3 highlights a woman's experience seeking care and the delays she encountered. This example emphasizes the importance of blood and referrals to facilities that can provide CEmONC.

■ DISCUSSION

Successful interventions to reduce maternal and perinatal mortality should ensure that women deliver in facilities with the capabilities and staff to manage both expected and emergent complications. The World Health Organization strongly advocates for all births to be assisted by skilled attendants.³⁹ Women are encouraged to give birth in health care facilities to ensure access to skilled health care professionals and timely referral to higher-level facilities for management of obstetric complications, if they occur. However, increasing facility-based delivery rates and EmONC capabilities alone will not ensure that the full range of barriers to appropriate care are addressed. Quality of care depends on a host of factors that SMGL only partially measured. Timeliness and appropriateness of referrals, accuracy of provider decision making and diagnoses, and quality of care provided are only a few factors that contribute to reducing deaths due to the third delay.

SMGL's Successes

SMGL implemented 6 strategies to reduce deaths due to the third delay by providing the most

timely and appropriate delivery care for women and their newborns. In SMGL districts in Uganda and Zambia, the number of CEmONC and BEmONC facilities increased, offering women greater access to maternity services. SMGL enhanced facility capabilities by providing additional infrastructure support and developed processes for medication and supply stocking. SMGL supported increased staffing, trained and mentored staff to implement evidence-based interventions, and provided communication and transportation systems for maternal transfers. SMGL's investments in the availability and accessibility of maternity health services were crucial to increasing the proportion of facility deliveries observed in both Uganda and Zambia and to decreasing maternal and perinatal deaths.^{32,40}

During Phase 2, the SMGL initiative focused on both the mother and newborn. Historically, many EmONC programs have focused heavily on either maternal or newborn health care rather than the provision of effective care for both women and newborns.^{41–43} Investing in facility-based care for both the mother and newborn, using available interventions, has been found in one study to avert an estimated 71% of newborn deaths, 33% of still-births, and 54% of maternal deaths.⁴⁴ Along with the noted extensive investments in maternal health, SMGL allocated substantial resources dedicated to perinatal survival—improved equipment and expanded training of providers, building of surveillance infrastructure for perinatal mortality, and improved data to action through BABIES. This expanded capacity is likely to have contributed to the overall reduction in perinatal mortality.

SMGL improved data systems, including health outcome information for the monitoring and evaluation of facility performance and accelerated implementation of death reviews to better understand remaining gaps in care and prevent future deaths. The initiative also supported national initiatives and expanded surveillance systems to improve the quality and specificity of maternal and perinatal data for action through maternal death surveillance and response systems. Improved identification, notification, and determination of causes and preventability of maternal deaths allowed decision makers and providers to develop and implement targeted improvements. Expansion of the maternal death surveillance and response system to include perinatal death identification and reviews and implementation of the BABIES matrix in Uganda provided guidance for how to improve newborn

"Whether the SMGL continues, or whether it stops, the BABIES matrix board has to continue. Because whatever we are doing, we are not doing it for SMGL, we are doing it for the better management of our mothers and babies!"

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health. These enhanced surveillance systems, built on existing data infrastructure and supported by development of national guidelines, are a lasting contribution to national data systems for tracking maternal and perinatal mortality over time.

Limitations of the SMGL Approach and Monitoring and Evaluation Methods

Despite the notable achievements of the SMGL initiative including a documented reduction in facility maternal mortality ratio of 43.8% in Uganda and 37.6% in Zambia, the SMGL endline evaluation found that the maternal mortality ratio in facilities was still unacceptably high: 300 maternal deaths per 100,000 live births in Uganda and 231 maternal deaths per 100,000 live births in Zambia. In both countries, although the majority of women delivered in health facilities (66.8% in Uganda; 90.2% in Zambia), most of the maternal deaths occurred in facilities,¹ a clear indication that critical gaps remain in improving care and preventing maternal deaths after women reach a health care facility.

More comprehensive studies are needed to document the impact of BABIES on perinatal survival and identify remaining gaps. SMGL efforts demonstrated a reduction in institutional perinatal mortality rates and stillbirth rates in both countries; however, no significant change was found in predischarge neonatal mortality rates. Additional work is also needed to better characterize contributors and interventions needed to impact early neonatal mortality.

SMGL improved facility infrastructure, equipment, and supplies during the initiative. However, the slow and uneven pace of the upgrades was a concern raised during the initiative.³⁶ Some sites reported additional needs for refurbishment that were not accomplished, such as further expanding CEmONC capacity, particularly in Zambia.³⁶ Additionally, with increased demand for services, the need for essential medications also increased. However, sites noted that the increased supply was not necessarily matched to their need.³⁶ Infrastructure and supply chain barriers may have hampered the impact of the initiative on addressing the third delay. The challenges related to these systems are not unique for health programs in resource limited settings, further investment is needed to support these systems in order to achieve real impact.

Although extensive monitoring and evaluation activities were implemented as part of the

The SMGL endline evaluation found that the maternal mortality ratio in facilities was still unacceptably high in both Uganda and Zambia.

Although many quality-of-care improvements were documented, some dimensions of quality of care were not captured.

SMGL initiative, the methods still had important limitations. In Zambia, at baseline, the implementing partners developed unique tools and systems for facility data collection that were not harmonized across districts, and some indicators could not be aggregated at baseline. As census and verbal autopsy data are dependent on secondary reporting by household informants, recall bias may have affected the reported timing and determination of live births, deaths, and health history provided for the deceased. Additionally, the interventions were not evaluated independently, making it impossible to determine the relative impact of any individual intervention.

Quality of Care is Essential

To address the third delay, identifying barriers in facility-based service provision is critical. In the case vignette of a woman's experience seeking care and the delays she encountered, Sarah's mother-in-law described the facility care and multiple barriers she encountered: lack of active interventions to prevent hemorrhage in the immediate postpartum period, lack of urgent blood transfusion protocol, insufficient blood supply, and a delay in referral to a facility that could provide CEmONC. At each step of her care, these delays compounded Sarah's critical health status. Understandably, stories like these influence other women's decisions about whether to deliver in a facility.²¹

SMGL documented numerous quality-of-care improvements, including increased availability and use of evidence-based protocols and practices. However, SMGL monitoring and evaluation did not capture some dimensions of quality of care, including important areas such as intrapartum monitoring, time from admission or decision to surgery for cesarean deliveries, adequacy of neonatal resuscitation, and effectiveness of care for small and sick babies. Respectful care at birth is an emerging area that SMGL did not measure. Models of quality-of-care assessment that include observational and structured interviews to allow for more refined measurement of maternity care processes and outcomes do exist and would have been a valuable addition to the routine monitoring implemented by SMGL.⁴⁵

Ensuring Sustainability

Additional resources will be required to maintain the advances that the SMGL initiative achieved in addressing barriers that contribute to third delay related maternal deaths. Strengthening and

expanding existing national systems for service delivery—including maternal and newborn health, HIV, family planning, and immunization services—are essential to achieve future gains.

The establishment of sufficient human resources for health requires countries to align national and local policies and programs to ensure equitable access to health workers.⁴⁶ In Uganda, the SMGL initiative aligned wages to national standards, transferred human resource management to the national systems to improve sustainability, and limited rotation of specialized staff away from maternities. Expanding preservice training may provide staff with the crucial skills needed sooner, rather than relying on and waiting for in-service training. Tailoring effective interventions to each site would help establish sufficient health care providers for the future. If supported by the national system, task shifting—where tasks are moved to less specialized health workers—can help improve health system efficiency, expand coverage, and save costs.⁴⁷ Other strategies that could be implemented include quality competitions and performance-based financing.^{48,49}

Although SMGL provided extensive health care provider training, the first year evaluation found only a modest increase (10%) in providers' obstetric knowledge.⁵⁰ After the interim assessment, the initiative incorporated active learning, which has been demonstrated to be effective for health workers,⁵¹ into their skill-building activities; this included interactive obstetric drills and ongoing mentorship, emphasizing the importance of ongoing reinforcement of skills. Further assessment of gaps in knowledge and practice would be useful to tailor trainings to ensure providers maintain and strengthen skills. Linking certification and accreditation with continuing medical education has been implemented in some settings to maintain skills, and models have been developed for low-resource settings.⁵² Investment in ongoing training and sustained mentorship and coaching will help staff retain skills and strengthen clinical practice.⁵³ Sites should explore lower-resource intensive models of mentorship to ensure that providers are supported and practices are evidence-based.^{54,55} Institutionalizing systems for monitoring and retraining staff in national-level policies can help ensure appropriate standards of care. To address that, SMGL enhanced surveillance and strengthened national data collection systems and trained hundreds of facility personnel in improved data capture methods. Further support of these systems is essential to

continue to provide improved data for decision making and performance evaluation. Integrating disease surveillance within the national health information system can create a valuable data resource that can inform changes in not only maternal and perinatal mortality but also non-communicable diseases and emerging epidemics.

Integrating disease surveillance within the national health information system can create a valuable data resource that could inform changes in not only maternal and perinatal mortality but also noncommunicable diseases and emerging epidemics.

CONCLUSION

The SMGL initiative focused on reducing maternal and perinatal mortality during the critical period around labor, delivery, and immediately postpartum. SMGL implemented 6 comprehensive intervention strategies to focus on the third delay: (1) improving infrastructure to provide EmONC, (2) ensuring sufficient supplies, equipment, and medications, (3) ensuring sufficient trained health care providers at facilities who (4) practice quality evidence-based clinical care, (5) supporting referrals to allow transfers to higher-level care, and (6) supporting effective maternal and perinatal surveillance systems. Implementation of these key strategies was associated with significant reductions in facility maternal and perinatal mortality in Uganda and Zambia over the 5-year SMGL initiative. Further improvements are needed, as maternal and perinatal mortality levels are still unacceptably high. Stakeholders need to leverage the gains made by and sustain the momentum of SMGL and continue efforts to ensure no mother or newborn dies a preventable death.

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ORIGINAL ARTICLE

The Costs and Cost-Effectiveness of a District-Strengthening Strategy to Mitigate the 3 Delays to Quality Maternal Health Care: Results From Uganda and Zambia

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A comprehensive district-strengthening approach to address maternal and newborn health was estimated to cost US\$177 per life-year gained in Uganda and \$206 per life-year gained in Zambia. The approach represents a very cost-effective health investment compared to GDP per capita.

ABSTRACT

The primary objective of this study was to estimate the costs and the incremental cost-effectiveness of maternal and newborn care associated with the Saving Mothers, Giving Life (SMGL) initiative—a comprehensive district-strengthening approach addressing the 3 delays associated with maternal mortality—in Uganda and Zambia. To assess effectiveness, we used a before-after design comparing facility outcome data from 2012 (before) and 2016 (after). To estimate costs, we used unit costs collected from comparison districts in 2016 coupled with data on health services utilization from 2012 in SMGL-supported districts to estimate the costs before the start of SMGL. We collected data from health facilities, ministerial health offices, and implementing partners for the year 2016 in 2 SMGL-supported districts in each country and in 3 comparison non-SMGL districts (2 in Zambia, 1 in Uganda). Incremental costs for maternal and newborn health care per SMGL-supported district in 2016 was estimated to be US\$845,000 in Uganda and \$760,000 in Zambia. The incremental cost per delivery was estimated to be \$38 in Uganda and \$95 in Zambia. For the districts included in this study, SMGL maternal and newborn health activities were associated with approximately 164 deaths averted in Uganda and 121 deaths averted in Zambia in 2016 compared to 2012. In Uganda, the cost per death averted was \$10,311, or \$177 per life-year gained. In Zambia, the cost per death averted was \$12,514, or \$206 per life-year gained. The SMGL approach can be very cost-effective, with the cost per life-year gained as a percentage of the gross domestic product (GDP) being 25.6% and 16.4% in Uganda and Zambia, respectively. In terms of affordability, the SMGL approach could be paid for by increasing health spending from 7.3% to 7.5% of GDP in Uganda and from 5.4% to 5.8% in Zambia.

INTRODUCTION

Sub-Saharan Africa has the highest lifetime risk of maternal mortality (1:36) of any region in the

world.^{1,2} For example, the maternal mortality ratio in 2015 was 546 per 100,000 live births, with an estimated 201,000 maternal deaths. The maternal mortality ratio in sub-Saharan Africa is almost 22 times that in Europe.^{1,2} Studies have documented the financial, economic, and social consequences of maternal deaths, including increased risk of death for newborns and lower educational achievement, poorer economic outcomes, and poorer health for surviving children.^{3,4} Coverage of essential antenatal, maternal, and newborn health services remains below levels needed to reach internationally agreed upon goals.⁵ Despite these continuing challenges, the maternal mortality ratio declined in sub-Saharan Africa between 1990 and 2015 by 45%,⁶ coinciding with the scale-up of essential antenatal, maternal, and newborn interventions.

Three health system barriers have long been known to delay timely access to quality obstetric and newborn

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care (the “3 delays”): (1) barriers in deciding to seek care at a health facility; (2) barriers in reaching a facility in time to receive the needed care; and (3) barriers in receiving high-quality, respectful, and timely care at the facility.⁷ To reduce these barriers, stakeholders may implement an integrated package of supply-side interventions, particularly health system strengthening activities to ensure quality care, and demand-side interventions within and outside the health facility setting to increase knowledge of, access to, and utilization of care.^{5,8}

The significant costs to households and communities of a maternal death are well documented.³ Existing literature suggests that essential maternal health interventions are highly cost-effective.^{9,10} For example, based on regional-level estimates from the World Health Organization’s (WHO’s) Choosing Interventions that are Cost-Effective (CHOICE) model, a full package of maternal care costs 36 International dollars (I\$) per disability-adjusted life-year (DALY) averted in high disease burden countries in sub-Saharan Africa (compared to no maternal care).⁹ Similarly, according to the Bill and Melinda Gates Foundation-funded Disease Control Priorities project, emergency obstetric care costs US\$10 per DALY averted in low- and middle-income countries.¹⁰ Thus, the cost per DALY averted for maternal care appears to be well below the average gross domestic product (GDP) per capita in any country in the world. However, these studies focus primarily on improvements in clinical care, which is associated with the third delay. A review conducted by the Disease Control Priorities project also contains primarily interventions based in health facilities.¹¹ The WHO-CHOICE model lists community-based interventions for antenatal and neonatal care “including outreach,” but it does not specify what constitutes outreach.⁹

Other studies demonstrate the effectiveness of interventions to reduce one or more of the 3 delays,^{12–14} but the literature on the cost of these interventions is limited. A recent review of the costs of maternal care in low- and middle-income countries found 8 studies assessing the costs of antenatal care and 18 studies assessing the costs of delivery.¹⁵ Of these, only 1 study from sub-Saharan Africa included the costs of community-based maternal support.¹⁵ Further, existing literature on the cost-effectiveness of maternal health interventions tends to focus on the additional costs and effectiveness of a single intervention^{16–20} that typically addresses only 1 of the 3 delays. A few cost-effectiveness studies include health systems strengthening as a complement to a demand generation intervention²¹ or

assess the cost-effectiveness of a more comprehensive approach to improving coverage of skilled care at birth.²² Overall, however, the literature assessing the costs and cost-effectiveness of a comprehensive health systems strengthening approach to address all 3 delays is scarce. An exception is a cost-effectiveness analysis of maternal and newborn interventions in Uganda under Phase 1 of the Saving Mothers, Giving Life (SMGL) initiative,²³ but this study did not account for the full costs of interventions, chiefly because indirect facility overheads were not considered.

The primary objectives of the current study were to estimate the costs and incremental cost-effectiveness of maternal and newborn care associated with SMGL’s comprehensive district-strengthening approach to addressing the 3 delays in selected districts in Uganda and Zambia. Secondarily, we assessed the sources of financing for the SMGL interventions. Findings from our analyses can inform stakeholder investments on cost-effective means to reduce maternal and perinatal mortality.

Three health system barriers have long been known to delay timely access to quality obstetric and newborn care—the 3 delays pertain to seeking care at a health facility, reaching a facility in time, and receiving quality care once there.

■ CONTEXT AND SMGL INTERVENTIONS

Uganda and Zambia have very high maternal mortality levels, despite the occurrence of substantial reductions, including downward national trends before and during the period of SMGL implementation.²⁴ The maternal mortality ratio in Zambia declined from 591 maternal deaths per 100,000 live births as measured in 2007²⁵ to 398 per 100,000 live births as measured in 2013.²⁶ The maternal mortality ratio in Uganda declined from 432 maternal deaths per 100,000 live births as measured in 2011²⁷ to 336 per 100,000 live births as measured in 2016.²⁸ The neonatal mortality rate in Uganda and Zambia in 2011–2013 was estimated to be 27 and 24 per 1,000 live births, respectively.^{26,28} In Uganda, 57% of women delivered in health facilities in 2011, including 52% of women in rural areas.²⁷ In Zambia, about two-thirds of women delivered in health facilities in 2013; however, in rural areas, this percentage was 56%.²⁶

Against this background, SMGL was implemented in 2012 in an effort to dramatically and rapidly reduce maternal mortality in selected districts of Uganda and Zambia (and later, Nigeria). The SMGL approach is based on context-specific solutions to maternal and, later, newborn health (MNH) problems. These solutions are identified and implemented through a coalition of partners,

The SMGL approach is based on context-specific solutions to maternal and newborn health problems.

The estimated costs of MNH interventions were assessed in selected districts where the SMGL approach was implemented and compared to estimated costs in 2012, prior to SMGL interventions.

including governments, nongovernmental organizations, and the private sector.²⁹ SMGL principles include the following:

1. Understanding the maternal health ecosystem in a given geographic area through formal assessment of both public and private sectors.
2. Using scarce resources rationally to address gaps and improve access to and quality of care.
3. Addressing all 3 delays to care to ensure access to lifesaving care within 2 hours of the onset of a complication, focusing on the period of labor, delivery, and the 72 hours postpartum when women and newborns are most vulnerable.³⁰
4. Decreasing missed opportunities by integrating MNH and HIV services.
5. Counting, analyzing, and reporting all maternal and newborn deaths, and using findings to improve care.²⁴

With substantial subnational variation in maternal mortality ratios within these countries, SMGL targeted districts that had among the poorest maternal health indicators in each country.²⁴ The districts selected in Uganda were Kabarole, Kamwenge, Kibaale, and Kyenjojo. In Zambia, the districts selected were Kalomo, Lundazi, Mansa, and Nyimba.²⁴

In the first year of implementation, SMGL was associated with a 35% reduction in the institutional maternal mortality ratio across the 2 countries.⁷ Donor investment was planned to be largest in the first years of the SMGL initiative, with national and local governments assuming greater responsibility for SMGL costs over time. Table 1 lists the interventions and activities included in the costing estimates for Uganda and Zambia.

■ METHODOLOGY

Study Design

We calculated the costs per maternal death averted and life-year gained by combining data on intervention costs that we compiled with direct outcome evaluation data from studies that previously documented maternal and newborn mortality associated with the SMGL approach. Health impact data in the SMGL-supported districts were collected in a separate evaluation of SMGL.^{30,31} The impact evaluation used a before-after design comparing selected health indicators and outcomes in 2012 (baseline) and 2016 (endline). These evaluations, including the data sources and

the impact results, are described elsewhere in this special supplement.³⁰

The estimated costs of MNH interventions were assessed in a subset of the districts where the SMGL approach was implemented and compared to estimated costs in 2012, prior to SMGL interventions. Since costs were not directly collected in the SMGL-supported districts prior to SMGL implementation in 2012, we derived comparison costs from the 2016 unit costs (e.g., cost per antenatal care visit, cost per vaginal delivery, cost per cesarean delivery) in neighboring districts where MNH programs were chiefly supported by country government efforts alone, to be consistent with the time frame for the effectiveness evaluation (end year as 2016). Table 2 lists the variables used in the cost-effectiveness analysis, along with the sources of data.

Because cost data prior to SMGL implementation were not available, we assumed that SMGL would affect the unit cost of health services through both the scale (quantity utilized) and quality of services.³² Thus, we selected comparison districts in the costing analysis for proxy measures of costs before SMGL, assuming that the unit prices of health services in these districts were similar to those in the SMGL-supported districts prior to interventions. We also assumed that unit costs in the comparison districts did not change substantially during the 2012–2016 time period, and we conducted sensitivity analyses to explore this assumption. We used districts as the unit of analysis because the SMGL approach was implemented at the district level, and many of the costs were incurred at the district level and could not be easily attributed to specific health facilities. This study assessed costs associated with provision of MNH care retrospectively in the SMGL intervention districts for the year 2016, including annualized start-up costs and capital costs over the 2012–2016 period. Start-up costs are defined as the costs for activities needed to establish interventions that are not incurred on an annual basis, while capital costs include the purchase of durable goods that are used over multiple years. Thus, we assumed effects are not cumulative across years except to the extent that continued capacity building, which is captured in start-up costs, allowed for increasing the effectiveness of the SMGL approach over time. We also assessed unit costs in comparison districts for the year 2016. We then used these unit costs together with 2012 utilization data from SMGL intervention districts to estimate costs in 2012 in the SMGL-supported districts (before SMGL started).

TABLE 1. Activities and Interventions Included in the Costing Estimates

Activity or Intervention	Implemented in Uganda, Zambia, or Both ^a
Activities targeting delay 1 ^b	
Train community groups (VHTs and SMAGs) to promote facility delivery and birth preparedness	Uganda and Zambia
Procure bicycles, equipment, and supplies for community groups	Uganda and Zambia
Provide financial support to community activities (e.g., funding to attend monthly meetings, supervision costs, community assessment mappings)	Uganda and Zambia
Produce a documentary about safe motherhood using traditional leaders	Zambia
Run mass media campaigns on safe motherhood (including development of materials, air time costs, and translation costs), engage community drama groups	Uganda and Zambia
Identify and engage community change champions in safe motherhood	Zambia
Provision of revolving Fund for Village Saving Schemes	Uganda
MNH outreach (project or community staff visits to communities)	Uganda and Zambia
Activities targeting delay 2 ^b	
Distribution of subsidized vouchers for transport to delivery in EmONC facilities, public and private (transport to antenatal and postnatal care were added in Phase 2)	Uganda
Procurement of ambulances, motorcycles, and motorbikes for transportation and referrals	Uganda and Zambia
District-level transport committees to improve referral	Uganda
Renovate MWHs near hospitals for high-risk women	Uganda and Zambia, primarily Zambia
Train MWH staff to operate maternity homes; costs and revenue from income-generating activities; provision of food for those in maternity homes (as applicable)	Zambia
Activities targeting delay 3 ^b	
Provide antenatal care	Uganda and Zambia
Provide basic delivery care	Uganda and Zambia
Provision of comprehensive emergency care (blood transfusion/cesarean delivery)	Uganda and Zambia
Upgrade care in neonatal special care units, including purchase of equipment, training, and provision of essential medicines	Uganda and Zambia
Increase facility EmONC capacity, including purchase of EmONC equipment and provision of essential medicines	Uganda and Zambia
Establish/expand/refurbish maternity blocks, neonatal special care units, laboratories, pharmacies, and operating theaters	Uganda and Zambia
Hire new doctors, nurses, and midwives	Uganda and Zambia, primarily Uganda
Train health workers in essential newborn care and neonatal resuscitation	Uganda and Zambia
Train doctors in surgical obstetric care and nurses in anesthesia, train/mentor nurses in basic EmONC	Uganda and Zambia
Other training and mentoring (e.g., rapid syphilis screening, PMTCT, essential newborn care, UBT, maternal and perinatal death reviews)	Uganda and Zambia; UBT in Zambia
Supervision of frontline workers to maintain/improve skills in obstetrics/newborn care	Uganda and Zambia
Provide essential medicines	Uganda and Zambia
Provide training and oversight for maternal death reviews	Uganda and Zambia
Conduct health facility assessments	Uganda and Zambia

Continued

TABLE 1. Continued

Activity or Intervention	Implemented in Uganda, Zambia, or Both ^a
Health systems strengthening and program management ^c	
Strengthen supply chain through training on procurement and stock management	Uganda and Zambia
Build capacity of facility staff to supervise community health workers (first delay)	Zambia
Provide computer-based medical records (SmartCare)	Zambia
Strengthen pharmacy, laboratory, and blood supply	Uganda and Zambia
Train health workers in data collection and health information systems (DHIS2)	Uganda and Zambia
Strengthen program management (staff, vehicles, meetings, workshops, etc., including management of SMGL program, monitoring and evaluation, etc.) (above facility costs)	Uganda and Zambia
Build provincial and district health team capacity with SMGL-supported staff (above facility costs)	Uganda and Zambia

Abbreviations: DHIS2, district health information system 2; EmONC, emergency obstetric and neonatal care; MNH, maternal and newborn health; MWH, maternity waiting home; PMTCT, prevention of mother-to-child transmission; SMAG, Safe Motherhood Action Group; SMGL, Saving Mothers, Giving Life; UBT, uterine balloon tamponade; VHT, Village Health Team.

^aIn countries shown in boldface, the activities were conducted in both SMGL and comparison districts, although frequently at lower intensity/scale in comparison districts than in SMGL districts. Source: Interviews with implementing partners and district and provincial health office staff.

^bPrimary delay addressed refers to which of the 3 delays the activities is assumed to mainly address (since some of the inputs/activities may address more than one).

^cCategorized as primarily addressing the third delay unless otherwise noted.

Selection of Study Areas

Planned data collection included 2 of the 4 learning districts in each country. In Zambia, we randomly selected Mansa and Nyimba from the 4 SMGL-supported districts for inclusion in these analyses. Mansa became 2 separate districts (Mansa and Chembe) in 2012, and data were collected from both. We also selected 2 districts, Kapiri Mposhi and Mbala, for comparative purposes for the costing analyses. The intent was to conduct the costing study in districts used in an external evaluation of SMGL at the end of Phase 1, where 2 comparison districts were selected to be similar to SMGL-supported districts across a number of factors (including health infrastructure, geography and climate, health utilization, morbidity and mortality, and socioeconomic context) that would also likely influence costs.²⁹ However, one of the comparison districts (Kabwe) later received extensive donor support for MNH programs and was excluded. We decided to select a second comparison district from the Northern Province. We randomly selected Mbala district after excluding districts participating in the World Bank's results-based financing project in the province.

In Uganda, we purposively included the greater Kibaale district (now existing as 3 districts; data were collected from all 3 districts) in the study because it was the only SMGL district to receive extensive support from one of the 2 main implementing partners.

From the other 3 SMGL-supported districts, we selected Kyenjojo as the remaining rural district with a district hospital. Both districts received similar SMGL-supported interventions, with the exception of transport vouchers, which were implemented in Kyenjojo only.³³ We also included the Fort Portal Referral Hospital, which received referrals from both Kibaale and Kyenjojo (and is located in a third SMGL district). For comparison purposes, we selected Masindi district, which served as a comparison district in an early evaluation of SMGL because it is located in the Western region and has a population and health system similar to the SMGL-supported districts. Due to limited time and budget, only one comparison district was included in Uganda.

In each of the selected districts of Uganda and Zambia, we collected data from the district health office, the government hospital in that district, and 2 randomly selected government health centers. Overall, we collected data from 5 districts, 4 hospitals, and 6 health centers in Uganda (3 health centers level III and 3 health centers level IV—one of each type in each of 2 SMGL-supported districts and in the comparison district), and 5 districts, 4 hospitals, and 8 health centers in Zambia. Data relating to MNH care activities in these districts were collected from district and provincial health offices (where appropriate) at the national level and from implementing partners, including 3 implementing

Overall, we collected data from 5 districts, 4 hospitals, and 6 health centers in Uganda, and 5 districts, 4 hospitals, and 8 health centers in Zambia.

Table 2. Parameters Used to Calculate District Costs of MNH Care, Life-Years Lost Due to Maternal Death, and Incremental Cost-Effectiveness of Deaths Averted

Number	Parameter	Value	Data Source	Notes
Costs (all)				
1	Discount rate	3%	WHO-CHOICE recommendation ³⁴	Locally published discount rates used in sensitivity analysis (1.5% in Uganda and 9.7% in Zambia) ^{35,36}
Costs 2012				
2	Costs associated with the first delay	Varies by district (see Table 4)	Interviews with health facility staff, district health office staff, provincial health office staff, and implementing partners in comparison districts	Interviews covered the period 2012 through 2016; start-up activities and capital costs were tracked. Costs for existing maternity waiting homes are included.
3	Costs associated with the second delay	Varies by district (see Table 4)	Interviews with health facility staff, district health office staff, provincial health office staff, implementing partners, and review of ambulance log books in comparison districts	Interviews covered the period 2012 through 2016; start-up activities and capital costs were tracked.
4	Unit cost of ANC	Varies by type of facility (see Table 3)	Data collection at health facilities in comparison districts, interviews with implementing partners	Inclusive of facility overhead costs
5	Number of ANC visits	Ratio of ANC visits to number of facility births	Data from health facility registers/district health offices in comparison districts	Number of facility births based on SMGL districts data from 2012
6	Unit cost of vaginal delivery	Varies by type of facility (see Table 3)	Data collection at health facilities in comparison districts, interviews with implementing partners	Inclusive of facility overhead costs and admissions (for mother and newborn)
7	Number of vaginal deliveries	Varies by district	Data from health facility registers/district health offices in comparison districts, Serbanescu and colleagues ³⁰	Number for SMGL districts in 2012
8	Unit cost of cesarean delivery	Varies by type of facility (see Table 3)	Data collection at health facilities in comparison districts, interviews with implementing partners	Inclusive of facility overhead costs and admissions (for mother and newborn)
9	Number of cesarean deliveries	Varies by district	Data from health facility registers/district health offices in comparison districts, Serbanescu and colleagues ³⁰	Number for SMGL districts in 2012
10	Above community/facility costs	Varies by district (see Table 4)	Interviews with health facility staff, district health office staff, provincial health office staff, and implementing partners in comparison districts	Interviews covered the period 2012 through 2016; start-up activities and capital costs were tracked.
11	Total costs of MNH care in 2012	Calculation	Based on parameters 2–10	
Costs 2016				
12	Costs associated with the first delay	Varies by district (see Table 4)	Interviews with health facility staff, district health office staff, provincial health office staff, and implementing partners in SMGL districts	Interviews covered the period 2012 through 2016; start-up activities and capital costs tracked. Costs for maternity waiting homes are included.
13	Costs associated with the second delay	Varies by district (see Table 4)	Interviews with health facility staff, district health office staff, provincial health office staff, implementing partners, and review of ambulance log books in SMGL districts	Interviews covered the period 2012 through 2016; start-up activities and capital costs were tracked.

Continued

Table 2. Continued

Number	Parameter	Value	Data Source	Notes
14	Unit cost of ANC	Varies by type of facility (see Table 3)	Data collection at health facilities in SMGL districts, interviews with implementing partners	Inclusive of facility overhead costs
15	Number of ANC visits	Ratio of ANC visits to number of facility births	Data from health facility registers/district health offices in SMGL districts	Number of facility births based on SMGL districts data from 2016
16	Unit cost of vaginal delivery	Varies by type of facility (see Table 3)	Data collection at health facilities in SMGL districts, interviews with implementing partners.	Inclusive of facility overhead costs and admissions (for mother and newborn)
17	Number of vaginal deliveries	Varies by district	Serbanescu and colleagues ³⁰	Number for SMGL districts in 2016
18	Unit cost of cesarean delivery	Varies by type of facility (see Table 3)	Data collection at health facilities in SMGL districts, interviews with implementing partners	Inclusive of facility overhead costs and admissions (for mother and newborn)
19	Number of cesarean deliveries	Varies by district	Data from health facility registers/district health offices in SMGL districts, Serbanescu and colleagues ³⁰	Number for SMGL districts in 2016
20	Above community/facility costs	Varies by district (see Table 4)	Interviews with health facility staff, district health office staff, provincial health office staff, and implementing partners in comparison districts	Interviews covered the period 2012 through 2016; start-up activities and capital costs were tracked.
21	Total costs of MNH care in 2016	Calculation	Based on parameters 12–20	In Uganda, included cost of patients referred to Fort Portal referral hospital
Deaths in 2012				
22	Number of facility-based deliveries	Varies by district	POMS and unpublished district data, ³¹ district offices in SMGL districts	Number of deliveries for SMGL districts in 2016 multiplied by the institutional delivery rate in 2012
23	Maternal death ratio	534 deaths (Uganda) and 370 deaths (Zambia) per 100,000 live births	Serbanescu and colleagues ³⁰	
24	Perinatal death rate	39.3 (Uganda) and 37.9 deaths (Zambia) per 1,000 births	Serbanescu and colleagues ³⁰	
25	Number of maternal deaths	Calculation	Parameter 22 × proportion of deliveries with live births/100,000 × Parameter 23	
26	Number of perinatal deaths	Calculation	Parameter 22/1,000 × Parameter 24	
27	Total number of deaths	Calculation	Parameter 25 + Parameter 26	
28	Life-years lost due to death	Years of life left estimated as 62.5 and 45.6 for perinatal and maternal death in Uganda and 62.3 and 45.7 for perinatal and maternal death in Zambia	WHO life tables ^{40,41}	Assume average age at death for maternal death is 27.5, for perinatal in first 2 days of life

Continued

Table 2. Continued

Number	Parameter	Value	Data Source	Notes
Deaths in 2016				
29	Number of facility-based deliveries	Varies by district	POMS and unpublished district data, ³¹ district offices in SMGL districts	Number for SMGL districts in 2016; varied in sensitivity analysis based on results for all SMGL districts ²⁴
30	Maternal death ratio	300 deaths (Uganda) and 231 deaths (Zambia) per 100,000 live births	Serbanescu and colleagues ³⁰	Decreased the percentage reduction in deaths results by 10 percentage points in sensitivity analysis
31	Perinatal death rate	34.4 (Uganda) and 28.2 deaths (Zambia) per 1,000 births	Serbanescu and colleagues ³⁰	
32	Number of maternal deaths	Calculation	Parameter 29 × proportion of deliveries with live births/100,000 × Parameter 30	
33	Number of perinatal deaths	Calculation	Parameter 29/1,000 × Parameter 31	
34	Total number of deaths	Calculation	Parameter 32 + Parameter 33	
35	Life-years lost due to death	Years of life left estimated as 62.5 and 45.6 for perinatal and maternal death in Uganda and 62.3 and 45.7 for perinatal and maternal death in Zambia	WHO life tables ^{40,41}	Assume average age at death for maternal death is 27.5, for perinatal in first 2 days of life. Years of life left estimated as 62.5 and 45.6 for perinatal and maternal death in Uganda and 62.3 and 45.7 for perinatal and maternal death in Zambia.
Incremental cost-effectiveness				
36	Incremental costs	Calculation	Parameter 21 – Parameter 11	In sensitivity analysis, reassess with all donor costs treated as incremental costs.
37	Incremental deaths averted	Calculation	Parameter 34 – Parameter 27	
38	Incremental life-years gained	Calculation	Parameter 35 – Parameter 28	
39	Incremental cost per death averted	Calculation	Parameter 36/Parameter 37	
40	Incremental cost per life-year gained	Calculation	Parameter 36/Parameter 38	

Abbreviations: ANC, antenatal care; MNH, maternal and newborn health; POMS, Pregnancy Outcome Monitoring Survey; SMGL, Saving Mothers, Giving Life; WHO CHOICE, World Health Organization's Choosing Interventions that are Cost-Effective.

partners in Uganda and over 30 in Zambia involved in MNH care, in the districts included in this analysis.

Ethical Approval

The data collection specific to this study was exempted from the need for ethical approval by Abt Associates Institutional Review Board and from the University of Zambia Biomedical

Research Ethics Committee in July 2017 because it did not include research on human subjects. The study received approval from the Makerere University of Public Health Higher Degrees, Research, and Ethics Committee in January 2018 and the Uganda National Council for Science and Technology (approval number SS 4511) in February 2018.

Data Collection

Data collection at health facilities occurred in July–August 2017 in Zambia and February–March 2018 in Uganda. Trained data collection teams extracted information on health facility area (square meters), staffing, service utilization, vehicles, and consumption of commodities from these facilities. Data were entered into Microsoft Excel templates designed for the study and were reviewed daily by data collection supervisors and again by the research team. Questions were sent to data collectors to verify information, and facilities were contacted again to clarify ambiguous information as needed. Similarly, structured templates were used to capture data at district health offices and, where appropriate, provincial health offices related to overall district health statistics (e.g., number of deliveries, number of health facilities) and activities related to MNH (e.g., training, health systems strengthening, mentoring, supervision, community outreach) during 2012–2016 for annualized start-up costs.

Data collection templates were constructed based on past analyses of expenditures in SMGL areas^{34,35} and sent to implementing partners. Data collectors then visited these partners to provide support for extracting the necessary data. Implementing partners provided data on all relevant start-up activity costs, capital expenditures, and routine activities for 2012–2016. Costs for national-level activities were not included unless the activity specifically focused on one of the districts included in these analyses; thus, for example, these analyses did not include costs for international staff and national staff working on multiple projects in addition to SMGL or costs for offices outside the SMGL districts.

Data were collected for all activities supporting MNH, whether or not they were “officially” part of SMGL. However, some activities were not assessed as part of the SMGL evaluation, including HIV/AIDS care or prevention for pregnant women and postpartum family planning outside the MNH clinics of health facilities, unless the SMGL program specifically included them.

Data were collected for all activities supporting MNH, whether or not they were “officially” part of SMGL.

Data Analysis Methods

We used a 1-year analytic horizon for deaths averted (i.e., the difference between deaths occurring in 2012 and in 2016) and a lifetime analytic horizon for life-years gained. We included costs from the health system perspective—that is, costs incurred by the health system and implementing partners. Costs incurred by patients and

volunteers’ time were not captured or included in the analysis. Capital items and start-up costs were converted into annual equivalent costs using standard formulas; we assumed a 3% discount rate³⁶ but explored locally published discount rates in sensitivity analyses.^{37,38} All costs were inflated to 2016 based on local GDP inflators and are presented in US dollars.³⁹

We used a financial approach to estimate the costs of activities presented in Table 1. Costs of activities targeting communities included the support of volunteer community groups (Village Health Teams in Uganda and Safe Motherhood Action Groups in Zambia), including costs to train, equip, and organize group meetings.

We employed a mix of top-down and bottom-up costing methods to estimate health facility costs.⁴⁰ Costs of administrative and support services (e.g., cleaning, maintenance) were allocated to maternal, newborn, and antenatal wards or clinics based on number of staff, size, number of prescriptions, or service utilization in a top-down manner. Costs for ambulances were allocated to MNH services based on a review of ambulance logs. Whenever possible, quantities of consumables used directly in provision of maternal and newborn care were estimated from existing registers and stock cards specifying the amounts issued to a ward or clinic. If these data were not available, we relied on either allocation based on utilization (for general drugs and supplies) or health facility staff opinion (for drugs used specifically for maternal health). Quantities of consumables were multiplied by their unit prices, which were collected at the national level. Staff costs, inclusive of salary and benefits, were allocated to MNH services based on assigned duty stations, opening hours, work patterns, and service utilization. In Uganda, costs for utilities and building costs in public facilities were estimated based on implementing partners’ accounts of costs for similar items; in Zambia, costs for utilities and buildings were estimated from previous costing exercises (R Homann, FHI 360, written communication, January 2018). Almost 40% of delivering facilities in Uganda SMGL-supported districts and 9% in Zambia are private.³⁰ Costs for maternal and newborn services at nongovernmental health facilities in Uganda were based on a previous study carried out in the same districts.⁴¹ Costs incurred at health facilities and reported by implementing partners were cross-checked to ensure that items were not double counted.

Total costs for MNH services for entire districts were estimated using the average unit costs from

sampled facilities for different types of services (e.g., antenatal care, vaginal delivery, cesarean delivery) and multiplying the results by the total utilization of these services in a district. These figures include costs for inpatient admissions. For estimates of costs before the start of SMGL, we used utilization numbers from the SMGL-supported districts in 2012 and unit costs from comparison districts, while for 2016 we used utilization numbers and unit costs from SMGL-supported districts in 2016. We disaggregated these calculations by type of health facility. We then added costs incurred at the community level and “above service delivery costs” (e.g., costs for offices located in districts, general and office support staff, program vehicles, and other general management and planning activities) to the facility-based costs. For SMGL districts, the programmatic costs and facility costs to address the first, second, and third delay total costs were added to derive the total costs for the districts. To convert costs incurred outside health facilities in comparison districts to costs incurred in 2012, we divided these costs by the number of facility deliveries in the comparison districts and then multiplied the results by the number of facility deliveries estimated to have occurred without SMGL in the SMGL districts. This calculation assumes that costs outside facilities varied directly with the number of deliveries at facilities; however, costs outside facilities in the comparison districts were a small proportion of all costs. For the 2012 cost estimates, we included observed community-level and above service delivery level costs from the comparison districts, under the assumption that these activities also likely existed in SMGL-supported districts before the start of SMGL. We calculated costs per facility delivery in 2012 (i.e., baseline facility delivery costs) and in 2016 (defined as the costs of improved facility delivery, which included all costs associated with delivery, demand generation, and transport). Incremental costs were calculated by taking the difference between the estimated total costs in 2016 and those in 2012. Sources of financing (donor, government, and private) were tracked throughout this exercise.

To estimate the health impact, we used the facility-based maternal mortality ratios and perinatal death rates in 2016 in SMGL-supported districts multiplied by the reported number of facility-based deliveries for the cohort of women giving birth in 2016 to determine the number of deaths in 2016.³¹ To estimate the number of deaths that would have occurred in the same

districts in the absence of SMGL, we started with the number of deliveries for SMGL districts in 2016 multiplied by the institutional delivery rate in 2012 to estimate the number of facility-based deliveries that would have occurred without SMGL. To account for secular trends in maternal mortality and perinatal deaths, we adjusted the facility-based maternal mortality ratios and perinatal death rates from 2012 by subtracting the change in these indicators at a national level from 2012 to 2016 from the SMGL district-specific 2012 figures (see *Supplement 1*).^{27,28,42,43} To reflect a generalizable cost-effectiveness applicable as broadly as possible, we used the facility-based death ratios/rates from all SMGL areas. However, since we collected costs in only half of the SMGL-supported districts, this approach assumes that costs in the districts included in the costing data collection did not differ substantially from those in the SMGL-supported districts where cost data were not collected. We subsequently explored this assumption in a sensitivity analysis (described below).

