MAY 2017

MOBILIZING MATERNAL HEALTH

Saving maternal lives in rural Tanzania through an innovative emergency transportation system

Touch Foundation
**TOUCH FOUNDATION** was founded in 2004 by Lowell Bryan, a Senior Partner Emeritus at McKinsey & Company, now President of Touch. Touch combines the best of private and public sector approaches and expertise to improve the health of Tanzanians by strengthening the health system. We focus our activities on two key elements of the health system: improving the quantity and quality of healthcare workers and enhancing healthcare delivery. Touch expands its impact by sharing acquired knowledge with the local and international public health community.

**ACKNOWLEDGEMENTS**

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FOREWORD
DEAR MEMBERS OF THE GLOBAL MATERNAL HEALTH COMMUNITY,

Reducing the high rates of maternal and neonatal mortality in the developing world, particularly in sub-Saharan Africa, remains one of the most vexing challenges facing the global public health community today. Many factors contributing to high maternal and neonatal death rates significantly correlate to the general absence of quality healthcare in close proximity to where the population resides. This is compounded by issues including early age of first pregnancy and lack of prenatal care, making it difficult to identify an entry point for effective intervention. Therefore, in collaboration with our partners The United States Agency for International Development (USAID), Vodafone Foundation, The ELMA Foundation, and Pathfinder International, Touch launched a program to reduce maternal and neonatal mortality rates in the Sengerema/Buchosa and Shinyanga districts of Tanzania.

After three years of work, involving brainstorming potential interventions, working through myriad logistical issues, and conducting a demonstration project, we can conclude there is one intervention with the potential to result in meaningful, relatively rapid improvements in maternal and neonatal mortality: providing emergency transportation for mothers facing difficult births to a facility where they can receive appropriate care. Our preliminary data indicate that such an emergency transportation system may be able to reduce maternal mortality rates by at least 27%. Moreover, although additional data are needed to make estimates with good confidence, we believe there is potential to make still further progress in reducing neonatal death rates. The following report summarizes our findings.

We plan to begin a second phase of work in Fall 2017, during which we will continue the initial demonstration project while simultaneously scaling the program. Additionally, we hope to develop metrics estimating the rates by which maternal and neonatal mortality could be decreased if the program were scaled nationally—or even replicated in other countries. A substantial part of this work will comprise estimating the costs of the program at scale and related cost-effectiveness in terms of lives saved. We also plan to explore alternative approaches to scaling the program such as community-based funding and national programs.

We would very much like to engage with anyone wishing to discuss our ideas or findings, and hope to find others who would like to partner with us in this ongoing effort.

Warm regards,

Lowell Bryan
President and Chairman, Touch Foundation
Senior Partner Emeritus, McKinsey & Company
Executive Summary

In July 2015, Touch Foundation and our partners launched an innovative Emergency Transportation System (EmTS) in two rural districts of Tanzania to provide timely access to appropriate care for women and newborns facing obstetric and post-natal emergencies. The EmTS was a component of a larger Mobilizing Maternal Health program addressing maternal and neonatal mortality through a combination of initiatives tackling all three delays leading to adverse outcomes: the delay in seeking care, the delay in reaching care, and the delay in receiving quality care [Thaddeus & Maine, 1994]. The real-time data collection built into our dispatch application, coupled with a rigorous analytical model developed by Touch, allowed us to identify the impact of each program component and its associated costs separately, thus highlighting the outstanding performance of the EmTS compared with other program components.

The design of the EmTS stemmed from the collaboration of a diverse set of partners, an approach which allowed us to combine technological advancements, private sector solutions, public health interventions, and community engagement solutions within an integrated transportation program. Touch and our partners prioritized upfront system analysis and analytical modeling to inform the blueprint of the system, embedding dynamic feedback mechanisms to drive continuous improvements.

We ultimately proved that, in the context of rural Tanzania, the creation of a cost-effective emergency transportation system has the potential to significantly reduce maternal deaths. During the first full year of operations in Sengerema/Buchosa district, the EmTS transported 1,430 women and 315 newborns. We estimate that 57 maternal lives were saved in the most conservative scenario, equivalent to a 27% decrease in maternal mortality within the district. Going forward, running the program in Sengerema/Buchosa district will cost the Tanzanian government approximately $110,000 per year, equivalent $2,000 per maternal life saved.

The 1,430 women transported in Sengerema/Buchosa district represent three times the number of emergencies transported prior to the EmTS inception. Twenty-four percent of those emergencies originated from the communities, where no transport system was available beforehand, while the remaining 76% were referred to the district hospital by lower-level health facilities. As 40% of deliveries are still estimated to occur at home, the number of emergencies called directly from the community remains a fraction of the actual need. More resources will be dedicated to increasing community awareness of the EmTS during the next phase of the program.

Key to the program’s success was complementing the innovative EmTS transport solution with targeted health system strengthening investments in health worker training and facility upgrades to ensure patients received appropriate care once transported to the referral facility. Robust impact data and real-time monitoring contributed to catalyzing change within the local government authorities, overcoming initial resistance to a hybrid public-private transportation model, and enabling officers to exercise appropriate levels of oversight over the emergency system in their respective districts.

While we acknowledge that additional, more fundamental system changes are needed to reduce maternal mortality to the standards of middle- or high-income country care, our analysis led Touch and our partners to focus future scale-up efforts on the emergency transportation solution as a cost-effective “quick-win,” with the potential to save lives immediately. We will continue working with the government authorities of Tanzania to ensure...
integration of the EmTS within the current health system, focusing on cost-effective improvements that will allow a full transition to the government with limited financial and managerial burden.

**Maternal Health Background**

**GLOBAL**

Approximately 300,000 maternal deaths occurred globally in 2015. Ninety-nine percent of those deaths occurred in low- and middle-income countries, with sub-Saharan Africa accounting for 66%, indicating that severe global socioeconomic disparities are a significant driver of maternal mortality. The causes of most maternal deaths are rarely documented in low-income countries. However, available epidemiological studies indicate direct causes (e.g., hemorrhage, hypertension, sepsis, and abortion) account for 73% of cases, while indirect causes (e.g., HIV/AIDS) account for the remaining 27%. Socioeconomic and health system-related factors can exacerbate these causes, contributing to further increased risk of maternal death or disability. Such factors can include young age of the mother, home birth, unmet need for family planning, absence of a skilled birth attendant, and long travel time to health facilities [Black et al., 2016].

Life-saving maternal health interventions historically strengthen health systems as a whole by addressing the continuum of care and covering various aspects of health service delivery. Given that the greatest proportion of maternal lives stand to be saved by providing care during labor and around childbirth [UNICEF & WHO, 2014], it is especially crucial to prioritize interventions that can reduce delays in reaching and receiving quality care for immediate impact.

**TANZANIA**

According to the World Health Organization (WHO), Tanzania ranks among the 30 countries with the highest maternal mortality ratios (MMR) worldwide, with an estimated 8,200 maternal deaths in 2015 [Trends in Maternal Mortality, 2015]. The country’s progress toward achieving the Millennium Development Goals (MDGs) related to reproductive and maternal health was slower than planned during the period from 2000 to 2015. The maternal mortality ratio significantly missed the MDG target of 193 deaths per 100,000 live births, with a reduction to 398 estimated by 2015. Unfortunately, statistics reported by the Government of Tanzania indicate a regression: according to the national Demographic and Health Survey released in early 2017, maternal mortality increased from 454 in 2010 to 556 in 2015.