The number of deaths averted was estimated by subtracting the number of deaths in 2012 from the number of deaths in 2016. We estimated the incremental cost-effectiveness by dividing the incremental costs by the number of deaths averted in SMGL areas. Additionally, we estimated the potential remaining years of life for pregnant women and newborns at the time of death and calculated the cost per life-year gained using national life-expectancy data.^{44,45} For averted perinatal deaths, we calculated the cost per life-year gained assuming that stillborn infants and newborns would have had a full life expectancy.⁴⁶

Sensitivity Analyses

We conducted sensitivity analyses to explore the potential impact of our assumptions on the results. Sensitivity analyses were done by changing input variable amounts and assessing how results were altered. The following scenarios and variables were considered for sensitivity analyses:

We conducted sensitivity analyses to explore the potential impact of our assumptions on the results.

1. We used locally published discount rates to calculate annual equivalent costs.
2. We re-estimated the increased number of deliveries at health facilities using data from all 4 SMGL-supported districts rather than the 2 districts included in the costing. Chance variation in the increase in the number of deliveries at health facilities between districts may change the results.

3. We re-estimated the proportion of facility deliveries by cesarean delivery, for the same reason as above and using the same method.
4. We re-estimated incremental costs by considering all donor-supported costs as incremental costs (as opposed to using estimated 2012 costs). Although donor funds may displace some other sources of funding, this provides an upper-end estimation of the incremental costs in the absence of other district data.
5. We re-estimated the cost of preventing a year of lost life considering a discount rate of 3% for future life-years, as suggested by the WHO-CHOICE guidance.³⁶

Applying each of these 5 scenarios, we also calculated a “combined-case” scenario in which all the above scenarios were included at the least favorable value. Finally, we re-ran the analyses using mortality rates/ratios specific to the 2 SMGL-supported districts included in the costing.

RESULTS

Unit Costs

Average unit costs of a vaginal delivery in facilities in SMGL districts were lower or comparable to costs in facilities in non-SMGL districts in Uganda in 2016 (Table 3). The opposite is true for Zambia, where average unit costs were generally higher in facilities in SMGL districts. Specifically, in Uganda facility-based cost (excluding training of staff) for a vaginal delivery ranged from \$24 to \$45 across types of facilities in districts where SMGL was implemented, compared to \$25 to \$57 across types of facilities in the comparison district. In Zambia, the cost of a vaginal delivery was \$42 at health centers and \$118 at hospitals (on average across types of hospitals) in districts where SMGL was implemented, compared to \$18 and \$56, respectively, in comparison districts.

Similarly, cesarean delivery unit costs in Uganda were lower in health centers (\$202) in SMGL districts than in health centers in the comparison district (\$337). However, the costs were

TABLE 3. Average Unit Cost of Selected Services at Health Facilities in 2016

	Uganda		Zambia	
	SMGL-Supported Districts	Comparison District	SMGL-Supported Districts	Comparison Districts
Vaginal delivery				
Health center III	\$41	\$42		
Health center IV	\$45	\$57		
Health center			\$42	\$18
District/general hospital	\$26	\$25	\$12	\$28
Referral hospital	\$24	Not available	\$125	\$112
Cesarean delivery				
Health center IV	\$202	\$337		
District/general hospital	\$163	\$140	\$33	\$616
Referral hospital	\$79	Not available	\$495	\$458
Antenatal care visit				
Health center III	\$3.66	\$5.49		
Health center IV	\$3.59	\$5.07		
Health center			\$4.50	\$3.96
District/general hospital	\$5.03	\$4.60	\$6.96	\$10.75
Referral hospital	\$4.92	Not available	\$38.90	Not available

Abbreviations: SGML, Saving Mothers, Giving Life.

Notes: The table includes only costs incurred at the facility level; it does not include training of facility staff. Results are presented in US 2016 dollars inclusive of capital and facility overhead costs. Data were not collected from the referral hospital receiving cases from Masindi.

higher in Uganda hospitals (\$163) in SMGL districts than in hospitals (\$140) in the comparison district. At the referral hospital in an SMGL district, the cost of a cesarean delivery was \$79 because the operating theater had a relatively high volume of services. In Zambia, the average cesarean delivery unit costs were lower in hospitals (\$468 on average across types of hospitals) in SMGL districts compared to hospitals (\$508) in comparison districts.

Average unit costs of an antenatal care visit were lower in health centers (\$3.66 for level III and \$3.59 for level IV) in SMGL districts than in health centers (\$5.49 for level III and \$5.07 for level IV) in the comparison district in Uganda. In contrast, hospitals in SMGL districts had higher average unit costs (\$5.03) compared to hospitals (\$4.60) in the comparison district for an antenatal visit. The cost structure in Zambia was different; health centers in SMGL districts had higher average

unit costs of an antenatal care visit (\$4.50) than facilities (\$3.96) in comparison districts, while there were mixed results from the comparison of SMGL hospitals and non-SMGL hospitals.

Each improved facility delivery cost about \$104 in Uganda and \$196 in Zambia.

Total Costs

In 2012 in Uganda, total costs for MNH care were estimated to be about \$650,000 per district, or almost \$66 per facility delivery, while total costs for MNH care in Zambia in 2012 were estimated to be just under \$425,000 per district or about \$101 per facility delivery. Total costs for MNH care per district for the year 2016 were approximately \$1.5 million in SMGL-supported districts in Uganda and almost \$1.2 million in Zambia (Table 4). This translates to approximately \$104 per “improved facility delivery” in Uganda and \$196 per improved facility delivery in Zambia.

TABLE 4. Total Costs Per District and Sources of Financing

	Sources of Financing ^a								
	Estimated Total Costs ^a per SMGL District		SMGL-Supported Districts			Comparison Districts			
	2016	2012	Government	Donor	Private	Government	Donor	Private	
Uganda									
Costs associated with:									
The first delay	\$300,422	\$0	0%	100%	0%	100%	0%	0%	0%
The second delay	\$58,165	\$40,123	2%	98%	0%	100%	0%	0%	0%
The third delay	\$983,364	\$613,329	48%	27%	24%	94%	3%	3%	3%
Above community/facility costs ^b	\$156,931	\$0	0%	100%	0%	100%	0%	0%	0%
Total cost	\$1,498,881	\$653,452	35%	49%	16%	96%	2%	2%	2%
Average number of facility deliveries	14,419	9,947							
Total cost per facility delivery	\$103.95	\$65.70							
Zambia									
Costs associated with:									
The first delay	\$116,590	\$7,608	10%	90%	N/A	52%	48%	N/A	
The second delay	\$107,149	\$10,239	40%	60%	N/A	100%	0%	N/A	
The third delay	\$799,081	\$405,234	74%	26%	N/A	97%	3%	N/A	
Above community/facility costs ^b	\$161,593	\$1,663	0%	100%	N/A	100%	0%	N/A	
Total cost	\$1,184,413	\$424,744	55%	45%	N/A	97%	3%	N/A	
Average number of facility deliveries	6,044	4,194							
Total cost per facility delivery	\$195.98	\$101.27							

Abbreviations: N/A, not applicable; SMGL, Saving Mothers, Giving Life.

^aResults are presented in US 2016 dollars, with capital and start-up costs converted to annual equivalent costs.

^bIncludes costs for offices located in districts, general and office support staff, program vehicles, and other general management and planning activities.

In 2016, donors covered about 49% of the MNH costs in Uganda and 45% of costs in Zambia in the SMGL-supported districts. In comparison districts, donors covered 2% (Uganda) and 3% (Zambia) of all costs in 2016. Costs incurred at private facilities accounted for 16% of costs in SMGL-supported districts in Uganda (although we were not able to assess the amount of donor financial support for births at private facilities). Donors supported the majority of costs associated with the first and second delays and just under 30% of costs related to the third delay in SMGL-supported districts.

Donors supported the majority of costs associated with the first and second delays and just under 30% of costs related to the third delay in both countries in SMGL-supported districts.

Incremental Costs

In Uganda, the cost per facility delivery in 2016 in the SMGL-supported index districts was \$38 higher than in 2012. Over 35% of the incremental cost went to support activities addressing the first delay, about 44% was spent on issues related to the third delay, 2% was spent on issues related to the second delay, and the remainder was spent on above community/facility costs for program support.

Similarly, the cost per facility delivery in Zambia in SMGL-supported districts was about \$95 more in 2016 than in 2012. Addressing the first delay accounted for about 14% of the incremental cost, and above community/facility costs

for program support were associated with approximately 21% of the incremental cost per facility delivery. About 52% of the incremental cost in SMGL-supported districts in Zambia addressed the third delay.

Incremental Effects

In Uganda SMGL areas, the institutional maternal mortality ratio was 534 deaths per 100,000 live births in 2012 and 300 in 2016. The institutional perinatal morality rate was 39.3 per 1,000 births in 2012 and 34.4 in 2016 in SMGL areas. The percentage of deliveries in facilities changed from 45.5% in 2012 to 66.8% in 2016, and the population cesarean delivery rate increased from 5.3% to 9.0%.³⁰

In Zambia SMGL areas, the institutional maternal mortality ratio declined from 370 deaths to 231 deaths per 100,000 live births and the institutional perinatal mortality rate declined from 37.9 to 28.2 deaths per 1,000 births from 2012 to 2016. The percentage of deliveries in facilities increased from 62.6% to 90.2% and the population cesarean delivery rate increased from 2.7% to 4.8%.³⁰

Incremental Cost-Effectiveness Ratios

Based on the number of facility deliveries in the 4 districts included in this analysis, scale-up of MNH activities is associated with averting 164 deaths in

TABLE 5. Incremental Cost-Effectiveness of SMGL in Uganda and Zambia

Number of Facility Deliveries in 2016 ^a	Number of Maternal Deaths ^b	Number of Perinatal Deaths ^b	Incremental Deaths Averted (Maternal and Perinatal)			Total Cost ^c	Incremental Cost ^c	Incremental Cost per Death Averted ^c	Incremental Cost per Life-Year Gained ^c
			Incremental Life-Years Gained						
Uganda									
Without SMGL	19,893	128	1,114			\$1,306,904			
With SMGL	28,838	86	992	164	9,549	\$2,997,763	\$1,690,859	\$10,311	\$177
Zambia									
Without SMGL	8,839	40	450			\$849,489			
With SMGL	12,087	28	341	121	7,362	\$2,368,826	\$1,519,338	\$12,514	\$206

Abbreviation: SMGL, Saving Mothers, Giving Life.

^aThe number of district deliveries in 2016 multiplied by the institutional delivery rate for 2012 (for “without SMGL”) and for 2016 (for “with SMGL”) reported in Serbanescu et al.³⁰

^bEstimated using the 2016 facility deliveries with SMGL (for both “with SMGL” and “without SMGL”) and the total maternal/perinatal death rates for all SMGL-supported districts in 2016 (for with SMGL) and 2012³⁰ with adjustments for national-level secular trends (see Supplement 1) to estimate deaths if SMGL had never occurred (for without SMGL).

^cResults are presented in US 2016 dollars, and represent the totals for the 2 SMGL-supported districts included in the analyses.

FIGURE 1. Results of Sensitivity Analysis for Uganda and Zambia

Uganda and 121 deaths in Zambia in the 2 SMGL-supported districts in 2016 included in this analysis (**Table 5**). This translates to 9,549 years of life gained in Uganda and 7,362 years of life gained in Zambia. In Uganda, the incremental costs were estimated to be about \$1,690,859, or \$10,311 per death averted and \$177 per life-year gained. With an estimated incremental cost of \$1,519,338 in Zambia in 2016, the incremental cost per death averted was \$12,514, or \$206 per life-year gained.

Sensitivity Analyses

Figure 1a and **Figure 1b** depict for Uganda and Zambia, respectively, the cost per death averted or the cost per life-year gained along the x-axis, with each bar representing the change in the incremental cost-effectiveness ratio associated with changing an assumption. In Uganda, including effects only from Kibaale and Kyenjojo districts would result in a cost per death averted of about \$25,550, with a cost per life-year gained of about \$511 (**Figure 1a**). In Zambia, while the

overall SMGL program was associated with reductions in mortality, using data from only Mansa and Nyimba resulted in a higher cost and reverse mortality effect (**Figure 1b**). This outcome was due to higher facility-based maternal and perinatal death rates in Mansa district in 2016 than in 2012, which were greater than the lower death rates in Nyimba district. The mortality increase in Mansa was largely due to more adverse outcomes that occurred in the referral hospital in Mansa in 2016, which provided delivery care to SMGL districts and to 5 additional non-SMGL-supported districts as well.

In Uganda and Zambia, results related to the cost per death averted were otherwise most sensitive to assumptions about using all donor costs as incremental costs. For any given scenario, the cost per death averted remained less than \$12,000 in Uganda and \$14,300 in Zambia. In a scenario combining the 5 main sensitivity analyses, where all assumptions were moved to the least favorable cost-effectiveness scenario, the cost per death averted was around \$12,411 in

Uganda and \$15,708 in Zambia. The cost per life-year saved was most sensitive to the assumption about whether to discount future life-years. When future life-years were discounted, the cost per life-year gained increased to \$384 in Uganda and \$460 in Zambia. In the scenario combining the 5 main sensitivity analyses, the cost per life-year gained was \$462 in Uganda and \$578 in Zambia.

■ DISCUSSION

In the 4 SMGL-supported districts included in these analyses, scale-up of MNH interventions prevented an estimated 285 institutional maternal and perinatal deaths in 2016.

We found that the incremental cost per life-year gained was \$177 in Uganda and \$206 in Zambia.

In the 4 SMGL-supported districts included in these analyses, scale-up of MNH interventions prevented an estimated 285 institutional maternal and perinatal deaths in 2016, or about 71 death per district per year (0.6 death averted per 100 facility deliveries in Uganda and 1.0 death averted per 100 facility deliveries in Zambia). GDP per capita is a commonly used benchmark to determine whether or not an intervention is highly cost-effective, with the cost per DALY averted below the GDP per capita used as the benchmark for being highly cost-effective.³⁶ The assessments of SMGL did not track changes in morbidity, and, to the extent that scale-up of MNH interventions prevented or ameliorated morbidity, our use of life-years gained likely underestimated the effects (as compared to DALYs averted).

Nevertheless, we found that the incremental cost per life-year gained in Uganda was \$177, or 25.6% of the GDP per capita of \$692, and the incremental cost per life-year gained in Zambia was \$206, which is 16.4% of the GDP per capita of \$1,257.

A previous study assessing SMGL activities in Uganda suggested an incremental cost ranging from \$28 to \$104 per improved delivery, depending upon which activities were included in the costs, compared with our finding of about \$38 per facility delivery.²³ Another study assessing a maternal voucher scheme in Uganda, however, found that it cost about \$340 per DALY averted, a higher ratio than we found here.²¹ However, only one district in our study promoted maternal vouchers, while a second had only 24% of facility deliveries supported by vouchers in 2016.³³ Another study assessing surgical interventions for maternal health found a cost per DALY averted ranging from \$7 to \$360, depending on the procedure.⁴⁷ Overall, the cost per life-year gained estimated here tends to be higher than the cost per DALY averted found in global models, but is similar to or lower than the cost per DALY averted from assessments of specific interventions in Uganda.

While recent estimates of unit costs of MNH activities are not available in Zambia, the unit costs found in this study are on the higher end of unit costs from other studies in Uganda. For example, a recent review found the cost of antenatal care in Uganda was about \$5.90 at health centers and \$6.40 at hospitals per woman,¹⁵ only marginally more than our estimated cost per antenatal care visit in Uganda. The same review also found that the cost per vaginal delivery in a facility in Uganda ranged from \$5 to \$46 across studies (compared with \$24 to \$45 in SMGL-supported districts and \$25 to \$57 in comparison districts documented here). The cost per cesarean delivery ranged from \$61 to \$108 (compared with \$31 to \$202 in SMGL-supported districts and \$140 to \$337 in comparison districts documented here).¹⁵ These findings suggest that the costs we estimated in our study are similar to or higher than those reported previously, at least for Uganda.

We did not see a marked change across the board in unit costs of services between SMGL-supported districts and comparison districts when we included only costs incurred at health facilities. In many cases, unit costs were lower in SMGL-supported districts. This was likely because of higher patient volumes in SMGL-supported facilities, with the increased efficiency in the use of capital and overhead costs offsetting the costs of increasing the quality of services. The exception was for vaginal delivery in Zambia, where unit costs were mostly higher in SMGL-supported districts than in comparison districts, but also where there was less difference in the number of deliveries between 2012 and 2016 than in Uganda. When we included costs incurred outside health facilities, including training, mentoring, and community mobilization—that is, the cost of an improved facility delivery—the cost per facility delivery in SMGL-supported districts was substantively higher than in comparison districts.

Funding for reducing the first delay constituted 36% of incremental costs in Uganda and 14% of incremental costs in Zambia, representing 20% and 10% of total costs in SMGL-supported districts, respectively. In comparison districts, the cost of activities addressing the first delay was either nonexistent (Uganda) or marginal (\$1.81 per facility delivery in Zambia). Costs for the activities addressing the second delay were 4% and 9% of total costs in SMGL-supported districts in Uganda and Zambia, respectively. While funding for the second delay was similar in the SMGL-supported and comparison districts in Uganda (transportation vouchers were not implemented in Kibaale,

and used only on a limited basis in 2016 in Kyenjojo), it was substantially higher in Zambia, where costs for maternity homes were a main cost driver for the second delay. For each facility delivery, \$17.73 was spent on activities addressing the second delay in Zambia SMGL-supported districts, contrasting with \$2.44 in comparison districts. The increase in costs per facility delivery was less marked (in percentage terms) for activities addressing the third delay, possibly representing either efficiencies, as noted above, or displacement of other funds. In terms of the total incremental costs, the third delay used the highest amount of resources in Uganda (about \$370,000 per district) and in Zambia (about \$394,000 per district). However, the results suggest that spending about 20% to 25% of MNH budgets to address the first 2 delays—critical delays that can prevent women from accessing care in a timely way—can be enough to improve receipt of timely facility care at birth. While securing and ensuring funding for activities to address the first 2 delays is critical, the results also suggest that in Uganda and Zambia, funding for facility deliveries was inadequate in 2012 to provide sufficient quantity and quality of care, with donors supporting more than 25% of costs addressing the third delay in SMGL districts in both Uganda and Zambia in 2016.

This study is limited by use of comparison districts that were assessed only at the end of the SMGL program. These districts serve as an imperfect proxy estimate of the cost of MNH services before the start of the SMGL program. In addition, use of before and after data to estimate the effects of the scale-up of MNH services is subject to confounding due to secular trends. Although we tried to account for secular trends using national data, the national trends may not have been realized in the SMGL districts over the same time period.

Because data from 2016 in comparison areas were used as proxies for unit costs in SMGL-supported districts in 2012, we assessed data from 2016 in comparison districts with data from SMGL-supported districts in 2012 to ensure comparability. In Uganda, there were about 700 births per facility in SMGL-supported districts in 2012 and 500 births per facility in comparison districts in 2016, while in Zambia, there were about 225 births per facility in both 2012 in SMGL-supported districts and 2016 in comparison districts. In Uganda, 6% of facility births were by cesarean delivery in the SMGL-supported districts in 2012, compared with 9% in comparison districts in 2016, while in Zambia the percentage of facility births by cesarean delivery was 7% and 3%, respectively.

Because data from comparison districts suggest a close match with intervention districts before the start of SMGL in some cases but a notable difference in other instances, we addressed potential biases in sensitivity analyses by using available data on likely ranges for changes in facility-based deliveries, cesarean deliveries, and incremental costs per facility delivery. In all cases, conclusions did not change substantively.

However, the effects presented here could potentially be underestimates for several reasons. Assessing progress in reducing facility maternal and perinatal mortality during the initiative required using facility data and data abstraction protocols. In 2012, each country faced the immediate challenge of how to produce baseline measurements of maternal and perinatal mortality in the period immediately before the initiative began and comparable measurements during the initiative, when data quality improvements were institutionalized. At baseline, each country used its existing data systems and infrastructure to devise its own independent data-collection approach. Although the definitions of indicators were standard, the quality of primary data used to calculate the number of maternal and perinatal deaths was substantially lower at baseline than at endline in both countries. In addition, differences in data collection existed between Uganda and Zambia. Thus, some deaths were likely missed in the baseline count, which would bias our results downward. Further, the proportion of deliveries in facilities increased over time, but we applied the facility-based death ratios/rates to all births. To the extent that women who would have given birth at home without SMGL would have worse outcomes than were observed for facility births, we underestimate the effects of the program.

Lacking data, we have not tried to incorporate these effects into the analyses. Further, the complete effects of the program, which may include increasing staff morale and their ability to deliver other interventions (such as family planning or prevention/elimination of mother-to-child transmission of HIV), were not captured in the effect estimates. While we did not assess changes in patient payments to access services, we also did not include the potential cost savings (from productivity losses and other social costs) resulting from preventing a maternal or newborn death.^{3,48}

Donors spent upwards of \$733,000 per district in Uganda and \$538,000 per district in Zambia in total annual equivalent costs, and in the first year of SMGL \$2 million and \$1.5 per district in real

The results suggest that spending about 20% to 25% of MNH budgets to address the first 2 delays can be enough to improve receipt of timely facility care at birth.

The SMGL project could be paid for by increasing health spending from the 7.3% of GDP in 2015 (in Uganda) and 5.4% (in Zambia) to 7.5% and 5.8% of GDP, respectively.

budgetary expenditures. These findings are in keeping with a previous study assessing SMGL expenditures (the data from these studies were reviewed as part of these analyses).^{34,35} Recent global estimates suggest that \$11 or more per capita per year in added costs are needed in sub-Saharan Africa to meet the full needs of MNH, sexual, and reproductive health care.⁴⁹ While not achieving the full 80% mortality reductions suggested by the \$11 per capita figure and including a different set of interventions, the incremental annual costs of the project represent about \$1.36 per person living in the SMGL-supported districts in Uganda and \$4.85 per person in Zambia. Thus, the SMGL project could be paid for by increasing health spending from 7.3% of GDP in 2015 (in Uganda) and 5.4% (in Zambia) to 7.5% and 5.8% of GDP, respectively.^{44,45} Further, SMGL used an accelerated and capital-intensive model in Uganda and Zambia. Excluding capital and start-up costs, the donor financing for recurrent costs in 2016 was about \$645,000 per district in Uganda and \$135,000 per district in Zambia—just over \$1 per person in Uganda districts and about \$0.86 per person in Zambia districts. The SMGL project utilized program implementation staff located in the SMGL-supported districts, the costs of which are included here. However, if the model is replicated, the cost structures the governments may use would possibly be different from those used by implementing partners, or some duplication of efforts may possibly be reduced. Thus, the 10% to 14% of costs represented by above service delivery and community costs could be reduced when the program is replicated. Further work assessing the future financial implications and budgetary impact of continuing SMGL (or implementing SMGL in other districts or countries) is needed.

While the results from Uganda and Zambia were similar in terms of their cost-effectiveness, the sensitivity analyses looking at results only for districts with cost data indicate that heterogeneity would certainly exist in applying the results to other settings and within countries themselves. SMGL was targeted to areas within Uganda and Zambia with high maternal mortality, with some activities tailored to each district. Similar targeted approaches are likely necessary in other settings, which may affect the cost-effectiveness in any particular setting. Further, the costs presented here do not account for potential changes to costs structures, demand for services, and average unit costs over time. In the future, increased uptake of family planning, further

increases in demand for and use of services, and so forth will likely change the unit costs of delivering MNH services as well as the mix of activities needed. Thus, the cost-effectiveness of district health strengthening approaches such as SMGL will likely also change over time.

This study adds to the literature by presenting actual costs and effects of a health systems strengthening approach that addressed the 3 key barriers to receiving MNH care. We find that the approach costs about \$177 to \$206 per year of life gained, depending on the context. Ministries of Health and donor agencies have already demonstrated a willingness to pay this amount per year of life gained; for example, first-line antiretroviral therapy cost over \$200 per person per year across 5 countries (including Zambia) in sub-Saharan Africa in 2010.⁵⁰ Thus, we conclude that the SMGL approach as demonstrated likely represents a very cost-effective health investment.

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ORIGINAL ARTICLE

Saving Lives Together: A Qualitative Evaluation of the Saving Mothers, Giving Life Public-Private Partnership

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Overall, the Saving Mothers, Giving Life partnership was praised as a successful model for interagency coordination. Key strengths included diversity in partner expertise, high-quality monitoring and evaluation, strong leadership, and country ownership. Uncertainty about partner roles and responsibilities, perceived power inequities between partners, bureaucratic processes, and limited Ministry of Health representation in the governance structure were some challenges that, if addressed by similar public-private partnerships under development, may improve long-term partnership success.

ABSTRACT

Background: Public-private partnerships (PPPs) have garnered appeal among governments around the world, making impressive contributions to health resource mobilization and improved health outcomes. Saving Mothers, Giving Life (SMGL), a PPP aimed at reducing maternal deaths, was born out of the need to mobilize new actors, capitalize on diverse strengths, and marshal additional resources. A qualitative study was initiated to examine how the SMGL partnership functioned to achieve mortality reduction goals and foster country ownership and sustainability.

Methods: We purposively selected 57 individuals from U.S. and global public and private partner organizations engaged in SMGL in Uganda and Zambia for qualitative in-depth interviews. Representative selection was based on participant knowledge of partner activities and engagement with the partnership at various points in time. Of those invited, 46 agreed to participate. Transcripts were double-coded, and discordant codes were resolved by consensus.

Results: Several recurring themes emerged from our study. Perceived strengths of the partnership included goal alignment; diversity in partner expertise; high-quality monitoring, evaluation, and learning; and strong leadership and country ownership. These strengths helped SMGL achieve its goals in reducing maternal and newborn mortality. However, uncertainty in roles and responsibilities, perceived power inequities between partners, bureaucratic processes, a compressed timeline, and limited representation from ministries of health in the SMGL governance structure were reported impediments.

Conclusion: While SMGL faced many of the same challenges experienced by other PPPs, local counterparts and the SMGL partners were able to address many of these issues and the partnership was ultimately praised for being a successful model of interagency coordination. Efforts to facilitate country ownership and short-term financial sustainability have been put in place for many elements of the SMGL approach; however, long-term financing is still a challenge for SMGL as well as other global health PPPs. Addressing key impediments outlined in this study may improve long-term sustainability of similar PPPs.

BACKGROUND

Public-private partnerships (PPPs), generally defined as “cooperative institutional arrangements between public and private sectors,” have garnered appeal among governments around the world.¹ In the field of international health, global health PPPs, a subset of PPPs, have made impressive contributions to national health policies and agendas, health advocacy, health resource

mobilization, and improved health outcomes.^{2,3} Global health PPPs, defined as “relatively institutionalized initiatives, established to address global health problems, in which public and for-profit private sector organizations have a voice in collective decision-making,”²⁻⁴ have mushroomed since the late 1990s with an estimated 10 new partnerships being formed annually.⁴ The proliferation of global health PPPs has triggered the need for research to better understand the barriers and facilitators to goal achievement within partnerships.⁵

The Saving Mothers, Giving Life (SMGL) partnership was born out of the U.S. Global Health Initiative (GHI), an overarching approach to U.S. global health

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policy introduced in 2009 that provided a guiding framework to strengthen and streamline existing U.S. global health programs. Recognizing the complexities, interconnectedness, and urgency of women's sexual and reproductive health issues, the GHI emphasized local ownership, integration of health sectors, and gender equality to improve the efficiency and effectiveness of global health programs. The goal of SMGL was to establish a highly-visible maternal health program that capitalized on diverse yet complementary strengths and marshalled additional resources. Along with financial support, each SMGL founding partner brought unique skills and expertise to the initiative:

- The U.S. Centers for Disease Control and Prevention (CDC) and the United States Agency for International Development (USAID) led the initiative for the United States Government (USG), with support from the Department of State and Department of Defense, to provide existing on-the-ground support for country maternal/newborn health and HIV/AIDS programs and technical expertise in health and development
- The Government of Norway made a commitment to expand the global focus on maternal mortality reduction and provided thought leadership in information systems
- Merck for Mothers guided the strategic direction of the initiative, supported on-the-ground program implementation and evaluation, worked with partners to raise public awareness, and served as the Secretariat
- The American College of Obstetricians and Gynecologists (ACOG) provided thought leadership in implementation science, clinical intervention, and technical skill building
- Every Mother Counts (EMC) provided leadership in communication strategies and emergency transportation and referral systems
- Project C.U.R.E. procured donated hospital supplies and equipment for SMGL-supported districts

Additional information on partner roles and responsibilities is available in [Table 1](#).

In July 2012, then Secretary of State Hillary Clinton announced SMGL as a 5-year initiative. The proof-of-concept phase was to be implemented for 1 year in Uganda and Zambia. If the SMGL model successfully decreased maternal mortality, it was anticipated that the model would

be expanded. The number of countries that would ultimately be involved in SMGL varied according to source, from 3 to 10. In January 2014, USAID announced SMGL would be scaled up nationally in Uganda and Zambia and move into 3 more sub-Saharan African countries. By 2017, SMGL was working in 3 countries: Nigeria, Uganda, and Zambia.

Given the continued interest for networked approaches to solving global health problems and the importance of "partnership" as the operational basis for SMGL, a qualitative evaluation was conducted to examine: how the SMGL partnership contributed to achieving its stated objective; how it was organized and how it functioned; and how it fostered country ownership and sustainability in the long term. This article focuses on partnership efforts in Uganda and Zambia where the initiative has ended and outcomes and impacts are available. Results from Nigeria are forthcoming.

■ SMGL GOVERNANCE AND GOALS

After partners were recruited and the memorandum of understanding signed, the governance structure was established. Each of the partners designated a representative to the 7-member Leadership Council, SMGL's governing body. Two seats were filled with USG representatives (from the Office of the U.S. Global AIDS Coordinator [OGAC] and USAID), and the other 5 seats were filled by the remaining partners. The Leadership Council met quarterly and was supported by 7 committees and working groups: operations, partnership, monitoring and evaluation, communications, publications, technical, and Phase 2 planning. The Leadership Council functioned as a coordinated effort to address emerging issues and steer the SMGL initiative toward its goal. Topics addressed included addition of new countries into the SMGL partnership; approval of new partners, country budgets, and evaluation and dissemination plans; and timeline and programming changes during Phase 2 to address challenges identified in Phase 1. Supported by Merck for Mothers, the Secretariat was established to execute the decisions of the Leadership Council, coordinate the inputs of USG and non-USG partners, provide oversight for country implementation and monitoring and evaluation activities, and develop yearly country budgets and work plans with stakeholders to promote timely funding ([Figure 1](#)). During the second phase, the Secretariat shifted to USAID.

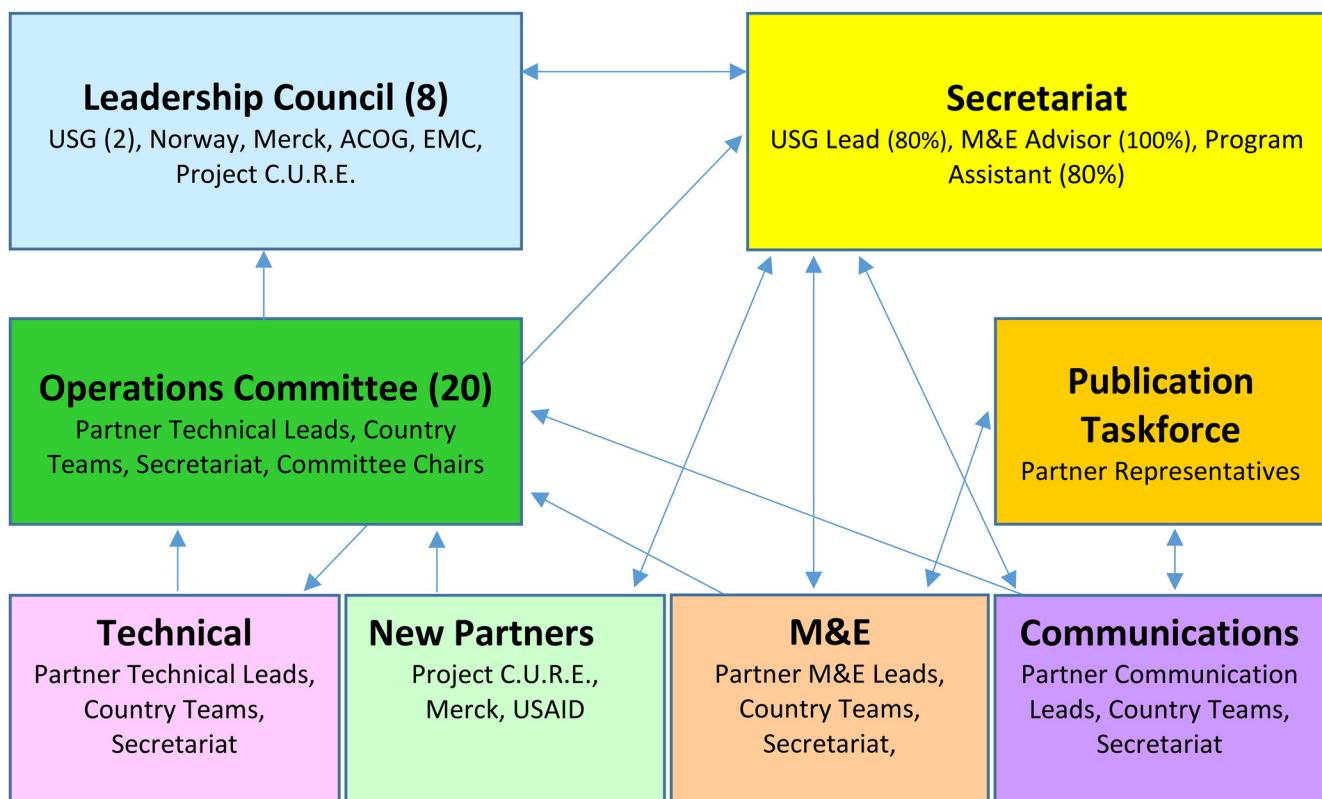
TABLE 1. Saving Mothers, Giving Life Partner Roles and Responsibilities, by Geographic Scope

Partner	Geographic Scope		
	Global	Uganda	Zambia
American College of Obstetrics and Gynecology	Thought leadership on implementation science	Mentorship training of OB/GYN society (USAID)	Support national adoption of uterine balloon tamponade (USAID-supported)
Every Mother Counts	<ul style="list-style-type: none"> Advocacy/media campaigns Co-Chair of Communication Committee 	Fund emergency transportation and referral systems	
Government of Norway	Thought leadership on health information systems	Funded Project C.U.R.E. to provide supplies/equipment	
Merck for Mothers	<ul style="list-style-type: none"> Support Phase 1 Secretariat Support website/communication 	Strengthen local private health care providers in Uganda	<ul style="list-style-type: none"> Develop entrepreneurial approaches for maternity waiting homes Support Zambia endline census
Project C.U.R.E.	Co-Chair of New Partnership Committee	Ensure availability of critical supplies/equipment for services (funded by USAID and Government of Norway)	
USAID (lead USG agency)	<ul style="list-style-type: none"> Lead SMGL for USG Support SMGL Secretariat for Phase 2 Co-Chair and fund M&E Working Group Lead MNH technical oversight, support country programs 	USAID Mission support for post-partum family planning, voucher programs, private-sector services, and quality assurance	USAID Mission support for behavior change efforts, technical training and mentoring, and district coordinators
State/OGAC	Technical guidance and funding to country teams, outside of the Country Operational Plan funds	CDC and USAID Missions provide HIV/AIDS technical oversight and support to country programs	
CDC	<ul style="list-style-type: none"> Lead M&E efforts for the SMGL initiative, including cross-country analysis Co-Chair M&E Working Group (funded by USAID) 	Lead M&E activities for the country including RAMOS, HFAs, POMS, MDSR, and BABIES (funded by OGAC)	Lead M&E activities for the country census, HFA, MDSR (funded by OGAC)
U.S. Department of Defense	N/A	N/A	<ul style="list-style-type: none"> Support work with 7 government military health facilities, including upgrading maternity wards and operating rooms Construct 7 maternity waiting homes
Peace Corps	Develop training curriculum on MCH for Peace Corps volunteers	N/A	Support community health workers located in SMGL districts

Abbreviations: BABIES, Birth Weight and Age-at-Death Boxes for Intervention and Evaluation System; CDC, U.S. Centers for Disease Control and Prevention; HFA, health facility assessment; M&E, monitoring and evaluation; MCH, maternal and child health; MDSR, maternal death surveillance and response; MNH, maternal and neonatal health; OB/GYN, obstetrics and gynecology; OGAC, Office of the U.S. Global AIDS Coordinator; POMS, Pregnancy Outcomes Monitoring Survey; RAMOS, Reproductive Age Mortality Study; SMGL, Saving Mothers, Giving Life; USAID, United States Agency for International Development; USG, United States Government.

The founding partners pledged over US\$200 million in cash and in-kind contributions over 5 years.⁶ The Secretariat began requiring quarterly submission of expenditures from each partner in 2013.⁷ Over the first 33 months of operation (January 2012–September 2014), the partners contributed 23% of the total SMGL pledge and cash flow to implementing partners was erratic. In late 2014, partners were asked to reconsider

and revise their initial pledges (both in-kind and cash) with the expectation that these revised pledges would be spent down during the remaining 3 years of the initiative, fostering accountability and more predictable funding. Revised partner pledges totaled US\$138 million. OGAC confirmed funding from the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) for SMGL implementation in Uganda and Zambia, by year, for the

FIGURE. Saving Mothers, Giving Life Partnership Governance Structure

Abbreviations: ACOG, American College of Obstetrics and Gynecology; EMC, Every Mother Counts, M&E, monitoring and evaluation; USAID, United States Agency for International Development; USG, United States Government.

The Saving Mothers, Giving Life partnership set an aspirational goal to reduce maternal deaths by 50% in SMGL-supported facilities within 1 year.

4 remaining years in decreasing tranches. Having a defined schedule for the decrease in funding from PEPFAR allowed for better planning at the SMGL Secretariat and country levels. It also meant that Uganda and Zambia would likely remain the focus of SMGL through the second phase of the initiative as OGAC was a major funder. (For more information on costs, incremental costs, and incremental cost per death averted in these 2 SMGL countries, see the companion article by Johns et al.⁸ in this supplement.)

SMGL Partnership Goal

Initially, the proposed SMGL goal was to reduce the maternal mortality ratio by 8% in SMGL-supported districts within 1 year.⁹ Almost immediately, this target was deemed too lackluster to engender a movement that could break down siloed patterns of working among USG agencies, build global commitment, signal urgency, and

drive creativity. Therefore, an aspirational goal was set at a 50% reduction in maternal deaths in SMGL-supported facilities within 1 year. This percentage, though unprecedented, was supported by mathematical modeling using the effect sizes of high-impact interventions with effective coverage of the population in the SMGL learning districts. In 2013, the SMGL goal was amended to include a 30% reduction in facility-based neonatal deaths and the time frame was expanded to September 2017. This expansion to include newborn mortality was established by the Leadership Council as interest in newborn outcomes increased globally and was also supported by similar modeling exercises.

The SMGL initiative was divided roughly into 3 phases: Design and Planning Phase (2011–2012), Phase 1 Proof of Concept (2012–2013), and Phase 2 Scale Up and Scale Out (2013–2017). An evaluation conducted after Phase 1 of the SMGL program revealed consensus among SMGL global leaders that the partnership was “greater

than the sum of its parts,” as it leveraged resources and stimulated new ideas.¹⁰ However, as found in prior evaluations of global health PPPs,^{2,3} the lack of clear roles and an agreed-upon operational and financing plan hindered its effectiveness and complicated planning. In addition, both USG agencies and host governments agreed that the national governments were supportive of SMGL, but they did not truly “own” the program. A number of factors hindered such leadership, including reliance on USG resources channeled outside of host-country government budgets, the understaffing of the respective Ministry of Health (MOH) positions, particularly at senior levels, and the reorganization of the Zambian MOH.

SMGL Phase 2 Modifications

During Phase 2, changes were also made to partnership procedures and processes. First, as mentioned previously, partners had to report their quarterly contributions, which the Leadership Council reviewed, and they revised their original pledges to be more realistic with the expectation that the revised pledges would be expended by the end of the partnership. The declining tranches of PEPFAR funding facilitated MOH yearly budget negotiations around domestic funding and institutionalization.

An Operations Committee comprised of partner technical leads also was constituted to assist with implementation. Operational issues were discussed and determined at this level, with only higher-level governance issues decided by the Leadership Council. Finally, there was an attempt to increase MOH leadership in SMGL by inviting MOH representatives from Uganda and Zambia to join the Leadership Council.

In 2014, Norway made the decision to transfer its monetary pledge from SMGL to the newly organized Global Financing Facility and to become inactive in the SMGL partnership. While the redirection of funds had no immediate effect on implementation, it influenced the decision of the partnership to limit its efforts to 3 countries. Coordination and direction were key components of leadership in the SMGL partnership. The Leadership Council and the Operations Committee, with input from district-level MOHs, developed an agreed-upon model to be standardized across all the implementing partners. There was also a small Secretariat that worked with the Leadership Council, Operations Committee, the Inter-Agency Working Groups, and the MOH to ensure execution. (For more

information about SMGL structure, timeline, phases, modifications, and goals, see the companion article by Conlon et al. in this supplement.¹¹)

METHODS

Study Design

We conducted a cross-sectional qualitative study between June and December 2017, with the majority of data collected in June and July.

Selection and Sampling

We purposively selected 57 individuals from U.S. and global public and private partner organizations engaged in SMGL Zambia and SMGL Uganda to participate in qualitative in-depth interviews. Since in-country implementing partners were not part of the SMGL governance structure and did not participate in key decisions influencing the direction of the partnership, they lacked the relevant knowledge for this line of partnership-focused inquiry. Thus, they were purposefully excluded from the study.

The sample size was estimated to include representatives from each major group, including the Leadership Council, host governments, and other donors. The sample size was also estimated to account for potential refusals and an adequate number of respondents to reach thematic saturation. Representative selection was based on participant knowledge of partner activities and engagement with the partnership at various points in time. In total, 46 individuals agreed to participate (Table 2). Informed consent was obtained for each interview. When possible, written consent was obtained. When interviews were conducted via phone and scanning consent documents posed a burden on the subject, full, recorded verbal consent was obtained.

Data Collection

Qualitative interviews were conducted in English in person and by telephone when logistical issues prevented a face-to-face meeting. Interviews were administered by 4 trained qualitative researchers from USAID. While a field guide was used to focus the interviews on our research aims, participants were largely enabled to direct the course of the conversation. All interviews were digitally recorded and notes taken. All interviews were transcribed and loaded onto a secure drive for review. Dedoose qualitative software was used to facilitate the thematic coding process.

TABLE 2. Participant Sampling Groups

	Sampled	Participated*	Interviewed on the Governance Framework	Interviewed for Country Ownership
U.S. government, headquarters	15	11	9	2
U.S. government, field	14	11	7	10
Host government, national	5	3	1	3
Host government, subnational	10	9	0	9
Global partner	13	12	11	3
Total	57	46	28	27

*Some participants were interviewed both on the Governance Framework and for Country Ownership.

Data Analysis

Each transcript was first reviewed and coded by a primary coder. A second coder reviewed all abstracts and noted disagreements, which were resolved by group consensus. Initial codes were prescribed based on the study aims and expanded upon as themes emerged from the first round of data. Semi-monthly team meetings were held to

BOX. Saving Mothers, Giving Life Partnership Strengths and Challenges

Strengths

- **Goal alignment:** Well-aligned, ambitious goal supported high achievement
- **Partner expertise:** Diversity in expertise through the partnership supported a comprehensive program
- **Strength of leadership:** Strong leadership helped support goal alignment and cooperation among partners
- **Strength of monitoring, evaluation, and learning (MEL):** Well-designed, robust MEL strategy supported the use of data for decision making and adaptive management
- **Country ownership:** Achieved through levels of partner coordination and adoption of practices in non-program districts
- **Sustainability:** Achieved through engagement of new partners, sources of funding, and infrastructure

Challenges

- **Representation on governance structure:** Some stakeholders were not represented in the governance structure, which affected service delivery
- **Roles and responsibilities – clarity, resources, and organizational structure:** Partner role ambiguity impeded success in some instances
- **Bureaucratic processes:** Issues such as flexibility, continuity of leadership, communication, human resources, and funding mechanisms created implementation challenges
- **Compressed timeline:** Compressed timeline impacted planning, evidence, and funding
- **Perceptions of power:** Unequal power dynamics between partners based on the level of financial contributions affected decision-making ability

discuss data concerns, emerging themes, and update the codebook.

Ethical Approval

The study received Institutional Review Board (IRB) approval from CDC's Center for Global Health (CGHHSR # 2017-222), University of Zambia ERES Converge IRB (FWA00011697), Uganda's Makerere University College of Health Science School of Public Health (IRB00011353), and ICF IRB (FWA00000845) for the global partnership.

RESULTS

Several recurring themes emerged from our inquiries into the strengths and challenges of the partnership, including: diversity in partner expertise; high-quality monitoring, evaluation, and learning (MEL); strong leadership; lack of clarity in roles and responsibilities; limited representation on the SMGL governance structure; and unbalanced power dynamics (Box).

Strengths

Goal Alignment

Partner goal alignment was strong. Most respondents identified a 50% reduction in the maternal mortality ratio (MMR) as the primary goal of the partnership. While it was frequently perceived as “very ambitious” or “aspirational,” several respondents suggested the ambitious nature of the goal mobilized commitment and resources that supported program success. One respondent from a subnational host government explained:

It was a very ambitious goal that in the first year [we would have] a 50% reduction in MMR. We looked at people [SMGL partners] and said, “Are you going to

make this? This goal is very high.” And they said, “It is good to aim high and then see how things work. At least we got to 30%. And then progressively we’ll be able to reduce the maternal mortality ratio by more than 30%.”

Respondents further noted that partner alignment on the goal facilitated decision making and coordination. One of the global partners commented:

I know that there’s the typical sort of bureaucratic challenges, rivalries, funding challenges—all the things that are always inherent in any kind a project. It just seemed like [the partners] really had the mission first and foremost in mind . . . I think that’s one of things that made SMGL function, was that the partners were sort of aligned on the key topline objective.

Partner Expertise

Respondents from both USG headquarters and field offices indicated that the diversity of technical expertise and funding was a key strength of SMGL, as illustrated by comments from a field office representative:

I think the partnership was aiming to achieve first of all, having a pool of varied resources. So we have a lot more than if we had one or two people involved, both financial as well as the technical support and understanding. And also just bringing the varied experiences from the different partners, I think, from the very beginning.

The respondents also found that the ability of the private sector to finance efforts directly was useful in filling public funding gaps, along with the ability to fund outside the set funding cycles of government and foundations. The presence of private-sector partners encouraged public-sector partners to consider the private sector when working in-country.

Strength of Leadership

Strong USG leadership, particularly from the Secretariat, was highly valued by the respondents. Respondents indicated that the small number of members enabled the Leadership Council to respond quickly to concerns. Partners expressed satisfaction that strong, consistent leadership allowed them to achieve results, such as a uniform maternal and neonatal health reporting system that would support efforts toward mortality reduction in spite of funding gaps and shortfalls. Leadership, in this case, was perceived by many respondents to fill a coordination role rather than

a directive role, which supported partnership success. As one global partner explained:

I think that effective leadership made a difference—there was always a sense of team. And that doesn’t happen without effort. There was remarkably little ego, which is really hard to do with these separate agencies with their own separate missions coming together for one mission as a team, so a lot of that was just really strong leadership and management, and tone setting, those types of things.

The ambitious goal set by the SMGL partnership mobilized commitment and resources that supported program success.

Strength of Monitoring, Evaluation, and Learning

SMGL prioritized MEL from the planning phase. The partners jointly developed a results framework and MEL plan that stipulated core indicators to capture through health facility assessments and baseline and endline program evaluations that were regularly tracked. Partners expressed positive sentiments about the creation and use of robust monitoring and evaluation systems at all levels of the partnership, from the community to global level. For example, a respondent from USG headquarters said:

It’s kind of a hallmark of SMGL that we don’t just produce fluff, we actually provide health outcome data, which is extremely rare in USAID-led projects. I’m very proud of the M&E [monitoring and evaluation] we have done and our ability to work across agency silos capturing outcomes in a really sterling, top-notch way.

Furthermore, a field representative applauded the SMGL’s encouragement of country innovations in MEL:

We decided to use our district health systems strengthening approach but with contiguous districts. . . . So bottom line to me was there was this allowance to allow systems to innovate within the countries of need, which has even happened in Nigeria.

Of the partners that referenced learning, the majority were from respondents in Uganda, who often referenced learning from Zambia MEL findings and using them to improve health outcomes in their own country.

Country Ownership

Perceived ownership of SMGL was high at the subnational level in both Uganda and Zambia by the end of the program. Partnership approaches that facilitated country ownership included working within and strengthening the existing health system rather than a parallel structure; engagement of government national and district

Diversity of technical expertise and funding among SMGL partners was one of its key strengths.

The SMGL partnership facilitated country ownership by working within and strengthening the existing health system, engaging government staff during program design, and aligning SMGL with existing national health road maps.

staff during program design; and alignment of SMGL with existing national health road maps. During a funding gap in the partnership, elements continued through a “relentless, gritty continuation of the approach and the outcomes,” as one USG headquarters respondent explained, attributed to district ownership and leadership. A subnational respondent from Uganda described how active involvement of local players helped to instill a sense of ownership in SMGL activities:

Partners have not done activities in the district without consulting the DHO [District Health Office], the Chief Administrative Officer, and with the Chief Administrative Office, the District Executive Committee. And monthly there have been project coordination meetings and that makes us own whatever we do, that we are implementing in these areas.

The level of support at the national MOH level was mixed. While the USG and the MOH in Zambia reported national MOH engagement was high, Zambian District Health Office staff and other donors commented on gaps in Zambian MOH engagement at the national level. In Uganda, respondents indicated that additional human and financial resources at the MOH to support and engage in program management would have enhanced country ownership. Still, as one respondent from Uganda explained, successes at the subnational level helped fuel support at the national level:

The district and local leadership were very excited about it. And then when it started to show pretty incredible successes, the government really got behind it, embraced it and wanted to roll it up and package it as one of their everyday work.

Sustainability

During the proof-of-concept phase, SMGL front-loaded funding to allow the respective MOH officials time to gradually assume increasing management and financial responsibility for the program. Upfront investments included hiring additional staff seconded to the ministry, purchasing vehicles and equipment, and providing construction and renovation of health facilities and limited commodities. The partnership’s decision to build this infrastructure for staffing, transportation, and construction within the existing national MOH system provided sustainable assets that the MOH could build upon moving forward.

Other elements aimed at achieving sustainability and scale-up of the program included incorporating SMGL elements into other USG-supported programs; ensuring MOH staff were involved in project roll-out and thus maintained institutional memory to continue incorporating SMGL elements in government-financed programs; and encouraging new donors to support the SMGL model in their programs. A respondent from Uganda indicated:

A lot of infrastructure improvements have been done . . . and equipment—those can probably stay longer. Maybe, five years or more. A lot of capacity has been built of the health workers and a number of them have been taken on by the districts of the government of Uganda. They have been put on the government payroll, so I believe with that knowledge that has been passed on to them, that is something that can stay on in the long term.

The Swedish International Development Cooperation Agency (SIDA) provided and continues to provide funds in Uganda and Zambia and to the Global Financing Facility, and the Global Fund to Fight AIDS, Tuberculosis and Malaria. The Belgian Technical Cooperation also continues to provide funds for the SMGL model as of 2018. A respondent from USG headquarters explained:

[In Zambia] the scale up had been quite vigorous and had attracted other financial support. I think that the Swedish aid agency directly provided financial support to districts to implement the SMGL model.

Challenges

Representation in SMGL Governance Structure

Most partners acknowledged that the governance structure made sense on paper (Figure 1), but some felt that the implementation of the committees did not always reflect the diagram, noting underutilization of some partners, unclear roles of specific working groups, or confusion over the value-add of different committees. Some partners mentioned areas of expertise they wished had been represented on the Leadership Council in order to address service delivery gaps on the ground, including midwifery, nursing, water, sanitation, construction, infrastructure, transportation, and supply chain. For example, a Zambian respondent at the subnational level indicated:

They’d say as a district we’re having a problem with transportation, but the partner comes with so much resources but cannot meet the one need that will actually impact everything else.

In addition, while partners reported strong district-level engagement in both countries, absence of national MOH representation on the Leadership Council was considered a missed opportunity. A respondent from USG headquarters stated:

They [the MOH] weren't even represented on the Leadership Council in the early days. And I think that was a serious mistake and something that I hope has been corrected and will continue to be corrected. The problem is that you don't have high officials in a host government who are willing to sit through long conference calls or travel to Washington for meetings talking about leadership and governance.

Roles and Responsibilities: Clarity, Resources, and Organizational Structure

Roles and responsibilities varied widely across partners and included areas of communication, data and analytics, advocacy, program implementation, and procurement. Individual partners and working groups within the partnership frequently reported a perceived lack of clarity in roles and responsibilities. A global partner explained:

The partners were kind of cobbled together pretty quickly, it seemed without a lot of thought of what would they do, how would they contribute in distinctive ways. And that's something that took a long time to resolve, and I'm not sure it even really was resolved.

Smaller global partners noted that it was more difficult for them to make a significant contribution given their limited resources and the ambiguity associated with their role. Two such smaller global partners described:

If I did it all over again, I don't know that I would have entered it [the partnership], only because of our [small] size and scope. I mean, just to think back, and it just seems kind of incredulous to think that we could have contributed more than we did.

I always felt almost bad when we would start celebrating the early reductions that we were talking about, and I don't feel like we really played a super meaningful role because it wasn't set such that we could think about "How can [we] help here? What can we do to play a meaningful role in the goals that have been set here?"

... You know they're bigger ... bigger budgets, bigger organizations. But we were tiny. So we could sort of stand aside saying, "What do you need us to do? Put us in coach."

In a few cases, mid-program shifting priorities within a partner organization resulted in reduced

compatibility between the organization's mission and partnership needs. Other respondents suggested that large-scale partners possessed an inherent rigidity through their own internal governance structures and organizational objectives, which might have limited their role in the partnership.

Absence of national MOH representation on the SMGL's Leadership Council was considered a missed opportunity.

Bureaucratic Processes

Bureaucratic processes were unique to each partner and sometimes resulted in funding delays, which begot implementation and human resources challenges. Several respondents at the country and global levels noted such challenges:

You can't just hire 'willy-nilly' [haphazardly or spontaneously] just because you have money and you have a program ... following these rigid rules of hiring also affected a lot of the timing, in terms of when you can hire. (Zambian partner)

There was a gap of almost 1 year, whereby there was no funding that came into the country. That was again a real challenge and delayed the program for almost a year. (Ugandan subnational partner)

I think in any partnership, a funding cycle has different sorts of decision makers and timelines, and I would not say we were fast. There were several delays in our funding, but it was often [because], you know, we didn't have congressional approval or things like that. So it's hard to control but it's the reality of how funding gets allocated. (Global partner)

Leadership turnover during political transitions impeded strategy and vision alignment across partners. One partner in Zambia, for example, discussed the difficulties of hiring short-term employees to fill human resource gaps due to discordance between local labor laws and unpredictability of USG funding. While many partners acknowledged that bureaucracy is inherent in government partnerships, some suggested that the private sector was not fully leveraged to counterbalance this challenge and that the partnership should have sought funding with more flexibility. One global nonprofit partner explained the type of flexibility it had in contrast with larger organizations:

It's a lot easier for a tiny little startup non-profit to say, "We're deciding where we're going to spend our money based on what we decide we want to do, so yeah, tell us where to put it." We could do that. I think for these bigger organizations it's just unrealistic to think that they could [do that].

Compressed Timeline

The desire to launch activities quickly and to show significant impacts in a brief period of time seemed to undercut planning and relationship development. Some members found themselves playing “catch-up” after implementation began, finding it necessary to insert themselves into a moving process, rather than taking position in a prearranged operational structure at the outset of program activities. One partner noted the challenge posed by the initial short timeline to gathering sufficient evidence, as countries were not guaranteed additional financial support unless they had achieved significant reductions in MMR during that year. Another partner explained:

I think some of the ground work that would ordinarily happen when trying to put together a partnership of this size, it just didn't because speed seemed really important. There's this real desire to get something off the ground quickly, and so there wasn't the planning and the groundwork that you would usually see with something like this until it was catching up and learning more information, figuring out how to plug in. So it wasn't the ideal dynamic.

Perceptions of Power

Financial capacity affected power dynamics in several ways. In at least one case, a partner on the Leadership Council was financially supported by another council partner. Partners of both public and private sectors observed that those with larger financial contributions had more decision-making power. Since USG invested more money than other organizations, this shifted more power to USG partners. One of these USG global partners explained:

Huge decisions like how many years to keep SMGL going [were] largely driven by funding. . . I think the USG held a huge role in decision making because we had the big purse.

Other partners described this imbalance with the terms “big P” and “small p” partners to illustrate the functional differences between certain partners:

[A]nd by big P [Partner] and small p [partner], it had to do with who had the biggest investments and therefore gets the biggest seat at the table. So that was a little bit concerning for us, because those big P partners seemed to have had more of the say in the partnership.

Generally, USG partners felt that the funding level of an organization reflected its level of

SMGL partners with larger financial contributions had more decision-making power.

Maternal and neonatal mortality reduction efforts should commit to a minimum of 5 years of support from the outset.

commitment and hence determined its ownership. Some USG partners even questioned the value of including non-USG partners, arguing that the administrative burden outweighed their added value.

■ DISCUSSION

Studies have clearly found that SMGL significantly reduced maternal mortality, and to a lesser extent perinatal mortality, in Uganda and Zambia.^{11,12} The current qualitative study reported on in this article aimed to shed light on remaining questions about the importance of using a partnership approach, whether the outcomes justified the means, and whether these efforts could be owned and sustained by local stakeholders, given the large influx of donor funding to achieve these results. We summarize our findings on overall partnership success factors, the governance structure, and country ownership and sustainability and place the findings in context of the partnership literature.

Overall Partnership Success Factors

Evaluations of large-scale global health PPPs, including Gavi, The Global Fund to Fight AIDS, Tuberculosis and Malaria, Roll Back Malaria, the International AIDS Vaccine Initiative, Stop TB Partnership, the International Partnership for Microbicides, Medicines for Malaria Venture, and the Global Alliance for Elimination of Leprosy, have reported the lack of a strategy and unclear roles and responsibilities as major challenges to partnership success.^{2,3,13–15} Another study found that launching prematurely and without a strategy were key perils of the 15 multi-stakeholder partnerships they reviewed.¹⁴ As previously mentioned, the SMGL Phase 1 evaluation, conducted 1 year after SMGL implementation, found the lack of an agreed-upon operational and financing plan hindered effectiveness of the partnership and complicated future planning.

Given that the goal established by then-Secretary Clinton was to reduce MMR by 50% within a year, there was pressure on all partners to demonstrate results in a short time period. This meant that the design and planning process was truncated to quickly start implementation and demonstrate results. Frustration was generated when SMGL funding was guaranteed for only 1 year with subsequent support based on achievement of reductions in maternal mortality within a short-time frame. Any future substantial systems approach focused on maternal and neonatal mortality reduction should commit to a minimum of 5 years of support from

the beginning. Our findings suggest both relationship building and evidence gathering takes time and partnerships would be well-served to structure their funding and planning strategies with these critical components in mind.

Despite the pressure to develop the partnership quickly and achieve ambitious results, our data suggest that the SMGL partnership was able to overcome many of these initial challenges (**Table 3**). For example, the partners were able to develop a mutually agreed-upon operational and financing plan, which helped clarify roles and responsibilities during Phase 2. This is owed, in part, to the governance structure and the responsiveness of the Leadership Council to integrate monitoring and evaluation activities. In addition, partners indicated willingness to be flexible in their roles to address issues as they arose. USG interagency collaboration and clarity of roles can often be challenging. SMGL seems to have found the right balance for effective coordination that could be used as a model for other interagency initiatives. Former U.S. Ambassador to Zambia Mark

Storella reported that SMGL in Zambia was “one of the best team-building experiences I had as a diplomat, we built cross-agency teams that fostered on the ground collaboration.”¹⁸

Partnership Governance

Global health PPPs often experience tensions between the perceived urgent need for results and adequate commitment to and investment in capacity of governance mechanisms to effectively manage these complex structures. Roehrich found that issues of incentivization, stakeholder trust, optimal balance of skills and capabilities, and information and power asymmetry can impact stakeholder alignment in PPP arrangements and, ultimately, program success.¹⁷ Partners often do not understand the pressures and incentives faced by different partners that can interfere with overall functioning and effectiveness of a partnership.³ The human resource capacity within a partnership’s secretariat has also been found to be critical in determining its success.^{3,14}

TABLE 3. Saving Mothers, Giving Life Partnership Strengths and Weaknesses Compared With Overall Partnership Success Factors

Success Factors	Summary of Partnership Literature ^{2,3,13,14,16,17}	SMGL Findings	
		Strengths	Weaknesses
Shared vision/operational approach	At the vision level, there are often high levels of agreement, but it is more challenging to align operational approaches and resources.	The partners had a shared vision in terms of reducing maternal and newborn deaths. Initially, operational approach was not clear, but the partners successfully negotiated a mutually agreed-upon operational approach and budget.	Country governments had limited input in developing the initial goal, but goal expectations were later modified. Partners assumed it was easy to integrate PEPFAR and MCH platforms.
Trust	Gaining trust takes time and initially relies on personal connections. Staff changes can significantly destabilize a partnership.	While there were many changes in the partnership, organizations continued their commitment to the partnership, even if at a lower funding level.	The rapid startup limited time at the outset to develop trust and define roles and responsibilities.
Clearly defined roles and responsibilities	Often, lack of clarity in roles and responsibilities can delay activities, create duplication, waste resources, and lead to miscommunication/mistrust among the partners.	As the operational plan was clarified, the roles and responsibilities became clearer.	Initially, there was confusion over roles and responsibilities, which was particularly challenging for some of the smaller partners.
Resources	The partnership can mobilize additional resources, but often fails to be sufficiently resourced to meet ambitious goals. There are high transaction costs. Due to inadequate use of country systems and poor harmonization, resources can be duplicated/wasted. Pledges are not always been realized.	The partnership facilitated the use of PEPFAR funds for maternal health activities. Presence of a private-sector partner provided more engagement with private service providers. Additional partners were leveraged to fill gaps and expand the approach.	The initiative was not fully funded, partners had to revise their pledges and recommit themselves to the partnership. The partnership was limited in its capacity to provide infrastructure support.

Abbreviations: MCH, maternal and child health; PEPFAR, U.S. President's Emergency Plan for AIDS Relief.

According to Buse, a good governance structure including the right constellation of partners and its modus operandi are essential to the success of a partnership.³ However, there are often tensions between ensuring adequate inclusivity and establishing a manageable quorum to effectively operate and make timely decisions. A system of accountability among partners is increasingly important and formalization of global health PPP governance structures is a must, but formalization needs to be balanced with the flexibility to respond to challenges and opportunities, particularly at the country level.¹³

Other global health PPP evaluations have identified key challenges as^{2,3,13-15}:

- Poor governance practices, including conflicts of interest
- Limited voice in decision making, particularly from host-country officials
- Limited focus on health systems
- Unclear performance metrics
- Poor understanding of the costs and benefits
- Insufficiently resourced arrangements to implement activities and pay for coordination costs

- Poor harmonization with governments and other development partners

Table 4 contrasts these challenges with our results.

Respondents indicated that SMGL had very robust health outcome metrics but lacked measures to assess partnership processes; was well-aligned with national government policies, including focusing on the public and private health system; and generally had an effective governance structure and processes. Like other global health PPPs, SMGL struggled to get full participation of national governments on the formal governance structure; fully address some of the power dynamics between the larger and smaller organizations; and fully realize financial commitments. While respondents generally felt the composition of the governance structure was appropriate, key skills, such as infrastructure, were missing. With that said, the partners were creative and flexible in responding to issues as they arose, refocusing efforts on 3 countries and leveraging an additional US\$100 million outside of the partnership to expand the approach.

Country Ownership

As previously mentioned, while not explicitly included as a goal, country ownership and

TABLE 4. Saving Mothers, Giving Life Governance Strengths and Weaknesses Compared With Established Success Factors

Success Factors	Summary of Partnership Literature ^{2,3,13,14}	SMGL Findings	
		Strengths	Weaknesses
Governance structure	Low participation from countries and NGOs on governing bodies but boards are becoming more representative. Partnerships require dedicated staff to support them.	The partnership developed a defined governance structure with voting and clearly identified organizational points of contact. Composition size was seen as a positive.	MOHs were not included on the Leadership Council during Phase 1. They were invited to join during Phase 2, but country factors inhibited their participation.
Secretariat	The Secretariat plays a vital role in the effectiveness of the partnership; the costs of coordination and communication are often not well understood or resourced.	The Secretariat provided stability to the partnership and was praised for its leadership.	
Governance process: M&E	Agreement on common metrics, data collection approaches, and partner roles are essential. It is important to have indicators that reflect the outcomes as well as the partnership processes.	Rigorous M&E enabled the partnership to demonstrate success and make program adjustments.	The Phase 1 evaluation touched on the partnership, but the partnership did not have any metrics that measured the partnership processes.
Governance process: decision making	Dominant decision makers are usually related to the size of funding.	Regular (technical, results, and financial) updates were provided via the Operations Committee and Leadership Council.	The partnership was largely seen as Washington-driven and USG-funded. There were some conflicts of interest and power dynamics between larger and smaller partners.

Abbreviations: M&E, monitoring and evaluation; MOH, Ministry of Health; USG, United States Government.

sustainability were key tenets of SMGL's approach. The GHI framework articulated 4 aspects of country ownership that needed to be addressed: (1) political stewardship; (2) institutional and community ownership; (3) capabilities; and (4) mutual accountability and financing.¹⁹ Table 5 compares key elements of country ownership and sustainability with our results.

SMGL was able to apply some lessons from global health PPPs started in the early 2000s. One area was to begin the discussions about country ownership and sustainability at the onset of the partnership. SMGL was designed to front-load funding to demonstrate a successful model in the first year that the MOH and other donors and constituencies (e.g., the private sector) could adapt and expand. This was thought to provide time for the MOH to gradually assume more responsibility and financing for the program, as SMGL's resources would decline. As with other global health PPPs, SMGL has been quite successful in garnering government ownership over time, particularly at the district level, as well as community and

provider buy-in. This has been combined with substantial increases in district-level capacities, especially in data analysis and use and in quality of care, which contribute to improvements in the health system overall.

Despite early indications that the SMGL approach was supported but not "truly owned" by governments,¹⁰ our results provide clear examples that both governments, particularly at the district level, have adopted key elements of the SMGL approach and have encouraged other donors to use this model. Both Uganda and Zambia have expanded elements of the SMGL approach, with MOH funds as well as with other donor support, beyond the initial districts.

Discussions about country ownership and sustainability began at the onset of the SMGL partnership.

Sustainability

Sustainability aims to systematize and institutionalize the 4 country ownership domains, described above, so that they become usual practice within the host country health system. While there is a large body of literature on sustainability, there is

TABLE 5. Saving Mothers, Giving Life Country Ownership and Sustainability Strengths and Weaknesses Compared With Established Success Factors

Success Factors	Summary of Partnership Literature	SMGL Findings	
		Strengths	Weaknesses
Country ownership ^{20–24}	Country ownership of partnership activities can strengthen national health policy processes, raise profile of specific health issues, and establish international norms and standards. Partnerships often fail to address broader health systems issues. Limited harmonization leads to considerable duplication, emergence of parallel systems, and little alignment between recipient country and partnership priorities. Parallel budget systems raise concerns of government ownership and sustainability.	SMGL activities were built on national policies/road maps and international best practices. The partnership reinvigorated commitments to reducing maternal/newborn deaths. The partnership focused on enhancing district health systems, both public and private, to achieve results. SMGL built health worker and community capacity to increase demand for and provision of quality maternal and newborn health services.	Rapid startup limited initial government ownership. Some misalignment between partners and country priorities existed.
Sustainability ^{25–29}	Transition planning is key but not sufficient. Ensuring financial sustainability is the most challenging aspect of partnerships; it is important to understand the cost of the entire system to be sustained, rather than just commodities. More studies and indicators to monitor successful transitions from donor-funded programs to country, public, civic, and/or private stakeholders are needed.	SMGL was designed to front-load funding so the MOH and other stakeholders could sustain the efforts. Communities and some districts were able to mobilize their own resources. The partnership between the MOHs and SMGL leveraged US\$100 million from donors to continue key aspects in the short run.	Partners used its results to advocate with key government stakeholders to sustain SMGL. While there was a high level of government ownership for SMGL, this did not result in national-level budget increases.

Abbreviations: MOH, Ministry of Health; SMGL, Saving Mothers, Giving Life.

limited data on metrics to track progress of the transition of large-scale donor health programs to local counterparts.²⁶ In addition, there are few examples of PPPs that have been sustained at a country level. In an effort to promoting self-reliance, USAID has successfully transitioned its family planning and reproductive health programs in several countries. Key transition domains for such graduation include leadership, financing, programming, and service delivery. Activities that support the transition include sustaining a supportive policy environment, creating financial sustainability, developing local stakeholder capacity, communicating to all stakeholders, and aligning programs.²⁶

Experience has found that poorly executed transitions of large-scale donor programs can reverse health gains. Two relevant studies for comparison with SMGL are the transition of the Gates' funded Avahan HIV program in India,²⁷ not a PPP, and the Gavi graduation model.²⁸ The review of the Avahan program found that while transition readiness among local stakeholders was important, it did not necessarily lead to institutionalization of key program elements after the 1-year transition period. In addition, institutionalization was not predictive of sustained program delivery.²⁷ For Gavi, political commitment was a crucial factor, particularly to increase and sustain immunization budgets. The larger the budget increase required, the more difficult it was for the country to secure financing. It was also important to ensure that the investment envelope included the total cost of the system rather than selected elements. Lastly, the expectation that a country will have to pay a greater share of the program costs over time allows for transition planning to start early in the partnership. Transition time is needed to (1) secure buy-in from multiple stakeholders; (2) ensure capability of structures and processes; and (3) finalize the funding mechanism(s) to mainstream the initiative.²⁸

Financial sustainability is the most challenging for all programs, not just global health PPPs. SMGL was not designed to specifically increase national maternal health budgets, but it was anticipated that the programmatic results would drive change and could be used to advocate for increases in domestic resources. There are examples where some districts, facilities, and/or communities have been able to raise some local resources and continue key practices (e.g., better data analysis) without additional resources. Both Ugandan and Zambian MOHs were active, in collaboration with SMGL, in encouraging other donors to support

many of the SMGL-supported activities so they would be sustained for years after the partnership. The future of long-term financing is affected by multiple factors and thus unclear at this time. Unfortunately, the Ugandan MOH's budget has been reduced in the past year. (For additional analysis and discussion on SMGL sustainability, see the companion article by Healey and colleagues²⁹ in this supplement.)

Limitations

There were several limitations to our study. First, while we had an 80% response rate, scheduling conflicts reduced the participation from senior Zambian MOH officials who could have provided valuable insights. Second, the team chose to exclude implementing partners from this study, because they did not participate in the SMGL governance structure and were not specifically selected for the partnership. Furthermore, given that SMGL used existing mechanisms, the implementing partners involved in the proof-of-concept phase transitioned to other implementing partners as the USG agreements were procured. However, this decision was not without sacrifice, as the partnership structure can have implications for implementing organizations. Lastly, the study team was comprised by USAID staff. The team took every measure to conduct the study with integrity and to maintain fidelity to the research and analytic processes prescribed and minimize biases. To address the latter, qualitative interviews and data analysis were conducted by USAID staff who had no prior experience or affiliation with the SMGL project. Respondents were informed before each interview that accuracy was our objective, that the interviewer was not otherwise affiliated with the SMGL project, and that the respondents' identity would remain anonymous. Respondents did not seem to hold back critical commentary related to USAID or other USG partners.

CONCLUSIONS

This qualitative study found that representatives of the SMGL partnership believed that the partnership approach, in part due to its diversity, supported the achievement of SMGL's results. The partnership faced many of the same challenges experienced by other global health PPPs, but local counterparts and SMGL partners were able to successfully address many of these issues. Despite agency bureaucracy, SMGL was praised as a successful model for interagency coordination. Examples of country ownership and short-term

financial sustainability have been put in place for many elements of the SMGL approach. Long-term financing is still a challenge for SMGL as well as other global health PPPs.

Given the importance of country ownership and response to local context, future global health PPPs should have greater focus at the country level, ensuring diverse representation of local stakeholders in partnership governance structures. In addition, global health PPPs should include regular self-assessments or reflective learning processes, with clear metrics, of the governance structure and its processes to reduce transaction costs and increase efficiencies, ultimately enhancing the effectiveness of the partnership to deliver even greater results.

The SMGL partnership was an ambitious attempt to dramatically reduce maternal and newborn deaths in just a few years through the strategic, cooperative efforts of government and private organizations with a shared goal. Its legacy will provide that strong leadership, a broad alliance of stakeholders, integrated monitoring and evaluation, and agile implementation can achieve dramatic results in global health.

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ORIGINAL ARTICLE

Community Perspectives of a 3-Delays Model Intervention: A Qualitative Evaluation of Saving Mothers, Giving Life in Zambia

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While the Saving Mothers, Giving Life's health systems strengthening approach reduced maternal mortality, respondents still reported significant barriers accessing maternal health services. More research is needed to understand the necessary intervention package to affect system-wide change.

ABSTRACT

Background: Saving Mothers, Giving Life (SMGL), a health systems strengthening approach based on the 3-delays model, aimed to reduce maternal and perinatal mortality in 6 districts in Zambia between 2012 and 2017. By 2016, the maternal mortality ratio in SMGL-supported districts declined by 41% compared to its level at the beginning of SMGL—from 480 to 284 deaths per 100,000 live births. The 10.5% annual reduction between the baseline and 2016 was about 4.5 times higher than the annual reduction rate for sub-Saharan Africa and about 2.6 times higher than the annual reduction estimated for Zambia as a whole.

Objectives: While outcome measures demonstrate reductions in maternal and perinatal mortality, this qualitative endline evaluation assessed community perceptions of the SMGL intervention package, including (1) messaging about use of maternal health services, (2) access to maternal health services, and (3) quality improvement of maternal health services.

Methods: We used purposive sampling to conduct semistructured in-depth interviews with women who delivered at home ($n=20$), women who delivered in health facilities ($n=20$), community leaders ($n=8$), clinicians ($n=15$), and public health stakeholders ($n=15$). We also conducted 12 focus group discussions with a total of 93 men and women from the community and Safe Motherhood Action Group members. Data were coded and analyzed using NVivo version 10.

Results: Delay 1: Participants were receptive to SMGL's messages related to early antenatal care, health facility-based deliveries, and involving male partners in pregnancy and childbirth. However, top-down pressure to increase health facility deliveries led to unintended consequences, such as community-imposed penalty fees for home deliveries. Delay 2: Community members perceived some improvements, such as refurbished maternity waiting homes and dedicated maternity ambulances, but many still had difficulty reaching the health facilities in time to deliver. Delay 3: SMGL's clinician trainings were considered a strength, but the increased demand for health facility deliveries led to human resource challenges, which affected perceived quality of care.

Conclusion and Lessons Learned: While SMGL's health systems strengthening approach aimed to reduce challenges related to the 3 delays, participants still reported significant barriers accessing maternal and newborn health care. More research is needed to understand the necessary intervention package to affect system-wide change.

INTRODUCTION

In 2015, the global maternal mortality ratio (MMR) was estimated at 216 maternal deaths per 100,000 live births.¹ While global efforts have contributed to a 44% reduction in maternal mortality between 1990 and 2015,^{1–3} 99% of global maternal deaths still occur in low- and middle-income countries.¹ In order to reduce MMR to a global average of fewer than 70 maternal

deaths per 100,000 live births by 2030 (Sustainable Development Goal 3), a concerted effort must be made at every level of the health system.⁴

In 2015, sub-Saharan Africa had the highest MMR in the world, at 546 maternal deaths per 100,000 live births.⁵ Zambia, however, has been taking steps to reduce maternal mortality. Between 1990 and 2015, Zambia's MMR dropped from 577 to 224 maternal deaths per 100,000 live births, representing a 61% reduction.⁵ While Zambia's MMR was reduced by an average of 3.8% per year,⁵ the country still needs to address several health systems challenges to achieve its target MMR of 100 maternal deaths per 100,000 live births by 2021.⁶

Maternal mortality is as much a health system challenge as it is a medical challenge.^{5,7} Multiple levels of the

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health system must work in concert to prevent and respond to complications that arise during pregnancy and childbirth. The most common causes of maternal mortality—hemorrhage, hypertensive disorders, and sepsis—can be managed if quality care is provided by a skilled birth attendant in a timely manner.³ According to the 2013–2014 Zambia Demographic and Health Survey (ZDHS), nearly one-third of all deliveries in Zambia take place at home without a skilled birth attendant.⁸ Even when a laboring woman makes it to the health facility in time to deliver, the majority of facilities in Zambia have an unmet need for basic emergency obstetric and newborn care (BEmONC), falling below the minimum United Nations standard.⁹ Of the women who delivered at home during the 2013–2014 ZDHS, the most often-cited reasons for delivering at home were distance, lack of transportation, and short duration of labor. These findings were consistent across wealth quartiles and educational attainment, illustrating significant barriers to accessing maternal health services in Zambia.⁸

The 3-delays model was first proposed by Thaddeus and Maine in 1994⁷ and has been used widely to classify and understand the root causes of maternal death across a health system.^{10–14} While most maternal survival interventions focus on either supply side^{15,16} or demand side,^{17,18} only a limited number of interventions have the resources, technical capacity, and scope to address all 3 delays at once.¹⁹

Saving Mothers, Giving Life (SMGL), a health systems strengthening intervention, aimed to reduce maternal mortality by addressing all 3 delays across 4, and after scale-up, 18 districts in Zambia from 2012 to 2017. Rigorous evaluation has confirmed that the SMGL approach reduced maternal mortality in both Zambia and Uganda.^{20,21} In the selected SMGL intervention sites in Zambia, the overall institutional delivery rate increased by 44% (from 62.6% to 90.2%) between 2012 and 2016, and in health facilities with emergency obstetric and newborn care (EmONC) services, delivery rate increased 12.2% (from 26% to 29.1%). During this same time, the institutional MMR declined by 37.6% (from 370 to 231 maternal deaths per 100,000 live births).^{21,22}

While early indicators in the SMGL implementation sites showed increased community sensitization about accessing maternal and newborn health (MNH) services early and often throughout pregnancy and childbirth,^{20–22} studies in similar settings demonstrate that perceived distance and quality of care determine a family's decision of

where to deliver as well as how and when they will access MNH services.⁷ While the indicators demonstrate the success of SMGL in reducing maternal mortality,^{20–22} little is known about how the community perceived the SMGL intervention in these selected sites. To address this gap, we conducted a qualitative evaluation to explore the community perspectives of the SMGL initiative in the 4 (later split into 6) intervention districts in Zambia.¹ Our study assessed community perceptions of the SMGL intervention package, including (1) messaging about use of maternal health services, (2) access to maternal health services, and (3) quality improvement of maternal health services.

METHODS

Study Design and Sampling

To explore the views of the community on the SMGL initiative, the study team used qualitative methods to gather insights from the community and the public health stakeholders who interacted with the SMGL program during the implementation period. The qualitative study was conducted in July 2016 during the fourth year of implementation. We purposively sampled a total of 171 individuals from communities in Mansa, Chembe, Lundazi, Nyimba, Kalomo, and Zimba. Of those sampled, we conducted in-depth interviews (IDIs) with 78 individuals representing women who delivered at home (n=20), women who delivered at a health facility (n=20), clinicians (n=15), community leaders (n=8), and public health stakeholders (n=15). We also purposively sampled 93 participants to participate in 12 focus group discussions (FGDs), with an average of 7 people per focus group, representing men (n=29; 4 FGDs) and women (n=33; 4 FGDs) from the communities and Safe Motherhood Action Group (SMAG) members (n=31; 4 FGDs). The SMAG members are government-established community health workers. We used both IDIs and FGDs to explore individual perspectives as well as group dynamics within a community in relation to understanding and uptake of health promotion messages and decisions on how, where, and when to seek and access MNH services. Semi-structured interview guides were used for both IDIs and FGDs (for focus group discussion guides, see Supplements 1–3; for key informant interview guides, see Supplements 4–7). The sample size was established to reach thematic saturation, which occurred when no new themes emerged from interviews. IDIs and FGDs lasted between 1 to 2 hours.

The qualitative study sampled 171 individuals from 6 districts implementing the SMGL program in Zambia.

Data Collection

The IDIs and FGDs were conducted in local languages—Cibemba, Cinyanja, and Citonga—and administered in-person by a trained qualitative research assistant who spoke the language of the assigned region. While a field guide was used to focus the interviews on research aims, participants directed the course of the conversation. All interviews were digitally recorded, and field notes were taken to supplement the transcriptions during analysis. All interviews were transcribed into English by trained research assistants and loaded onto a secure drive for review and quality checks. Written informed consent was obtained for each interview and FGD.

Data Analysis

To verify data quality, data were reviewed by 2 analysts during data collection, transcription, and data entry. Three levels of review were carried out: the first review was done immediately after each interview to ensure completeness of the interview; the second review ensured all data on the audio recordings were captured; and the third review was completed after transcription to ensure that translations preserved the original meaning. Data validity was achieved through triangulation of different data sources to cross-check for completeness of information.

Transcribed interviews were imported into NVivo version 10 qualitative software (QSR International, Burlington, MA, USA) to facilitate the coding process. Deductive coding was employed by coders. Since SMGL used the 3-delays model as its underlying program theory, an initial code book was developed in which parent codes for each of the 3 delays were created, and child codes representing SMGL's key interventions were organized under their respective parent code.

The primary coder used this code book to group data by SMGL intervention and delay. A second coder reviewed all transcripts and noted disagreements, which were resolved by group consensus. Memo-writing was also used throughout the data analysis process to explore emerging themes. Additional codes were added as new themes emerged. The study team met frequently to discuss emerging themes and to consolidate and update the code book. After the initial analysis was completed, a third researcher reviewed the data, ensuring intercoder reliability.

Ethical Approval

Ethical approval was granted by the ERES Converge Institutional Review Board (Ref. No. 2011-Oct-007).

RESULTS

The SMGL initiative addressed gaps and limitations highlighted at baseline related to the 3 delays to access and use of MNH services in the SMGL learning districts.

First Delay: Perception of Key Messages on Safe Motherhood to Increase Demand for and Use of MNH Services

In addressing the gaps and limitations highlighted at baseline related to the first delay⁷ SMGL implemented a sensitization of “Safe Motherhood” campaign from 2012 to 2014. The goal of the campaign was to increase demand for MNH services in SMGL’s original 4 learning districts. Safe motherhood messages were spread through trained community leaders (chiefs, civil leaders, and headmen), SMAG members, clinicians (nurses, midwives, and clinical officers) and mass media. Key messages centered on the importance of early antenatal care (ANC), health facility deliveries, and involvement of male partners in MNH services (Table).

Key messages aimed to increase demand for MNH services by focusing on the importance of early ANC, health facility deliveries, and involvement of male partners.