Given this reality, the Tanzanian government and international donors have redoubled their commitment to mothers during the Sustainable Development Goals (SDGs) era. Moving forward, Tanzania’s aim is to reduce the maternal mortality ratio to 292 deaths per 100,000 live births by 2020, and to 140 by 2030 (the SDG target). Progress to-date in Tanzania has been inequitably distributed with drastic urban-rural, geographic, and economic disparities. The Lake Zone of Tanzania, comprising six regions² and

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1. Although Touch and our partners acknowledge that 2.7 million neonatal deaths occur each year and neonatal health is inherently linked to maternal health, this paper mainly focuses on maternal health and related interventions as we have strong evidence to prove our impact on maternal lives saved. The effects on neonatal health are discussed in a dedicated section below and they will require more data gathering and analysis to be confirmed.

2. Kagera, Mwanza, Geita, Mara, Simiyu, Shinyanga.
17 million people, experiences some of the poorest reproductive and maternal health outcomes nationally and has therefore been prioritized by Big Results Now! implementation plan developed by the Tanzanian government.

The Tanzanian government’s strategic Framework related to maternal and neonatal health highlights the need for full implementation and financing of scalable, evidence-based, cost-effective interventions [Ministry of Health and Social Welfare, 2015]. In the context of chronic lack of funding for public health expenditures, the current challenge is to bring validated, novel solutions to scale while maintaining or increasing coverage of mainstream interventions, such as family planning or preventing mother-to-child transmission (PMTCT) of HIV. Cost-effectiveness remains essential for any intervention to achieve sustainability and integration within the local health system.

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a. World Bank, 2015
b. This represents 11.3% of the national budget, significantly below the target of 15% at which the GoT committed in 2001 as part of the Abuja Declaration.
**THREE DELAYS MODEL**

Nearly 30 years ago, Thaddeus and Maine developed the Three Delays Model (Figure 1) to delineate risk factors and inform strategies designed to mitigate adverse maternal health outcomes. The model is predicated on the facts that most maternal complications are emergencies that cannot be easily predicted, and that maternal deaths can be avoided through tertiary preventions (i.e., addressing the complication once diagnosed). The model centers around three delays during the patient journey through the health system: 1) the delay in seeking care, 2) the delay in reaching care, and 3) the delay in receiving quality care.

At each delay, there are distinct casual determinants and corresponding interventions. For example, the determinants of the delay in seeking care include home deliveries relying on traditional birth attendants, while determinants of the delay in reaching care include available transport, road infrastructure, and quality of referral systems [Watts et al., 2016]. Determinants of delays in receiving quality care include the shortage of quality providers and the limited availability of blood, supplies, and essential equipment [Black et al., 2016]. To improve access to and quality of available health services, each delay and its corresponding determinants must be analyzed and addressed, as well as contextualized within the wider framework of health systems strengthening initiatives [Watts et al., 2016].

**Figure 1: The Three Delays Model**

There are three major delays that women face in receiving the required care for delivery and Mobilizing Maternal Health (MMH) has established a system to address all of these delays.

<table>
<thead>
<tr>
<th>Delay 1— Recognition and decision to seek care</th>
<th>Delay 2— Transport to care</th>
<th>Delay 3— Receiving quality care</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Educate communities on pregnancy, childbirth and newborn care (i.e., awareness campaigns, community health workers)</td>
<td>• Improve access to health services in rural and remote areas</td>
<td>• Train healthcare workers in quality care, especially those in rural areas</td>
</tr>
<tr>
<td>• Facilitate income generation schemes to empower women to make decisions about their reproductive health</td>
<td>• Build maternity waiting homes next to health facilities for expectant mothers to reside before their due date</td>
<td>• Equip health facilities with required equipment and supplies</td>
</tr>
<tr>
<td>• Strengthen links between traditional and formal health sector</td>
<td>• Encourage individual and community-based saving schemes to cover cost of transport</td>
<td>• Provide training in respectful maternity care to all healthcare workers</td>
</tr>
<tr>
<td></td>
<td>• Provide transportation support in cases of emergency using alternative forms of transport (i.e., motorcycle ambulances for mountainous terrain, ambulance taxis)</td>
<td>• Improve referral systems between health centers and hospitals</td>
</tr>
</tbody>
</table>

Selected common interventions (not all are implemented by MMH)
A Technology-Based Emergency Transportation System Tailored to the Local Setting

**HYPOTHESIS: SAVING LIVES THROUGH A COST-EFFECTIVE, SUSTAINABLE TRANSPORTATION SYSTEM**

Since 2014, Touch Foundation (Touch) and our partners have collaborated with the Ministry of Health, Community Development, Gender, Elderly and Children (MoH) and local government authorities to implement an innovative Emergency Transportation System (EmTS) providing women and newborns facing obstetric and post-natal emergencies with quick and efficient access to appropriate care in two rural districts of Tanzania (Figure 2). We postulated that by providing access to high-quality emergency care through EmTS, maternal mortality would be drastically reduced, especially among the poorest segments of the population living in remote and difficult-to-access areas, where no medical emergency service was previously available. By designing the program to limit upfront capital investments and keep operational costs as low as possible, we ensured the EmTS would provide a highly cost-effective and sustainable solution to the government in the long-term.

We conceived the EmTS to address the second and third delays of the Three Delays Model: minimizing delays in reaching and receiving adequate care. While directly addressing transportation, the program also included a focus on health systems-strengthening to ensure women receive a high quality level of care upon reaching the appropriate health facility. Touch and our partners worked with the district authorities and service providers to identify and address the main bottlenecks in the system, which included:

- **The absence of a dispatch center accessible by the population and a standard emergency triage protocol** applied across the district to filter and direct emergencies to the appropriate facilities
- **Limited healthcare worker skills** to manage obstetric emergencies (e.g., lack of basic and comprehensive emergency obstetric and neonatal care training)
- **Poor infrastructure** (e.g., unavailability of dedicated C-section theatres at referral hospitals or electrical supply at lower-level facilities)

**EmTS: AN INNOVATIVE SOLUTION TO SAVE LIVES**

The EmTS was designed to improve efficiency of the existing inter-facility referral system, as well as to extend access to emergency transportation to the local communities, including those living in the hardest-to-reach, most remote areas of the districts. The system relies heavily on technological solutions to standardize processes, support real-time decision making, and minimize operational costs (Figure 3).

Patients trigger the EmTS by making a toll-free call to the 24/7 dispatch center, the first of its kind in Tanzania. Vodafone Foundation and Vodacom Tanzania established this toll-free number to

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3. The program was originally launched in the two rural districts of Sengerema District Council and Shinyanga District Council. Although Sengerema District Council was then split into the two districts of Sengerema and Buchosa, we continued covering both Sengerema and Buchosa districts through a single dispatch center and referring all CEmONC emergencies to the Sengerema Designated District Hospital. For this reason, going forward we will refer to the original Sengerema District Council as Sengerema/Buchosa district.
ensure services are accessible to the general public, leveraging the widespread use of mobile phones even among the poorest and most rural segments of the population.

Upon receiving an emergency call, a trained dispatcher remotely “triages” the patient. He/she assesses the patient’s condition by collecting critical health information through a series of pre-defined questions. Supported by a decision-making application running on a tablet, the dispatcher enters the information received, and the application triggers a set of sequential logical questions. At the end of the process, upon determining the patient’s condition, the application indicates whether the patient needs to be transferred to a health facility and, if so, to what facility. The entire triaging process takes, on average, two minutes.

Emergency transportation is then arranged to the nearest facility for basic emergency care, or to the district/regional referral hospital for management of more severe conditions. All emergencies originating in the communities are first transported to the closest health facility for stabilization, also including a nurse to escort the patient in her subsequent journey to the referral hospital.
Figure 3: The Emergency Transportation System

CALL TO DISPATCH CENTER (TOLL-FREE)

Women experiencing emergency at home or at lower level facility

REMOTE TRIAGE

No emergency condition, no maternal or newborn emergency

Referred to closest facility—no transport through EmTS

Comprehensive emergency obstetric and newborn care (CEmONC) emergency

Basic emergency obstetric and newborn care (BEmONC) emergency

DISPATCH TRANSPORT

and notify facility of upcoming patient arrival

Stabilization at BEmONC facility (if originating from community)

Arrival to BEmONC facility

Arrival to CEmONC facility

SAFE DELIVERY

CONFIRM JOURNEY AND PAY TAXI

FOLLOW UP ON EMERGENCY AND COLLECT DATA (e.g., case audit)

CASE CLOSED
To arrange the emergency transportation, the dispatch application prompts the dispatcher to contact the district medical office requesting an ambulance. In the case of a negative response, the application displays a list of the taxi drivers nearest to the patient location along with their contact information. The dispatcher then contacts the drivers, confirms their availability, and arranges for transportation. The dispatch application seamlessly integrates with a mobile payment system (M-Pesa), ensuring that drivers receive the pre-negotiated rate for the journey in their personal mobile money accounts as soon as transportation is successfully completed. From a managerial and administrative perspective, integration of the M-Pesa automated payment system into the dispatch center application simplifies the processing of the large number of payments made to taxi drivers scattered throughout the districts.

As transportation is being arranged, the health facility is notified of the upcoming patient arrival. The dispatcher ensures the patient’s condition is promptly communicated to the receiving health facility to allow clinical staff adequate time to prepare for the emergency arrival, minimizing any delays in receiving care once the patient reaches the facility.

The dispatch application allows dispatchers to monitor and evaluate each emergency in real-time and take corrective steps if necessary. The system also stores the details of each emergency and facilitates the collection of outcomes data for each patient, from admission to discharge. The aggregate data are used to monitor operations and identify system challenges or bottlenecks.

**EmTS: CRITICAL SUCCESS FACTORS**

We designed the EmTS to consider the low-resource setting in Tanzania, directly address bottlenecks in the system, and prioritize financial efficiency and long-term sustainability. Below are critical factors that contributed to the success of the program.

**Supplementing government ambulances with private taxis**

Our upfront assessment of the Sengerema/Buchosa district ambulance system confirmed that poor fleet maintenance, unavailability of spare parts, and chronic lack of fuel were the major reasons for the district office’s limited provision of emergency transport services. In addition, the small number of working vehicles were mostly located at the referral district/regional hospital, requiring long journeys to reach emergency patients located in remote villages and subsequently transport them back to the referral facilities.

We introduced the use of private taxis to complement the limited and inefficient ambulance service, leveraging local drivers’ extensive knowledge of their surrounding communities. This solution increased the availability of emergency transportation and reduced the time required to locate, pick up and transport patients, particularly those living in the most remote areas, when compared with ambulance drivers located in the district town center. The involvement of taxi drivers from local villages had the added benefit of creating a sense of community support and pride among these drivers, which was also instrumental in overall program success, including increasing general community awareness of the EmTS.

4. Shinyanga district represented the exception, owning several ambulances scattered across dedicated health centers to lower average travel time.

5. Although referred to as private taxis, these are often not actual taxis but rather individuals living in remote villages owning a car and being available to transport obstetric and neonatal emergencies when requested.
We ensured patient safety by training taxi drivers on how to properly handle transportation of obstetric emergencies, and equipping them with an emergency transportation kit (e.g., gloves, flashlight, cleaning materials) to improve the patient’s conditions during transportation.

Overall, supplementing government-run ambulances with local taxi services connected to our dispatch center notably increased the number of emergencies transported to the appropriate health facility (Figure 4).

• In Sengerema/Buchosa district, the program now runs with 56 active taxi drivers who serve a total of approximately 40,000 pregnant women, and transported 1,430 maternal emergencies in 2016 at an average cost.

**Figure 4: Maternal emergency transports in Sengerema/Buchosa and Shinyanga districts**

<table>
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<th></th>
<th>Sengerema/Buchosa</th>
<th>Shinyanga</th>
</tr>
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<tbody>
<tr>
<td>Q3 2015</td>
<td>61</td>
<td>38</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>101</td>
<td>153</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>369</td>
<td>241</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>369</td>
<td>247</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>320</td>
<td>221</td>
</tr>
<tr>
<td>Q4 2016</td>
<td>371</td>
<td></td>
</tr>
<tr>
<td>Q1 2017</td>
<td>396</td>
<td></td>
</tr>
</tbody>
</table>
of $45 per transport. The most active taxi drivers transport up to 20 emergencies per month, while the average is approximately 3 per month.

- In Shinyanga district, 45 active taxi drivers serve a population of approximately 20,000 pregnant women, and at steady state will transport approximately 900 maternal emergencies per year, at an average cost of $54 per transport.

While the EmTS processes and IT application offer a sustainable, long-term solution that will continue to support the government in providing emergency transportation, local taxi drivers provide a temporary bridge between the current state of extreme need and the efficient setup of a well-maintained fleet of ambulances strategically located across the district. The bridging solution has proven successful in rural Tanzania, and has the potential to be extended in much of the sub-Saharan context where health systems remain weak and government management capabilities face limitations.

**Healthcare worker training**

Healthcare worker training was designed to selectively upgrade clinical competencies of frontline emergency staff to ensure proper management of emergency cases once patients arrive at the appropriate health facility. Healthcare workers from OB/GYN departments in district and regional referral hospitals received training in comprehensive emergency obstetric and newborn care (CEmONC) to properly manage the most severe emergency conditions referred from communities and lower-level facilities.

Healthcare workers in health centers and dispensaries were trained in basic emergency obstetric and newborn care (BEmONC), with a special focus on stabilization of patients to be referred to higher-level facilities.

In Sengerema/Buchosa districts, we trained a total of 71 healthcare workers in CEmONC (three-week training session) from one district hospital and 54 in BEmONC (two-week training session) from lower-level facilities. In Shinyanga district, we trained 56 healthcare workers from regional hospitals and 67 from lower-level facilities, respectively.

**Infrastructure upgrades**

Regional and district hospitals were selected to be the final destination for the most severe emergencies, including those conditions requiring CEmONC management. To ensure these facilities could handle increased patient flows and case severity, infrastructure and clinical equipment received significant upgrades, representing the largest capital investments made by the program. An analytical model based on population demographics, clinical records and available epidemiological data was developed upfront to predict patient flows across all facilities; infrastructure and equipment upgrades in district and regional hospitals were designed and sized accordingly.