Strengths

Overall, there was a high level of awareness of SMGL’s messaging. When asked about the messages they heard related to the SMGL program, most participants were able to recite key messages from the campaign, including the importance of delivering in a health facility, danger signs during pregnancy and childbirth, involving male partners during pregnancy, and how to prepare financially for the birth. Of note, SMAGs were consistently mentioned as a key source of information related to maternal and child health and were seen as an important link between community members and health facilities:

When these pregnant women are escorted by the SMAGs, it carries more weight because after discharge the woman will go and tell other women in the community that I was escorted by the SMAGs . . . and this news spreads in the community and this motivates the community. (woman, SMAG member)

[W]hen the SMAGS took that step to be giving health education to the women, the governments have managed to build other clinics to help reduce complications

TABLE. First Delay: Perception of Key Messages on Safe Motherhood to Increase Demand for and Use of Maternal and Newborn Health Services

Delay Defined in the Context of SMGL Initiative	Strengths	Challenges and Unintended Consequences	Recommendations/Steps for Future Interventions
First Delay: Decision to seek care <ul style="list-style-type: none"> • Traditional beliefs/cultural norms (belief that deliveries should be conducted in the presence of family elders if a problem was anticipated) • Lack of birth preparedness • Lack of male/spouse involvement in birth preparedness plans • Lack of community's understanding of danger signs during pregnancy and child birth • Perceived low quality of care at health facility • Challenges in deciding when to seek care 	Increase community demand for MNH services <ul style="list-style-type: none"> • Community sensitization using safe-motherhood health messages • Birth preparedness information given during ANC visits to encourage women and their families to financially plan for health facility use when needed • Involvement of men, chiefs, and headmen as "change champions" • Provision of pamphlets and education on "danger signs" during pregnancy and childbirth (e.g., postpartum hemorrhage, pre-eclampsia) • Engagement of community volunteers and SMAGs to assist with community mobilization to encourage health facility deliveries when needed 	<ul style="list-style-type: none"> • Health messages needed consistency and continuity to have full impact • Financial and resource challenges for families and program were reported • Overzealous chiefs enforced penalties on families not using health facilities for deliveries to put pressure on them • SMAGs needed sustained support systems to continue volunteering and assisting communities 	<ul style="list-style-type: none"> • MOH to increase funding for MNH programs to start with community engagement • Government stakeholders to continue collaborations to assist with collective funding for MNH programs • Engage Ministry of Chiefs and Traditional Affairs to assist with MNH agenda • Deliver health communication messages through radio and community drama programs to raise knowledge and awareness of danger signs and where to seek and use MNH care • Provide financial incentives for community volunteers
Second Delay: Reaching the health facilities <ul style="list-style-type: none"> • Distance to health facilities • Bad roads and difficulty of access, especially during rainy season • Lack of transportation • Lack of communication when transportation was needed 	Increase access to high-impact MNH services <ul style="list-style-type: none"> • Awareness to plan financially for communication and transportation to health facility • Government to improve road access and ambulances • SMGL program provided boats and ambulances • Community assistance from people with vehicles; reimbursements made for fuel • Health facility staff assisted with their mobile phones during emergencies • SMAGs provided with bicycles to assist women to go to the health facilities • Construction of MWHs 	<ul style="list-style-type: none"> • Impassable roads are still a challenge especially in the rainy season • Some roads through the game reserves were impassable • Vehicle breakdowns and maintenance needs were reported often • Mobile phone receptivity due to poor or unavailable network • Some SMAGs did not receive bicycles • MWHs used for other clinical services when empty 	<ul style="list-style-type: none"> • Continue to engage other government sectors, such as the Ministry of Transport and Communication • Program plans to include repair and maintenance of vehicles • Plan for training and reimbursement of drivers is imperative for programs • Delegate MWHs to SMAGs for maintenance through community cooperatives for sustained use
Third Delay: Receiving care at the health facility <ul style="list-style-type: none"> • Not enough staff to handle number of patients 	Improvements in quality of MNH services <ul style="list-style-type: none"> • Improved staff capacity and attitudes through training and supportive supervision 	<ul style="list-style-type: none"> • Increased number of patients at health facilities • Failure of some equipment due to lack of maintenance and poor electricity supply 	<ul style="list-style-type: none"> • Availability of policy and guidelines of MNH care • Adequate human resources • Improved infrastructure and maintenance as per demand

Continued

TABLE. Continued

Delay Defined in the Context of SMGL Initiative	Strengths	Challenges and Unintended Consequences	Recommendations/Steps for Future Interventions
<ul style="list-style-type: none"> • Lack of trained staff • Poor attitudes of staff • Lack of equipment and supplies 	<ul style="list-style-type: none"> • Improved infrastructure of labor and operating rooms • Hired anesthetist and laboratory technicians • Obstetric/gynecologists reimbursed to provide mentoring and supportive supervision to new physicians • Nurse/midwives trained, mentored, and supervised in EmONC • Refresher courses in procurement/logistics of medicines and equipment • Improvement of referral policy and ambulance use • Provision of consumable supplies and equipment • Supported availability of blood and blood products within reach 	<ul style="list-style-type: none"> • Supervision and placement of nurses and midwives not hired through the MOH became a challenge • Sustainability challenge to continue with staff salaries of hired midwives 	<ul style="list-style-type: none"> • Training and supportive supervision for EmONC and mother-friendly services • Plan for continued procurement and repair of equipment • Referral monitoring and counter-referrals

Abbreviations: ANC, antenatal care; EmONC, emergency obstetric and newborn care; MNH, maternal and newborn health; MOH, Ministry of Health; MWH, maternity waiting home; SMAG, Safe Motherhood Action Group; SMGL, Saving Mothers, Giving Life.

in pregnant women. It's like the SMAGs talk to the government on our behalf. (man, spouse of a woman with a health facility delivery)

It used to happen that when a woman delivers, she will have heavy bleeding that no one can attend to her. But in the last 4 years, when the woman is in that condition, the SMAGs will attend to her by taking her to the health facility. (man, spouse of a woman with a health facility delivery)

Clinicians perceived an increase in men attending ANC appointments with their partners. Both men and women found it beneficial for male partners to attend ANC appointments, noting that having an additional person at the appointment helped the couple retain important information. By attending ANC appointments, male partners had a better understanding of how to prepare financially for the pregnancy and delivery:

When men learn the information from the clinic, they go home knowing that there is need to keep money for emergencies. When you have prepared money for the baby you should keep some for the other things that are needed at the health facility. (woman, health facility delivery)

Male respondents discussed supporting their pregnant wives by reminding them to take "iron pills" (ferrous sulfate), making sure they have nutritious food to eat, and making sure they do not do heavy work, such as farming, during pregnancy.

Another successful component of the messaging campaign was related to the use of SMAGs and clinicians to encourage women to attend ANC appointments early in their pregnancies. Although some women still delayed their first ANC appointment, midwives perceived a change due to widespread sensitization meetings:

After the SMGL we have seen quite a number of women booking a bit early for antenatal care unlike before. I think some messages are reaching some women that whenever they are pregnant they are supposed to come and book for antenatal care. (woman, clinician midwife)

When women were probed about their decision-making process for attending ANC sessions, most of them reported they had heard about the importance of starting ANC early, even if they did not always follow through. For example, a woman cited laziness as a reason for delaying the start of her ANC appointments:

I delayed starting my ANC and I started at 6 months pregnant. I was just lazy (laughing) I don't know, just being lazy. (woman, health facility delivery)

When probed about their decision-making process for delivering at a health facility, factors such as birthing in a “clean environment” and being attended to by a trained clinician were considered important. While messaging seemed to encourage some behavior change, there were still some women who preferred to deliver at home.

Challenges

In order to meet SMGL’s goal of increasing health facility deliveries, some chiefs and headmen instituted penalty fees for home deliveries. Penalty fees consisted of paying the chief either 50 kwachas or a goat (US\$5). While not part of the SMGL intervention, community members cited the penalty fees as a factor influencing their decision to deliver in a health facility, even if other factors, such as distance, ultimately prevented their health facility delivery:

[W]e are afraid to deliver at home because the chief said that if anyone delivers from home one should pay a goat. Most of the women are afraid to pay the chief and this is why we come to deliver at the facility. (woman, home delivery)

When families who experienced a home delivery brought their newborn to the health facility for children’s clinic vaccinations, some were charged an additional penalty fee to obtain the under-5 card, which are required to receive basic medical care for children under 5 years old. Penalty fees for under-5 cards reportedly ranged from 5 to 70 kwacha (US\$0.50 to \$7), depending on the health facility. The burden of paying a fine to obtain an under-5 card created an additional barrier, preventing women from accessing newborn and child health services. Instead of paying the fine, some mothers avoided the health facility altogether:

[S]ometimes when they deliver at home, they [some mothers] just stay away when the baby is due to start under-5 [clinic]. (woman, health facility delivery)

In addition, some participants mentioned challenges related to the role of traditional birth attendants (TBAs) in their communities. While TBAs historically attended home deliveries, some were trained to become SMAGs, who were responsible for bringing laboring women to the health facility. Due to their changing role, SMAGs who were formerly TBAs refused to attend home deliveries for fear of repercussions: “[I]n the past

we used to do it, but this time things have changed because if I conduct a delivery at home, I will be in trouble” (woman, SMAG member). Echoing this sentiment, some women delivered at home unattended, because TBAs refused to help.

Changing the role of TBAs also had unintended consequences at health facilities. One nurse explained that since TBAs were no longer allowed to attend home deliveries, they trained their support staff member (classified daily employee) to attend deliveries when she or the other nurse-midwife were not available at the health facility. Classified daily employees are hired to clean health facilities and are not classified as skilled birth attendants.

Second Delay: Perception of Improvement of Access and Utilization of MNH Services

At baseline, respondents noted that geographic barriers, such as distance, rivers, and wildlife conservation parks, prevented mothers and their families from accessing care when needed.²³ To address these second-delay challenges,⁷ SMGL and the Ministry of Health (MOH) provided ambulances, motorcycles, and other emergency vehicles; renovated maternity waiting homes (MWHs); and increased EmONC capacity of existing health facilities.

Provision of Ambulances to Hospitals

Most participants felt that the provision of ambulances to district hospitals improved the referral system. Participants from all intervention districts explained that prior to the SMGL intervention, there were no ambulances in some districts, so hospitals had to rent private vehicles to transport patients during emergencies, which put the financial burden on the patients’ families:

[W]hen they just call to inform them of the illness, the hospital sends an ambulance to come and get that person . . . we used to book vehicles on our own to transport the patient to the hospital from the clinic. (man, unknown delivery location of spouse)

Of note, clinicians at hospitals were more enthusiastic about the ambulances than clinicians at rural health facilities. For example, participants from rural health facilities noted that women still faced significant delays accessing the hospital during emergencies, even with the provision of ambulances to the region. A few clinicians shared examples of times when they still waited 2 to 3 hours for an ambulance to arrive because hospitals were so far away:

Penalty fees were seen as a factor influencing the decision to deliver in a health facility, even if other factors, such as distance, ultimately prevented their health facility delivery.

To address second-delay challenges, SMGL and MOH provided emergency vehicles, renovated maternity waiting homes, and increased EmONC capacity of existing health facilities.

We have a big challenge, because what happens when we call for an ambulance, they have to inquire from us. After inquiring, if they are satisfied, then they'll send an ambulance, which will come after 2 hours or 2 to 3 hours ... then again to travel back. It takes 6 hours on the road. (woman, clinician nurse)

While clinicians and community members felt that emergency transportation improved, many expressed frustrations that the intervention did not go far enough. In particular, many people faced significant challenges traveling from the community to the health facility. When prompted about the main challenges facing their communities, women said they needed the emergency transportation system to expand to the villages. Some women who delivered from home said that their home delivery was unintentional; it had been caused by transportation challenges:

Because you are unable to book [transportation], you find that you cannot hold it anymore. It is not deliberate that you should deliver from home, no. (woman, home delivery)

Renovation of Maternity Waiting Homes and Maternity Wards

Perception of the success or challenges of SMGL's renovation projects depended on the informant's district, indicating that the quality of MWHs varied from district to district. Those who viewed the mothers' homes favorably cited increased bed space, proximity to maternity wards, and belief in the importance of delivering in a health facility, even if the MWH lacked beds. Of note, clinicians from Lundazi felt that the MWHs played a significant role in reducing home deliveries:

So it [the new MWH] is helping actually to ... curb home deliveries, so people are coming to lodge in the mothers' [home] which is very well furnished. Everyone is happy to come and deliver from the health facility because they have a nice stay. (woman, clinician nurse)

In the same vein, many clinicians said that the size of their labor and delivery wards were too small, and they often did not have enough beds and blankets for women, causing women to sleep on floors. For example, a midwife at a hospital said that the labor ward only had 2 beds, but sometimes they had 4 patients in labor at a time. Furthermore, where there had been renovations, a few participants noted that the projects were never finished. Most key informants said that both water and toilets were available in most labor

wards, though a couple mentioned challenges related to bringing water into the labor wards.

In addition, while many participants said that some newly constructed health facilities were closer to their communities, many were still concerned about how long it took them to reach the nearest health facility:

Since [the new health facility] opened, some are now coming here, but for the majority it is still very far for them to come here. (woman, health facility delivery)

Others mentioned challenges due to seasonal migration, explaining that families will go to their "farming sites" during farming season and fishermen will go to "fishing camps." Consequently, even when new health facilities were constructed closer to communities, some families would leave the community for months at a time.

Third Delay: Perception of MNH Service Quality

At baseline, participants reported challenges related to quality of care that made them hesitant to deliver in a health facility.²³ These challenges included a shortage of both human resources and medical supplies and equipment, as well as disrespectful attitudes of clinicians toward clients and their families. The lack of essential commodities placed the burden of purchasing and procuring items on laboring women and their families, which created an economic barrier for many seeking care in health facilities.²³ To improve quality of care, SMGL trained clinicians, provided mentorship opportunities, and procured essential equipment.

Strengths

Most clinicians considered training and mentorship to be major strengths of SMGL. Clinicians in rural health facilities were especially enthusiastic about the newborn resuscitation training, as they were able to apply what they learned directly to their practice:

[L]ike this morning I was resuscitating one [a newborn], before I did the training I used to fidget ... baby sure is going to die, but this time I don't fidget because I know what to do, I know how to suction and when to suction, I know when to use the Ambu bag and how to use it...the baby is there sucking, I thank God. (woman, clinician midwife)

While most clinicians appreciated the training, some said the trainings should have reached more of their colleagues. For example, a midwife suggested that all clinicians should receive EmONC

training, even if they do not work at an EmONC health facility, in order to improve the timeliness of referrals during obstetric emergencies.

Most clinicians also felt that the commodities they received were a major strength of SMGL, attributing the new equipment to saving their patients' lives:

[S]ome fetal distress have been managed just using the vacuum extractor, and the babies have survived. When you think of the time which you have taken to open the woman, the baby would have died, but because of the availability of the extractor they saved a life. (woman, clinician midwife)

The training and equipment also positively affected the community's perception of care at the health facility, trusting that the clinicians have the equipment and knowledge necessary to do their jobs in an emergency:

We feel happy if we bring the woman to someone who has gone through training to handle the pregnancy. For example, when I brought my wife after she was examined, they discovered that the baby was in a breech position. So my wife got worried thinking that she may die. But she was encouraged that everything will be fine. She was examined again when we went back the baby had gone into a proper position and she delivered well. (man, spouse of a woman with a health facility delivery)

In health facilities facing shortages of medical consumables, women were requested to bring their own birthing supplies, such as cloth, gloves, candles, and disinfectant.

Staffing shortages affected client wait times and patient care.

Challenges

While efforts were made to improve staffing levels in health facilities, most clinicians and community members reported human resources challenges. In some health facilities, additional midwives were needed to meet the increased volume of deliveries. Staffing shortages affected client perceptions of quality of care, as some pointed to long wait times and nurses who were "not polite":

We need more nurses. When there is just 1 nurse the work is not good because it takes time to be attended to more especially us who come from far places. (woman, home delivery)

In addition, while most clinicians were positive about the supplies of essential equipment and commodities, many reported that over time, certain pieces of equipment broke and were not replaced. For example, many of the lights provided by SMGL for labor and delivery wards either broke or became dim, so clinicians returned to their former practice of using candles to light the ward during nighttime deliveries:

[S]o those candles, 1 hand holding the candle, 1 hand holding the woman, it's really difficult. What if the woman also came in with shock? So you have to use the candle in the other hand, ahh you know at night your colleague is at home, you can't even call for help ... so it was really a challenge, the lighting, they were really helping us to see drugs, even handle the woman. ... Now lighting is bad, so we have gone back to the candles. (woman, clinician nurse)

Similarly, while SMGL provided delivery packs to health facilities, some health facilities faced shortages of medical consumables. As a result, women were requested to bring their own birthing supplies, such as cloth, gloves, candles, and JIK (used as a disinfectant of used instruments). In particular, clinicians and community members reported that requiring women to supply their own JIK prevented some from delivering at a health facility:

There's self-stigma, they can't even come and deliver here at the health facility because they have no pins, they have no JIK. That one is one of the hindrances. ... We used to receive JIK from the district. Now since the district stopped we are not getting JIK so it's one of the things that hinder the women to come for delivery. (woman, clinician nurse)

■ DISCUSSION

This study focused on the community's perception and knowledge of safe motherhood messages, infrastructural improvements, and quality of care initiatives that occurred during SMGL, which aimed to reduce maternal and newborn morbidity and mortality while strengthening the health system to address the 3 delays. While SMGL succeeded in reducing maternal mortality,^{20,21} our qualitative study reveals ongoing gaps in Zambia's health system.

Behavior change programs have shown that health messages can influence behavior at a community level.^{24–27} Thus, SMGL developed safe motherhood messages to promote the early ANC booking and the use of MWHs and health facilities for childbirth. Women and their partners felt that the messages helped them develop birth plans, attend ANC together as partners, and recognize danger signs during pregnancy. Studies have shown that increased awareness of danger signs during pregnancy is associated with increased preparation for childbirth.²⁸

Our findings indicate that clinicians perceived an increase in the use of MNH services. This perception is supported by findings from SMGL's

first year of implementation, which saw a 35% increase in health facility deliveries between 2012 and 2013.^{20,21} The engagement of men and community leaders to promote behavior change for women's health is imperative in patriarchal societies, since access to care is controlled by men.^{29,30} Interventions to change social norms should include key community members in order to achieve desired public health effects.^{31–34} Involving local leaders, such as chiefs, headmen, and SMAGs, was seen as central to the success of the messaging campaign.

While safe motherhood messages seemed to encourage use of MNH services, the institution of penalty fees for home deliveries by some chiefs and headmen—in an effort to reduce maternal deaths in their communities—was an unintended consequence of SMGL. In Zambia, like in many African countries, traditional chiefs as influential leaders hold significant decision-making power at the local level.³⁵ While some see this power as undemocratic,³⁶ others cite examples of chiefs promoting progressive agendas, such as preventing child marriages, reducing HIV incidence, and stopping gender-based violence.³³ While SMGL did not condone or promote penalty fees, the chiefs' decisions to impose penalty fees represents significant buy-in for the intervention at the local level. Programs should be aware of how local leaders may alter the intended intervention and plan for how to respond.

While respondents viewed penalty fees as a deterrent from having home deliveries, population-based studies in Zambia have shown that fees associated with pregnancy care are not a major influencing factor for families' decision on health facility use.^{8,37} While monetary concerns are certainly a barrier to accessing care, other factors, such as perceived distance to a health facility and perceived quality of care, play a larger role in influencing care-seeking behavior.^{8,38} Of particular concern, study participants complained that penalty fees caused mothers to delay bringing their children to health facilities for under-5 child health services, which could negatively affect child health.³⁹ With that said, payment for supplies and services are not the only factors that influence the decision to use health services.^{39–41}

While our findings indicate that women and families accepted the importance of using health facilities for childbirth, distance and road access, especially during the rainy season, were still considered a major challenge. Studies have shown that distance to the health facility is a key factor influencing families' decision to seek

care.^{7,8,42} When a laboring woman needs emergency care, health facilities capable of providing EmONC services can be hours from rural health facilities.⁴³ While improvements were made at the district level, a shortage of ambulances at rural health facilities left women stranded. Besides the efforts at health facility level, the MOH needs to conduct regular maintenance of ambulances to ensure an effective referral system.⁴⁴ In addition, ambulances alone cannot make change without also improving the referral system in which ambulances operate, such as improved mobile communication and interfacility feedback.⁴⁵ The government and regional health authorities must allocate resources to interfacility transport vehicles, maintenance, and improved referral systems to ensure women can access lifesaving care during obstetric emergencies.

As part of the health systems strengthening model, SMGL refurbished and built MWHs near health facilities to provide women with a place to stay before and after delivery. While the community found them useful, some MWHs did not have adequate supplies, such as beds, linen, or a sustainable source of food for the women. A study of MWHs in Kalomo and Choma districts in Zambia found that women living in catchment areas with a medium- or high-quality mothers' shelter had nearly double the likelihood of delivering at a health facility.³⁸ This finding reflects what our study participants reported, that women in Zambia would use the MWHs if they perceived it to be of good quality, meaning that it would afford them privacy, a bed, sheets, running water, functioning toilets, and food. Other studies show similar findings.^{38,46–48}

While clinicians were enthusiastic about the training and mentoring they received, our study revealed that there are still considerable human resource challenges in SMGL intervention districts. Chronic shortages of clinic staff are a challenge reflected in other low- and middle-income countries and can influence the quality of MNH services.^{10,49} While 19 additional clinical staff members were hired during SMGL implementation, the increased demand for MNH services made it difficult to meet the new need. Other studies have shown that demand-side interventions can overburden health facilities and workers if the supply side cannot meet the added demand for services.^{15,16} While SMGL worked on both the supply side and demand side, the intervention was limited in its ability to influence the national pipeline of doctors, nurses, and nurse-midwives.

While monetary concerns are a barrier to accessing care, other factors (e.g., perceived distance to a health facility and perceived quality of care) play a larger role in influencing care-seeking behavior.

Furthermore, the promotion of women-friendly health facilities, which relates to privacy and dignity surrounding childbirth, has attracted a debate among the global research community.^{7,50–53} In our study, some participants reported the lack of space and privacy in delivery rooms and stated that some staff members were not polite to patients or their families. To provide maternity care of optimal quality, the MOH and public health stakeholders need to be aware of patients' personal, sociocultural, and clinical needs to ensure that these conform to women's and their families' needs.^{54–56}

Despite reductions in maternal mortality in Zambia's SMGL-supported districts, our qualitative study highlights ongoing challenges in Zambia's health system, particularly related to the second and third delays.

Despite reductions in maternal mortality in Zambia's SMGL-supported districts,^{20,21} our qualitative study highlights ongoing challenges in Zambia's health system, particularly related to the second and third delays. Despite investment in ambulances, EmONC facilities, and MWHs, participants felt that the intervention did not go far enough to reduce second-delay barriers. Similarly, ongoing shortages of clinicians were shown to overshadow some of the gains made in training, mentoring, and equipment, as health care worker shortages can affect women's experiences of care. As second- and third-delay challenges are often related to infrastructure and pipeline of clinicians,^{20,57} a larger government role might be necessary to close the gap.

Limitations

Interviews were conducted in 3 local languages and translated to English for analysis, which could have resulted in missed nuances in the translated transcriptions. Furthermore, as with all qualitative studies, we recognize a lack of generalization of the findings beyond the intervention districts. However, lessons from these sites can be interpreted for other districts in Zambia to promote and strengthen health systems while understanding communities' perspectives. In addition, triangulation of results was possible through the use of both IDIs and FGDs at data collection, thereby increasing the credibility of the lessons learned.

CONCLUSION

Based on the results, there is not a single "magic bullet" to reducing maternal and newborn morbidity and mortality. Rather, our results highlight the interaction of the MNH system as a whole: as safe motherhood messages shifted attitudes and increased demand for MNH services, the health system needed to respond in kind. SMGL's persistent challenges related to perceptions of access to

care and shortage of clinicians does not indicate a failed intervention; instead, it demonstrates the challenges inherent to a system-wide approach. Issues such as poverty, infrastructure, human resources for health, and political and financial commitment are long-term sustainability challenges that are beyond the scope of SMGL. Despite significant gains in reducing maternal mortality, the effects of these ongoing challenges were felt at the community level.

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ORIGINAL ARTICLE

Did Saving Mothers, Giving Life Expand Timely Access to Lifesaving Care in Uganda? A Spatial District-Level Analysis of Travel Time to Emergency Obstetric and Newborn Care

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A spatial analysis of facility accessibility, taking into account road networks and environmental constraints on travel, suggests that the Saving Mothers, Giving Life (SMGL) initiative increased access to emergency obstetric and neonatal care in SMGL-supported districts in Uganda. Spatial travel-time analyses can inform policy and program efforts targeting underserved populations in conjunction with the geographic distribution of maternity services.

ABSTRACT

Introduction: Interventions for the Saving Mothers, Giving Life (SMGL) initiative aimed to ensure all pregnant women in SMGL-supported districts have timely access to emergency obstetric and newborn care (EmONC). Spatial travel-time analyses provide a visualization of changes in timely access.

Methods: We compared travel-time estimates to EmONC health facilities in SMGL-supported districts in western Uganda in 2012, 2013, and 2016. To examine EmONC access, we analyzed a categorical variable of travel-time duration in 30-minute increments. Data sources included health facility assessments, geographic coordinates of EmONC facilities, geolocated population estimates of women of reproductive age (WRA), and other road network and geographic sources.

Results: The number of EmONC facilities almost tripled between 2012 and 2016, increasing geographic access to EmONC. Estimated travel time to EmONC facilities declined significantly during the 5-year period. The proportion of WRA able to access any EmONC and comprehensive EmONC (CEmONC) facility within 2 hours by motorcycle increased by 18% (from 61.3% to 72.1%, $P < .01$) and 37% (from 51.1% to 69.8%, $P < .01$), respectively from baseline to 2016. Similar increases occurred among WRA accessing EmONC and CEmONC respectively if 4-wheeled vehicles (14% and 31% increase, $P < .01$) could be used. Increases in timely access were also substantial for nonmotorized transportation such as walking and/or bicycling.

Conclusions: Largely due to the SMGL-supported expansion of EmONC capability, timely access to EmONC significantly improved. Our analysis developed a geographic outline of facility accessibility using multiple types of transportation. Spatial travel-time analyses, along with other EmONC indicators, can be used by planners and policy makers to estimate need and target underserved populations to achieve further gains in EmONC accessibility. In addition to increasing the number and geographic distribution of EmONC facilities, complementary efforts to make motorized transportation available are necessary to achieve meaningful increases in EmONC access.

INTRODUCTION

In 2015, an estimated 303,000 women around the world died of a maternal cause, and approximately 201,000 of these deaths occurred in sub-Saharan Africa.¹ Additionally, almost half of the 2.6 million stillbirths and 30% of newborn deaths in sub-Saharan Africa were due to intrapartum causes.^{2,3} Most maternal and newborn deaths are preventable with adequate care at birth.⁴ In 2004, the World Health Organization (WHO) recommended skilled birth attendance at every

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birth and estimated that 50% to 70% of maternal deaths could be averted with timely access to emergency obstetric interventions.^{5,6} However, access to quality services in low-resource countries continues to be a challenge, especially for women and newborns who require emergency obstetric and newborn care (EmONC).

Physical distance to health care facilities has been widely recognized as an important determinant of accessing health facility delivery.^{7–10} While EmONC has been considered an essential strategy to save maternal and newborn lives, EmONC coverage in sub-Saharan Africa remains uneven and met need for EmONC has remained low.^{11–13} For example, in Mali, substantially higher maternal case-fatality rates were associated with travel times greater than 2 hours among women who accessed hospital care in 2005–2007.¹⁴ For women who need obstetric and other emergency surgery, the benchmark proposed by WHO is no more than 2 hours of travel time to the nearest facility with surgical capacity, which is roughly the interval from onset of bleeding to death if a woman with obstetric hemorrhage does not receive adequate treatment.^{15,16} Health researchers have suggested that at least 80% of any country's population should have access to selected emergency surgical and anesthesia services, including cesarean deliveries, within the 2-hour time frame.^{16,17}

Adequate availability of EmONC services is defined by WHO as an area having at least 5 EmONC facilities, including at least 1 comprehensive EmONC (CEmONC) facility, per 500,000 population.¹⁵ Although the ratio of EmONC facilities to the population has been used as a proxy for adequate distance or travel time to reach a facility during an emergency, an optimal geographic distribution of EmONC services is also a critical determinant of timely access.¹⁵ To achieve the 2030 Sustainable Development Goal 3.1 of reducing global maternal mortality to less than 70 maternal deaths per 100,000 live births,¹⁸ researchers and policy makers have called specifically for the equitable distribution of EmONC facilities.

Implemented between 2012 and 2017, the Saving Mothers, Giving Life (SMGL) project aimed to rapidly reduce deaths related to pregnancy and childbirth through the implementation of multiple evidence-based approaches to address the 3 dangerous delays pregnant women face in childbirth: delays in deciding to seek care, delays in reaching a facility in time, and delays in receiving quality care at facilities.^{19–22} To reduce the second and third delays, the SMGL initiative

sought to make facility delivery care accessible to all women within 2 hours. This goal required that SMGL-supported districts had a sufficient number of EmONC facilities equitably distributed geographically and adequate transportation to reach appropriate care. Consequently, SMGL-supported efforts in Uganda focused on improving availability and distribution of EmONC services, expanding motorized transportation to these facilities through vouchers for motorcycle taxis, and creating a coordinated ambulance service.^{23–25}

Improved spatial analyses using geographic information system (GIS) technology has expanded our ability to provide more accurate estimates of travel time to and disparities in access to EmONC.^{26,27} Travel-time modeling, estimating the most efficient travel time to a facility along established roads and walking paths, has emerged as one of the most robust analytical spatial techniques applied in maternal health.²⁷ Rather than calculating unrealistic straight-line distances, these algorithms account for the effects of elevation, road conditions, and landscape barriers. Furthermore, these algorithms allow for the estimation of travel times using different transportation modes, such as on foot (walking), bicycle, motorcycle, or car/truck/ambulance (4-wheeled vehicles) and corresponding travel speeds.

Because national government health planning is frequently organized and implemented at the district level, spatial analyses to support district and subdistrict interventions are greatly needed. Most studies of accessibility to EmONC care in sub-Saharan Africa, however, have focused on the national level.^{28–30} A few studies have analyzed point-in-time accessibility at subnational and administrative levels, mapped adverse maternal outcomes, prioritized ambulance services, or pinpointed underserved areas necessitating EmONC upgrades.^{30–32} This study adds to the literature by using travel-time accessibility modeling to assess changes in estimated travel time to EmONC in SMGL-supported districts in Uganda over the 5-year period of implementation. We examine whether geographic access improved during SMGL implementation and identify areas where access issues persisted at the conclusion of the project.

METHODS

The 4 SMGL-supported districts in Uganda—Kabarole, Kamwenge, Kibaale, and Kyenjojo—form a contiguous unit in the western region of

GIS has expanded our ability to provide more accurate estimates of travel time to and disparities in access to EmONC.

the country. Among the combined 2017 population of just over 2 million were an estimated 538,706 women of reproductive age (WRA) aged between 15 and 49 years (Table 1).¹⁹ Population density is low, with over 78% of the 4-district area designated as rural and the largest urban population residing in Kabarole.^{34,35}

Transportation challenges are common in the SMGL-supported districts. The topography is mountainous, particularly in Kibaale district. Large national parks are mostly impassable forest and rugged terrain, and numerous rivers and lakes create geographic barriers (Figure 1). Only a small portion of the rural road network is passable by 4-wheeled vehicles, and only 2 paved roads connect Kamwenge and Kyenjojo districts with Fort Portal town, the district capital of Kabarole. Kibaale district did not have any paved roads during the SMGL implementation period.

The measurement of EmONC functionality used in our analysis was based on facility performance of a core set of lifesaving interventions, known as “signal functions,” in the 3 months prior to the health facility assessments (HFAs).³⁶ EmONC facilities are defined as having the ability to, at a minimum, (1) administer parenteral antibiotics, (2) administer uterotonic drugs for active management of the third stage of labor and prevention of postpartum hemorrhage, (3) use parenteral anticonvulsants for the management of pre-eclampsia/eclampsia, (4) perform manual removal of placenta, (5) perform removal of retained products, (6) perform assisted vaginal delivery, and (7) perform neonatal resuscitation. CEmONC facilities have the additional capability to perform cesarean deliveries and blood transfusion.¹⁵ Although the Ugandan Ministry of Health has further mandates about the distribution of government facilities,³⁷ our analysis applies WHO benchmarks for EmONC and CEmONC of

at least 5 EmONC facilities, including at least 1 CEmONC facility, per 500,000 population. SMGL-supported facilities include those added to the study area during the SMGL initiative as well as existing facilities that were upgraded to provide EmONC.

Data Sources

The initiative employed HFAs and other monitoring and evaluation methods to assess the progress and impact of interventions across the SMGL's implementation phases: Phase 0 (pre-implementation planning in 2011–2012), Phase 1 (June 2012 to December 2013), and Phase 2 (January 2014 to October 2017).

Health Facility Assessments

To assess changes in facility infrastructure, functionality, and use, SMGL implementing partners in Uganda conducted HFAs in SMGL-supported districts at baseline, the end of Phase 1, and end-line (November 2016).¹⁹ The 3 assessment periods were conducted in 111, 127, and 129 health facilities, respectively, which provided over 95% of all facility deliveries in the SMGL study area at each time point. HFAs documented performance of EmONC functions during the 3 months prior to the assessments as well as the geographic location of facilities (accuracy of ± 10 meters).³⁷ Our analyses used all facilities included in HFAs for any of the 3 assessment periods.

EmONC functionality was based on facility performance of a core set of life-saving interventions, known as “signal functions.”

SMGL-supported health facilities provided care for over 95% of all facility deliveries in the SMGL study area at each time point.

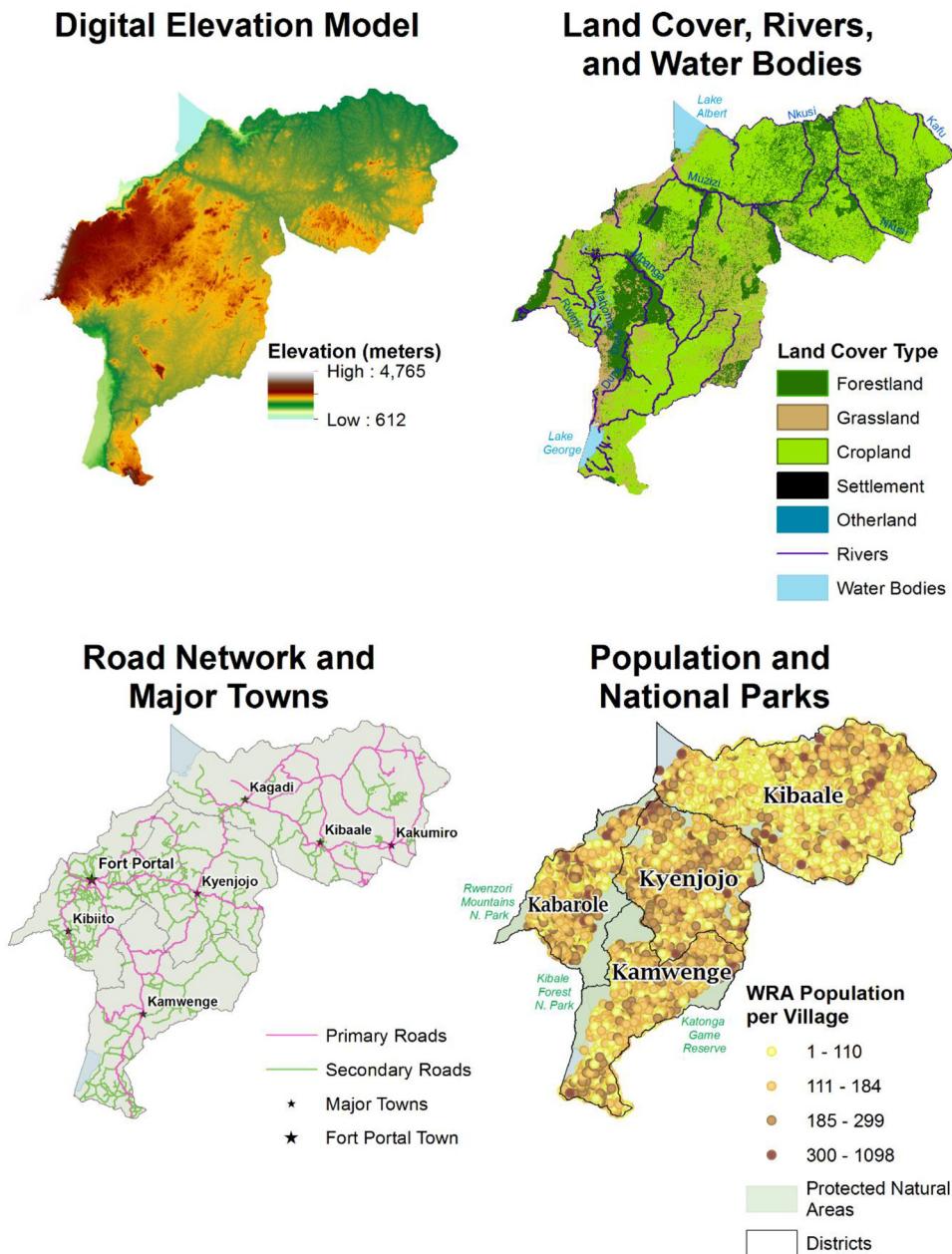
TABLE 1. Demographic Factors, SMGL-Supported Districts in Uganda, 2016

District	Total Population, 2016 ^a	Number of WRA, 2016 ^a	Population Density (People/km ²) ^b	Urbanization Level (% Urban) ^b
Kabarole	456,052	121,794	259	26.0
Kamwenge	392,501	101,650	177	5.5
Kibaale	818,176	206,596	185	7.9
Kyenjojo	428,451	108,666	179	15.4
Total	2,095,180	538,706	173	21.3

Abbreviations: km², kilometers squared; SMGL, Saving Mothers, Giving Life; WRA, women of reproductive age.

^a Estimated from SMGL Reproductive Age Mortality Study, 2017.¹⁹

^b 2014 National Census Main Report, Uganda Bureau of Statistics.³³

FIGURE 1. Visual Representation of Data Sources Used in Health Care Accessibility Modeling Analysis

Abbreviation: WRA, women of reproductive age.

5.1.18 (WHO, Geneva, Switzerland,) to a 92-by-92 meter resolution to match the resolution of other layers (Figure 1). This land cover raster used a 6-ecosystem scheme that accounted for forestland, grassland, cropland, settlement, wetlands, and other land cover.

We created updated shapefiles for lakes and rivers using Uganda Bureau of Statistics (UBOS) data³⁵ and OpenStreetMap (www.openstreetmap.org) shapefiles. When a data source had incomplete information about a river network, we manually digitized our master river shapefile with Digital

Globe EnhancedView Web Hosting Service (<https://evwhs.digitalglobe.com/myDigitalGlobe>) satellite imagery obtained in June 2018. We considered water bodies as being completely impassable and rivers as being partially passable, if crossed by a primary or secondary road, by an assumed bridge.

We merged and cleaned the shapefiles of the UBOS road network data from the 2014 Uganda Census and the OpenStreetMap road network digitized in mid-December 2017 via the Humanitarian OpenStreetMap Team.^{38,39} We created subsets of all primary (between district capitals) and secondary road shapefiles (between towns and major villages) for use in the AccessMod analysis (Figure 1). The resulting road shapefile was cross-checked against Digital Globe satellite imagery. We ascertained the proportion of roads that were paved and unpaved and changes in paving that occurred over time. Since the majority of the roads were unpaved and no substantive changes occurred within the project duration, we applied travel speeds for unpaved roads only to yield the most conservative travel time estimates.

Elevation and slope data were obtained from the Shuttle Radar Topography Mission digital elevation model produced by the U.S. Geological Survey, both with a 92-by-92 meter pixel resolution.⁴⁰ The model provided elevation information to the tool and was used to determine the relative slope of each raster pixel.

National parks, from the World Database on Protected Areas, were derived by the United Nations Environment World Conservation Monitoring Centre and considered impassable unless a road passed through it. They were included in the final maps to provide context.⁴¹

Within AccessMod, the land cover, road network, river, and water body datasets were combined into a merged land cover raster file, with a 92-by-92 meter resolution, and used in the travel-time analyses.

Population Data

Household population data from all villages in the 4 Ugandan districts were collected in 2017 as a component of the SMGL Reproductive Age Mortality Study (RAMOS).¹⁹ While RAMOS's primary aim was to measure and identify main causes of maternal mortality, the study also enumerated households, household members, WRA, and all recent deaths.¹⁹ We cross-checked geographic coordinates collected in the

2017 RAMOS with UBOS geographic data and reconciled discordant coordinates.^{34,35,42} Overall, 538,706 WRA resided in 3,749 villages across the 4 districts in 2016 (Figure 1).

Analytic Methods

To assess whether districts met the WHO benchmark of EmONC availability, we followed the WHO guidelines, which recommend a minimum of 5 EmONC facilities per 500,000 population, including at least 1 CEmONC facility in each district.³⁷ For each district, we calculated the recommended number of EmONC facilities by dividing the estimated district population by 100,000. For each time period, we then computed the observed number of EmONC facilities and compared them to the recommended number of facilities.