Dedicated C-section theatres were built, and existing post-labor wards renovated and extended, preparing the hospitals to bear the increased patient load and average case severity. Core clinical equipment was procured to outfit the newly-built C-section theatres, and basic equipment was

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6. The EmTS transported 315 neonatal emergencies during 2016.
7. In addition to the 1,430 mothers, the EmTS transported 21 neonatal emergencies during the same period, equivalent to an expected 80 per year.
8. We targeted to train 2 health workers per lower-level health facility. In some facilities the training was however not necessary because other NGOs had already completed BEmONC training for a large number of health workers.
Structure of the health system in Tanzania

District level health system

District hospital
• 1 per district
• Type of care:
  - Specialized care
  - Primary care
• Typical highest ranking staffing:
  - MD

Health centers
• 1 per ward
• Type of care:
  - Primary care
• Typical highest ranking staffing:
  - AMO or Clinical officer

Dispensaries
• 1 per village
• Type of care:
  - First line care
• Typical highest ranking staffing:
  - Nurse or Medical attendant

Sengerema/Buchosa and Shinyanga snapshot

Sengerema/Buchosa districts*:
• Population: 750,000
• Number of pregnancies per year: 40,000
• Facilities:
  - 1 district hospital
  - 9 health centers
  - 68 dispensaries

Shinyanga district:
• Population: 370,000
• Number of pregnancies per year: 20,000
• Facilities:
  - 1 regional hospital
  - 4 health centers
  - 36 dispensaries

* Note: After the beginning of the program, Sengerema district was split into two districts: Sengerema and Buchosa districts
delivered to the labor-and-delivery (L&D) wards to allow healthcare workers to better care for mothers. Equipment provided was often designed for low-resource settings, and healthcare workers received training on equipment use and maintenance. In addition, hospital engineering staff received training on equipment maintenance and repair.

Lower-level facilities typically focus on providing basic care and preparing mothers and newborns experiencing an emergency condition for upward referral at any given time during the day and night. In order to ensure 24/7 operations, L&D and post-labor wards at each health center and dispensary were electrified through solar power. These facilities were also equipped with a Non-pneumatic Anti-shock Garment (NASG), a first-aid device used to stabilize women who are suffering from obstetric hemorrhage and shock, and facility staff received specialized training on how to best operate the device.

The upgraded infrastructure of Sengerema Designated District Hospital (SDDH) serves as a notable example of how the analytical model was used to predict gaps and address system bottlenecks:

- Prior to the EmTS program, SDDH managed approximately 10,000 deliveries per year, with a C-section rate of approximately 10%.

- In addition to the chronic shortage of trained staff in the L&D ward to attend to the roughly 30 deliveries per day and overcrowding in the labor and post-labor wards, with up to three mothers (and newborns) per bed during peaks, the hospital had just two surgical theatres. These theatres were continuously occupied with emergency C-sections, disrupting the operations of other departments.

- Our patient flow model for the Sengerema/Buchosa district predicted an additional influx of approximately 1,100 emergency cases per year at SDDH, highlighting a critical overload of a hospital already under significant pressure.

- Based on the modeling, our targeted capital investment plan prioritized the construction of a dedicated C-section theatre inclusive of sterilization facilities, the expansion of the L&D and post-labor wards with the addition of 12 and 16 beds, respectively, and the purchasing of critical equipment to furnish the new C-section theatre (e.g., sterilizers, surgery room equipment) and the additional space available in the wards (e.g., hospital beds, clinical and nursing equipment).

**PROGRAM PARTNERS WITH COMPLEMENTARY STRATEGIC ADVANTAGES**

As the EmTS is built upon the integration of technology, private sector solutions, public health interventions, health system process optimization, and community engagement, the early engagement of funders and partners with complementary skills and knowledge to address all aspects of the program was key to our success.

**Private sector involvement and funders**

The partnership with Vodafone Foundation allowed the program to leverage investments made by Vodacom Tanzania in cell tower expansion to broaden mobile coverage and services in remote areas, ensuring that all segments of the population, regardless of location, could access the emergency system. Vodacom Tanzania’s provision of a dedicated toll-free number enabled more people to request emergency transportation and access quality care. The integration of the Vodacom M-Pesa mobile payment system into the dispatch application ensured automated, real-time payment of taxi drivers, both minimizing operational and administrative costs related to the management of financial flows and increasing the interest of rural taxi drivers in participating in the program. The
Key EmTS interventions in Sengerema/Buchosa and Shinyanga districts

Set up and operate dispatch center
- **Set up district dispatch center** for management of emergency transportations
- **IT & Equipment**: set up dispatch center application and purchase IT equipment
- **Staff**: hire and manage dispatchers
- **Payments**: manage transportation payments

Establish basic emergency obstetric and newborn care (BEmONC) centers
- **Construction**: build or renovate L&D and post-labor infrastructure as needed
- **Equipment**: procure equipment and consumables for BEmONC service provision
- **Training**:
  - Train all staff in BEmONC and provide close up supportive supervision and mentoring
  - Train all **lower-level facilities in stabilization** and basic emergency transportation system protocols

Upgrade referral comprehensive emergency obstetric and newborn care (CEmONC) centers
- **Construction**: build or renovate L&D, C-section and post-labor infrastructure as needed
- **Equipment**: procure equipment and consumables for CEmONC service provision
- **Training**: train all MNCH staff in CEmONC and support specialist training of nurse anesthetists

Develop and manage network of taxi drivers
- **Identify and contract** preferred taxi drivers across the district
- **Train** drivers on basic EM transportation system and safety protocols

Create community awareness of EmTS
- **Develop awareness** campaigns to educate communities and health workers on emergency transportation system
data-driven design of the program appealed to the corporate social responsibility interests of for-profit firms, and brought together the private sector with non-governmental program implementers and large bilateral and multilateral organizations, as well as key ministries and departments within the Government of Tanzania.

The generous contributions from private and bilateral donors, including USAID, Vodafone Foundation, and The ELMA Foundation were essential to program execution. In addition to pure financial support, collaborating closely with the funders—USAID in particular—allowed the implementation team to develop and solidify relationships with core government stakeholders and convene with other implementing partners working in the same focus area.

**Lead implementers with complementary skills**
A team of implementing partners with complementary skills was assembled to ensure proper program design and execution. With oversight from Vodafone Foundation to guide the program and guarantee compliance with funder requirements, Touch and Pathfinder International were the on-the-ground program implementers.

With more than 12 years of experience working in the Lake Zone, Touch provided local health systems knowledge, familiarity with processes at both the district and regional hospital levels, as well as established relationships and goodwill with both local and national stakeholders. Touch’s private-sector approach rooted in robust upfront needs analysis and rigorous analytical modelling facilitated the development of a program design based on available data with flexibility to incorporate identified system improvements. Touch also managed all upgrades and process development at district and regional hospital levels, including dispatch center setup, while closely collaborating with district authorities and Pathfinder International to coordinate emergency protocols between lower-level and referral facilities.

Complementarily, Pathfinder International’s established in-country presence allowed the program to mobilize high-level government officials and ensure their early buy-in. Pathfinder’s extensive implementation experience and its local footprint in rural Tanzania allowed us to engage communities and implement the program at lower-level facilities. Pathfinder’s team identified and managed the taxi drivers’ networks, trained staff and supported the focus on operations at lower-level facilities, while also engaging with district officials to improve sustainability and eventually transition ownership to local authorities.

**Specialist implementation partners**
During the design phase of the program, it became clear that optimal execution would require additional specialist skills in areas outside of either Touch or Pathfinder’s expertise. Several partners were thus engaged to provide the necessary level of expertise:

- **D-tree International**, built the decision-making software to support dispatchers in managing incoming emergency requests.

- **Riders for Health**, performed an upfront on-the-ground assessment of major system bottlenecks related to transportation solutions, specifically in Sengerema/Buchosa district. The hybrid system complementing ambulances with private taxis was developed based on Riders for Health’s assessment of both public (i.e., ambulance fleet) and private transportation solutions, including road conditions and health facility accessibility across seasons, quality of communication between health facilities and ambulance services, and ambulance fleets management (e.g., fuel availability, vehicle maintenance and associated costs).

- **VillageReach** performed an assessment of the availability of supplies and medicines across the district to inform the routing of emergencies to the appropriate facilities.
• New York University College of Nursing conducted supervision and mentoring training at both Sengerema district and Shinyanga regional hospitals to senior clinicians in order to prepare them to mentor and supervise student nurses, midwives, residents, and novice clinicians on how to provide effective and efficient maternity care to mothers and newborns.

• Leveraging previous Touch investments in Geographic Information System (GIS) equipment and training of core staff our local partner CUHAS School of Public Health, data spanning geographical distribution of infrastructure, equipment, staff, and service availability in all district facilities were collected and visualized, allowing for optimal program design per district.

**FOCUS ON SUSTAINABILITY**

Touch and our partners’ general commitment to addressing Tanzania’s healthcare crisis is coupled with a philosophy that international development should not foster dependency, but rather work to effect long-lasting, positive change. By partnering with organizations with a vested, long-term interest in the country—including domestic and international governments, private companies conducting business in Tanzania, and local healthcare institutions—we ensure the longevity of our impact, which will endure as we transition improved infrastructure and programs to our local partners. As such, long-term sustainability of the EmTS has been a priority since program inception, including a focus on solutions that enable full transition of ownership to the Government of Tanzania with limited financial or managerial burden.

**Co-design & integration with existing systems**

While the government’s ownership of managerial and financial responsibilities will realistically be achievable once program impact and cost-effectiveness are proven and thoroughly disseminated, we engaged early with government officials regarding program design and implementation to foster local ownership from the onset and ultimately facilitate a smooth transition. This close collaboration with the government and the effort to embed the EmTS into the existing health system resulted in alignment of clinical guidelines for the dispatch decision-making application with the current health system policies and procedures. The emergency triage system was based on existing referral protocols, while new community referral guidelines were developed and approved in collaboration with the MoH.

The transportation solution was co-designed with government authorities, facilitating integration within current systems. In fact, before the launch of the EmTS, a limited number of inter-facility emergency referrals and transportations were already being executed using available district ambulances. However, no emergency transportation was possible directly from the communities. The introduction of private taxi drivers for emergency transportation complemented the ambulance services rather than replacing them, increasing the volume of emergencies transported and expanding direct access to more rural communities and home births.

**Endorsement by key stakeholders**

Collaborating closely with the district authorities during system design and set-up ensured their early endorsement of the EmTS. The Government of Tanzania’s financial and managerial commitment continuously increased after the program was launched and data began showing a substantial
decrease in maternal deaths across the districts. Government authorities started directly recruiting and paying dispatchers, and actively promoting the establishment of private taxi driver associations. Witnessing the importance of a functioning transportation system, district and regional medical officers renewed their efforts to increase availability of their own ambulance services by enlarging their fleet and enhancing their repair and maintenance. Although the percentage of emergency cases transported by ambulance has consistently increased, reaching 27% and 23% in Sengerema/Buchosa and Shinyanga districts respectively (Figure 5), private taxis remain critical to ensuring prompt transportation when receiving emergency calls from the most remote areas.

A High-Impact, Cost-Effective Solution

Demonstrating evidence of the significant results achieved by the EmTS is a crucial element of discussions with Tanzanian stakeholders, both for fostering buy-in and establishing a case for sustainable scale-up of the program. As with most programs in low-income countries, the unavailability and unreliability of data, especially at the district and ward levels, proved formidable obstacles to measuring outcomes. Touch and our partners worked to overcome these challenges and leverage the professional and private sector experience of the team on the ground to develop a robust analytical model which uses validated assumptions to account for data gaps. Touch’s model estimates current and future patient flows and associated case fatality rates across each district’s delivery setting (i.e., home, lower-level facility, hospital), and assesses the ratio of emergencies in need of BEmONC vs. CEmONC services. The dispatch application supports the collection and analysis of actual data on patient flows and case fatalities that are used by the model to calculate the program’s impact and cost-effectiveness.

EmTS: REDUCING MATERNAL MORTALITY

In 2016, during the first full calendar year of operations, the EmTS transported approximately 1,430 women across Sengerema/Buchosa district9, three times the number of emergencies transported in 2014 prior to the EmTS’ inception. Twenty-four percent of the total 2016 maternal emergencies originated from the communities, where no transport system was available beforehand, while the remaining 76% were referred to the district hospital by lower-level health facilities (Figure 5). Although the number of emergencies that originate in the communities has been steadily growing, 40% of deliveries are still estimated to occur at home in the Sengerema/Buchosa district, and the number of emergencies called directly from the community remains lower than expected. Analysis of the data has already prompted us to dedicate more resources to increasing community awareness of the EmTS.

Through our model we estimate that, in the most conservative scenario, the EmTS saved 57 maternal lives across Sengerema/Buchosa district in 2016, equivalent to a 27% decrease in maternal mortality. This number was estimated by comparing the number of deaths projected by the model without

9. Impact and cost-effectiveness of the EmTS has been estimated using the Sengerema/Buchosa district as the implementation in Shinyanga district is still in the ramp-up phase
Figure 5: Break-down of emergency transportations in Sengerema/Buchosa and Shinyanga districts

Emergencies by means of transport, Sengerema/Buchosa

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Taxi</th>
<th>Ambulance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3 2015</td>
<td>72%</td>
<td>28%</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>85%</td>
<td>15%</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>92%</td>
<td>8%</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>98%</td>
<td>2%</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>97%</td>
<td>3%</td>
</tr>
<tr>
<td>Q4 2016</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>Q1 2017</td>
<td>73%</td>
<td>27%</td>
</tr>
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</table>

<table>
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<th>Quarter</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Q3 2015</td>
<td>61</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>101</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>369</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>369</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>320</td>
</tr>
<tr>
<td>Q4 2016</td>
<td>371</td>
</tr>
<tr>
<td>Q1 2017</td>
<td>396</td>
</tr>
</tbody>
</table>

Emergencies by origin, Sengerema/Buchosa

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Home</th>
<th>LLF</th>
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</thead>
<tbody>
<tr>
<td>Q3 2015</td>
<td>82%</td>
<td>18%</td>
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<tr>
<td>Q4 2015</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>84%</td>
<td>16%</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>78%</td>
<td>22%</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>72%</td>
<td>28%</td>
</tr>
<tr>
<td>Q4 2016</td>
<td>68%</td>
<td>32%</td>
</tr>
<tr>
<td>Q1 2017</td>
<td>59%</td>
<td>41%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quarter</th>
<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>Q3 2015</td>
<td>61</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>101</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>369</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>369</td>
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<tr>
<td>Q3 2016</td>
<td>320</td>
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<tr>
<td>Q4 2016</td>
<td>371</td>
</tr>
<tr>
<td>Q1 2017</td>
<td>396</td>
</tr>
</tbody>
</table>
Emergencies by means of transport, Shinyanga

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Taxi</th>
<th>Ambulance</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3 2015</td>
<td>38</td>
<td>8%</td>
<td>100%</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>153</td>
<td>3%</td>
<td>100%</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>241</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>247</td>
<td>3%</td>
<td>100%</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>221</td>
<td>23%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Emergencies by origin, Shinyanga