We estimated the minimum travel time to the nearest EmONC and CEmONC facilities using the AccessMod Accessibility module. AccessMod uses the least-cost path algorithm to calculate the quickest way of traveling between 2 points, using roads or off-road travel, as appropriate.⁴³ Travel time is also dependent on travel speeds for each transportation mode—walking, bicycles, motorcycles, and 4-wheeled vehicles—with land cover influencing the speed of walking. Bicycles and motorcycles can be outfitted with sidecars as makeshift ambulances.^{43,44} We determined these speeds using direct observation combined with other published sources.^{34,43,46–51} Walking was the only mode of travel used for areas without primary or secondary roads. Speeds were reduced by two-thirds to account for slower transportation speeds of pregnant women and to further account for travel on unpaved roads. Tobler's function, which corrects walking speed based on the direction of slopes on the terrain derived from the digital elevation model, was used to adjust both walking and bicycling speeds.⁵²

We performed AccessMod travel-time simulations for the 4 transportation modes to EmONC and CEmONC facilities, focusing on a 2-hour upper limit of the estimated travel time, consistent with WHO recommendations for EmONC access.¹⁵ All estimated transportation modes, except walking, assumed access to the nearest road by foot and travel by an immediately available vehicle to the closest facility providing EmONC care. We did not consider district boundaries as barriers to movement; however, we only estimated access to EmONC facilities within the SMGL-supported districts, allowing for movement between districts but not to facilities outside these districts. With

AccessMod uses the least-cost path algorithm to calculate the quickest way of traveling between 2 points, using roads or off-road travel, as appropriate.

At baseline, substantial differences were noted between the recommended and observed number of EmONC facilities in the SMGL-supported districts.

At endline, Kyenjojo and Kabarole exceeded the WHO-recommended number of EmONC facilities, achieving 8 EmONC facilities for over 400,000 people per district.

ArcGIS Desktop version 10.3.1 (Environmental Systems Research Institute, Redlands, CA), we created a continuous distribution of estimated travel time needed to reach an EmONC facility for each transportation mode and categorized the continuous travel-time raster into 4 incremental 30-minute travel-time zones (0 to 30 minutes, 31 to 60 minutes, 61 to 90 minutes, and 91 to 120 minutes), plus a fifth category for more than 2 hours of travel time (>120 minutes). Instead of using AccessMod's native Zonal Statistics module, we converted the raster into a shapefile of different travel-time zones in ArcGIS version 10.5. We mapped all travel-time zones to reach any EmONC and CEmONC services for each transportation mode.

Combining the travel-time zones with georeferenced village population data, we estimated the number and proportion of WRA with access to EmONC and CEmONC services within each travel-time zone. We obtained the proportion of WRA within a travel-time zone by summing all WRA residing in villages located within each travel-time zone then dividing by the complete enumerated WRA population. We defined "adequate EmONC access" as the ability to reach an EmONC facility within 2 hours of travel time, and "poor EmONC access" as the inability to reach an EmONC facility within 2 hours. We assumed all travel to be from a woman's home to a facility.

We calculated the relative percentage change in the proportions of WRA residing within each travel-time zone and across each transportation mode, by subtracting the baseline percentage from the endline percentage and dividing by the baseline percentage. For the population percentages, z scores, based on the normal approximation to the binomial distribution, were used to calculate P values.

Ethical Approval

The study protocol was reviewed and approved by recognized ethics committees in Uganda and complied with Ugandan Ministry of Health procedures for protecting human subjects. This study was reviewed and approved by the U.S. Centers for Disease Control and Prevention's Center for Global Health Human Subject Review Board, which determined that it did not constitute human subjects research.

RESULTS

At SMGL baseline, substantial differences were noted between the recommended and observed

number of EmONC facilities in the 4 SMGL-supported districts (Table 2). Only 10 facilities in a population of over 2 million provided EmONC services, 7 of which provided CEmONC. None of the districts met the recommended benchmark for per-capita EmONC availability. Three districts met the recommended benchmark of at least 1 CEmONC facility at baseline (Kabarole, Kibaale, and Kyenjojo), while Kamwenge had no CEmONC facility.

SMGL increased the number of facilities performing EmONC across all districts. Most of the increases occurred during SMGL's first year (Phase 1), when the total number of EmONC facilities more than doubled, from 10 to 25 facilities (Table 2). Comparatively fewer changes in the number of EmONC facilities occurred between the conclusion of Phase 1 and endline; an additional 2 EmONC facilities in Kibaale and 1 in Kyenjojo were added, while Kamwenge lost 2 EmONC facilities.

At endline, Kyenjojo and Kabarole exceeded the WHO-recommended number of EmONC facilities, achieving 8 EmONC facilities for over 400,000 people per district. Although Kamwenge attained the WHO benchmarks in Phase 1, it lacked the recommended per-capita number of EmONC facilities at endline. Kibaale, the most populous district, never met the WHO benchmarks for EmONC, despite increasing its total number of EmONC facilities from 5 to 7, with 5 of the 7 providing CEmONC at the conclusion of both Phase 1 and endline.

Table 3 provides the percentage of estimated WRA population able to reach EmONC and CEmONC within 2 hours or more than 2 hours, by transportation mode, for the 4 districts combined. The greater number of EmONC facilities resulted in significant increases in the proportion of WRA with "adequate" access (within 2 hours) to both EmONC and CEmONC (Table 3).

As expected, there were large differences in access between nonmotorized and motorized transportation modes. However, adequate access improved substantially during the SMGL initiative, regardless of the transportation mode. Adequate access to EmONC services by nonmotorized transportation (walking) increased from 6.7% at baseline to 15.0% at endline (125% relative increase) and from 17.9% to 37.6% by bicycle (110% increase). Adequate EmONC access by motorized transport was higher; access to EmONC by motorcycle increased from 61.3% at baseline to 72.1% at endline (17% increase), while access by 4-wheeled vehicle rose from

TABLE 2. Recommended and Observed Number of EmONC^a and CEmONC Facilities per Capita in SMGL-Supported Districts at Baseline (2012), Phase 1 (2013), and Endline (2016)

	Baseline				Phase 1				Endline			
	Population ^a	Recommended EmONC ^{b,c}	Observed EmONC ^{c,d}	Observed CEmONC ^{c,e}	Population ^a	Recommended EmONC ^{b,c}	Observed EmONC ^{c,d}	Observed CEmONC ^{c,e}	Population ^f	Recommended EmONC ^{b,c}	Observed EmONC ^d	Observed CEmONC ^{c,e}
Kabarole	415,600	5	3	3	421,700	5	8	6	456,052	5	8	6
Kibaale	681,300	7	3	3	717,500	8	5	5	818,176	9	7	5
Kamwenge	332,000	4	3	0	339,500	4	5	2	392,501	4	3	3
Kyenjojo	383,600	4	1	1	397,700	4	7	3	428,451	5	8	3
Total	1,812,500	20	10	7	1,876,400	21	25	16	2,095,180	23	26	17

Abbreviations: CEmONC, comprehensive emergency obstetric and neonatal care; EmONC, emergency obstetric and neonatal care; RAMOS, Reproductive Age Mortality Study; SMGL, Saving Mothers, Giving Life; WHO, World Health Organization.

^aEstimated from SMGL RAMOS 2013.¹⁹

^bEmONC encompasses facilities performing at least 7 lifesaving interventions within the past 3 months. CEmONC indicates those facilities providing 9 lifesaving interventions in the past 3 months.

^cUses the WHO minimum-recommended number of EmONC and CEmONC per 500,000 population (5 EmONC, including at least 1 CEmONC, per 500,000).

^dObserved EmONC includes facilities that may not have provided assisted vaginal delivery in the past 3 months.

^eObserved CEmONC includes facilities that may not have provided assisted vaginal delivery in the past 3 months; a few facilities reported shortage of blood in Phase 1 in the previous 3 months but were still classified as CEmONC facilities.

^fEstimated from SMGL RAMOS 2017.¹⁹

Source: SMGL Uganda Health Facility Assessments, 2012, 2013, and 2016.

65.1% to 74.1% (14% increase). Relative increases in the percentage of WRA with adequate access to CEmONC using motorized transport also occurred. Adequate access to CEmONC by motorcycle increased from 51.1% to 69.8% (37% increase), while access by 4-wheeled vehicles increased from 55.2% to 72.3% of WRA (31% increase). Additionally, the percentage of WRA with access to EmONC within 60 minutes or less by motorcycle increased from 27.3% to 44.4% (63% increase) and by 4-wheeled vehicles increased from 33.1% to 48.6% (47% increase).

When stratified by district, there were substantial differences in the baseline and endline proportions of WRA with adequate access to CEmONC (Figure 2), with similar patterns for EmONC access by district (data not shown). Kabarole, the most urbanized and densely populated district, began SMGL with 89.6% of estimated WRA having adequate access to CEmONC, which increased to 93.1% at endline, a relative increase of about 3%. Conversely, in sparsely populated Kamwenge, where only 13.1% of estimated WRA had adequate access at baseline, the added SMGL-supported facilities increased adequate CEmONC access to 71.6% at endline, a 447% increase. In Kibaale, the proportion of WRA with adequate access to CEmONC was 41.8% at baseline but increased to

56.5% by endline, a 35% increase. In Kyenjojo, adequate CEmONC access increased from 66.9% of WRA at baseline to 70.5% at endline, a relatively modest 5% increase.

Maps depicting travel-time zone access to EmONC and CEmONC by nonmotorized (Figure 3 and Figure 4) and motorized (Figure 5 and Figure 6) transportation help visualize access improvements that occurred after the addition of new services supported by SMGL. The maps provide a gradient of the travel time needed for adequate access to EmONC services. Adequate access to EmONC facilities is shown in a green-to-brown gradient, displaying 0 to 30 and 90 to 120 minutes, respectively. Areas outside of this gradient—whether gray, blue, or green—denote poor EmONC access.

At baseline, access to EmONC services was concentrated around major towns in Kabarole, Kyenjojo, and Kibaale, with some additional services along the Kabarole-Kamwenge road (Figure 3 and Figure 5). With the addition of new EmONC services through the SMGL initiative, areas with adequate access appear dispersed across the districts. For nonmotorized transportation, the amount of land covered by the zones of adequate access is small, indicating that the majority of WRA still had poor access in the absence of

In Kamwenge, where only 13.1% of WRA had adequate access at baseline, the added SMGL-supported facilities increased adequate CEmONC access to 71.6% at endline, a 447% increase.

TABLE 3. Estimated Proportion of WRA Within Each Travel-Time Zone in SMGL-Supported Districts in Uganda (2012–2016), by Transportation Mode

Transportation Mode ^a	EmONC Facilities					CEmONC Facilities				
	Baseline, 2012 (%)	Phase 1, 2013 (%)	Endline, 2016 (%)	% Change ^b	Sig. Level ^c	Baseline, 2012 (%)	Phase 1, 2013 (%)	Endline, 2016 (%)	% Change ^b	Sig. Level ^c
Walking, minutes										
0–30	1.4	2.4	2.6	+88	***	1.2	1.9	1.9	+55	***
31–60	1.5	3.5	3.5	+131	***	1.4	2.4	2.7	+96	***
61–90	2.0	4.0	4.4	+124	***	1.7	3.0	3.1	+89	***
91–120	1.8	4.3	4.5	+152	***	1.5	3.2	3.3	+118	***
≤120	6.7	14.2	15.0	+125	***	5.8	10.5	11.1	+91	***
>120	93.3	85.8	85.0	-9	***	94.2	89.5	88.9	-6	***
Bicycle, minutes										
0–30	3.7	6.3	6.5	+77	***	3.4	4.8	5.0	+45	***
31–60	4.0	8.6	8.5	+113	***	3.5	6.6	6.8	+96	***
61–90	4.8	10.4	11.0	+129	***	3.6	7.7	7.9	+118	***
91–120	5.4	10.8	11.6	+115	***	3.8	9.2	9.4	+150	***
≤120	17.9	36.0	37.6	+110	***	14.3	28.2	29.1	+103	***
>120	82.1	64.0	62.4	-24	***	85.7	71.8	70.9	-17	***
Motorcycle, minutes										
0–30	11.6	21.3	21.9	+89	***	10.6	16.9	17.2	+62	***
31–60	15.7	22.3	22.5	+44	***	12.2	22.3	23.2	+91	***
61–90	19.7	16.8	16.8	-15	***	15.7	17.6	17.7	+13	***
91–120	14.3	10.7	10.9	-24	***	12.7	12.0	11.7	-7	***
≤120	61.3	71.2	72.1	+18	***	51.1	68.7	69.8	+37	***
>120	38.7	28.8	27.9	-28	***	48.9	31.3	30.2	-38	***
4-wheeled vehicles, minutes										
0–30	13.7	24.7	25.4	+85	***	12.3	20.2	20.6	+68	***
31–60	19.4	23.5	23.2	+20	***	15.8	24.1	25.2	+60	***
61–90	20.1	15.1	15.4	-23	***	15.8	16.3	15.9	+1	NS
91–120	11.9	10.2	10.2	-15	***	11.4	10.7	10.6	-7	***
≤120	65.1	73.4	74.1	+14	***	55.2	71.3	72.3	+31	***
>120	34.9	26.6	25.9	-26	***	44.8	28.7	27.7	-38	***

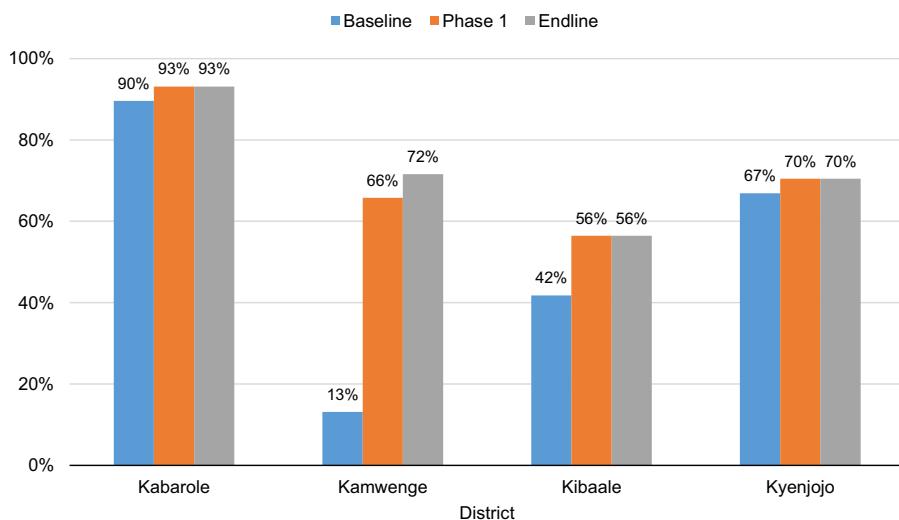
Abbreviations: CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; SMGL, Saving Mothers, Giving Life; Sig. level, Significance level; WRA, women of reproductive age.

^aWalking mode includes walking alone. Bicycle mode includes walking to a road and use of a bicycle. Motorized transportation modes (motorcycle, 4-wheeled vehicles) include walking to the road and use of a motorized transportation thereafter.

^bRelative % change (% change) is calculated by the formula, $((p_2 - p_1)/p_1) * 100$.

^cAsterisks indicate significance level of the % change between baseline and endline, calculated using z scores: *** $P < .01$, ** $P < .05$, NS = not significant.

FIGURE 2. Percentage of Women of Reproductive Age Living Within 2 Hours of CEmONC Facilities by Motorized Transportation and SMGL District



Abbreviations: CEmONC, comprehensive emergency obstetric and newborn care; SMGL, Saving Mothers, Giving Life.

motorized transport. Adequate access to EmONC by motorized transportation was clearly expanded into new areas of Kamwenge district and central and southern Kibaale districts. Similar geographic patterns were found for CEmONC access (Figure 4 and Figure 6). SMGL upgrades and additions led to more widespread distribution of adequate EmONC and CEmONC access. While the areas with poor EmONC and CEmONC access shrank in most districts, several notable gaps in access by motorized transportation remained, particularly on the northern border of Kibaale, in eastern Kamwenge, in western Kabarole, and on the border between Kabarole and Kamwenge.

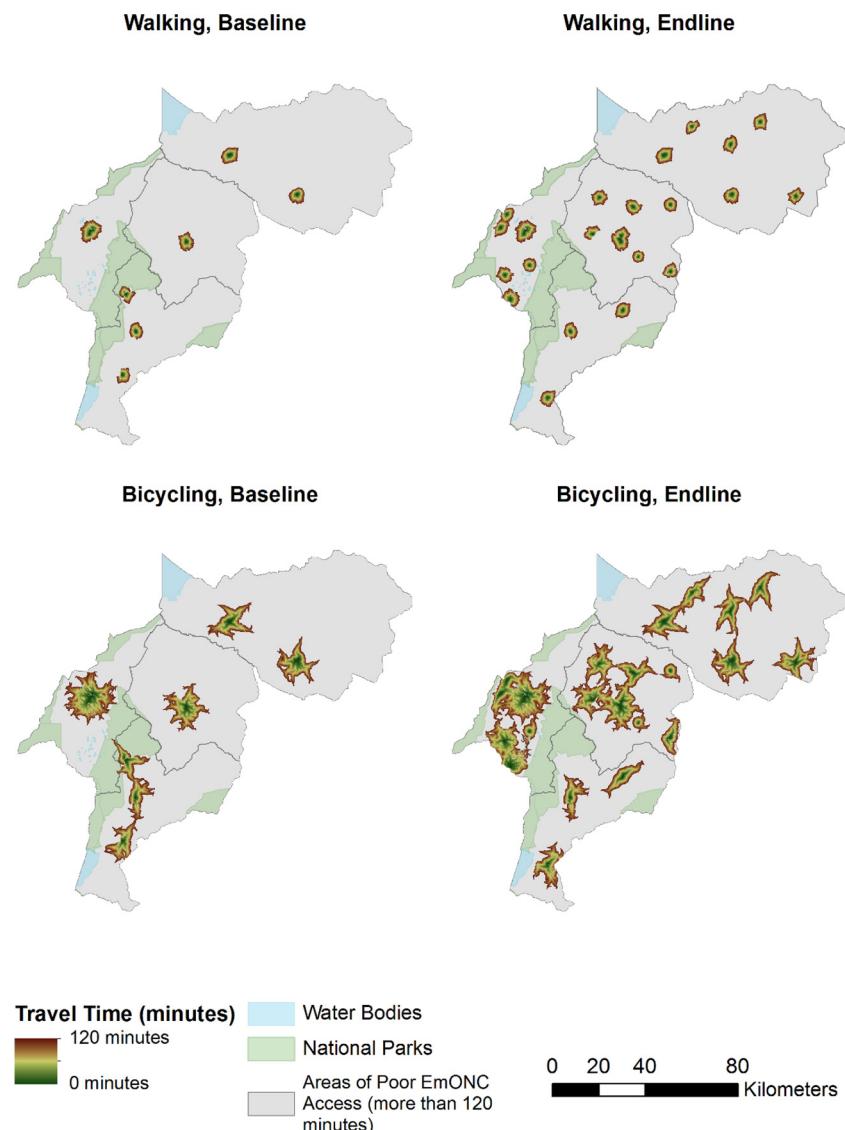
■ DISCUSSION

Addressing access to care requires a systems approach, including synergistic interventions at the community, facility, and health system levels designed to decrease travel time to care and increase access to motorized transportation. Our travel-time analyses show that the SMGL initiative reduced travel time to EmONC services through a rapid expansion of health facilities able to provide EmONC. The number of facilities providing EmONC and CEmONC services more than doubled from baseline to endline. Two districts met the WHO standard for EmONC, while all 4 districts met the standard of at least 1 CEmONC

facility. Overcoverage of EmONC care in Kabarole district and undercoverage in Kamwenge and Kibaale districts left the population of Kibaale and Kamwenge districts with less than the recommended number of EmONC facilities per capita by endline.

A central goal of the SMGL initiative was to ensure that all WRA in each SMGL-supported district had access to EmONC within 2 hours of travel. Despite SMGL's extensive facility upgrade achievements, an estimated one-quarter of WRA continued to have poor access to EmONC care by motorized transportation at the conclusion of the initiative. Because higher-level CEmONC facilities were distributed inequitably due to overconcentration in urban areas, access to CEmONC remained especially uneven across the districts. For example, despite Kyenjojo adding 2 facilities over the course of the SMGL initiative, the new CEmONC facilities were located close to an existing CEmONC facility. This led to only a 5% increase in adequate CEmONC access across the district by motorized transport. In contrast, in Kamwenge district, where access to CEmONC care by motorized transport at baseline was very limited, the addition of 3 geographically distributed CEmONC facilities significantly increased access to CEmONC care (447% increase). Clustering of high-level facilities in urban areas is a problem for increasing access to care to larger geographic

The number of facilities providing EmONC and CEmONC services more than doubled from baseline to endline.

FIGURE 3. Distribution of Estimated Travel Time to EmONC Facilities, Walking or Bicycling and Walking

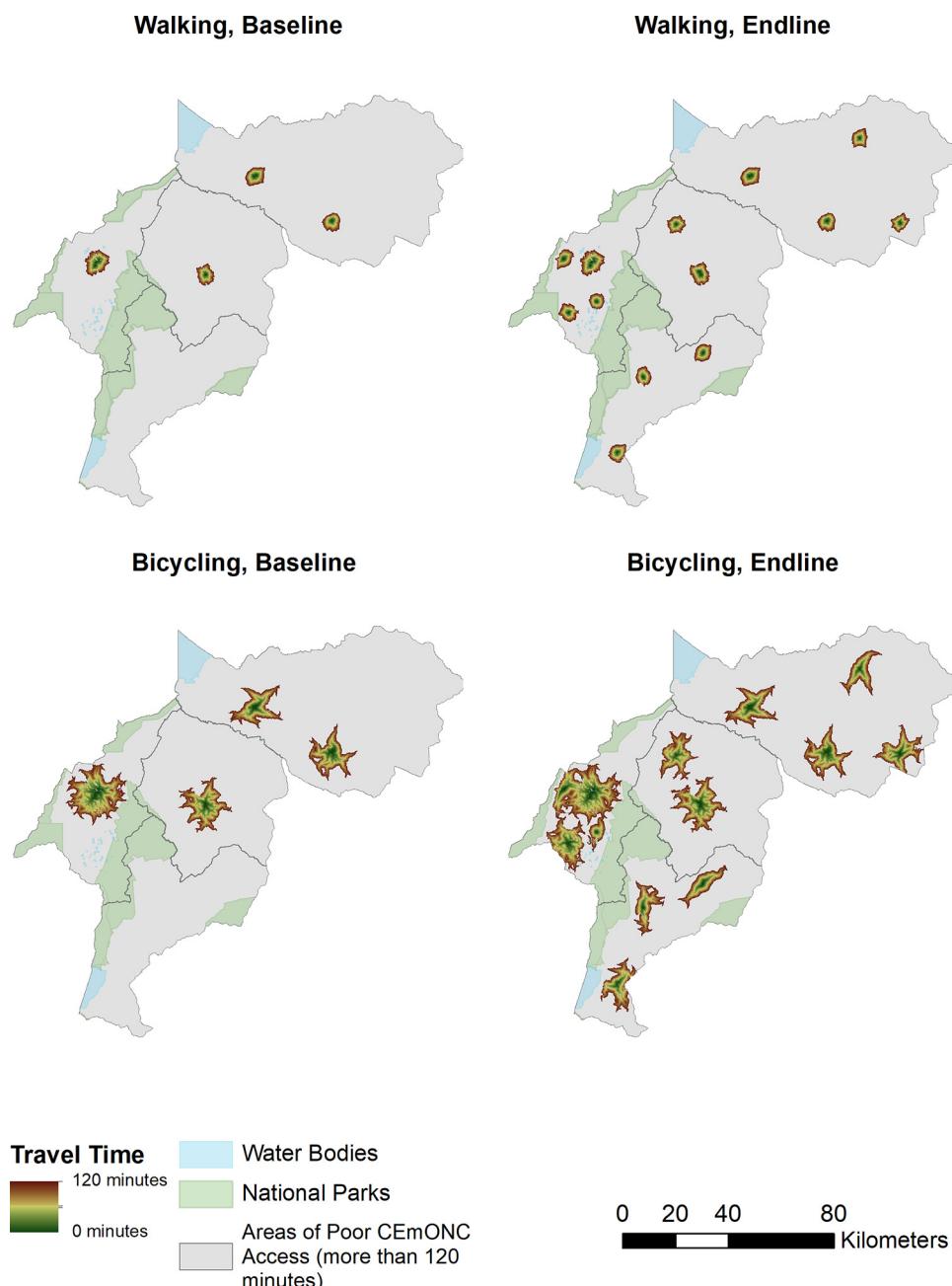
Abbreviation: EmONC, emergency obstetric and newborn care.

Strategic placement and equitable distribution of EmONC facilities in the remaining underserved areas could provide a far greater percentage of WRA with adequate access to EmONC care.

areas, unless access to motorized transport is increased.

It is worth noting that our analysis focused only on facilities that could provide the full complement of EmONC signal functions. Numerous facilities in SMGL-supported districts provided partial EmONC, with 4 to 5 signal functions, which did not meet the criteria for full EmONC functionality. Taking all facilities that provide delivery services into account, we found that 18% of WRA had poor motorized access—outside

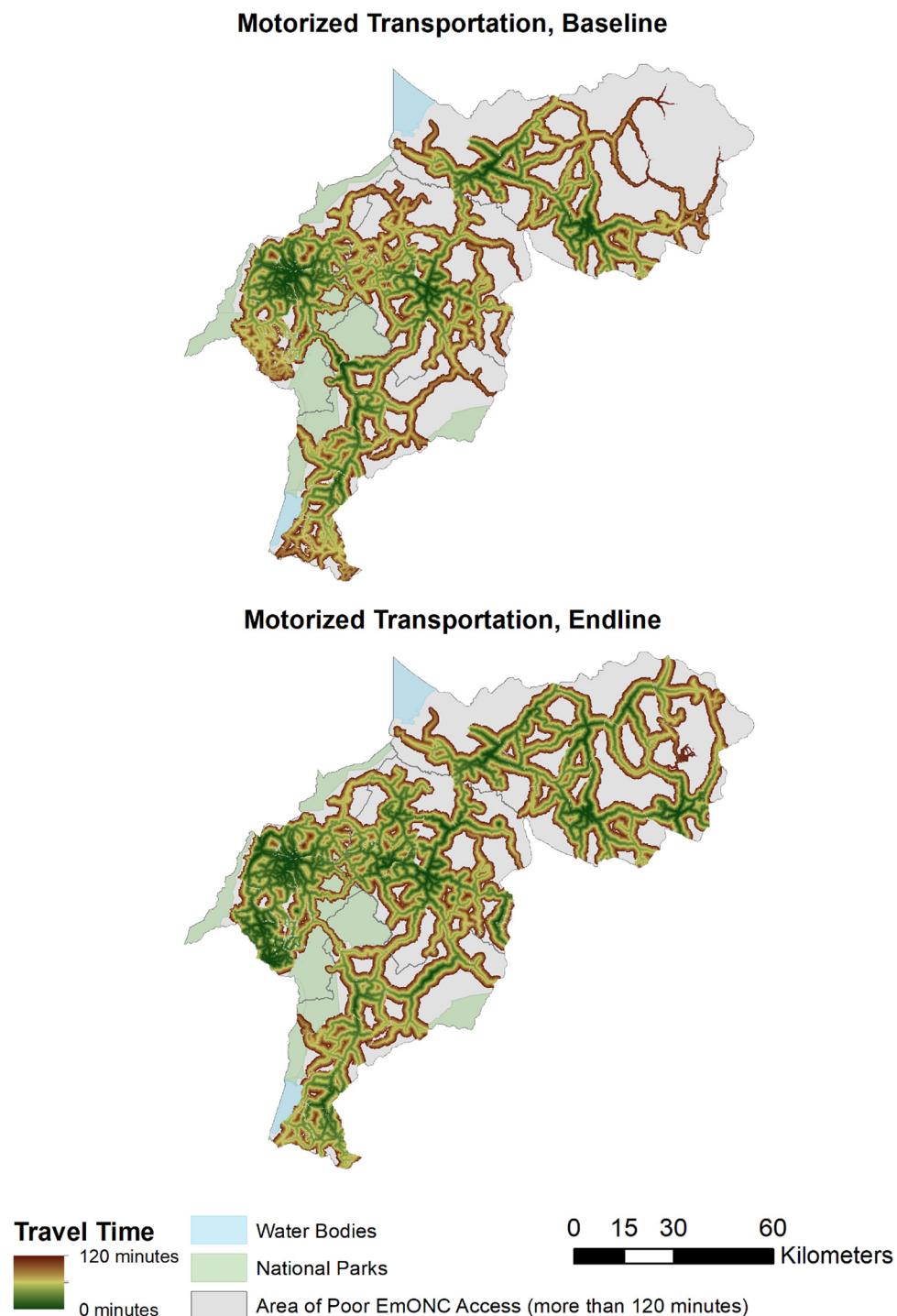
of 2 hours—to any facility that provided deliveries at endline (data not shown). To meet remaining geographic gaps, a combination of efforts to bring partial EmONC facilities to full EmONC capacity, combined with efforts to improve motorized transport access in these still-underserved areas, could increase adequate access for WRA who still had poor access at the conclusion of SMGL. Strategic placement of EmONC facilities in the remaining underserved areas and a focus on equitable distribution could

FIGURE 4. Distribution of Estimated Travel Time to CEmONC Facilities, Walking or Bicycling and Walking

Abbreviation: CEmONC, comprehensive emergency obstetric and newborn care.

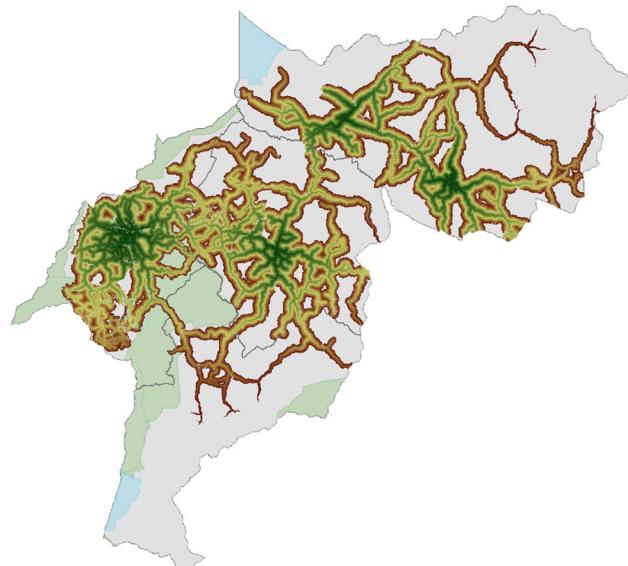
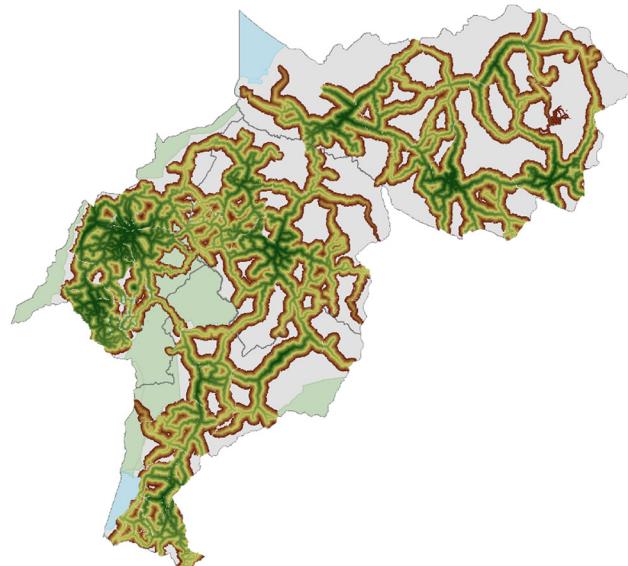
provide a far greater percentage of WRA with adequate access to EmONC care. The results of this analysis provide a geographic outline for future strategically located upgrades to

facilities in areas with continued poor access.^{26,27} Additionally, the SMGL geodatabase could be used to inform other public health efforts in the districts, including immunization campaigns,

FIGURE 5. Distribution of Estimated Travel Time to EmONC Facilities Using Motorized Transportation^a

^a Transportation defined as motorcycles or 4-wheeled vehicles.

Abbreviation: EmONC, emergency obstetric and newborn care.

FIGURE 6. Distribution of Estimated Travel Time to CEmONC Facilities Using Motorized Transportation^a**Motorized Transportation, Baseline****Motorized Transportation, Endline**^a Transportation defined as motorcycles or 4-wheeled vehicles.

Abbreviation: CEmONC, comprehensive emergency obstetric and newborn care.

Geographic inaccessibility is a major barrier to reducing preventable maternal and newborn mortality and morbidity.

and placement of other essential services such as family planning and HIV testing.

Although SMGL did not capture systematic baseline and endline data on the actual transportation used by women in SMGL-supported districts to reach care, there is evidence that the actual use of motorized transport increased. Deliveries in EmONC facilities increased from 28.2% to 41.0% in the SMGL-supported districts in Uganda.¹⁹ According to exit interviews at EmONC facilities conducted at the conclusion of Phase 1, 90% of women used motorized transportation to reach the EmONC where they delivered.⁵³ Additionally, SMGL implementing partners supported the use of motorized transportation through “boda-for-mothers” vouchers—private-service vouchers that included subsidized motorcycle transport—and organized a district ambulance network that included 5 4-by-4 ambulances and 16 eRanger tricycle ambulances at facilities.^{20,21} Linking ambulances through a district network allowed the closest ambulance to the emergency to be assigned for timely referral of mothers and newborn babies with complications.⁵³ The redemption of vouchers increased over the SMGL implementation period, although the voucher supply was reduced in Phase 2 due to interruptions in funding.⁵⁴ Although our geographic models included estimates of adequate access by walking, reaching delivery care by nonmotorized means is clearly not practical. Wider availability of motorized transportation to reach EmONC facilities is necessary to ensure adequate access.

Spatial analyses using GIS have great potential to inform programs and policies in safe motherhood initiatives.⁵⁵ Our study was unique in that we were able to perform travel-time modeling across multiple time points of a multi-year safe motherhood project. The GIS analyses benefited from the project’s investments in health systems strengthening at the district level and extensive monitoring and evaluation efforts.

Our travel-time models were based on the most recent data about road network, population, and facility functionality using health facility and reproductive health census data. While we had the opportunity to use direct current population counts by village instead of modeled raster population estimates, publicly available population raster data have been used in other travel-time modeling analyses.^{17,30,43,56–63}

By using open-source programs—such as AccessMod—and advancements in geospatial

technologies, it has become easier to perform meaningful actionable travel-time analyses that can be used with monitoring and evaluation programs. With minimum investment in measuring devices, training, and software, district personnel can use existing health information management data or special EmONC assessment studies in combination with population and land cover data to perform travel-time analyses.

Limitations

This analysis has several limitations. As noted, although we were able to estimate that an increased proportion of WRA had adequate access to EmONC at SMGL endline, the analysis was limited by the lack of data on actual changes in transportation use for women delivering in EmONC facilities. Therefore, we could not assess the relative contributions of decreased distance to care versus greater availability and use of motorized transportation. In addition, the actual proportion of WRA with adequate EmONC access may be lower or higher than our estimates due to assumptions we made. First, we used land and road class speeds that were relatively conservative compared with another recent global analysis.¹⁷ While lower than the average, the speeds we applied did not account for any variation that might have occurred due to varying road conditions/obstructions or traffic patterns. We estimated travel times for dry road conditions only and could not account for flooding or poor road conditions in rainy seasons. These types of barriers would most likely have reduced speed and lengthened travel time to care, or made travel impossible, as shown in a study conducted in Mozambique.⁶⁴ We assumed that women walk in the most logical path—usually a straight line—from their homes to the nearest road, from where they would access the nearest facility. In real life, women may take various routes to access the nearest road and to travel to the nearest EmONC facility. They may take a longer route if a road or bridge is under repair or if they do not go to the nearest EmONC facility. They may temporarily move away from their home close to their delivery date to live in a family member’s home or maternity waiting home near an EmONC facility. Our analysis also did not take into account referrals from lower-level facilities to EmONC facilities.

Additionally, our estimates did not differentiate between private and public facilities. Access times may be longer for WRA living within an

adequate distance to private care but who have to travel further to a public facility. While SMGL-supported private service vouchers with transportation support could augment access to private delivery facilities among women who could otherwise not afford the costs, these vouchers were available only during Phase 1.²⁰ Therefore, Phase 1 distance-to-care estimates may be less affected by differential access to private care than Phase 2 estimates.

CONCLUSION

Our study findings suggest that reducing distance to and increasing optimal distribution of EmONC facilities can increase adequate access to EmONC. Increases in the proportion of WRA with adequate EmONC access due to the SMGL initiative suggest that the SMGL-supported districts made significant advances in bridging the gap in access to timely emergency delivery care. Further gains could be achieved using spatial analyses to strategically estimate placement of EmONC services to reach the greatest number of geographically disadvantaged women, either through the addition of new facilities or upgrading of existing facilities already providing routine obstetric care.

Health care modeling of distance and travel time can help inform the planning of appropriate interventions to overcome spatial disparities in access to maternity care in sub-Saharan Africa. Geographic inaccessibility is a major barrier to countries' efforts to reduce preventable maternal and newborn mortality and morbidity. Periodic assessments of EmONC capabilities, locations, and travel time to EmONC services that take into account actual geographic conditions can enable policy makers and planners to make more informed decisions on the spatial distribution of services and the most effective strategies to improve access.

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ORIGINAL ARTICLE

Saving Mothers, Giving Life Approach for Strengthening Health Systems to Reduce Maternal and Newborn Deaths in 7 Scale-up Districts in Northern Uganda

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Saving Mothers, Giving Life (SMGL) strengthened the health system in 7 districts in Northern Uganda through a quality improvement approach. Quality improvement teams removed barriers to delivering maternal and newborn health services and improved emergency care, reducing preventable maternal and newborn deaths in a post-conflict, low-resource setting.

■ ABSTRACT

Background: Uganda's maternal and newborn mortality remains high at 336 maternal deaths per 100,000 live births and 27 newborn deaths per 1,000 live births. The Saving Mothers, Giving Life (SMGL) initiative launched in 2012 by the U.S. government and partners, with funding from the U.S. President's Emergency Plan for AIDS Relief, focused on reducing maternal and newborn deaths in Uganda and Zambia by addressing the 3 major delays associated with maternal and newborn deaths. In Uganda, SMGL was implemented in 2 phases. Phase 1 was a proof-of-concept demonstration in 4 districts of Western Uganda (2012 to 2014). Phase 2 involved scaling up best practices from Phase 1 to new sites in Northern Uganda (2014 to 2017).

Program Description: The SMGL project used a systems-strengthening approach with quality improvement (QI) methods applied in targeted facilities with high client volume and high maternal and perinatal deaths. A QI team was formed in each facility to address the building blocks of the World Health Organization's health systems framework. A community component was integrated within the facility-level QI work to create demand for services. Above-site health systems functions were strengthened through engagement with district management teams.

Results: The institutional maternal mortality ratio in the intervention facilities decreased by 20%, from 138 to 109 maternal deaths per 100,000 live births between December 2014 and December 2016. The institutional neonatal mortality rate was reduced by 30%, while the fresh stillbirth rate declined by 47% and the perinatal mortality rate by 26%. During this period, over 90% of pregnant women were screened for hypertension and 70% for syphilis during antenatal care services. All women received a uterotonic drug to prevent postpartum hemorrhage during delivery, and about 90% of the women were monitored using a partograph during labor.

Conclusions: Identifying barriers at each step of delivering care and strengthening health systems functions using QI teams increase participation, resulting in improved care for mothers and newborns.

■ INTRODUCTION

Maternal and newborn mortality in Uganda remains unacceptably high.¹ The maternal mortality ratio (MMR) is recorded at 336 maternal deaths per 100,000 live births.² With funding from the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and the United States Agency for International Development (USAID), the Saving Mothers, Giving Life (SMGL) initiative was launched in 2012 with the Ministry of Health (MOH) in Uganda and Zambia to

reduce such deaths. Most maternal and newborn deaths occur during labor, delivery, and the immediate postpartum period.³ Hence, strategies to address the deaths centered on the 3 major delays in accessing and using health care during these periods, namely, delays in seeking appropriate care, inability to access the most appropriate care in a timely manner, and inconsistencies in the quality of care provided at health facilities.

The SMGL initiative was implemented in 2 phases. Phase 1 was the proof of concept, implemented in 4 districts of Western Uganda—Kyenjojo, Kamwenge, Kabarole, and Kibaale—between June 2012 and December 2013. The population of the 4 districts was estimated to be 1.3 million in 2013.² Phase 2 continued

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efforts in the 4 Phase 1 districts and scaled up the best practices developed in Phase 1 to 7 more districts in Northern Uganda—Nwoya, Gulu, Omoro (recently carved out of Gulu), Pader, Lira, Dokolo, and Apac—between February 2015 and December 2016. The 7 new districts had an estimated population of 1,812,800 between January 2016 and September 2017. The learnings from the SMGL-supported districts in Northern Uganda were further spread to 9 surrounding districts in the same region (Oyam, Alebtong, Amolatar, Kitgum, Agago, Amur, Lamwo, Kole, and Oture) starting in 2016, supported under the maternal and child health PEPFAR platform (Figure 1). These districts had an estimated population of 1,773,600 in 2016.