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Home</th>
<th>LLF</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3 2015</td>
<td>38</td>
<td>95%</td>
<td>100%</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>153</td>
<td>87%</td>
<td>100%</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>241</td>
<td>84%</td>
<td>100%</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>247</td>
<td>85%</td>
<td>100%</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>221</td>
<td>90%</td>
<td>100%</td>
</tr>
</tbody>
</table>
the EmTS and the actual number of deaths recorded following program implementation. Estimating the variation in maternal mortality for home deliveries required additional modeling. Our baseline model provided an estimate of the number of home deliveries and related maternal deaths without the EmTS (“no EmTS”). While we were able to assess the decrease in home deliveries following implementation of the EmTS, no data on the associated variation in maternal mortality existed for comparison. We therefore decided to analyze the “no EmTS” home-based deliveries through regression analysis by creating a continuum of death probabilities across those deliveries, using the known average mortality ratio as the regression constraint. We identified two scenarios for consideration:

**Figure 6: Impact of the EmTS on maternal lives saved in Sengerema/Buchosa district**

<table>
<thead>
<tr>
<th></th>
<th>2016 without EmTS</th>
<th>2016 with EmTS^a</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SDDH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deliveries</td>
<td>9,312</td>
<td>10,239</td>
</tr>
<tr>
<td>Deaths</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td><strong>HC/DISP.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deliveries</td>
<td>13,827</td>
<td>13,243</td>
</tr>
<tr>
<td>Deaths</td>
<td>64</td>
<td>29</td>
</tr>
<tr>
<td><strong>HOME</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deliveries</td>
<td>16,054</td>
<td>15,711</td>
</tr>
<tr>
<td>Deaths</td>
<td>131</td>
<td>109</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deliveries</td>
<td>39,193</td>
<td>39,193</td>
</tr>
<tr>
<td>Deaths</td>
<td>214</td>
<td>157</td>
</tr>
</tbody>
</table>

Program Impact: 57+ LIVES SAVED

^a Estimated based on the conservative scenario assumption

---

a. Does not include an additional 8 women transported to SDDH who died soon after and whose death was attributed back to LLF or home
b. Additional 480 women were transported to SDDH, but they would have been transported also in absence of the EmTS (i.e., baseline)

---

10. This hypothetical scenario was assessed by starting from a baseline assessment for June 2014–May 2015, then projecting the increase in number of deliveries according to the World Bank reported Tanzanian population growth, and using the average mortality ratio as reported by the Demographic and Health Survey 2015/2016.
a) Aggressive: transported women represented the most severe cases originated from the communities

b) Conservative: transported women represented the average severity of the cases originated from the communities

The underlying assumption was that transporting more severe cases facing a higher probability of death would translate to more lives saved. In the conservative scenario that assumes women transported from the communities were experiencing emergencies of “average severity,” we estimate that 57 maternal lives were saved across the district, resulting in a 27% overall decrease in MMR (Figure 6). While the aggressive scenario leads us to an estimation of 155 maternal lives saved (i.e., 72% overall decrease in MMR), we believe that the actual number of lives saved lies somewhere in the middle.

When considering the following additional factors, it is clear that our model’s estimated range of maternal lives saved is conservative:

- In the baseline scenario, we assumed Sengerema/Buchosa rural districts experienced the average maternal mortality ratio of Tanzania, but these districts likely have above-average MMR [Government of Tanzania, 2014].

- Lower-level facilities are increasing the accuracy with which they report maternal deaths, whereas previously under-reporting was widespread to avoid death audits.

Consequently, the number of maternal lives saved by the EmTS in lower-level facilities is likely underestimated.

At Sengerema district hospital, case fatality rates for transported emergencies decreased by 88% during the program’s first two years, despite a three-fold increase in the number of emergencies received (Figure 7). Although referral hospital mortality statistics were expected to worsen when more severe emergencies were referred from lower-level facilities, the targeted health system strengthening approach embedded in the program and the resulting investments in infrastructure and equipment upgrades and staff training contributed to an overall improvement in the quality of care delivered, ultimately reducing the number and percentage of maternal deaths at the hospitals. During the same two-year period, case fatality rates at lower-level facilities also decreased by approximately 60%.

Patient flow analytical model

To inform the design of the program, we modelled the expected patient flows, starting from the baseline situation in the district. Noting that the existing level of detail recorded on district deliveries was insufficient to accurately establish a baseline, Touch developed an analytical model estimating the number and type of deliveries at home, in lower-level facilities, and in district/regional hospitals, as well as associated maternal mortality ratios. Starting from this baseline scenario, we estimated the number of emergency cases across the different levels of care (including those from the community) and the increase in facility workloads expected following the introduction of the EmTS. For example, 458 emergencies were transported to the Sengerema district hospital the year before our program was launched. Our model estimated that approximately 1,100 additional emergencies would have required transport to the district hospital each year, and another 1,400 additional emergencies would have required transport to lower-level facilities directly from
The community. The projected number of deliveries, adjusted by type (i.e., expected case-mix and severity), allowed planning for targeted investments at district facilities to upgrade infrastructure (e.g., C-section theatres, post-labor wards) and procure clinical equipment. To ensure the analytical model provided reliable outputs, Touch and our partners dedicated considerable resources and time collecting available data, performing quality checks and triangulation, and developing estimates for missing data. Although health facilities are required to report key indicators to the Health Management Information System (HMIS), the quality and consistency of reporting is limited by inaccurate data transcription and systematic under- and over-reporting by facility administrators. Accuracy of home delivery data is less reliable still, especially regarding mortalities. Data on facility-based deliveries were adjusted using extrapolation (in the case of under-reporting facilities) and demographic statistics (e.g., population by ward) to ensure consistency and drive ad hoc data audits, as needed. Similarly, we estimated the number of home deliveries by cross-checking official data provided by the district authorities with demographic indicators of fertility and pregnancy rates.

11. Before the EmTS, in Sengerema/Buchosa district all emergencies originated from lower level health facilities, as emergency transportation was not available directly to the community.
EmTS: ENSURING COST-EFFECTIVENESS

Tanzanian local health authorities face chronic underfunding. Limited financial resources make it difficult for authorities to consider the inclusion of new health programs into their budgets, unless the additional financial burden related to operational and capital spending is minimal. The EmTS represents a cost-effective solution that reduces the need for upfront capital investments and requires limited operational costs.

Touch and our partners designed the program to enable donor organizations to fund upfront capital investments, while allowing government authorities to incorporate the limited program’s operational costs into their budgets. Donor contributions notwithstanding, we believe that the demonstrated impact of the EmTS in saving maternal lives should justify its adoption by government authorities.

In line with this approach, we assessed the cost-effectiveness of the EmTS from the perspective of the local government (Figure 8). We considered only those annual operational expenses that local health authorities must bear, including transportation costs, dispatch center staff salaries, and dispatch software maintenance; this scenario will be realized in the next few years when the government will own and manage operations in the districts where Touch and our partners introduced the program. Comparing the annual costs with the impact in terms of lives saved, we estimated the cost-effectiveness of the EmTS at approximately $2,000 per maternal life saved, equivalent to $52 per maternal life-year saved once life expectancy and average pregnancy age in Tanzania are factored in.

In case of a scale-up of the EmTS without external funder support, the government will need to incur upfront capital investments of approximately $350,000–$400,000 per district, which includes major infrastructure and equipment upgrades as well as health worker training at the different levels of care. Most of these investments will strengthen the Tanzanian health system as a whole and improve delivery of care well beyond the implementation of the EmTS, facilitating their budget inclusion by the local government authorities.

<table>
<thead>
<tr>
<th>Projected number of additional emergencies in Sengerema/Buchosa district</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL DELIVERIES IN THE DISTRICT: 39,193 deliveries</td>
</tr>
<tr>
<td>EMERGENCIES TRANSPORTED PRIOR TO THE EMTS: 458 women</td>
</tr>
<tr>
<td>ADDITIONAL WOMEN IN NEED OF EMERGENCY TRANSPORT: 2,500 women</td>
</tr>
</tbody>
</table>

12. The cost of managing the system was not included, as we assumed that this could be managed by current district staff.
13. Based on Sengerema/Buchosa program data.
14. The estimate is based on our experience in the Sengerema/Buchosa district, and it may vary significantly based on the contingent situation of the health system in the scale-up districts.
Key Learnings and Opportunities

Our program has continued evolving throughout the years, incorporating feedback from our team in Tanzania and from a real-time data dashboard built into our dispatch application. In collaboration with our partners, we are continuously designing and testing operational improvements to address identified gaps, inefficiencies experienced by our team, and suggestions from other stakeholders.

IMPROVEMENTS TO THE INITIAL DESIGN

The dispatch application allowed our team of project managers to easily monitor:

- real-time patient flows
- case fatality numbers
- hospital and facility service performance
- taxi driver activities
- dispatch center operations

Figure 8: Program cost effectiveness

<table>
<thead>
<tr>
<th>Program cost</th>
<th>Program impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>$350K–$400K (Program cost)</td>
<td>57+ LIVES SAVED PER YEAR</td>
</tr>
<tr>
<td>$110K (Program development &amp; set-up)</td>
<td>$2,000 PER MATERNAL LIFE SAVED</td>
</tr>
</tbody>
</table>
The dashboard is designed to provide real-time information on the system, including live transportation cases, while supporting program staff in following up and collecting qualitative information on select cases (e.g., tracing the clinical pathways of EmTS cases leading to maternal deaths). Our continuous feedback and review process has already resulted in various modifications to and improvements upon the initial design:

- An analysis of the data from lower-level facilities showed that stabilization of patients before transport to referral hospitals took up to five hours in some cases, prompting the program team to refresh training and coaching on the procedures for preparation of transport cases and reinforce the importance of swift action in the case of emergency.

- Our team and IT partners have also updated the dispatch application to allow for increased flexibility. For example, dispatch center operations revealed the number of active taxi drivers to be quite fluid, requiring a modification of the dispatch application to enable dispatchers to periodically update the taxi driver list in order to reduce the time for selection and dispatch of taxis during an emergency call.

- We have updated and strengthened control processes related to administration of the payment system to avoid glitches and tampering.

- We supported local government authorities in creating taxi driver associations to streamline negotiations of tariffs and contracting.

- We are also working directly with village leaders to strengthen the accountability of taxi drivers to their communities, improve performance (e.g., avoid taxis stopping during emergencies for unrelated issues, ensure taxis adhere to set pickup and delivery protocols), and foster long-term sustainability of the taxi network system.

- We are currently using patient flow and system performance data to conduct a clinical review of the triage protocol with medical experts. By comparing the case mix of emergencies transported to the referral hospitals and to each lower-level facility, as visualized through our dispatch application dashboard, we plan to assess the efficacy of the current dispatch decision tree system and redesign the triage protocol in order to optimize the number and distribution of emergency transport cases across participating facilities.

**FUTURE IMPROVEMENTS**

We also identified longer-term improvements that we will implement in the next phase of the program, as they require additional investments and resources to be finalized.

**Focus on strategic high-volume BEmONC facilities**

The EmTS and the triage decision tree were designed to transport CEmONC cases to the referral district/regional hospitals, while expecting lower-level facilities to manage all BEmONC cases, including those transported from the communities. However, an analysis of Sengererema/Buchosa’s emergencies by type and severity highlighted a systematic over-reliance on referrals to the district hospital. Data from the first full year of operation show that 1,078 emergencies were transported from lower-level facilities to SDDH, while only 36% of those were identified as emergencies requiring CEmONC services.
These data triggered a qualitative survey of district lower-level facilities which revealed that basic emergency cases routed from the facilities to the district hospital were caused by staff either lacking the confidence to handle the emergency case or being unable to access necessary equipment and supplies. This finding indicated that, although all healthcare workers in the district facilities were trained in BEmONC per the MoH’s approved curriculum, greater emphasis on skills transfer and confidence-building and the provision of basic equipment and supplies are needed to ensure healthcare workers can provide services to the fullest extent.

In the next phase of the program, Touch and our partners will add a more focused curriculum of supportive supervision and mentorship to the standard training at select BEmONC facilities, while continuing to train staff across all district facilities on emergency stabilization and transportation protocols.

- Local trainers will travel to select high volume facilities across the district and establish direct contact with those rural healthcare workers who are on the front lines delivering BEmONC care.

- The mentorship system will ensure healthcare workers from selected lower-level facilities continuously develop and refine their BEmONC skills, creating a long-term, sustainable impact on the district’s health system.

- The training program will be complemented by an assessment and subsequent procurement of necessary equipment and supplies to support these high-volume sites in delivering care.

**Increase community awareness, cost-effectively**

The EmTS is accessible both to lower-level health facilities experiencing complicated emergencies that cannot be managed safely locally, and to private citizens experiencing complications during home births. As mothers delivering at home still account for about 40% of total deliveries, it remains critical for the communities to be aware of the EmTS and the toll-free number available to request emergency transportation.

During the initial phase of the EmTS, the system leveraged a network of community healthcare workers (CHWs) covering all wards and villages of the district. A key element of the wider *Mobilizing Maternal Health* program, they primarily focused on supporting a maternal care referral system by actively enrolling and following up with pregnant women within their communities, ensuring proper attendance of antenatal care (ANC), and fostering delivery at healthcare facilities; they also contributed to spreading awareness of the EmTS and the toll-free number. They were often present during home births and called the dispatch number once an emergency arose. An analysis of the data shows that approximately 24% of emergencies originate from the communities, with a steady increase seen over time as system awareness also spread through word-of-mouth.

As the formal absorption of CHWs within the Tanzanian health system is still uncertain and their deployment is still mainly funder-driven, we plan to limit our reliance on CHWs and improve sustainability by increasing our focus on community engagement campaigns across health facilities and within the communities to create and improve awareness of the EmTS and toll-free number. We also hope to cultivate word-of-mouth mechanisms to sustain community engagement in the long-term.
Increase focus on neonatal care

Every year 2.7 million neonates die worldwide, with low- and middle-income countries accounting for the majority of these deaths. Between 2000 and 2015, progress toward achieving the MDGs related to neonatal and child health in Tanzania was mixed. While the under-five child mortality rate decreased more than 8% annually and did reach the MDG target, the reduction in neonatal mortality was much slower, with 40% of deaths of Tanzanian children occurring in the first 28 days of life [Watts et al., 2016]. Moving forward, the target is to reduce neonatal mortality rates from the current 26 deaths per 1,000 live births to 16 by 2020, and to 10 by 2030. Three causes of neonatal mortality make up more than 80% of cases: 1) complications from prematurity, 2) intrapartum-related neonatal deaths (including birth asphyxia), and 3) neonatal infections (sepsis, meningitis, pneumonia, and diarrhea) [UNICEF & WHO, 2014]. As with mothers, known risk factors of neonatal mortality include a complex combination of individual, socioeconomic, and health systems factors.