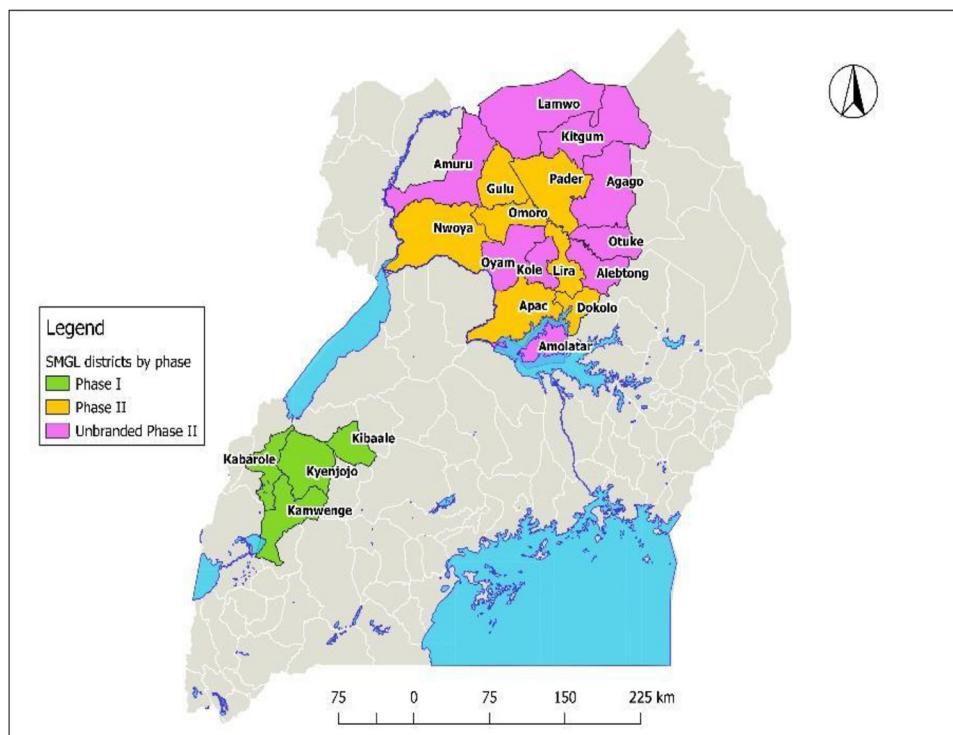
The scale-up phase in Northern Uganda was carried out in 3 waves. Wave I targeted 20 high-volume public and private not-for-profit facilities with more than 100 deliveries per month—where 64% of deliveries, 74% of newborn deaths, and 95% of maternal deaths occurred in 2013—and 144 surrounding communities.⁴ Wave II involved 60 medium-volume facilities with 50 to less than

100 deliveries per month, which included primarily third-level health centers (HC IIIIs) and an additional 370 communities within the catchment areas of the supported facilities. Wave III involved 38 low-volume facilities with less than 50 deliveries per month, including second-level health centers (HC IIs) that conduct deliveries (Figure 2). The wave-spread approach to implementation of quality improvement (QI) strategies was based on successes of QI in the early waves and availability of funding for implementing QI strategies within other intervention districts.

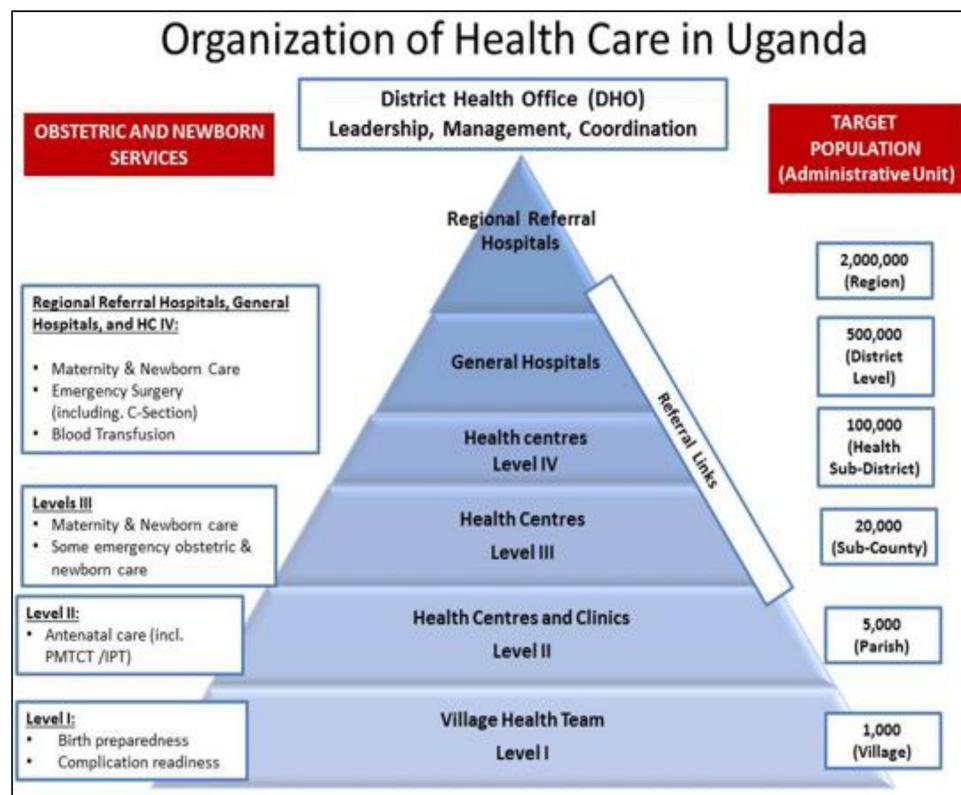
As in the initial scale-up, the implementation strategy for these new districts targeted all levels of the health system. The national level provided technical oversight and competency building. The district coordinated and supported application of technical knowledge, decision making, and resource mobilization. Health facilities provided quality maternal and newborn health (MNH) services and strengthened emergency care functions. The community level created demand for services including referral tracking.

This paper describes the scale-up of SMGL in Northern Uganda starting in 2015 and the

FIGURE 1. Map of Uganda Showing the Various Phases of SMGL Implementation



Abbreviation: SMGL, Saving Mothers, Giving Life.

FIGURE 2. Levels of Health Care Service Delivery in Uganda

Source: Northern Uganda Health Integration to Enhance Services (NU-HITES) Assessment Report for Emergency Obstetric Care in Northern Uganda, 2014.

Abbreviations: C-section, cesarean section; HC, health center; IPT, intermittent preventive treatment; PMTCT, prevention of mother-to-child transmission (of HIV).

results as of December 2016. The first 7 scale-up districts (Phase 2) are referred to as the SMGL-supported districts and the last 9 scale-up districts, implemented under the maternal and child health PEPFAR platform, are referred to as the unbranded SMGL-supported districts. The latter did not have rigorous monitoring and evaluation, as no funds were allocated or staff dedicated to those activities. Our findings may help inform program managers and health care providers in other low-resource settings on the use of quality improvement methods to strengthen the health system to reduce preventable maternal and newborn deaths.

■ PROGRAM DESCRIPTION

SMGL is a multi-partner initiative designed to rapidly reduce deaths stemming from pregnancy and childbirth through a comprehensive set of

evidence-based interventions in high-mortality, low-resource settings. The initiative established an ambitious target of a 50% decline in the MMR within 1 year to address the need for accelerated progress to meet the fifth Millennium Development Goal (MDG5) of a 75% reduction in MMR by 2015. SMGL draws upon the investment and expertise of public and private organizations and existing infrastructure, partnerships, and services, including U.S. government platforms, for combating HIV/AIDS and improving maternal and child health.⁵

The scale-up Phase 2 in Northern Uganda involved spreading lessons from experience gained in reducing maternal and newborn deaths in the Phase 1 SMGL-supported districts in Western Uganda (Table 1). The scale-up used a wave-sequence model of spread wherein learning from early intervention sites was spread to

TABLE 1. SMGL Interventions Implemented During Phase 1 and Scaled Up During Phase 2 to Reduce the 3 Delays in Northern Uganda

SMGL Interventions (Phase I)	SMGL Intervention Scaled Up to Phase 2 of Northern Uganda	Nonbranded SMGL Scale-Up (in Northern Uganda)
Increase awareness and seeking care for safe delivery to reduce the first delay	✓	✓
Training of village health teams to encourage birth preparedness and increase demand for facility-based delivery care	✓	✓
Community outreach activities to counsel women, families, local leaders, and community organizations	✓	✓
Distribution of mama kits to incentivize facility-based births	X	X
Community mobilization messages (e.g., radio, billboards, and newspaper articles) and drama skits	✓	✓
Promotion of demand- and supply-side financial incentives to facilitate women seeking, accessing, and using quality care services (e.g., transport and delivery care vouchers, user-fee reductions, and conditional cash transfers)	Use of saving groups to save for birth expenses	Use of saving groups to save for birth expenses
Increase access to quality health care services to reduce the second delay	✓	✓
Upgrade a sufficient number of public and private facilities with appropriate geographical positioning to provide—24 hours a day/7 days a week—clean and safe basic delivery services	✓	✓
Ensure that a minimum of 5 EmONC facilities are providing the recommended lifesaving obstetric interventions 24 hours a day/7 days a week	✓	✓
Hire a sufficient number of skilled birth attendants to consistently provide quality, respectful basic delivery care, diagnosis, and stabilization of complications	X	X
Create a consultative, protocol-driven, quality-assured, and integrated communication/transportation referral system available 24 hours a day/7 days a week that ensures women with complications reach emergency services within 2 hours	✓	✓
Improve quality, appropriate, and respectful care to reduce the third delay	✓	✓
Train health professionals in emergency obstetric care, including obstetric surgeries	✓	✓
Ensure mentoring of newly hired personnel and supportive supervision	✓	✓
Strengthen supply chains for essential supplies and medicines	✓	✓
Ensure implementation of quality effective interventions to prevent and treat obstetric complications	✓	✓
Introduce sound managerial practices utilizing “short-loop” data feedback and response, to ensure reliable delivery of quality essential and emergency maternal and newborn care	✓	✓
Strengthen maternal mortality surveillance in communities and facilities, including timely, no-fault medical death reviews performed in follow-up to every institutional maternal death with cause of death information used for ongoing monitoring and quality improvement	✓	✓
Promote a government-owned health management information system that accurately records every birth, obstetric and newborn complication and treatment provided, and birth outcome at public and private facilities in the district	✓	✓

Abbreviations: EmONC, emergency obstetric and newborn care; SMGL, Saving Mothers, Giving Life.

✓, SMGL interventions were implemented.

X, SMGL interventions were not implemented.

surrounding sites.⁶ The spread sites were selected based on certain criteria, such as client volume in terms of deliveries per month, readiness to change (defined as the ability to adopt best practices from the learning phase), and leadership, in terms of willingness of the facility leadership to embrace QI activities in their respective facilities. The sites meeting these criteria were then organized into waves. Spread was implemented through coaching visits to the wave sites, engaging both coaches who supported the learning phase and champions from the learning phase sites. Each wave received a minimum of 3 monthly coaching visits before another wave was launched. Within a 12-month period, all wave sites were implementing the changes from the change package, an evidence-based set of best practices crucial to the improvement of an identified care process, such as the use of partograph for monitoring the third stage of labor.

Coaches were selected according to defined criteria: they had been champions for improvement of work in maternal, newborn, and child health (MNCH) in their respective facilities, were located in the intervention areas, had expressed willingness to mentor others, and had been involved in health services for MNH. The coaches were recruited across the intervention districts to support facilities within a defined geographical area. They were linked to the technical support supervision structure and included gynecologists, pediatricians, medical officers, and midwives at all levels for continuity of the improvement activities (Figure 2).

With engagement of key MNH stakeholders at national, district, and facility levels in Northern Uganda, SMGL addressed gaps, impeding delivery of quality antenatal care (ANC), labor and delivery, and newborn care services, through formation of QI teams targeting frontline health care providers and managers involved in the provision of maternal and newborn care services, mainly medical officers, midwives, records officers, laboratory technicians, pharmacists/dispensers, and facility managers. These teams were situated in maternity units and met on a weekly or monthly basis to fulfill their improvement objectives to track weekly performance, share results with the facility administration, and share personal experiences in quarterly learning meetings. The interventions for strengthening the health system included regular skill building through coaching and mentorship visits, quarterly peer-to-peer learning meetings, maternal and perinatal death reviews to identify and avert similar causes of deaths, regular performance and data improve-

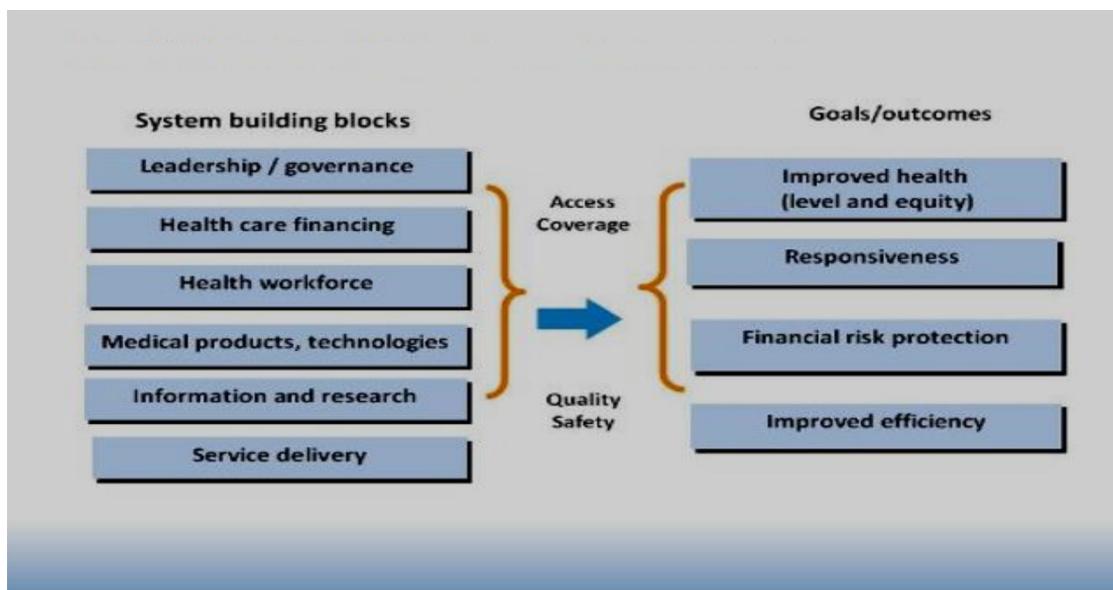
ment meetings at facility and district levels, fourth-level health centers (HC IVs) updated to provide comprehensive emergency obstetric and newborn care (CEmONC), and establishment of skills labs at health facilities. The strategy for addressing each health system building block to improve MNH⁷ (Figure 3) is described next.

Leadership and Governance

The project engaged staff from the MOH Reproductive and Child Health and Health Promotion divisions to provide technical updates and implement maternal and perinatal death review (MPDR) tools in the Northern Ugandan project districts. MOH designated 12 maternal and newborn technical mentors from teaching and referral institutions in the region, who then dedicated 25% of their time every month to support program activities facilitated by the SMGL project. They participated in technical supervision of facilities, training of MPDR committees to conduct maternal and perinatal audits, and support for improvement teams. The mentors from national and regional levels supported skills development of health care providers at various levels of health facilities (HC IIIs, HC IVs, and hospitals). They were advised to include this activity as part of their work plans for supporting facilities without interrupting routine activities. With time, these roles would be integrated in the routine technical supervision of facilities by all levels for continuity. These mentors continued to work with the SMGL project staff over the year to improve demand, access, and quality care through monthly mentorships at health facility and community levels. The project facilitated the mentors' transportation to different facilities and communities within their geographical areas of operation.

Within each intervention district in Northern Uganda, project staff worked under the district health officer to engage the district health team, partners, and political leaders in quarterly coordination and performance improvement meetings; make designated CEmONC facilities functional through rehabilitation and re-equipping of infrastructure; reallocate human resources to under-staffed high-volume facilities; conduct monthly coaching/mentorship and supervisory visits; and hold quarterly district-level MPDR meetings. The quarterly meetings involved coordinating efforts aimed at reducing maternal and newborn mortality, reviewing data, and discussing performance improvement based on district-specific barriers to accessing quality MNCH services

SMGL addressed gaps impeding delivery of quality ANC, labor and delivery, and newborn care services through the formation of QI teams.

FIGURE 3. The WHO Health Systems Framework

(Figure 4). Since QI activities for SMGL involved leadership across district, facility, and community levels, the improvements in uptake of services and reductions in mortality were used as an indirect estimate of the influence of leadership and governance.

Health Care Financing

The respective district health officers, facility managers, and project staff mobilized resources from local NGOs and district councils to address the identified facility-level gaps. The district health officers with other district technical leaders quantified facility-specific gaps and presented proposed budgets to their district councils for allocation of funds to address those gaps. For example, funds were allocated to renovate and make functional the operating theaters of Lalogi and Awach (Gulu district), Ogur (Lira district), and Pajule (Pader district) HC IVs. In specific locales, they also mobilized local NGOs (e.g., Straight Talk organization in Gulu district), which provided solar lighting kits to 3 HC IIIs. In-charges of health facilities were mobilized to budget for photocopying and printing of partograph sheets and purchase basic equipment, such as blood pressure machines, using primary health care funds—monies allocated to each health facility per quarter from government.

Delays in fund disbursement for primary health care were counteracted with resource mobilization from NGOs.

Health Workforce

The Pader district health office received support to send a staff member for training in anesthesia and to reallocate midwives to lower-level facilities that did not have midwives (Box 1). In other facilities, facility staff, including medical officers and midwives, were organized into QI teams and coached monthly by a team of trained local coaches/mentors—reproductive health trainers within the intervention districts—and project staff to identify and address critical gaps in care processes. A local support network of technical and improvement experts from Gulu and Lira regional referral hospitals and universities, plus district-based reproductive health trainers and champions from health facilities, was established to visit health facilities monthly to address knowledge and skills gaps and to motivate health care providers. This network was further integrated into the routine technical supervision for health workers at all health facilities. Onsite continuous medical education was institutionalized and used to build and improve provider skills and aid retention of skills over time.

During 2015–2016, 303 of the total 450 relevant medical personnel were trained in emergency

Two-thirds of relevant medical personnel were trained in emergency obstetric and newborn care, long-acting family planning methods, and newborn resuscitation/Helping Babies Breathe.

FIGURE 4. Agenda for a Learning Meeting Held for Phase II Facilities in Northern Uganda Involving Facility, District, and Implementing Partner Stakeholders



Maternal and Newborn Care Improvement Collaborative
USAID/Applying Science to Strengthen and Improve Systems (ASSIST) Project
Quality Improvement Learning Session
13th – 14th July 2015
At Pauline Hotel, Lira

DAY ONE		
Time	Item	Presenter
8.00	Arrival and registration	ASSIST Admin
8:30	Introductions and QI LS objectives	ASSIST- Facilitator
9.00	Progress in the improvement of the quality of MNCH services to date	ASSIST- Facilitator
10.30	Break	
11.00	Setting up of knowledge Cafes for the different intervention areas	All facilitators
1.00	Lunch	
2.00	Plenary session: Improving the quality of antenatal care	Group one
3.30	Plenary presentation: Improving the quality of obstetric labor management	Group two
5.00	Day's evaluation	ASSIST- Facilitator
5.15	Tea break, End of day	
Day 2		
8.30	The role of facility leaders in improving the quality of health care	ASSIST- Facilitator
9.30	Plenary presentation: Improving the quality of delivery care	Group three
10.30	Break	
11.00	Plenary presentation: Improving resuscitation and management of birth asphyxia	Group four
12.00	Plenary presentation: Improving routine delivery of essential newborn care package	Group five
1.00	Lunch	
2.00	Plenary presentation: Improving the quality of preterm care	Group six
3.00	Plenary presentation: Improving MPDR as a QI tool	Group seven
4.00	Action plan development	Rapporteur-ASSIST
4.45	Overall evaluation	ASSIST
5.00	Closure, tea break and admin issues	All, ASSIST

Abbreviations: LS, learning session; MNCH, maternal, newborn, and child health; MPDR, maternal and perinatal death review; QI, quality improvement.

obstetric and newborn care, long-acting family planning methods, and newborn resuscitation. To enhance skills in newborn resuscitation, Helping Babies Breathe skills labs were established in 14 facilities at regional, general hospital, and HC IV levels. Monthly onsite technical mentorship and QI coaching sessions supplemented this capacity building, reaching 450 health workers in the 7 initial Phase 2 SMGL-supported districts every month at HC IIIs, HC IVs, and hospitals. Project and district management teams convened quarterly peer-to-peer learning sessions, bringing together representatives from the 118 facilities to share their results and challenges.

Medical Products and Technologies

The staff responsible for supplies and drug management—pharmacists, dispensers, and storekeepers in supported facilities—were coached on the specific drugs and supplies to order and the ordering schedules of the national medical stores, as a means of preventing stock-outs. SMGL coordinated with the medicine management supervisors, 1 per health subdistrict, in each district to redistribute drugs and supplies to facilities with stock-outs. In addition, routine maintenance and repairs of medical equipment were facilitated for lower-level health facilities through coordination with the medical engineering departments at the 2 regional referral hospitals of Gulu and Lira. Following a review of equipment needed in participating facilities, sites in Northern Uganda received donated equipment for maternal and newborn care, including radiant warmers, bulb syringes, oxygen concentrators, emergency drug trolleys, anesthetic machines, wheelchairs, delivery/postnatal beds, drip stands, bed pans, blood pressure machines, and thermometers from Project C.U.R.E. The district was engaged to integrate the supervision of equipment for MNCH and support future replacements and repairs.

Health Information Systems

At 23 high-volume health facilities (>100 deliveries per month) in the 7 SMGL-supported districts, data were entered into the Pregnancy Outcomes Monitoring System (POMS), a database in Microsoft Access that includes every mother who delivered in a health facility and the outcome of every pregnancy. The Rapid Assessment of Pregnancy-Associated Institutional Death (RAPID) paper-based tool was used to ascertain all maternal deaths that occurred at high-volume facilities on a quarterly basis. This assessment was conducted by

BOX 1. Health Workforce Development for Pader District

What worked for Pajule Level IV Health Center?

1. Human resource management: Identified and trained an interested health worker in anesthesia
2. District support for in-service training: Lobbied for funds from IntraHealth International to support the training of a staff member and also granted him a paid leave
3. Retention of staff member: Promoted the new anesthetic officer in order to retain him

an external team of project staff in conjunction with the MNCH improvement team. Results of the RAPID tool were used to confirm the maternal deaths captured in the POMS database. These data were vital to guide program implementation and timely reporting. Midwives and records officers were trained in the use of POMS and the RAPID tool for improvement.

Data improvement committees comprised facility and department in-charges, and records officers were established to meet monthly to review these data and discuss progress and data-quality issues. These officers also disseminated best practices between facilities and other stakeholders.

Quarterly aggregated data from participating public and private not-for-profit facilities in a district were shared and feedback provided to individual facilities during quarterly data review meetings (Box 2). These data were validated with data from the District Health Information System 2 (DHIS2) and the national health information reporting system. The project also maintained a Microsoft Excel database with monthly facility process and outcome indicators from which time-series charts were generated to track progress for each site and district.

The SMGL program strengthened reporting and data quality across all 118 supported facilities in the 7 SMGL-supported districts, with the 95 low-volume facilities providing MNCH program data through the national DHIS2 system. By December 2016, at the end of the SMGL program in Northern Uganda, the DHIS2 MNCH data were comparable with data from the POMS system in the 23 high-volume facilities. In the 9 unbranded SMGL-supported districts, the national DHIS2 system was strengthened through onsite mentorships and training in health management information system tools to collect quality data for reporting. Program performance in the unbranded SMGL-supported districts was assessed using DHIS2 data.

The SMGL program strengthened reporting and data quality across all 118 supported facilities in the 7 SMGL-supported districts.

BOX 2. Selected Saving Mothers, Giving Life Process and Output Indicators Monitored

Some of the indicators that were tracked:

- Active management of third stage of labor
- Postpartum hemorrhage rate
- Correct partograph use to monitor labor
- Successful newborn resuscitation
- Essential newborn care package

The SMGL established and/or revitalized MPDR committees at 67 HC IIIIs, HC IVs, and hospitals in the Phase 2 facilities.

SMGL also established and/or revitalized MPDR committees at 67 HC IIIIs, HC IVs, and hospitals in the Phase 2 facilities. These committees were trained during onsite coaching and mentorship visits and supplied with MPDR forms. The MPDR committees in each facility met monthly and were supported in submitting their MPDR reports to the MOH through their respective district health offices. To further support facility team work on the MPDR recommendations, district MPDR committees were established in all 7 SMGL-supported districts. These committees met quarterly to review recommendations made at the facility level and develop district-based maternal and perinatal mortality reduction action plans. The committees were incentivized through promoting feedback from the district and MOH on all notified deaths as well as participating in stakeholder meetings. Maternal and perinatal death surveillance and response (MPDSR) is expected to be sustained in the future through the MPDSR guidelines, which regulate all actors at community, health facility, district, national, and other sector levels. The MPDSR committees oversee implementation of these guidelines at the facility, district, and national levels.

Service Delivery

In line with the MOH national QI framework and strategic plan, QI teams were established in 118 health facilities to review MNH processes, identify gaps, implement solutions, and monitor performance. In the 20 high-volume facilities, hospitals and HC IVs, QI teams were trained to conduct MPDRs, provided with MPDR tools, and supported to address emerging gaps (Box 3).

CEmONC facilities were supported to perform cesarean deliveries. In Pajule HC IV (Pader District), Lalogi HC IV (Gulu District), and Ogur HC IV (Lira District), surgical theater functionality gaps were jointly identified with district leadership, and district resources were mobilized to

BOX 3. Community- and Facility-Level Interventions to Address the 3 Delays

Community-Level Quality Improvement Interventions to Address the First and Second Delays

1. Ensure that women with pregnancy signs in the community attend their first antenatal care visit in the first trimester
2. Identify pregnant women with complications for management at the health facility
3. Ensure that every pregnant woman has a birth plan and saves for emergency birth expenses and delivery at the health facility
4. Encourage postnatal follow-up visits to check for mother and newborn wellness (days 2–3 and 4–7)

Facility-Level Quality Improvement Interventions to Address the Third Delay

1. Routine screening for complications during antenatal and labor and delivery care
2. Active monitoring of the labor process using a partograph
3. Active management of the third stage of labor
4. Helping Babies Breathe and essential newborn care packages provided
5. Preterm delivery management through antenatal corticosteroid use and kangaroo mother care
6. Establishment of and support to district and facility maternal and perinatal death review committees

address them (Box 4). The project facilitated training of 14 staff members in theater operating procedures at regional referral hospitals of Gulu and Lira. Laboratory teams from 2 HC IVs (Ogur and Amach) received support for training in blood transfusion services at the Gulu regional blood bank to obtain accreditation. Lalogi and Pajule HC IVs already had the capacity to perform blood transfusions.

Practices relating to improving care during labor and delivery, particularly the use of partograph and active management of third stage of labor, and newborn care, specifically improving newborn resuscitation and provision of the essential newborn care package, were adopted. For instance, special newborn care corners were established in 5 of 8 HC IVs, and the technical capacity for newborn intensive care was enhanced at 2 regional referral and 3 general hospitals.

Community-Level Activities and Networks

Community-level activities included demand creation for quality MNH services, implementation of

change packages, data collection and reporting, and strengthening of community networks. Community-level activities were led by village health teams (VHTs), the lowest level in the National Health Service delivery system. VHTs were responsible for mobilizing and promoting community participation through activities described in the following section.

Community Activities to Address Delays 1 and 2

The SMGL initiative in the learning districts developed materials and tools to support behavior change communication, such as radio talk shows, job aids, and posters. VHTs worked with resource persons and utilized gatherings at worship places, ceremonies, and other events and places to disseminate information about ANC and facility deliveries. Some community dialogue sessions were targeted to communities with low coverage of facility deliveries. Interpersonal communication was used during the home-to-home approach to reach out to individual postpartum and pregnant mothers. This approach was used to address individual needs and barriers to health seeking. A community-facility care pathway was designed by USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project to standardize care for pregnant women and newborns (Figure 5). This pathway linked VHT activities to the facility and vice versa—with the facilities supervising VHT work—and formed the basis for community improvement team members, community processes, gaps analysis, monitoring, and coaching.

Through the SMGL intervention, VHTs mapped women of reproductive age (15 to 49 years) within their catchment area as well as community resources such as markets, religious houses, and traditional birth attendants that could all aid in increasing first ANC visits during the first trimester and health facility deliveries. Knowing where women lived and who they listened to facilitated identification of pregnancies through home-to-home visits and community engagements.

The program supported the formation and functionality of QI teams at the village, parish, subcounty, and district levels; supervision followed the same structures. The teams engaged health facility service providers and community health workers—as VHTs—in implementing interventions to increase first ANC visits and facility deliveries. Community-level trainings were conducted that empowered VHTs with knowledge, skills, and tools for identifying, referring, and

BOX 4. District-Led Initiatives to Make Functional Operating Theaters

- In June 2015, the project team and the Gulu district health office (DHO) and the Gulu regional referral hospital jointly visited Lalogi and Awach health centers (HC IVs) to identify the critical issues affecting theater functionality
- A report was prepared by the Gulu DHO and presented to the district council
- The district council resolved to allocate funds in the subsequent financial year to conduct renovations of the 2 theaters
- In February 2016, renovation work of both theaters commenced at both HC IVs and was completed within 6 months
- The SMGL project supported the training of facility teams in theater operating procedures, surgical skills, and blood transfusions

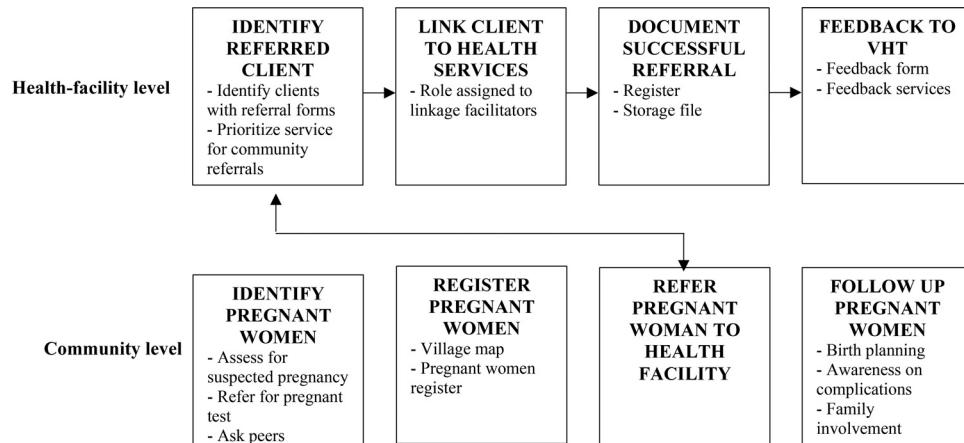
supporting women with suspected pregnancies. The VHTs then conducted home-to-home visits, registering women with suspected pregnancies and referring them to health facilities for pregnancy testing and first trimester ANC visits.

To allay myths and misconceptions surrounding early disclosure of pregnancy, which presents a barrier in first ANC uptake, the program supported community-level dialogue meetings and health education talks that engaged local leaders, pregnant women, male partners and mothers-in-law, health facility service providers, VHTs, traditional birth attendants, and district health office personnel.

Using a job aid, the project trained VHTs on the common danger signs in pregnancy and provided timely health facility referrals to pregnant women presenting with these signs. Every pregnant woman was supported in having a birth plan and saving for emergency birth expenses and delivery at a health facility. During the SMGL-supported community dialogue meetings with pregnant women, their partners, and local leaders, midwives and VHTs provided women with a list of essential items for labor and delivery. They also provided information on the cost of emergency transport and linked the women to existing village loans and savings associations for birth-related savings.

On average, pregnant women were saving US\$20 to \$30 for birth expenses. During each ANC visit, midwives checked to see how the women were progressing in acquiring birth items; a community follow-up was later conducted by the VHTs. To enhance emergency transportation of pregnant mothers in labor, contact information for reliable Boda-Boda riders (a motorbike taxi) and district ambulance drivers was shared during SMGL-supported community meetings.

Knowing where women lived and who they listened to facilitated identification of pregnancies through home-to-home visits and community engagements.

FIGURE 5. Health Facility and Community Care Pathway Developed

Source: USAID ASSIST Project | Uganda

Abbreviations: PW, pregnant woman; VHT, village health team.

Across the 7 SMGL-supported districts, the program engaged traditional birth attendants together with local leaders in meetings where midwives illustrated the risks of home deliveries for the mother and newborn. Traditional birth attendants were mapped according to villages and each was linked to a VHT in their catchment for follow-up. In front of their leaders, they committed to stop delivering women and, instead, committed to referring suspected pregnant women to the health facility for early ANC and escorting them to hospital for delivery.

A program evaluation obtained insights on how QI influenced improvements in care seeking, service provision, and reduction in maternal mortality in the communities and health facilities within the 7 SMGL Phase 2 districts.

METHODS

Wave-Sequence Approach

The wave-sequence approach focuses on spreading improved care delivery to other parts of a system. The term “wave” indicates that this method of spread occurs sequentially to reach increasingly larger sections of a health care system. Wave-sequence spread is used when it is not possible to cover the whole system all at once.⁶ Initial work in Wave I focused on improving quality of care and developing a team of regional mentors and coaches to support spread in Waves II and III. The community-level work began in Wave I, with interventions targeting 144 communities in the catchment areas of 16 of 20 high-volume facilities. Wave II involved deploying regional mentors and other learning platforms. Effective changes were spread from the 20 initial sites to 60 spread

facilities, and later to 38 Wave III facilities. Wave II focused on HC IIIs and Wave III on HC IIs. In a similar way, community interventions were also spread to 370 communities attached to 32 out of 98 spread facilities in the first wave, with the intention of identifying best practices and scaling up for the remaining communities in Waves II and III.

Program Evaluation

A program evaluation was carried out to obtain insights on how QI influenced improvements in care seeking, service provision, and reduction in maternal mortality in the communities and health facilities within the 7 SMGL Phase 2 districts. The evaluation was a facility- and community-based cross-sectional design and used a mixed-methods approach to enrich information on how QI activities influenced improvements. Both purposive and random selection procedures were used to obtain a reasonable representation of the different study groups and their related contextual conditions. In August 2016, cross-sectional data were collected through interviews with a random sample of MNH care providers and postpartum and pregnant mothers from select Phase 2 health facilities and communities, using a structured interview questionnaire.

The sample of facilities was determined based on the level of health facility, monthly volume of deliveries, and anticipated proportion of facilities with attributes of interest, such as those that

offered delivery services and were in the intervention sites. Other factors included the alpha error, confidence level, and margin of error. Thus, given a confidence level of 95% (1.96 confidence interval), margin of error (15%), p as the anticipated proportion of facilities with the attribute of interest (.5) $q = 1 - p$, and design effect, the evaluation covered 32 health facilities. The sample was adjusted to each facility type to accommodate both low- and high-volume facilities.

The sample for providers was estimated by considering the number and level of selected facilities, provider selection criteria, and the general human resource capacity at the facilities. Health workers who provide MNH services in each of the selected facility were interviewed. A total of 125 MNH care providers were purposively selected from 25 intervention facilities from the 7 SMGL Phase 2 districts.

A sample of 103 postpartum and pregnant mothers were purposively selected from 12 intervention communities in 7 SMGL Phase 2 districts. These mothers had more than 1 birth, with their last birth occurring within the intervention period (2015 to 2016). In computing the sample size for mothers, we considered the potential to use the sample to explore differences within the same group and the potential to assess different outcomes. The sample size was determined using the formula for the calculation of sample size in populations and thus considered a standard normal deviation of 95% confidence interval of 1.96 (z); proportion of women who attend ANC (p); the complementary probability of P ($1 - p$), that is, the percentage of women not attending antenatal visits (q); and alpha error of 5%. It is estimated that about 90% to 93% of pregnant women in Uganda had at least 1 ANC visit and 48% had 4 visits. With an expected response rate of 96%, an adjustment of the sample size estimate to cover for nonresponse was made by dividing the sample size calculated with a factor f , that is, n/f , where f is the estimated response rate. This process yielded a desired sample size of 104 mothers.

The SMGL facility component was assessed on the following domains: gains/value added to the quality of the work of health care providers, sustainability of SMGL activities, and the effect of SMGL activities on the quality of services and maternal deaths over the intervention period. Among beneficiaries (postpartum and pregnant mothers), emphasis was on understanding their experiences in terms of quality of services and satisfaction with provider services at the intervention facilities.

Quantitative data were analyzed using the Statistical Package for the Social Sciences for Windows version 16.0 (SPSS Inc., Chicago, IL, USA). Univariate analysis was conducted to describe the experiences of mothers and health care providers in SMGL-supported communities and health facilities, respectively. Descriptive statistics were obtained on quantifiable variables under assessment. Qualitative data with health care providers and mothers were transcribed verbatim into full text and coded using a thematic analysis to illuminate the context of interventions as a whole. The quotations included in the text best represent the range of ideas voiced around key themes and were edited without altering the meaning or violating anonymity.

■ RESULTS

Trends in Maternal Death Ratios and Newborn Death Rates

Trends in maternal death ratios and newborn death rates in the SMGL-supported districts of Northern Uganda were determined based on data from POMS and RAPID for the 23 high-volume facilities of the 7 SMGL-supported districts, and the results were triangulated with data from the national DHIS2 system. These data were also compared with DHIS2 data for a random sample of other districts in the region without SMGL interventions to estimate the effect of the interventions on maternal and newborn mortality. In addition, DHIS 2 data from the preintervention period (2014) in SMGL-supported Phase 2 districts were used as a baseline to estimate the effect of the intervention.

For the intervention districts, data for each indicator were computed to estimate the effect of the intervention and then compared with results in the DHIS2 for validation. DHIS2 results also documented maternal and newborn mortality in both SMGL Phase 2 and unbranded SMGL-supported districts to determine whether a reduction occurred in newborn and maternal deaths in SMGL-supported districts compared to the unbranded SMGL-supported districts in selected comparator facilities, using data captured in the national health management information system. Additional analysis was conducted to quantify the coverage of different services given to the mothers and their newborns at the intervention sites. Thus, the indicators used were not district level but reflect outcome data in these selected facilities.

Data in the national DHIS2 system, summarized in Table 2, show that the facility MMR in the

In the 7 Phase 2 SMGL-supported districts in Northern Uganda, MMR decreased by 21%, from 138 to 109 maternal deaths per 100,000 live births between 2014 and 2016.

TABLE 2. Summary of Key Maternal and Newborn Outcomes in National, SMGL, and Unbranded SMGL districts, 2014–2016^a

	National			Unbranded SMGL			SMGL		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
Maternal death									
Deliveries	862,538	1,122,838	998,162	42,218	47,215	45,721	45,631	49,174	50,521
Maternal deaths	1,071	1,543	1,807	25	50	38	63	60	55
Institutional MMR/100,000	124	137	181	59	106	83	138	122	109
Perinatal death									
Total births	845,877	936,790	980,574	41,914	46,591	45,629	45,697	48,814	49,855
Total perinatal deaths	27,464	33,589	30,248	1,064	1,476	1,059	1,529	1,628	1,267
PNMR/1,000 total births	32.5	35.9	30.8	25.4	31.7	23.2	33.5	33.4	25.4
Predischarge newborn deaths									
Total live births	825,303	914,387	958,398	41,137	45,740	45,011	44,482	47,455	48,831
Total early newborn deaths	6890	11,186	8,072	287	625	441	314	269	243
ENMR/1,000 live births	8.3	12.2	8.4	7.0	13.7	9.8	7.1	5.7	5.0
Fresh stillbirth									
Total births	845,877	936,790	980,574	41,914	46,591	45,629	45,697	48,814	49,855
Total fresh stillbirths	12,213	12,531	11,156	496	507	288	720	744	419
FSBR/1,000 total births	14.4	13.4	11.4	11.8	10.9	6.3	15.8	15.2	8.4

Abbreviations: ENMR, early newborn mortality rate; FSBR, fresh stillbirth rate; MMR, maternal mortality ratio; PNMR, perinatal mortality rate; SMGL, Saving Mothers, Giving Life.

^aRates are facility based.

7 SMGL-supported districts in Northern Uganda of Phase 2 decreased by 21%, from 138 to 109 maternal deaths per 100,000 live births, between December 2014 and December 2016. Nationally, the institutional MMR increased between 2014 and 2016 from 124 to 181 maternal deaths per 100,000 live births. With the spread of SMGL best practices in January 2016, institutional maternal mortality in the unbranded SMGL-supported districts in Northern Uganda was also reduced by nearly 22%, from 106 to 83 maternal deaths per 100,000 live births between 2015 and 2016.

Between 2014 and 2016, facility perinatal mortality rate was reduced by 25%, from 31.6 to 23.6 perinatal deaths per 1,000 live births, in the 7 SMGL-supported districts according to the DHIS2 (Table 2). With the spread of SMGL best practices to the 9 unbranded SMGL-supported districts from January 2016, the perinatal mortality rate fell by 25%, from 31.7 perinatal deaths per 1,000 live births in 2015 to 23.2 perinatal deaths per 1,000 live births by December 2016.

Nationally, perinatal mortality dropped between 2014 and 2016 (Table 2).

The predischarge newborn mortality rate also declined faster in the 7 SMGL-supported districts in Northern Uganda than the national average (Table 2). Predischarge newborn deaths were reduced by 30%, from 7.1 to 5.0 deaths per 1,000 live births between 2014 and 2016 in the 7 SMGL-supported districts of Northern Uganda. With the spread of SMGL best practices, the early newborn mortality rate was reduced by 28%, from 13.7 deaths per 1,000 live births in 2015 to 9.8 deaths per 1,000 live births in 2016. Nationally, predischarge neonatal deaths remained unchanged from 2014 to 2016, despite an increase in 2015 (Table 2).

The fresh stillbirth rate was reduced by 47%, from 15.8 to 8.4 stillbirths per 1,000 births between 2014 and 2016 in the 7 SMGL-supported districts (Table 2). With the spread of SMGL best practices, the fresh stillbirth rate was reduced by 43%, from 10.9 to 6.2 stillbirths per 1,000 births between 2015 and 2016 in the 9 unbranded SMGL-

supported districts. Nationally, fresh stillbirths also declined from 2014 to 2016, but to a smaller degree (21%) (Table 2). It is important to note that some mortality rates in unbranded SMGL-supported districts were lower in 2014 than in 2015 or even in 2016. This is likely because these districts were newly carved out from the old districts with a small number of facilities and population.

Improvements in Service Delivery

In Phase 2 facilities, over 90% of women were screened for hypertension and about 70% of women were screened for syphilis during ANC. All women received a uterotonic drug to prevent postpartum hemorrhage during delivery and about 90% of women were monitored using a partograph during labor. About 92% of babies not breathing spontaneously at birth were resuscitated successfully. Over 95% of newborns were discharged having received all elements of the essential newborn care package: cord care, eye care, skin-to-skin contact, initiation of breastfeeding within 1 hour of birth, thermal care, administration of injectable vitamin K, immunization with bacilli Calmette-Guerin and polio vaccines, and screening for infections.