The EmTS program was developed to include a component of neonatal care, with triage protocols, transportation processes, and quality improvements at facilities already designed to address neonatal emergencies. Touch and our partners leveraged the experience of Thrive Health’s Newborn Health Program, formerly known as Breath of Life, in strengthening the quality of neonatal care in low-resource settings. By providing neonatal emergency medical devices appropriate for low-resource settings and training and mentoring core clinical staff, the program supported the creation of Neonatal Intensive Care Units at the referral district and regional hospitals. Health professionals received the tools they need to deliver high-quality care to newborns suffering from common and easily treatable conditions, such as jaundice, respiratory distress, and hypothermia. Measuring the EmTS’ impact on neonatal mortality presents even greater challenges than those faced when assessing maternal mortality, due to even less available data and increased data unreliability. While preliminary results from our model suggest a considerable decrease in neonatal mortality across the districts, those results need to be further confirmed and validated.

With neonatal mortality at about 5-6 times the rate of maternal mortality, the opportunity to further leverage the EmTS program and enhance the impact on neonatal lives saved is substantial. When comparing causes of death for mothers and neonates, the difference is the time scale by which we measure delays. With approximately 36% of neonatal deaths occurring within the first day [Oza, Cousens, & Lawn, 2014], often not allowing time for transport in case of emergency (e.g., birth asphyxia accounts for 31% of all neonatal deaths in Tanzania [Afnan-Holmes et al., 2015]), the necessity to bring quality neonatal care closer to the communities is evident. In the next phase of the EmTS program, we will increase our focus on curbing neonatal mortality by improving neonatal emergency care at the select BEmONC facilities and limiting as much as possible the need to transport neonatal emergencies across greater distances.

Together with our partners, we will ensure healthcare workers are trained in neonatal emergency interventions and the selected facilities have access to the appropriate neonatal care equipment and supplies. Touch will also improve the measurement and analysis of neonatal data to refine the impact model and enhance confidence on actual results and cost-effectiveness related to neonatal interventions.
CONCLUSION AND NEXT STEPS
At present, many sub-Saharan countries focus on improving maternal and neonatal care through increased availability of healthcare workers and improved equipment at lower-level facilities. An efficient and cost-effective emergency transportation system has yet to be prioritized, mostly due to its complex management and perceived cost. Indeed, direct management of ambulance fleets, including initial procurement, preventive maintenance, repair, and operationalization, is often the main obstacle preventing creation of a well-functioning emergency transportation system in developing countries (as confirmed by our assessment in Sengerema/Buchosa district).

The creation of the EmTS, based on a streamlined, technology-driven emergency dispatch center with remote triage capabilities and the outsourcing of transportation logistics to private taxi drivers, provided the districts with a lean and cost-effective emergency transportation system with increased capacity and reliability. In the long-term a well-functioning health system will require all lower-level facilities to provide at least basic emergency care, with CEmONC services provided by multiple referral facilities located closer to rural patients; however, the current pressure on district and national budgets requires a shorter-term bridging solution in the interim to bring patients to appropriate health facilities. The implementation of an efficient and reliable emergency transportation system can swiftly reduce maternal and neonatal mortality rates, while supporting the long-term enhancement of the health system as a whole.

The EmTS has been tested and its impact validated in two rural districts in the Lake Zone of Tanzania. The results prompted Touch and our partners to commit to scaling up the system to a regional level. A regional emergency transportation system connecting and integrating several districts will provide a solid ground for government buy-in to replicate and scale nationally. As Tanzania’s decentralization by devolution (D-by-D) approach empowers district authorities with full government responsibilities, a regional scale-up will require the development of a coordinated emergency transportation system across multiple administrative areas (i.e., district and regional authorities), and it will include lower-level health facilities as well as district and regional hospitals for specialized interventions. The scale-up phase will build upon lessons learned from the previous phase and expand sustainability and buy-in from local to national government.

The replication of the EmTS in additional districts will require a detailed assessment of infrastructure and availability of resources (including trained staff, supplies and equipment, and blood supply) to identify the improvements needed and to prioritize CEmONC and BEmONC facilities. Touch and our partners will plan infrastructure upgrades for those facilities expected to absorb a larger proportion of maternal and neonatal emergencies, and we will train healthcare workers to confidently manage cases. Touch will select high-volume BEmONC sites, strategically located to optimize the flow of emergencies across the district and minimize transportation costs.

These facilities will function as accessible centers of excellence for BEmONC services for the population living in the most remote areas of the district. Inter-district facility referrals will also be considered. The set-up and maintenance of BEmONC facilities will mitigate excessive workload pressure at the referral hospital, which will manage only the most complex CEmONC cases, plus a limited number of BEmONC cases originating in close proximity to the facility. The standard BEmONC training will be complemented with a supportive supervision program in which district trainers will periodically visit the select facilities and complete refresher trainings and mentoring visits to ensure staff maintain and absorb the acquired skills. In addition, all district facilities will receive a Non-pneumatic Anti-shock
Garment (NASG) to improve patient safety during transportation, and health workers will be trained on basic stabilization procedures and emergency transportation protocols. We will work to increase community awareness related to the EmTS and toll-free emergency number using a combination of media, including m-health solutions, and direct community engagement.

We have made substantial progress toward program sustainability over the last three years. The EmTS is currently embedded in the district health system, with the referral hospital and the Council Health Management Team (CHMT) responsible for its daily operations. During the next phase of the program, we will increase our focus on sustainability. We will develop an upfront phase-out plan with the local government authorities, creating a clear path to their full financial and managerial ownership of the program. The growing support from local government due to the results achieved to-date bodes well for increased commitment.

We will continue our two-pronged approach for the dissemination of results. First, we will continue working with local authorities to implement the system and demonstrate the impact on maternal and neonatal mortality ratios in their districts. Due to Tanzania’s decentralized decision making system, cultivation of local leadership will ensure local decision-makers support the integration of the EmTS into their plans and budgets. Second, we will intensify our engagement at the national level with the Ministry of Health and other stakeholders to influence policymaking and promote national adoption of the program. Buy-in from national stakeholders will help facilitate broad expansion of the EmTS program across Tanzania and validate local government plans for its adoption and implementation.
TOUCH FOUNDATION’S PARTNERS

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Pathfinder International is driven by the conviction that all people, regardless of where they live, have the right to decide whether and when to have children, to exist free from fear and stigma, and to lead the lives they choose. Since 1957, Pathfinder International has partnered with local governments, communities, and health systems in developing countries to remove barriers to critical sexual and reproductive health services. Together, Pathfinder International expands access to contraception, promotes healthy pregnancies, saves women’s lives, and stops the spread of new HIV infections, wherever the need is most urgent. Pathfinder International’s work ensures millions of women, men, and young people are able to choose their own paths forward.

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USAID is the lead U.S. Government agency working around the world to end extreme poverty and enable resilient, democratic societies to realize their potential. In order to support these goals, President John. F. Kennedy created the United States Agency for International Development by executive order in 1961. Currently active in over 100 countries worldwide, USAID was born out of a spirit of progress and innovation, reflecting American values and character, and motivated by a fundamental belief in doing the right thing. Today, USAID staff work to further America’s foreign policy interests in expanding democracy and free markets while also extending a helping hand to people struggling to make a better life, recover from a disaster or striving to live in a free and democratic country.

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The ELMA Foundation
The ELMA Foundation is the primary foundation within The ELMA group of foundations. Its mission is to improve the lives of Africa’s children and youth through the support of sustainable efforts to advance education, improve health, and relieve the effects of poverty.
REFERENCES


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