The institutional delivery rate in the 118 facilities in the 7 Phase 2 SMGL-supported districts increased by 5.2% between 2014 and 2016. Access to cesarean delivery also increased as 3 more HC IVs began offering this service, giving a total of 8 facilities providing this intervention. Overall, the facility-based cesarean delivery rate increased from 3.9% to 4.2% of deliveries. The number of mothers receiving antiretroviral therapy (option B+) for the prevention of mother-to-child transmission of HIV increased by 39.9% in these facilities, and the rate of low birthweight was reduced by 31.8%.

The Effect of QI on Care Seeking and Service Delivery

The 103 postpartum and pregnant mothers were asked about their experiences with the services provided at a health facility during ANC to assess service satisfaction from the QI interventions. The provider was central to their assessment of quality of services at the facility. Politeness of nurses ($n=76$, 74.2%), clear explanations provided by nurses during health talks ($n=54$, 52.6%), and time spent with the nurses ($n=40$, 38.7%) stood out as positive experiences (Figure 6).

When asked about the health workers' attitudes toward mothers at ANC, mothers expressed that providers were receptive and described them as welcoming, good, friendly, and caring. These comments resonate with the results indicating an increase in use of ANC and health facility delivery, described above, and are validated by the following comments:

They were positive [health care providers]. I still had blood coming out from me. They prescribed drugs and told me to return for follow-up. (Mother from Apac)

They treat mothers with love and respect. They are also happy when the baby is clean and healthy. (Mother from Apac)

They [health care providers] are always understanding and educate us [mothers] on what to do and how to eat in order to regain the lost blood. (Mother from Dokolo)

They have a good attitude, but they treat you according to how you are caring about your child, for example, washing the baby's clothes. (Mother from Nwoya)

Postpartum and pregnant mothers were asked about their impression of the services at their last ANC visit and delivery, compared to their previous birth. They largely pointed to a positive change in the quality of services and expressed that health workers were more polite during the most recent pregnancy:

In the past, health workers were rude to me [mother], but these ones [health care providers] are humble and polite. (Mother from Gulu)

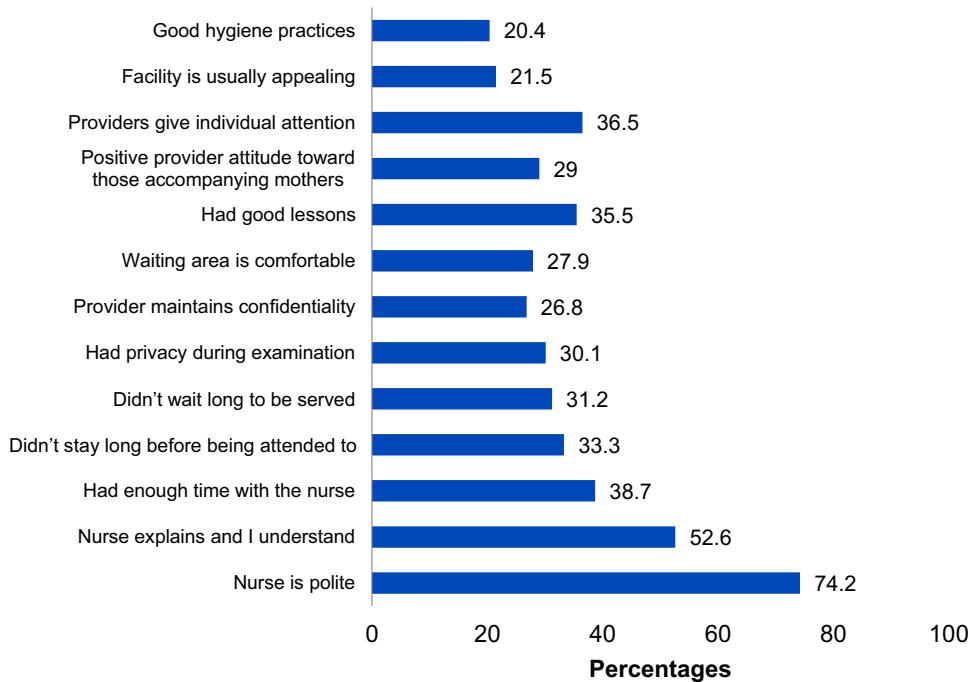
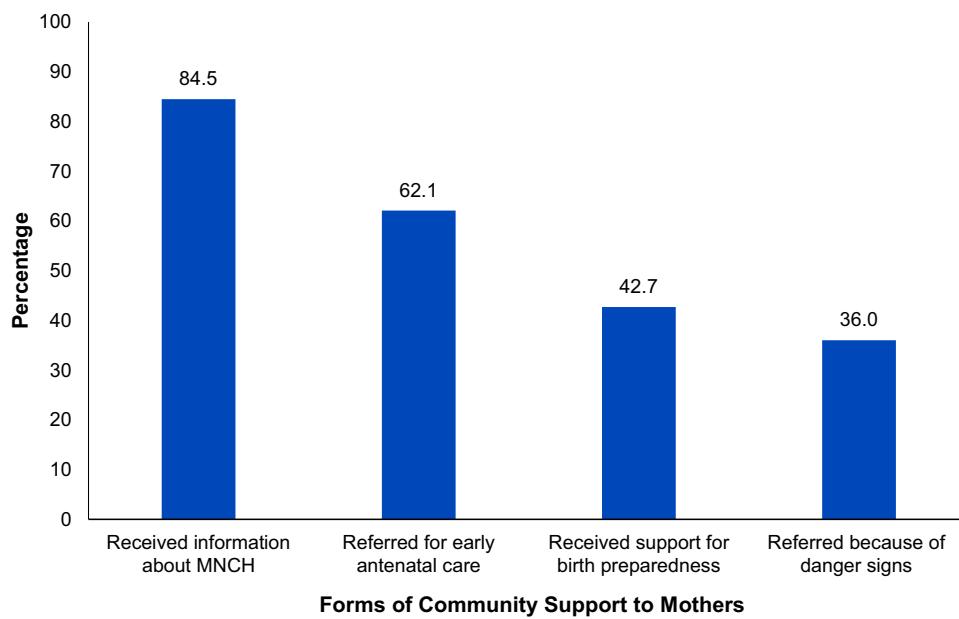
[T]he current ones are more caring than the previous ones. In fact there is an improvement in the quality of services. The services are better compared to the previous ones. (Mother from Apac)

It [health care services] was much better this time because health workers seem to work faster on the pregnant women. (Mother from Nwoya)

Postpartum and Pregnant Mothers' Experience of VHT Work

In Figure 7, mothers were asked about the form of support received from the community health workers (VHTs). More than 80% had received information about maternal and newborn care from VHTs and 62% ($n=64$) had been referred for early ANC by VHTs. Only 36% ($n=37$) were referred by

When asked about the health workers' attitudes toward mothers at ANC, mothers expressed that providers were receptive and described them as welcoming, good, friendly, and caring.

FIGURE 6. Postpartum and Pregnant Mothers' Experiences With Antenatal Care Services (n=103)**FIGURE 7.** Forms of Community Support to Postpartum and Pregnant Mothers (n=103)

Abbreviation: MNCH, maternal newborn, and child health.

VHTs because of pregnancy danger signs. More than two-fifths (43%) of VHTs were reported as supporting postpartum and pregnant mothers in preparing for birth.

Effect of QI Strategies on MNH Services Over the Intervention Period

Following implementation of QI strategies, health care providers in the Phase 2 districts were asked to look back to the period before SMGL activities at their respective facilities and compare MNH services before and after SMGL. All (n=125, 100%) of the providers stated that the quality of service delivery improved and maternal and newborn deaths were reduced at their facility. All of the providers also reported that facility deliveries improved in the previous year, which they mainly attributed to the home-to-home activities of the VHTs and use of ANC charts during their health education talks with women and other villagers.

The use of partographs to monitor women during labor improved following SMGL interventions with more than 50% (n=63) of providers reporting attaining skills in use of partograph through the mentorship approach. This is illustrated by a comment from a health care provider in Nwoya:

I learnt how to carry out syphilis test and to use a partograph for monitoring mothers during labor. (Health care provider from Nwoya)

Three-quarters of the health care providers (n=94, 75%) cited a reduction in the number of mothers referred to a higher-level facility, as illustrated by the following comment:

There are now a few mothers being referred for higher level care from this facility. (Health care provider from Gulu)

Effect of QI Strategies on Provider Skills

All of the health care providers (n=125, 100%) reported that SMGL improved the way they work, citing their skills and standard of work as being improved due to SMGL coaching/mentorship:

There is increased interest in work because with the skills and knowledge gained, work can be easier. (Health care provider from Apac)

Health workers also indicated that they gained skills in the uptake of evidence-based practices, such as use of partograph, newborn resuscitation,

documentation, and data use to inform decisions. This gain is expressed in the following comment:

I am able to monitor my work through documentation journal. (Health care provider from Gulu)

However, more than half (n=80, 64%) of providers expressed concerns about an increased workload resulting from implementation of QI activities. Directly, mentorship activities took time that would otherwise be spent with mothers. Indirectly, more mothers came to facilities following QI activities at the community level, yet staffing levels remained constant.

All providers stated that the quality of service delivery improved and maternal and newborn deaths were reduced at their facility.

Sustainability of QI Activities at Facility and Community Levels

The majority (n=112, 90%) of providers thought that all SMGL activities could be sustained since the QI strategies are in the required guidelines for MNH. The following items were repeatedly singled out as possible areas for continuity: use of partograph, referral of mothers from communities, continuous medical education in place of SMGL onsite training, documentation, use of emergency tray, kangaroo method of care, and use of tests, such as HIV testing, urinalysis, and blood pressure checks. This finding is expressed in the following quotations:

Active management of the third stage of labor, use of partograph, essential newborn care and all activities shall continue at this facility. (Health care provider from Dokolo)

All activities can be sustained as long as you do it properly. (Health care provider from Gulu)

All activities can be sustained. (Health care provider from Nwoya)

The quality improvement teams will continue. (Health care provider from Apac)

All VHTs (n=36, 100%) expressed continuity of 1 or more QI activities within their mandate since all aspects of their work are voluntary. Such activities included house-to-house visits by VHTs, health education, and referral. Asked about how these activities can be sustained, providers suggested taking advantage of the already established relationships with the clergy to educate the population and using their location to reach women within their own communities, as illustrated by the following statements:

All health care providers reported that SMGL improved the way they work, citing their skills and standard of work as being improved due to SMGL coaching/mentorship.

Following up these mothers and referral will remain since we as VHTs, we stay with these mothers in the community. (VHT from Lira)

We will continue sensitizing the women about facility delivery and ANC. (VHT from Gulu)

We shall remain working even when the project ends. (VHT in Pader)

QI approaches are increasingly being used in low- and middle-income countries to strengthen health systems and to improve service delivery and health outcomes.

Challenges Experienced in Implementing QI Strategy

Health care providers expressed the most common challenges were associated with workload due to understaffed critical cadres, rotation of staff, poor documentation, late reporting of mothers for delivery, long distances to the facility, inadequate resources, occasional stock-out of partographs, and inconsistent supply of drugs, mama kits, and mosquito nets (Figure 8).

At the community level, challenges were documented, such as limited VHT skills and knowledge of MNH, while the health needs of the women are diverse; their work is hindered by inadequate resources for the women, especially transport to the health facility; long distance from home to the facility makes it hard for referred mothers to keep their ANC appointments; nonadherence of mothers to VHT guidance; and poverty in the community (Figure 9).

■ DISCUSSION

QI approaches are increasingly being used in low- and middle-income countries to strengthen health

systems and to improve service delivery and health outcomes. Much of the literature on QI approaches in these settings focuses on documentation of implementation and process evaluation.⁸ A few studies, such as one in Ecuador,⁹ have described scale-up processes for QI interventions. This paper describes an intervention that used a wave-path approach.

In Ghana, a quasi-experimental, pre- and post-intervention analysis of the QI intervention analyzed system deficiencies and 97 improvement activities that were implemented between January 2007 and December 2011. Data were collected on outcomes and implementation rates of improvement activities. Maternal mortality decreased by 22% between 2007 and 2011, from 496 to 385 maternal deaths per 100,000 live births, despite a 50% increase in deliveries and 5- and 3-fold increases in the proportion of pregnancies complicated by obstetric hemorrhage and hypertensive disorders of pregnancy, respectively.¹⁰ This multitiered QI strategy in Ghana showed that within 7 months of introduction of a QI program to triage sick mothers and to clean and organize the neonatal intensive care unit to reduce errors, there was a 4-fold reduction in the percentage of mothers needing emergency cesarean surgery with unacceptable waiting times, over 93% accuracy in identification of the sickest mothers, and a 37% increase in hand hygiene compliance.¹⁰

In our intervention using the wave approach to scale up QI in Phase 2 districts, a decline in

FIGURE 8. Common Challenges Faced in Implementation of Quality Improvement Strategies (n=125)

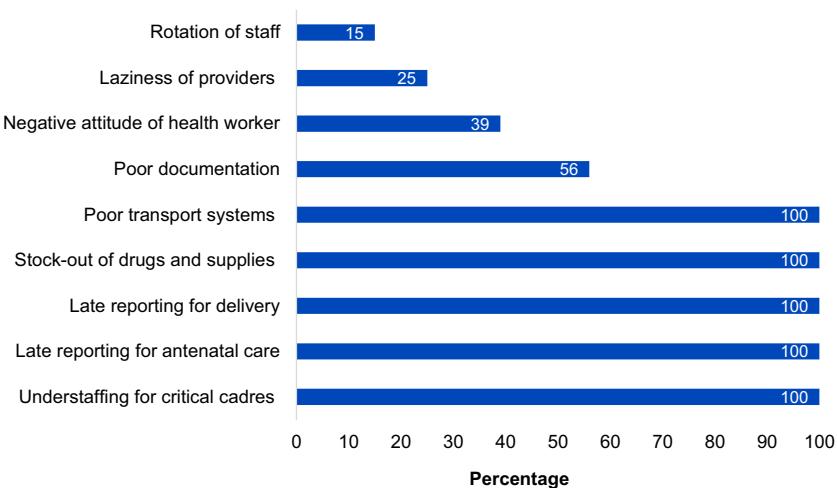
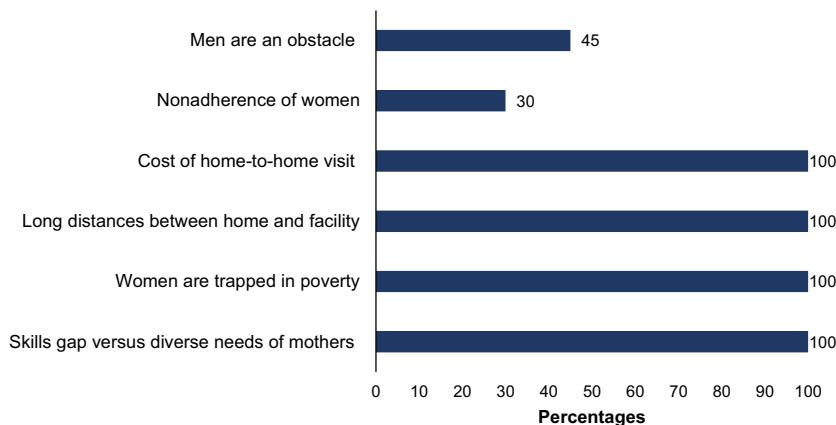


FIGURE 9. Common Challenges Faced by Village Health Teams in Percentages (n=125)

maternal and perinatal mortality within 2 years was associated with the project's activities to strengthen the health system. Similar results were not observed in the unbranded SMGL-supported districts in Northern Uganda until 2016, when best practices from the Phase 2 SMGL intervention districts were spread to 9 other districts in Northern Uganda.

Between December 2014 and December 2016, data from the Uganda DHIS2 systems showed that institutional MMR decreased by 20%, from 138 to 109 maternal deaths per 100,000 live births in 2016 in the Phase 2 facilities. In the 9 unbranded SMGL-supported districts of Northern Uganda, institutional maternal mortality was reduced by 21% to 75 maternal deaths per 100,000 live births with the spread of SMGL best practices starting in January 2016.

Newborn deaths have also been reported to decline with QI techniques. Endline analysis to assess the standard of neonatal care found a reduction in mortality rate among newborns admitted to Central Beira Hospital's Neonatal Intensive Care Unit after the first year of the Doctors with Africa CUAMM intervention in Mozambique. Most of this reduction was attributed to the decrease in deaths from asphyxia, sepsis, and prematurity.¹¹

In the Uganda Phase 2 districts, we found a decline in the perinatal mortality rate (stillbirth plus pre-discharge/early newborn mortality) between 2014 and 2016. A decrease of 25% was observed in the 7 SMGL-supported districts, from 31.6 to 23.6 deaths per 1,000 births between

2014 and 2016. The reduction in stillbirths implied improvement in the quality of labor and delivery care. In the 9 unbranded SMGL-supported districts of Northern Uganda, the perinatal mortality rate declined by 25% within 1 year with the spread of SMGL best practices starting in January 2016. System-strengthening activities addressing the main gaps in service delivery through the work of QI teams, supported by district management and QI coaching from the USAID ASSIST Project, were the most important factors explaining the observed results. The ASSIST Project provided QI technical assistance to Uganda's MOH and implementing partners with the overall goal of providing quality health services and building a system through which these services can be delivered in a sustainable way.

It is widely agreed that communities should take an active part in improving their own health outcomes.¹² Although strategies vary considerably, community-based interventions may encompass encouraging healthier practices and care seeking among communities and families, recruiting and training local community members to work alongside trained health care professionals, and community member involvement in service provision, including diagnosis, treatment, and referral. A range of approaches exist within these broad categories, including community health workers, traditional birth attendants, health campaigns, school-based health promotion, home-based care, and even community franchise-operated clinics.¹³ In the Northern Uganda districts, as the health care

Between December 2014 and December 2016, data from the Uganda DHIS2 systems showed that institutional MMR decreased by 21%, from 138 to 109 maternal deaths per 100,000 live births in Phase 2 facilities.

It is widely agreed that communities should take an active part in improving their own health outcomes.

service delivery systems improved, the uptake of facility deliveries also increased, supported by the community component of the intervention. VHTs educated mothers on the importance of timely ANC and facility deliveries, which resulted in increases in early ANC attendance and births in facilities.

The use of data and the improvements in the health management information system led to identification of priorities for targeted QI efforts that led to improvements in the quality of care. The established monitoring and evaluation activities of the SMGL initiative and functionalized data improvement committees at facility and district levels conducted meetings on a monthly and quarterly basis, respectively. Death reviews informed facility teams on the causes of death that led to further QI activities. For example, Helping Babies Breathe skills laboratories were established and supported in selected high-volume facilities where newborn deaths were high due to birth asphyxia, improving staff skills in newborn resuscitation. Collectively, these interventions were associated with reductions in maternal and perinatal deaths within the relatively short period of the intervention.

In settings with limited registration of births and deaths and incipient health information systems, monitoring of maternal mortality is largely done through model-based estimates.³ POMS, RAPID, and national DHIS2 systems were direct sources for estimating the effect of the intervention by contrasting maternal deaths in the intervention and unbranded SMGL-supported facilities prior to and after the spread of SMGL best practices. These data sources were used to track changes in service delivery and maternal deaths resulting from the intervention.

The interventions were rolled out by QI teams operating at different levels, including district, health facility, and community. Our results suggest that to kick-start improvement activities and achieve impact in a short period of time, implementers need to identify critical elements of maternal and newborn care package; define standard care pathways in the community and at the health facility; communicate with and engage key actors at each step in the process; form improvement teams comprising the different actors in each care step; use champions at district, facility, and community levels to scale up and support other sites; identify and review data regularly for decision making; and use a systematic scale-up strategy to spread better practices throughout a large geographic area.

CONCLUSION

A participatory health system strengthening approach applied in the SMGL initiative in the Northern region of Uganda had a positive effect on reducing institutional maternal and newborn mortality. Working at all levels of the health system not only strengthens the system but also fosters better performance through supportive leadership, engaged improvement teams, well-supplied facilities, trained health workers, and social support networks. Linking community activities with health facilities is a key strategy for reaching target populations and improving care seeking. The participatory nature and skill-building potential of improvement activities was important for overcoming barriers to quality of care associated with limited skills.

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ORIGINAL ARTICLE

Sustainability and Scale of the Saving Mothers, Giving Life Approach in Uganda and Zambia

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The Saving Mothers, Giving Life district health systems strengthening approach provides a sustainable model for reducing maternal mortality at scale. Lessons from the learning districts demonstrated increased efficiency in allocation of resources for maternal and newborn health, better use of strategic information, improved management capacities, and increased community engagement.

■ ABSTRACT

Background: Saving Mothers, Giving Life (SMGL) significantly reduced maternal and perinatal mortality in Uganda and Zambia by using a district health systems strengthening approach to address the key delays women and newborns face in receiving quality, timely, and appropriate medical care. This article documents the transition of SMGL from pilot to scale in Uganda and Zambia and analyzes the sustainability of the approach, examining the likelihood of maintaining positive trends in maternal and newborn health in both countries.

Methods: We analyzed the potential sustainment of SMGL achievements using a tool adapted from the HIV-focused domains and elements of the U.S. President's Emergency Plan for AIDS Relief Sustainability Index and Dashboard for maternal and neonatal health programming adding a domain on community normative change. Information for each of the 5 resulting domains was drawn from SMGL and non-SMGL reports, individual stakeholder interviews, and group discussions.

Findings: In both Uganda and Zambia, the SMGL proof-of-concept phase catalyzed commitment to saving mothers and newborns and a renewed belief that significant change is possible. Increased leadership and accountability for maternal and newborn health, particularly at the district and facility levels, was bolstered by routine maternal death surveillance reviews that engaged a wide range of local leadership. The SMGL district-strengthening model was found to be cost-effective with cost of death averted estimated at US\$177-206 per year of life gained. When further considering the ripple effect that saving a mother has on child survival and the household economy, the value of SMGL increases. Ministries of health and donor agencies have already demonstrated a willingness to pay this amount per year of life for other programs, such as HIV and AIDS.

Conclusion: As SMGL scaled up in both Uganda and Zambia, the intentional integration of SMGL interventions into host country systems, alignment with other large-scale programs, and planned reductions in annual SMGL funding all contributed to increasing host government ownership of the interventions and set the SMGL approach on a path more likely to be sustained following the close of the initiative. Lessons from the learning districts resulted in increased efficiency in allocation of resources for maternal and newborn health, better use of strategic information, improved management capacities, and increased community engagement.

■ INTRODUCTION

Maternal mortality is viewed as a nearly intractable problem in the developing world where the vast majority of maternal deaths occur. When Saving Mothers, Giving Life (SMGL) began in 2012, Uganda's maternal mortality ratio was 310 maternal deaths per every 100,000 live births and in Zambia, 440 maternal deaths per every 100,000 live births.¹ While the medical interventions to prevent mortality were well known, there was limited evidence that significant reductions in

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the maternal mortality ratio were possible in the short term. The SMGL initiative hypothesized that a health systems approach would demonstrate significant reductions in maternal and newborn mortality in Uganda and Zambia.² The SMGL approach addressed key principles using interventions based on local context (Box 1). We hypothesized that tailoring interventions to country public health systems and cultural contexts would also enhance sustainability.

SMGL was designed within the context of the Accra Agenda for Action (2008) and publication of the Africa Union's *Campaign on Accelerated Reduction of Maternal, Newborn and Child Mortality in Africa (CARMMA)* (2009) and the World Health Organization's *The Abuja Declaration: 10 Years On*³ (2011) and *Beginning with the End in Mind: Planning Pilot Projects and Other Programmatic Research for Successful Scaling Up* (2011).⁴ Initiated within the U.S. Government's Global Health Initiative (GHI), SMGL employed country ownership and strategic coordination/integration as its guiding principles.⁵ It promoted a whole-of-U.S. Government approach to management, incorporating the U.S. Agency for International Development (USAID), U.S. Centers for Disease Control and Prevention, U.S. President's Emergency Plan for AIDS Relief (PEPFAR), Peace Corps, and Department of Defense. From its inception, SMGL was designed to reinforce and strengthen the existing host government health system, build on extant service-delivery platforms—particularly at the district level, and enable countries to achieve their own vision for improved maternal and newborn health.⁶ It was designed to be sustainable and have a clear pathway, through host country systems, to scale. In fact, the majority of the interventions supported by SMGL were not “new” to the host country; rather, they were existing interventions that were refined, strengthened, and, in most cases, taken to greater scale of implementation through partnership. During Phase 1 (2012–2013), SMGL was piloted in 4 districts in Zambia and 4 districts in Uganda—later split into 6 districts in each country—with high maternal mortality. During Phase 2 (2013–2017), the program increased the number of districts to 18 in Zambia and 13 in Uganda.

The SMGL theory of change built on a district health systems strengthening approach to surmount critical demand- and supply-side delays that prevent women and newborns from receiving basic and emergency care in a timely manner while also increasing capacity and resilience of the health care system² (Figure 1).

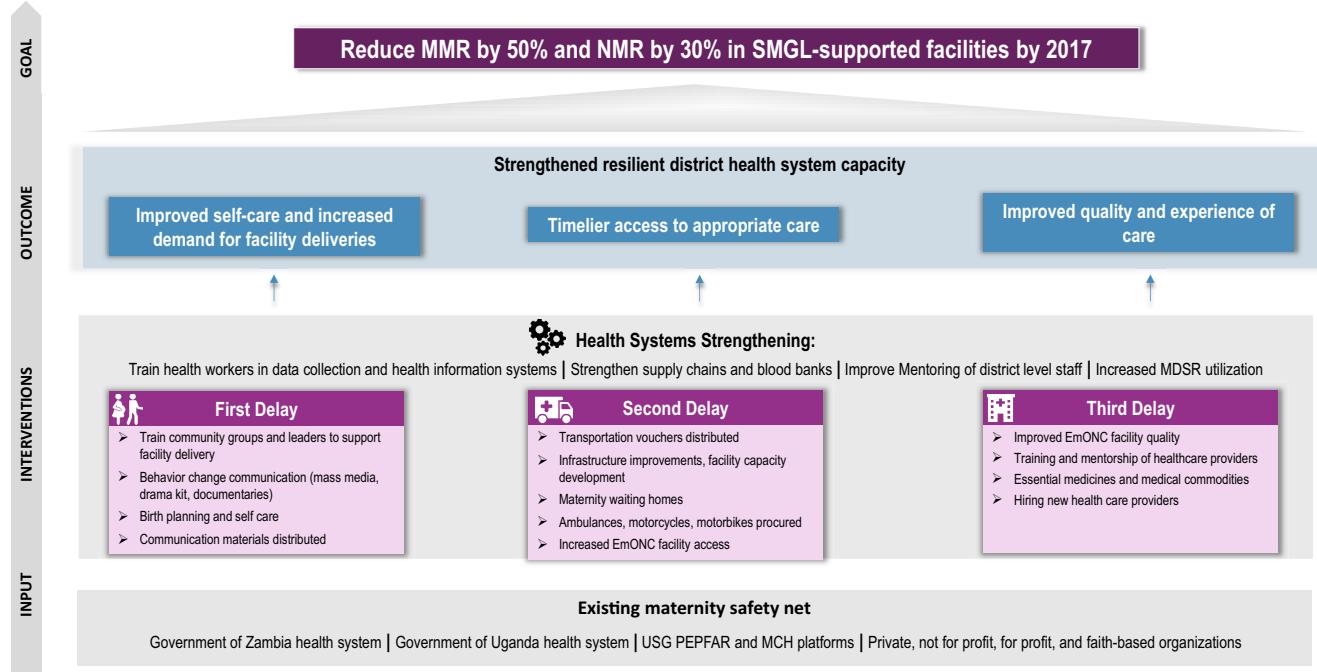
BOX 1. SMGL Primary Principles

SMGL primary principles include:

1. Surmount the 3 main delays—whether supply- or demand-side—to women receiving lifesaving care
2. Assess and strengthen the existing safe-motherhood safety net in a district, addressing gaps and mobilizing all types of service providers—whether public, private, nongovernmental, or faith-based organization
3. Integrate maternal health care, HIV-related services including prevention of mother-to-child transmission of HIV, and family planning
4. Improve care during labor, delivery, and the first 48 to 72 hours and organize services to ensure access to emergency obstetric care within a 2-hour travel window
5. Capture, analyze, and report all maternal and newborn deaths in a district

The concept of ‘scale’ in this situation—referring to the geographic expansion of the SMGL-supported district-wide approach to maternal, perinatal, and newborn mortality reduction through government and other partner financing—is particularly important given that SMGL began as a proof of concept and, even at the end of the initiative, only covered a small percentage of each country’s population. To date, the SMGL approach has been taken to scale in 6 of the 10 provinces in Zambia through the government-led Reproductive, Maternal, Newborn, Child, Adolescent Health and Nutrition (RMNCAH/N) Continuum of Care (CoC) program, covering 53% of Zambia’s population (Figure 2). Scaled up through the Ministry of Health (MOH)—with additional direct funding from the Swedish International Development Cooperation Agency (Sida), USAID, and the U.K. Department for International Development (DFID)—the RMNCAH/N CoC program adapts the district- and province-wide health systems strengthening approach with attention to access, demand, quality, and system strengthening and expands focus beyond the 72 hours around delivery to the broader life-cycle for women, adolescents, and children. A majority (80%) of the almost US\$125 million total funding (over 5 years—2016 to 2021) were earmarked for direct funding to the districts, with the remaining 20% identified for the province and national levels.

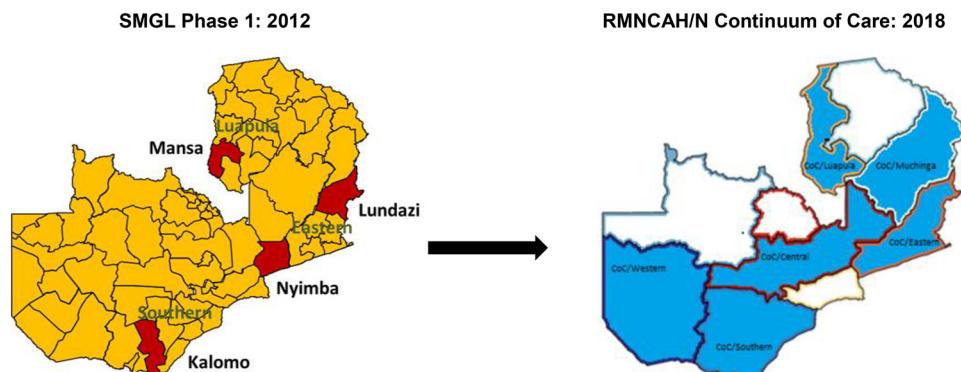
USAID and DFID have procured further technical assistance to continue systems strengthening interventions and focused support to scale up best practices, such as mentorship and data for decision making. SMGL’s core interventions (Figure 1) are included in the RMNCAH/N CoC program with a similar approach to first addressing capital investments—such as lifesaving skill

FIGURE 1. SMGL Theory of Change Model

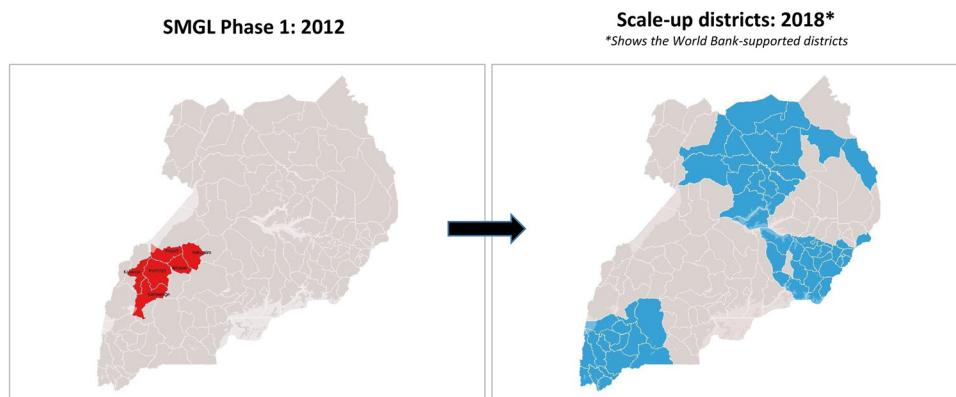
Abbreviations: EmONC, emergency obstetric and newborn care; MCH, maternal and child health; MDSR, maternal death surveillance and response; MMR, maternal mortality rate; NMR, neonatal mortality rate; SMGL, Saving Mothers, Giving Life; USG, U.S. government.

development, deployment of skilled birth attendants, infrastructure upgrades, construction of maternity waiting homes, and procurement of equipment and vehicles—followed by a shift in

focus in subsequent years to supporting recurring costs, providing strategic mentorship, and conducting outreach. Maternal and newborn health continues to have a significant focus under the

FIGURE 2. Scale-Up of SMGL Approach in Zambia, 2016–2021

Abbreviations: COC, continuum of care; RMNCAH/N, reproductive, maternal, newborn, child, adolescent health and nutrition; SMGL, Saving Mothers, Giving Life.

FIGURE 3. Scale-Up of SMGL Approach in Uganda Through World Bank Support, 2016–2021

Abbreviation: SMGL, Saving Mothers, Giving Life

CoC program and is the largest technical area of funding, with the majority of districts requesting funds for community-level Safe Motherhood Action Groups (SMAGs), emergency obstetric and newborn care (EmONC) training, maternity waiting homes or staff housing, and mentorship.

In Uganda, scale-up will reach approximately 75% of all districts in 2018 with support from World Bank Global Financing Facility activities; Belgium government-supported maternal, newborn, and child health projects; and USAID maternal and child health programs. The Uganda MOH's *Investment Case for Reproductive, Maternal, Newborn, Child and Adolescent Health Sharpened Plan for Uganda*⁷ drew heavily on the SMGL experience and lessons learned⁸ and will serve as the guiding document for sector investments. "SMGL helped the MOH to take a health systems approach with district leadership," explains Dr. Jesca Nsungwa Sabiti of the MOH. At the national level, SMGL provided a testing ground for the Uganda MOH on the impact of providing salary supplements to increase the number of doctors in rural areas. This laid the groundwork for the Wage Bill,⁹ which was aimed at hiring additional doctors at level 4 health center facilities to provide surgical delivery, decongesting district hospitals, and bringing comprehensive EmONC (CEmONC) capacity closer to rural populations. The Wage Bill, put in place in 2016, included allowances to incentivize physicians to serve in rural areas and to improve doctor-to-patient ratios. Related reforms will take effect in 2018 and 2019.⁹

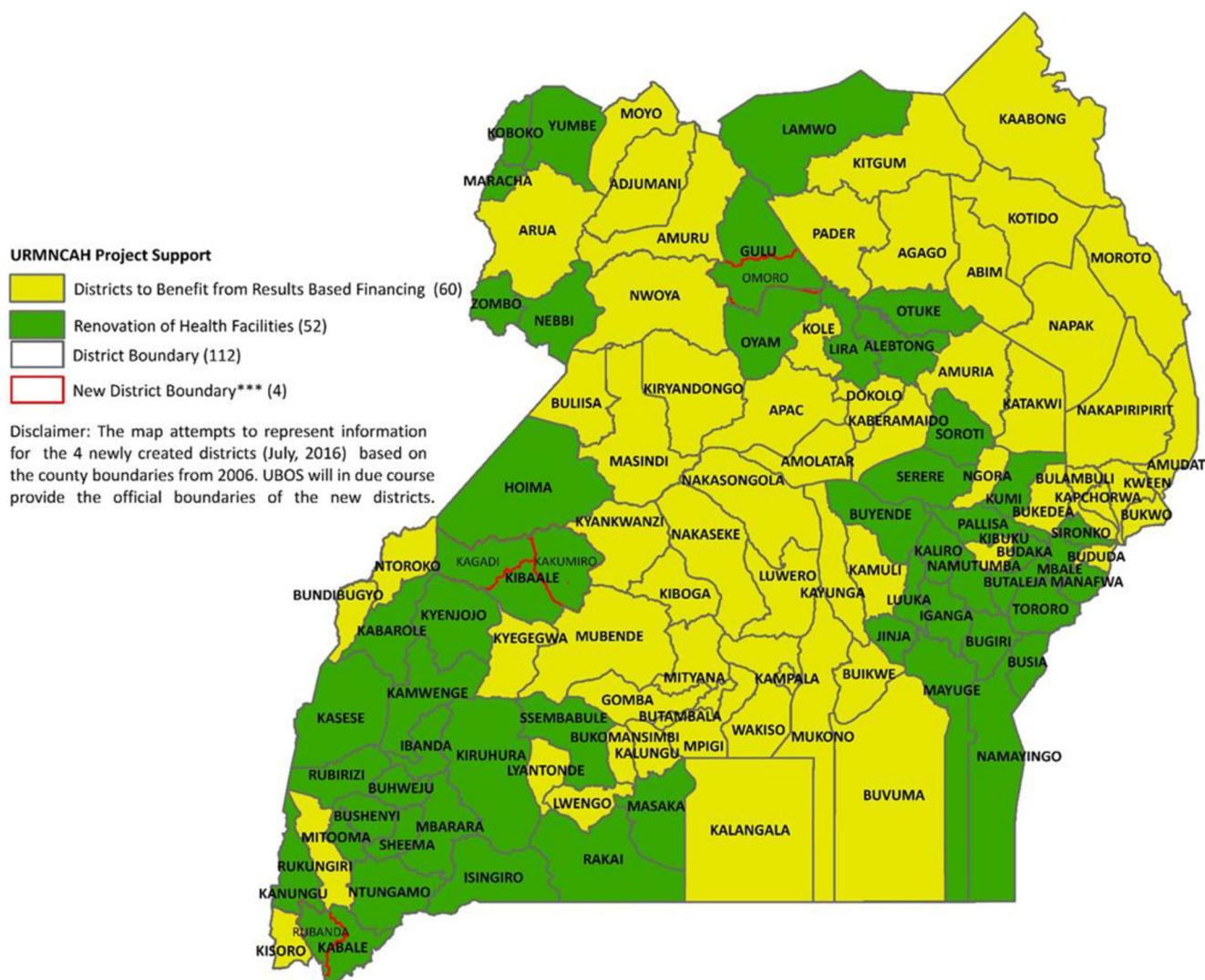
The Uganda Reproductive, Maternal, and Child Health Services Improvement Project,¹⁰ developed in 2016 by the World Bank and launched in 2017, will take the SMGL health systems approach to scale in 80 of Uganda's 121 districts (Figure 3). Another World Bank-supported program, the Uganda Reproductive Health Voucher Project, includes a modified version of the piloted SMGL program that provides vouchers for poor women to access safe delivery.

The USAID-funded Regional Health Integration to Enhance Services project,¹¹ covering 61 districts, and Belgium Government investments¹² in maternal and child health, similarly built on core components of the SMGL approach through results-based financing (Figure 4).

In 2014, Nigeria was added as the third SMGL country with implementation continuing through September 2019. Although this article does not assess the prospective sustainability in Nigeria directly, it documents the global scale of the SMGL approach in Cross River State, which is composed of 18 local government authorities with a total population of 3.7 million. The SMGL 'whole market' or health systems strengthening approach is employed with involvement of both public and private providers and supported by funding provided from Cross River State, USAID, and Merck for Mothers. Geographic information system travel-time mapping was used to select EmONC facilities that needed to be upgraded in order to increase women's access to lifesaving care in their catchment areas. Since SMGL entered Phase 2 in 2014, other countries, including Afghanistan, have

For the Uganda Ministry of Health, SMGL provided a testing ground on the impact of providing salary supplements to increase the number of doctors in rural areas.

FIGURE 4. Scale-Up of SMGL Approach in Uganda Through Regional Health Integration to Enhance Services, 2012–2022



Abbreviations: UBOS, Uganda Bureau of Statistics; URMNCAH, Uganda reproductive, maternal, newborn, child, and adolescent health.

redesigned their maternal and newborn programs based on the SMGL approach.¹³

In the context of the significant scale-up of the SMGL approach in Uganda and Zambia, we analyzed the likelihood that the approach will be sustained and, in turn, that the encouraging results will continue on a larger scale.

Method: Sustainability Framework

The SMGL design and approach was influenced by existing global thinking, with strong emphasis on reducing maternal and newborn mortality

in Africa, increasing country ownership, and strengthening local capacity.¹⁴⁻¹⁷ In 2009, the U.S. Government launched GHI, which characterized country ownership as the ability of the government, communities, civil society, and private sector to lead, prioritize, implement, and be accountable for a country's health response as outlined by a 4-dimensional framework: (1) political leadership and stewardship, (2) institutional and community ownership, (3) capabilities, and (4) mutual accountability, including finance. Since that time, ideas related to country ownership and capacity strengthening have evolved and focused

on the ultimate goal of sustainability beyond foreign assistance. Our focus on sustainability looks at whether the results of SMGL, particularly maternal and perinatal mortality reduction, will continue at similar rates after the initiative and whether the approach will continue to be used in host country systems.

SMGL was designed based on the GHI principles and built on PEPFAR's foundational work and partnerships in-country during that period.^{18,19} Our primary question was: If we can be so successful in reducing deaths to people living with HIV and AIDS, why not for mothers giving birth?

In 2014, PEPFAR developed the Sustainability Index and Dashboard (SID) that covers 4 domains of sustainability: (1) governance, leadership, and accountability; (2) national health systems and service delivery; (3) strategic investments, efficiency, and sustainable financing; and (4) strategic information.⁶ Although designed for HIV and AIDS, SID provides a familiar framework for assessing sustainability and supplements global and host country literature in this area.^{20,21} We modified the SID domains with questions specific to maternal and newborn health and added a domain of "community normative change" to assess the prospective sustainability of SMGL interventions in reducing maternal and newborn mortality along the 3 delays. The added domain measured social and behavior change, demand for quality services, and the role of local leaders and champions in influencing change (**Table 1**).

To collect information on sustainability, 86 key informants from the SMGL-supported districts in both Uganda and Zambia, the countries' respective ministries of health, the U.S. Government, and implementing partners were interviewed individually, in person or by phone, or in group discussions (**Table 2**). Key informants came from a range of SMGL districts, and additional in-depth interviews were held with select informants from the original Phase 1 SMGL districts. In addition to reviews of key stakeholder interviews, data from the health facility assessments (HFAs) on capacity and readiness of the system to provide EmONC signal functions were extracted to provide a clear understanding of the existing maternal health safety-net in the original SMGL-supported districts in each country. HFAs were carried out at 3 time-points: (1) at baseline in 2012, to inform SMGL planning and design and needed investments; (2) at the end of the pilot year in 2013, to gauge progress and inform funding and

operational decisions during years 2 to 4; and (3) at initiative endline in late 2016, to assess outcomes. After assessing the 5 domains of sustainability, major findings were organized into the main SMGL focal areas of demand for care, access to care, quality of care, and overall health systems strengthening.

■ RESULTS

The most salient findings from the data review and stakeholder interviews across adapted SID domains are presented here.

Community Normative Change

In several languages in Uganda and Zambia, the greeting of a mother who has given birth includes an element of surprise and relief that she has survived the perils of childbirth: in Bemba, *Mwapusukeni* ("You have survived"); and in Luganda, *Kulika omwana* ("Thank God you have survived with this baby"). Overcoming fatalism and encouraging confidence in a health care system that can respond to the complications related to birth is an important step in increasing demand for facility-based deliveries. Also essential are skilled and competent birth attendants and communities that are engaged to champion this change. The most significant evidence of sustainability in this domain is the formalization and institutionalization of robust community volunteer groups to champion maternal and newborn health; continuation of activities and leadership for maternal health from change champions; and proliferation of maternity waiting homes by diverse funding actors in collaboration with local communities in Zambia. Birth plans may be sus-

SMGL was designed based on the GHI principles and built on PEPFAR's foundational work and USG partnerships in-country.

Overcoming fatalism and encouraging confidence in a health care system is an important step in increasing sustained demand for facility-based deliveries.



Mothers wait with Safe Motherhood Action Group member at Lundazi Urban Health Centre, Zambia. © Amy Fowler/USAID

TABLE 1. SMGL Sustainability Index Domains and Key Questions

Domains	Prompts/Questions for Ministry of Health Staff, Leadership, and Decision Makers at National, Provincial, and District Levels
<ul style="list-style-type: none"> • Community normative change • Behaviors • Demand for quality services • Social norms 	<ul style="list-style-type: none"> • How has the % of deliveries in health facilities changed? • Is there a change in proper use of and demand for waiting shelters? • What % of women/families had a birth preparedness plan, saved money, and pre-arranged for transportation? • How has the use of vouchers in Uganda changed and been institutionalized? • What is the evidence of local customs/norms changing? • How has male engagement in birth planning and maternal health changed? • What is the sustained level of engagement of community health cadres for normative change (SMAGs in Zambia, VHTs in Uganda)? • Is there evidence of prolonged leadership of “change champions” in the community?
<ul style="list-style-type: none"> • Governance, leadership and accountability • Willingness to champion change • Planning/coordination • Policies and governance • Civil society engagement • Private-sector engagement • Public access to information 	<ul style="list-style-type: none"> • Are there national or local champions that emerged from SMGL who successfully advocate for improved maternity services? • How has SMGL influenced changes in government policies and guidelines that are critical to long-term improvements in maternal and newborn survival? • At the national level, which guidelines, policies, or tools were updated? Has the implementation of policies been institutionalized at the lower level to sustain the benefits to maternal and newborn health? • Has the role of the community workers/VHTs in ensuring women are linked to appropriate care been institutionalized? • Will the role of the private sector in providing maternal and newborn health services continue after SMGL? Has the government established public-private partnerships? • What evidence exists of change in public access to information on maternal and newborn health at the district level or below? • Has the role of the community workers/VHTs in ensuring women are linked to appropriate care continued after SML?
<ul style="list-style-type: none"> • Health system and service delivery • Service delivery • Human resources for health • Commodity security • Quality management 	<ul style="list-style-type: none"> • Have signal functions—such as newborn resuscitation, administration of anticonvulsants and oxytocics, cesarean section, and manual removal of placenta for EmONC and CEmONC—been institutionalized? • Has the government scaled up the district systems strengthening approach/key components of SMGL? Which components has the government picked up? • Has there been a transition of SMGL-supported human resources to government positions or has the government at the district level started to fund the SMGL-contracted positions? To what extent? • Has the government picked up the funding of lifesaving drugs such as oxytocin and commodities such as balloon tamponades or anti-shock garments to prevent and/or treat postpartum hemorrhage and eclampsia? • Has the government institutionalized some type of district/health facility assessments/quality assurance approach to use as the basis of planning and budgeting? • Is the blood supply for transfusion adequate? Is fresh frozen plasma available?
<ul style="list-style-type: none"> • Strategic investments, efficiency, and sustainable financing • Domestic resource mobilization (capital investments and recurring costs) • Technical and allocative efficiencies 	<ul style="list-style-type: none"> • Has there been an increase in domestic financial resources for maternal and newborn health in SMGL-supported districts to continue the quality of services? • Has the government budgeted and allocated funding for the scale-up of the SGML approach in other districts? Have they included funding considerations for both capital investments and recurring costs? • What key components were taken to scale by the government? • What components of SMGL were eliminated or reduced as they were not affordable or cost-effective? Was there any study on efficiency or cost-effectiveness? • Did SMGL influence planning of Ministry of Health resources or improve technical/allocative efficiencies?

Continued

TABLE 1. Continued

Domains	Prompts/Questions for Ministry of Health Staff, Leadership, and Decision Makers at National, Provincial, and District Levels
<ul style="list-style-type: none"> • Strategic information • Epidemiological and health data • Financial/expenditure data • Performance data 	<ul style="list-style-type: none"> • Were maternal death audits institutionalized? • Were data reviews institutionalized? • After SMGL, how are districts/facilities continuing to use data to improve maternal and newborn outcomes?

Abbreviations: CEmONC, comprehensive emergency obstetric and newborn care; EmONC, emergency obstetric and newborn care; SMAG, Safe Motherhood Action Group; SMGL, Saving Mothers, Giving Life; VHT, village health team.

tainable, but it is too early to tell if host country governments will continue to print and distribute them, despite interest in and current commitments to doing so. In Uganda, vouchers were not directly sustainable but the findings from the voucher pilot will inform larger social protection schemes in the country.

SMGL worked with ministries of health and other partners to leverage and strengthen predominantly effective existing interventions and promoted change champions, community volunteer groups for education and referrals (SMAGs in Zambia and village health teams [VHTs] in Uganda), and improved access to

delivery services through a system of vouchers in Uganda and maternity waiting homes in Zambia.

At the national level, both Uganda and Zambia expanded the formal role of community change agents for maternal survival by formalizing guidelines and training packages for SMAGs and VHTs, which were implemented in both SMGL and non-SMGL districts. SMGL also ensured that tested materials for birth planning and outreach—radio spots, local language documentaries, and counselling aids for community leaders—were made increasingly available.

TABLE 2. Key Informants for SMGL Sustainability Domains

Stakeholders	KIIs on Sustainability of SMGL (No.)	Participants in Group Interviews on Sustainability (No.)
U.S. Government, field		
Uganda	4	0
Zambia	6	0
Host government, national		
Uganda	4	3
Zambia	2	0
Host government, subnational		
Uganda	7	0
Zambia	4	38
In-country partner		
Uganda	7	8
Zambia	5	0
Total	39	49

Abbreviations: KIIs, key informant interviews; SMGL, Saving Mothers, Giving Life.

The most significant findings, however, were at the district level and below, stimulated by increased information on safe motherhood at the local level and the transfer of ownership of maternal health to traditional leaders, communities, and women and their families (Table 3).

In both countries, change champions, particularly traditional leaders and chiefs in Zambia and district local councils in Uganda, were active and, according to multiple informants, directly increased male involvement in birth and delivery preparedness. This support continued regardless of availability of financial support from SMGL and was cited in focus group discussions as an important factor for sustainability. The district health office in Kalomo, Zambia, confirmed, “Now every time Chief Chikankata has a meeting with Headmen, he asks us to come. Previously these were only ‘women’s issues’ but now everyone is involved. The male engagement has meant more women are delivering at facilities and has even reduced child marriage.” Local leadership said this also influenced demand for family planning from women and support from their husbands. In some cases, local ownership resulted in unintended consequences, such as chiefs developing by-laws requiring antenatal care and fining male members of the household who allowed women to deliver at home without a justification (Kalomo and Nyimba). While this was incorrectly attributed directly to the SMGL intervention, it was a sincere reflection of local ownership and embedding of SMGL activities into community structures, which undoubtedly increased antenatal care and facility deliveries.²

Printed birth plans under SMGL aimed to increase birth preparedness and awareness of

danger signs, which contributed to the significant demand for maternity waiting homes by both women and district leadership.^{22–25} Birth plans provide a facilitated opportunity for health care providers to discuss pregnancy, delivery, and postnatal care and to plan for social support, logistics, nutrition, and care with pregnant women and their partners. The results of a birth plan audit conducted by Communications Support for Health estimated that 139,200 people in Zambia were exposed to the birth plan. Results from a random sample stated that over 70% of respondents recalled having seen the birth plan: 51% of women said they used the birth plans to learn about danger signs, with 48% saying they used it to prepare logistics and 43% saying they used it to remind them to save money. Birth plans included smiley and frowny faces that allowed women and families to assess their experience of care as a feedback tool for facility staff.

While not unique to SMGL, the scale of distribution of birth plans, mentoring of health workers to use the birth plans for counseling, and systematic inclusion in the package of support for safe motherhood made the tool a routine part of facility outreach and counseling and, as demand for services increased, was appreciated and requested by expecting mothers and facility staff. District MOH leadership in Zambia, recognizing the importance of the plans, committed to continued printing and distribution beyond SMGL.²⁴

In Uganda, the transport voucher system pilot implemented during SMGL successfully enabled women to deliver their babies at facilities and facilitated adherence to the national plan of 4 antenatal visits, while addressing the first and

In Uganda, the transport voucher system pilot enabled women to deliver their babies at facilities and facilitated adherence to the national plan of 4 antenatal visits.

TABLE 3. Indicators and Data on Community Norms

	Uganda	Zambia
% change in institutional delivery rate (2012–2016)	47% increase (from 45.5% to 67%)	44% increase (from 63% to 90%)
# trained SMAGs/VHTs reporting to health center (cumulative individuals trained from baseline)	11,189	13,658
# of change champions	N/A	350 ²³
% of all institutional deliveries in SMGL-supported original districts supported by transport vouchers (2012–2016)	24%	N/A
% change in number of facilities with a maternal waiting shelter from 2012 to 2016	N/A	69% increase

Abbreviations: HFA, health facility assessment; N/A, not available; SMGL, Saving Mothers, Giving Life; VHT, village health team.

^a Data from HFAs unless otherwise noted.

second delays. Because it is not inherently sustainable without being embedded in another program, the voucher system will be scaled up under the World Bank's Uganda Reproductive Health Voucher Project and is being considered as a component of the national health insurance scheme. In Zambia, maternity waiting homes were the MOH's central tool for increasing access to health facility delivery and were cited as in high demand by all districts. Waiting shelters were associated with 49% of facilities by 2016, which was an increase of 69% from the baseline. District health officials cited these shelters as contributing to sustained access to care but highlighted concern that demand would soon exceed supply if the government was not able to continue new shelter construction. Communities and districts are now requesting new maternity waiting homes through other donor support and continuing to contribute materials and labor through communities.²⁵

For sustainable changes in community norms, several informants highlighted the need to stay vigilant in reaching local leaders and influencers with locally relevant information. In Uganda, this included active engagement of traditional birth attendants as village health workers (VHWs). In Zambia, sustainable changes included maintaining incentives and support structures for SMAGs and traditional leaders, particularly as the approach extends to new districts. Routine costs of VHWs and SMAGs have been largely absorbed by the host governments and other donor partners but will need continued oversight to ensure sustainability, especially for larger purchases such as bicycles. In Zambia, districts involved in both SMGL and the CoC program began budgeting for SMAG training, monthly meetings, and SMAG incentives from their own government grants and from donor funding. Engaging traditional leaders by, for example, paying honoraria as was done under SMGL in Zambia, was considered costly and controversial but was still determined to be a critical investment and a powerful and sustainable tool for shifting norms. Several district and provincial health officials in Zambia stressed the need for long-term sustainability plans to tackle cross-sectoral challenges that were beyond the remit of SMGL—such as roads, literacy, and poverty—in order to continue making significant progress in maternal and newborn health. Host countries and funding partners need to better coordinate investments to address the thorny underlying roots of poor maternal and newborn health to catalyze a more rapid decline in maternal and perinatal morbidity and mortality.

BOX 2. Guidelines, Policies, and Training Materials Developed or Updated Under SMGL

Zambia

- Clinical mentorship guidelines
- Quality improvement guidelines
- Maternal and perinatal death surveillance and response
- EmONC training (revised to include UBT placement)
- SMAG training
- Every Newborn Action Plan
- Neonatal management guidelines

Uganda

- Clinical mentorship guidelines (AOGU)
- Maternal and perinatal death surveillance and response
- Perinatal death surveillance and response (BABIES matrix)
- Essential Training in Operative Obstetrics (from ACOG/AOGU partnership)

Abbreviations: ACOG, American College of Obstetricians and Gynecologists; AOGU, Association of Obstetricians and Gynecologists Uganda; BABIES, birth weight and age-at-death boxes for an intervention and evaluation system; EmONC, emergency obstetric and newborn care; SMAG, Safe Motherhood Action Group; UBT, uterine balloon tamponade.

Governance, Leadership, and Accountability

Multiple respondents echoed the sentiments on increased ownership and leadership of maternal health issues that the external evaluation of SMGL captured in 2013: “[Before SMGL] there were many mothers dying in silence. At least now when mothers die, people notice, and they try to learn from it. It’s a big issue. Now when a mother dies, we know before lunch.”²⁶ Ministry of Health district leadership noted that SMGL created champions and leaders—well beyond just medical professionals—for maternal health across the district. Increased visibility and leadership and greater accountability were the most notable findings within this domain. This was exemplified in the maternal death review process in both Uganda and Zambia, which started by bringing in key stakeholders under SMGL, with health sector officials and communities identifying roles each can play in reducing maternal mortality and, in Zambia, with the district commissioners chairing this committee. This is now a routine process for maternal death reviews, an important factor for districts sustaining ownership and action on findings.

At the national level, SMGL incorporated and codified evidence-based interventions through new and updated policies, guidelines, and training materials (Box 2). These core documents are used routinely for planning and training and will

The ability of SMGL to mobilize and sustain public-private partnerships did not prove to be as sustainable and scalable as anticipated.

continue as guiding documents for the health sectors in both countries. In Uganda, an MOH official noted that “the Ministry of Health sees SMGL as a learning opportunity for the rest of the system.”²⁶ This was realized over the course of SMGL in both countries through testing improvements to change policies, tools, and systems.

The ability of SMGL to mobilize and sustain public-private partnerships did not prove to be as sustainable and scalable as anticipated. It was difficult to attract new global partners after the decision was made, at the end of Phase 1, to select only 1 additional sub-Saharan African country, Nigeria. In Zambia, while 2 local partners, Lafarge Cement and Stanbic Bank, joined SMGL and made important contributions, they have not yet committed to longer-term agreements beyond their initial corporate social responsibility investments. However, there was increased awareness of maternal health issues among these large companies that demonstrated the pull of the success of SMGL to bring new players into the big push for reducing maternal mortality.

Health System and Service Delivery

At the national level, the revised policies and guidelines in both countries benefited districts beyond SMGL and will be cornerstones as the approach continues to national scale. Significant outcomes included introducing uterine balloon tamponade training and other skills sessions in the EmONC curriculum in Zambia to better control postpartum hemorrhage, which is the leading cause of maternal mortality. A significant shift from offsite training to onsite mentorship programs was made in both countries, which became the host governments’ core approach. In Zambia, the high-frequency/low-dose method of mentorship was supported because it was positive and encouraged health workers while previous mentorship approaches had been viewed as negative and punitive. Tackle boxes for postpartum hemorrhage and eclampsia were innovations provided to health workers, based on the mentorship experience. In Uganda, most notably, the health professional associations took the lead in providing mentorship to health workers. Routine mentoring visits have been reported as an effective tool to increase knowledge and improve practical skills among health professionals.²⁷ Mentorship is less costly than retraining staff and helps develop a greater culture of shared responsibility between levels of the health system. As a formal tool used by the ministries of health, mentorship also led to

local innovation. A former provincial health director in Zambia, Dr. Mathew Ngambi, described how doctors and midwives in Luapula Province formed WhatsApp groups for continued mentorship and provision of advice with a focus on maternal health. While conducting drills on treating eclampsia and postpartum hemorrhage, a mentor in Southern Province noted the time it took as the midwife rushed to various places in the health center to gather supplies, medications, and fluids. In response, the mentor designed tackle boxes containing all the essential supplies for these 2 conditions to be placed in arm’s reach of the delivery table.

To further bolster training and mentoring and ensure knowledge retention, availability of updated protocols and guidelines is also crucial; HFAs reported availability increased at almost all facilities in Uganda during implementation of the SMGL initiative. For topics such as eclampsia and magnesium sulfate, postabortion care, and postpartum hemorrhage, the increase in availability of protocols and guidelines from baseline to the end of Phase 2 was significant, increasing from 9% to 74%, 8% to 50%, and 15% to 86%, respectively. We posit this will bolster long-term improvements in service delivery.

In both Uganda and Zambia, HFA results demonstrated that commodity security improved despite ongoing challenges. In Uganda, essential medicines, such as oxytocin and magnesium sulfate, became increasingly available at public health facilities during the 12 months preceding the HFA (2013 and 2017), although some essential antibiotics, such as gentamicin, and other routine antenatal care medications were less available during the same period. Zambia also saw improvements across several key drug availability indicators, although the overall picture was mixed. Hospitals had higher drug and HIV test kit stock rates, but one-quarter of the hospitals faced stock-outs for oxytocin. For medicines such as gentamicin and magnesium sulfate, availability improved at the end of Phase 1 but was reduced in Phase 2. Decreasing trends between end of Phase 1 and endline for several service delivery indicators might indicate that the focused and well-funded programming during Phase 1 was not yet institutionalized across districts and facility types, as funding decreased during Phase 2. These mixed results show the strategic value of leveraging existing supply chain systems and the impact of increased accountability for maternal mortality on the larger health system—since SMGL did not directly support the supply chain—in both

countries. It also illuminates an area where additional focus may be required in order to truly sustain achievements (**Table 4**).

SMGL's direct financial support for capital investments in health facility infrastructure—such as increasing access to running water, electricity, and communications—and skill-building was an important factor for improving confidence in the health system and providing critical support to district and provincial health directors. Such investments are likely to have a long-term impact on service quality and availability, as this type of system strengthening can endure well beyond SMGL and translate into progress in other health areas. In focus group discussions, district and provincial leadership said that their staff and budgets were sufficient to maintain the current infrastructure investments to date; however, this deserves continued attention moving forward. Although further capital investments are planned under donor-supported scale-up activities in both Uganda and Zambia, it is unlikely that the host governments, without support, would continue those investments in the near-term. The number of facilities providing the 7 basic EmONC (BEmONC) signal functions increased from 3 at baseline to 8 at endline in the 4 district-regions in Zambia and from 3 to 9 in the 4 districts in Uganda. Using the World Health Organization minimum recommended level of 5 EmONC facilities per 500,000 population, 3 of the 4 original SMGL districts in both Uganda and Zambia achieved the recommended minimum. Similarly, facilities providing 9 CEmONC signal functions increased from 4 to 5 facilities in

Zambia and 7 to 17 facilities by endline in Uganda across SMGL districts.

Capacity to provide a blood transfusion is essential for surgical delivery and resuscitation for severe obstetric hemorrhage and is a CEmONC signal function. To expand the number of facilities with CEmONC capacity in Uganda, SMGL provided blood bank refrigerators to level IV health centers and transported blood from the regional blood banks to these facilities. SMGL provided training for lab technologists on blood grouping and cross matching and for doctors and nurses in prescribing and delivering blood transfusions. In Zambia, where over one-third of blood transfused is for pregnant women, an increased supply of blood was provided to SMGL-supported districts and a pilot initiative began to provide fresh frozen plasma—which has a 1-year, compared to 1-month, shelf life and does not require cross matching—to selected health centers. The 2016 HFA in Zambia, showed that blood transfusion capabilities were maintained in all districts except for Kalomo, which lost this capacity when Zimba district was split off and the remaining district lacked a functioning operating theater. Since 2016, there have been important improvements in the district including increased training, new full-time district leadership, and completion of the only surgical theater in the district. The Zambian government has increased funding to the National Blood Transfusion Service, as external donor funds declined, and plans to develop blood banking hubs nationally in 2018–2019, which may address some of the constraints.²⁸ Inadequate blood supply, however, continues to be a challenge that needs

The number of facilities providing the 7 BEmONC signal functions increased from 3 at baseline to 8 at endline in Zambia and from 3 to 9 in Uganda.

TABLE 4. HFA Data on Health Systems and Service Delivery in Original 8 SMGL Districts, 2012–2016

	Uganda		Zambia	
	Baseline	Endline	Baseline	Endline
Infrastructure – facilities with electricity	56%	96%	57%	93%
Infrastructure – facilities with running water	75%	100%	90%	97%
No stock-out of medicines – oxytocin	56%	82%	75%	75%
No stock-out of medicines – magnesium sulfate	48%	64%	20%	43%
Population-based cesarean delivery rate	5.3%	9.0%	2.7%	4.8%
24 hours a day/7 days a week services at facilities	78%	89% (NS)	65%	96%
Facilities with available transportation (vehicle or motorcycle)	61%	59% (NS)	55%	73%
Facilities with communications equipment	93%	99%	45%	100%

Abbreviations: HFA, health facility assessment; NS, not significant; SMGL, Saving Mothers, Giving Life.



A service provider examines a client at the SMGL-supported Kakumiro Health Center in Uganda. © Amy Fowler/USAID

additional funding in both Uganda and Zambia to reduce maternal deaths.

Human resources for health is an area that will continue to require significant support post-SMGL despite substantial strides made, particularly in Uganda. In Uganda, facilities were supported under SMGL to reduce vacancy rates and recruit health staff—at the government rate—who would be absorbed with the increase in salaries as stipulated in the Wage Bill⁹ when it comes into effect in 2019. Almost three-quarters (74%) of health workers hired directly by SMGL in Uganda were eventually absorbed into the health system and all those staff continue to be paid by the government at salary levels stipulated in the national policy. This was an important boost for the sustainability of activities and availability of service providers in the associated facilities. In Zambia, “retired but not tired” midwives were hired directly by SMGL for health centers that lacked a nurse or midwife; however, they could only be given 1-year renewable contracts due to retirement laws and regulations. Enrolled nurses were given additional midwifery training, in part due to lessons learned from SMGL. As Zambia works to expand the pipeline of skilled health workers, SMGL highlighted the opportunity for the government to consider further involvement in and formalization of hiring options for the skilled but retired or out-of-work midwife cadre to support health services.

Overall analysis of the sustainability domain questions in the HFA reports demonstrated significant improvements and prospects for sustainability across indicators for human resources, health facility infrastructure, and access to EmONC services in both Uganda and Zambia.²⁸ There was

some reduction in performance of some indicators following Phase 1, when there was a funding gap of 1 year due to a significant break in implementing partners in both Uganda and Zambia due to procurement timelines as well as an extended delay in funding reaching both countries. During Phase 2 there was a planned reduction in funding during the second year by 25% from the first year, a 50% reduction the following year, and a 75% reduction in the final year to naturally push for greater government ownership. These circumstances provided an opportunity to demonstrate the sustainability of interventions and the ability of local and national governments to assimilate activities from the “big push” into national maternal and newborn health programs. Through this lens, Uganda had greater success in sustainable improvements for human resources for health. However, in both countries, early investments in infrastructure are likely to continue to pay dividends in access to quality care and services.

Strategic Investments, Efficiency, and Sustainable Financing

While SMGL was not designed to specifically increase national maternal health budgets, we hoped that the programmatic results would drive governments to increase domestic resource allocation for continued quality maternal and newborn services.⁸ In the end, SMGL did not contribute to significant changes in either country’s domestic resource mobilization or increased government funding. SMGL maximized allocative efficiency by identifying high-impact activities that, when clustered, addressed the 3 delays and provided health system benefits to population groups beyond mothers and newborns, such as emergency transportation, improved infection prevention, water supply and electricity at health facilities, and availability of surgical services and operating theaters—all critical components of a functioning health system. SMGL districts in Zambia cited a significant change in the district’s annual plans for maternal health. Several districts cited the value of a ‘blueprint’ for health systems areas of improvement and, in particular, cited an important increase in planning and prioritization around the first and second delays (demand and access to services). In Zambia, for example, multiple district partners highlighted the increased investment in community structures and health promotion to increase demand. This approach was recently codified with requirements from the MOH that 10% of all budgets must directly benefit the community.

SMGL maximized allocative efficiency by identifying high-impact activities that, when clustered, addressed the 3 delays and provided health system benefits to population groups beyond mothers and newborns.

In Zambia, SMGL funds were channeled directly to 2 of the 4 focus provinces that oversaw implementation in the SMGL districts—approximately US\$300,000 per province per year—from the U.S. Government and Sida (for 1 year) to support the SMGL approach. This direct support further engaged the districts and resulted in a natural transfer of central activities from SMGL support to direct funding. As already noted, SMGL directly influenced greater investments under the CoC program in Zambia and the World Bank Reproductive, Maternal, and Child Health Services Improvement project in Uganda, leveraging 5-year investments of US\$125 million in Zambia and US\$140 million in Uganda. In Zambia, this translated into prioritizing interventions under SMGL for direct funding from donors and direct host-country resources and, in Uganda, the Sharpened Plan Investment Case⁷ for RMNCAH built heavily on the SMGL approach.

A separate study in this supplement by Ben Johns et al.²⁹ was conducted to determine costs—incremental costs and incremental cost per death averted—of the SMGL district strengthening approach. They found that the incremental cost for maternal and newborn care per SMGL-supported district in 2016 was US\$845,000 in Uganda and US\$760,000 in Zambia. This translates into about US\$38 per facility birth in Uganda and US\$95 per facility birth in Zambia in 2016. In Zambia, the cost per death averted was US\$12,514, or \$206 per life-year saved. In Uganda, the cost per death averted was US\$10,311, or \$177 per life-year saved. The researchers concluded that the approach was cost-effective, with the cost of life-year gained as a percentage of gross domestic product (GDP) being 26% and 16% in Uganda and Zambia, respectively. The authors concluded that the SMGL program “could be paid for by increasing health spending from 7.3% to 7.5% of GDP in Uganda or 5.4% to 5.8% of GDP in Zambia.” This is far less than domestic investments for other health areas, such as HIV and AIDS.³⁰ The analysis did not take into consideration the costs associated with the considerable ripple effects a maternal death has on children, families, and communities.^{31,32}

The district strengthening approach, as demonstrated in SMGL, represents a substantial cost-effective health investment, one that low- and middle-income countries can afford.²⁹

Strategic Information

At the national, provincial, and district levels, improvements in strategic information were viewed

not only as sustainable systems-level improvements in the way data are made available, used, and analyzed, but also as a catalyst for increasing leadership and prioritization of maternal and newborn health. The former provincial health director of Luapula Province noted, “Success of SMGL really grew out of improved information, audits and the ability to use data to hone in on problems and demonstrate that with planning and focused resources the problems could be addressed. We were able to see the results of our work and started asking other districts for similar information.”

In both Uganda and Zambia, maternal and perinatal death surveillance and review systems (MPDSR) were institutionalized and training programs and guidelines developed with the support of SMGL. Progress in MPDSR has been sustained in both countries in Phase 2 of SMGL. At the hospital level, for example, according to the HFA, 93% of hospitals in Uganda and 100% in Zambia conducted maternal death reviews in 2016. In Zambia, 75% of all deaths in SMGL districts were reported and reviewed in 2016. In focus group discussions, district leadership felt the process had become routine and could be sustained without external support. In both countries, non-healthsector leadership is now involved in death reviews, which continue to build political will and address maternal health appropriately within the broader community context, further adding to the likelihood of sustainability. In Zambia, district commissioners were appointed as heads of the district MDSR committee and required to submit their maternal death reports to the national government; this ensured a high level of political investment in reporting maternal deaths and in understanding the multiple causes of death. In Uganda, the birth weight and age-at-death boxes for an intervention and evaluation system (BABIES) matrix²⁸—a simple data tool to better track and understand newborn deaths and stillbirths—facilitated understanding of the timing and causes of perinatal deaths through closely tracking fresh and macerated stillbirths and early neonatal deaths. It is now being used comprehensively in 6 of 13 SMGL districts and has been proposed in the Uganda MPDSR guidelines.

SMGL strengthened Health Management Information System (HMIS) data in both countries through vigorous review of registers and health information aggregation reports by implementing partners with district health office staff. The data collection approach, implemented on a quarterly basis, included data collection from all possible data sources in a health facility across all existing

At the hospital level, 93% of hospitals in Uganda and 100% in Zambia conducted maternal death reviews in 2016.

Despite uneven implementation following the first year, quarterly data reviews continued to yield positive results.

departments—data that were later triangulated with the health information aggregation report. This worked as a validation process for HMIS and consequently improved site-level data collection and reporting. Ministry of Health district staff in Zambia commented that it became routine for SMGL team members to call and question them about their data quarterly. Consequently, district health workers took more interest and began reviewing data at the district headquarters before submitting, a process that continued after SMGL funding ended and is likely to be sustained. In Uganda, Pregnancy Outcome Monitoring Survey data were used to update the monthly maternity register summaries that were entered and reported into the national District Health Information System 2 database. This community data collection tool, which remains in place, was strengthened so that it could be used for pregnancy and MPDSR. SMGL supported procurement and supply of facility tools and data registers and facilitated orientation of health workers on the registers, if needed. One district health director in Zambia commented that the district would print registers if they were not available from the national level. This is not a universal position at the district level but, with continued external funding under the CoC program and heightened scrutiny at the national and provincial levels, these minor but critical tools are likely to remain in place for the foreseeable future.

In both Uganda and Zambia, the focus on routine data reviews beyond the facility resulted in routine, more meaningful, review meetings, where gaps were identified and addressed with decision makers in the room. These were simple but important problem-solving exercises. For example, a province in Zambia realized that a facility that had made only limited improvement in the number of antenatal care visits did not have a motorbike and reallocated one from an incoming shipment so the facility could conduct routine outreach to remote communities. This small data-based problem-solving process was repeated over time and helped address many health system issues that had previously seemed insurmountable. One district health director in Zambia noted that “as the SMGL metrics were absorbed into their performance standards, they [health care workers] became more accountable.” She felt this would be a key driver of sustainability.

■ DISCUSSION

The rapid reduction in maternal mortality seen in Phase 1 of SMGL and the maintenance of

these improvements, despite planned annual declines in external financial inputs during Phase 2, suggests that the health improvements demonstrated in SMGL-supported districts will be sustained. Despite uneven implementation following year 1 due to changes in U.S. Government implementing mechanisms in both countries and erratic funding flows, quarterly data reviews continued to yield positive results. In addition, because many lessons from SMGL have been incorporated into national policies and practice and have attracted support from other development partners and the private sector, these approaches will continue to be used and tested, at least in the immediate term. The challenge of inadequate human resources and low host-country financial investments, however, remain threats to further progress toward achieving long-term global and national development goals. Also, as frequently noted by local leadership, maternal mortality will continue to be affected by poverty, poor infrastructure, and weak education systems, which were not addressed by SMGL and will remain rate-limiting factors for improvement.

Gauging sustainability of the SMGL health systems approach against these domains can provide important insight into projected maternal and newborn outcomes as SMGL goes to scale in both countries. We suggest that addressing the following 4 questions can lay the groundwork for judging the impact of SMGL on sustainable improvements in the survival of mothers and newborns.

Will There Be Sustained Impact on Demand for Safer Births?

We have described changes in community norms and behaviors that resulted in dramatic increases in facility delivery. Factors included involvement of community leaders as change champions, changing attitudes toward the role of men in birth planning, improved quality of facility delivery services, and increased accountability by political and health leadership in the outcomes of pregnancy. Learning from each tragic maternal or newborn death and improved trust and communication between communities and health workers can overcome the fear and fatalism that many perceive and help ensure continued progress in eliminating preventable deaths. From the baseline to endline census data, maternal mortality decreased by 41% in Zambia and 44% in Uganda in SMGL districts. These results aligned with trends in

quarterly routine data collection throughout the implementation of SMGL.³³

Will Timely Access to Facility Births and EmONC Services Be Sustained?

Rural districts with deficient road and transportation infrastructure, high rates of poverty, and health facilities too few and far between were the settings for SMGL. Crucial to the initiative's success was an approach that focused on district system strengthening, which resulted in a variety of appropriate local solutions being developed. In Uganda, the use of transportation vouchers to utilize the available "Boda Boda" cyclists, the organization and coordination of ambulances (Box 3) to maximize efficiency, and upgrading facilities so that CEmONC functions were closer to people, all helped reduce the second delay. As a result, the met need for EmONC facilities increased by 65% in Uganda. In Zambia, the provision of bicycles, motorcycles, and ambulances, prioritizing pregnant women for use of these services; the construction and refurbishing of maternity waiting homes; and improved radio and mobile phone communication systems had similar effects during Phase 1, although by the end of Phase 2 the ability to provide services to meet demand had decreased by 11%. This result may suggest either that over the course of the SMGL initiative demand for EmONC services substantially increased through successful promotion of facility-based deliveries or that additional resources must be allocated to facilitate timely access to facilities. In either case, for both countries, district leadership and local resource allocation should continue to help guide and implement appropriate and efficient solutions. National leadership, governance, and better planning for adequate development and staffing of EmONC facilities are also crucial. General improvements in transportation and communication infrastructure and reductions in poverty may have the largest long-term impact on timely access to services. Making maternal and perinatal mortality a broader social priority and involving other sectors in planning, leadership, and accountability of related systems and services are also crucial to sustaining progress.

Will Quality Childbirth and Pregnancy Services Be Sustained?

As Dr. Jesca Nsunga Sabiiti, acting commissioner of community health in the Uganda MOH, stated, "counting deaths at district is the first step to better accountability." Mentorship of midwives in both

small and large health facilities played an important role in improving the skills and competence needed to respond quickly to obstetric complications and, perhaps more importantly, did not create gaps in service as off-site training often does. Although filling human resources gaps by hiring additional doctors and nurse-midwives was a necessary quick fix to ensure continuous availability of services at health centers, it cannot be sustained without improved national planning and budgeting for human resources and the willingness of the government to change retirement policies or create mechanisms for rehiring retired providers. Commodity security for essential drugs, especially uterotronics, at health centers and in communities; an improved supply of blood products; and more effective transfusion-prescribing practices will be crucial for reducing the leading cause of maternal mortality, obstetric hemorrhage, and will require greater national investment in national blood services and quality management of commodities to foster zero tolerance of stock-outs. SMGL demonstrated that other interventions, such as balloon tamponade, may also serve an important role in preventing maternal deaths, especially if CEmONC facilities are not easily accessible. SMGL also demonstrated the utility of partographs in improving the timeliness of referrals in obstetric emergencies and has helped to expand their continued use. We recognize, however, that SMGL was not fully successful in addressing all aspects of quality and that, in addition to considering sustainability of the approach, greater attention will be required to tackle adequate access to all aspects of EmONC, particularly cesarean delivery, and to addressing newborn mortality.

We believe that district-level commitment and leadership is crucial to ensuring that quality ser-

In Zambia, an 11% decrease in the ability to provide services over the course of the initiative suggests that additional resources must be allocated to facilitate timely access to facilities.

BOX 3. Foundational Ambulance Systems in Established in Uganda

Uganda did not have well-developed protocols for the organization of ambulance services. With SMGL support, district committees were organized and protocols adopted nationally. Several innovations included:

- Phone consultations for referral cases
- Development of ambulance teams
- Triplicate referral logbook
- On-call rooms for ambulance drivers
- Monthly and quarterly review of referrals and outcomes.

These helped to establish practices and policies, which have been adopted nationally. They will require modest support, which has been envisioned under existing activities for ongoing maintenance.

Abbreviation: SMGL, Saving Mothers, Giving Life.

We believe that district-level commitment and leadership is crucial to ensuring that quality services are maintained.

vices are maintained. The introduction of MPDSR as standard practice, ensuring every death is counted and learned from, helps create and sustain a quality improvement culture. SMGL's contribution to MDSR and the BABIES matrix, and, specifically, the involvement of community leadership in these processes, is a best practice that can be replicated globally.

The infrastructure improvements and equipment remaining in SMGL-supported health facilities will have a sustained impact in SMGL-supported districts. These investments have already paid dividends in lives saved and demand maintained, even beyond the target populations for the project. As a result, the described scale of the SMGL approach includes robust initial infrastructure investments. These improvements were based on careful facility assessments and addressed the specific needs of these districts. HFAs, while not a novel concept, should be an important part of other maternal, newborn, and child health efforts and will require flexibility in external funding to address critical gaps that are identified—whether lack of an incinerator or staff housing or a weak supply chain for essential commodities. Ensuring that maintenance of facilities is continued and that EmONC facilities are located appropriately addresses issues of quality and access—2 of the delays targeted under SMGL. Institutionalization of services and maintenance of infrastructure also lend hope for the prospective sustainability of positive outcomes demonstrated by SMGL.

Has SMGL Contributed to the Long-Term Strength and Resilience of the Health System?

The district systems strengthening approach made important contributions to the strength and resilience of the greater health systems in Uganda and Zambia, beyond just maternal and newborn health. For example, substantial increases in electricity, 24 hours-a-day/7 days-a-week service, transportation, and communications will have important ripple effects across the provision of all health care. However, for long-term sustainability, both countries will need to increase financial commitments for health as a proportion of their overall budgets.⁸ The benefits of SMGL included better coverage for HIV programs, especially for the prevention and elimination of mother-to-child transmission of HIV. Robust data collection and continuous learning and quality improvement will benefit other programs through better data quality and more complete health records. Pregnancy registration and identification

of community maternal and newborn deaths will contribute to the transition to universal vital registration in resource-limited settings. Community health workers contributed to changing norms by providing health education to communities and involving fathers; by saving the lives of mothers and babies, they have increased their own value to their communities. Addressing transportation and communication issues for emergency services—including radio and ambulance systems as well as Boda Boda vouchers—can improve response to road traffic injury and other medical emergencies. The costing of services and linking them to outcomes has supported the expanded use of results-based financing and will improve the efficiency of financing. SMGL significantly catalyzed other donor-supported efforts, notably the World Bank program in both countries, Sida and DFID projects in Zambia, and Belgian-supported activities in Uganda. We hope these lessons will have a positive influence more broadly through the information shared in this supplement and elsewhere.

Limitations

The most salient limitation of the methodology is that we are analyzing the likelihood of sustainability in the near- to mid-term and 5 or 10 years beyond the initiative. This is mitigated by the fact that SMGL used a declining fund model² after the first year of the initiative and, unintentionally, there was a 1-year break in funding² to both Uganda and Zambia during which core activities continued and results improved. The second limitation is that while we have confidence in the sustainability of the SMGL results, we do not believe the need for technical assistance, capacity building, or support has ended, and we have not analyzed in detail the type of continued support that will be required. Translating findings from HFAs into prioritized programming, for example, will require some level of technical assistance and capacity building for the near-term in both countries. As the SMGL approach is scaled up, it is imperative that such assistance—as is currently envisioned—provides this support. Finally, a limitation of assessing the sustainability of SMGL is that the initiative itself was not designed to be sustained, but rather to prove that reductions in maternal mortality were possible and introduce a sustainable approach to maternal and newborn mortality reduction for scale. The branding of the initiative as such may have unwittingly undermined country ownership of SMGL by linking it too directly to funding agencies—vs. the Ministries of Health—just as analyzing the sustainability of

SMGL as an initiative may be seen to mask the true focus on the sustainability of a health systems strengthening approach to maternal mortality reduction. Similarly, aspects of the initiative were cumbersome and, we posit, could have been avoided by building on lessons from the SMGL experience. For example, the start-up of SMGL was rapid with a “build the plane as you are flying” mentality, which resulted in confusion at the community and district levels and, initially, planning and coordination challenges for partners.

CONCLUSIONS

From the onset, in order to promote ownership and sustainability, SMGL was designed to reinforce host country government structures, policies, guidelines, and priorities. Strategic, long-term capital investments were made to enable districts to achieve national standards, including essential infrastructural renovations of health facilities and maternity waiting homes, provision of required equipment and supplies, training of medical personnel in critical lifesaving skills for CEmONC and BEmONC and mentorship, development of systems and procedures for verbal autopsies/maternal audits, and provision of ambulances. These investments represented a “big push” that was criticized³⁴ as donor-driven and unsustainable but were deemed crucial to demonstrating the potential of the SMGL model. Following the capital investments, SMGL resources declined annually and implementation shifted to maintaining human and infrastructure investments. The early success of SMGL was a powerful contributor to building momentum and enthusiasm for the model and catalyzing scale, which continued to build through the life of the initiative. Will the level of scale achieved—covering over half of Zambia and three-quarters of Uganda—lead to improved and sustained health outcomes for mothers and newborns at national level? Will the results of SMGL be maintained and improved upon? Data from HFAs and multiple interviews in both countries suggest that increases in demand for quality services, access to care, and quality of care—through support from SMGL—have made a course change in focus districts and are likely to continue to reduce maternal and newborn mortality and morbidity. The SMGL theory of change has proved robust and the model successful, whether implemented directly by host-country ministries of health alone, in the case of select districts in Zambia, or with support from additional implementing partners. While we believe strongly in the potential of a systems approach to decrease maternal and newborn

deaths, no approach can be effective without strong political will, at all levels, and a society’s zero tolerance for preventable maternal and newborn deaths.

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