BACKGROUND

Mandate of the Ghana Health Service
The mandate of the Ghana Health Service is to “provide and prudently manage comprehensive and accessible health service with special emphasis on primary health care at regional, district, and sub-district levels in accordance with approved national policies.”

Vision and Mission of the Ghana Health Service
The vision and mission of the Ghana Health Service are embodied in the objectives and functions of the agency. The Ghana Health Service’s stated objectives are to: 1) implement approved national policies for health delivery in the country; 2) increase access to good quality health services; and 3) prudently manage resources available for the provision of health services.

Core Business of the Organization
The Ghana Health Services seeks to achieve its objectives through developing appropriate strategies and setting technical guidelines to achieve national policy goals and objectives; undertake management and administration of the overall health resources within the service; promote a healthy mode of living and good health habits; establish an effective mechanism for disease surveillance, prevention, and control; determine charges for health services; provide in-service training and continuing education; and perform any other functions relevant to the promotion, protection, and restoration of health.

A key focus of the Ghana Health Service is maternal and infant health, in keeping with its objective to meet Millennium Development Goals (MDGs) 4 and 5. As part of its efforts to meet MDGs 4 and 5, the Ghana Health Service partnered with Grameen Foundation in 2008 to create MOTECH (Mobile Technology for Community Health). Grameen Foundation, a global NGO headquartered in Washington, DC (with an office in Accra), helps the world's poorest – especially women – improve their lives and escape poverty by providing them with access to appropriate financial services, life-changing information and unique income-generating opportunities. Its mobile phone-based solutions demonstrate its industry leadership in the technology for development field. Grameen Foundation’s mobile health work, in particular, helps the poor in remote, rural areas take control of their health and their lives through relevant, timely information tailored to their particular health needs.

The MOTECH initiative has two interrelated mobile applications which focus on improving the health of pregnant women and infants in poor rural areas in Ghana: Mobile Midwife sends targeted, time-specific, evidence-based voice messages containing important health information to pregnant women and new parents in their local language, and the Nurse Application allows community health nurses to electronically record care given to patients so they can easily identify clients in their area due for critical care. A key innovation of MOTECH is the linking of these components. If a patient misses scheduled prenatal care, the Mobile Midwife service sends a message to remind the woman to go to the clinic. If she fails to attend, her nurse is alerted via text message, enabling the nurse to follow up quickly.

Relation of Organizational Activities to National Priorities in the Ghana Shared Growth and Development Agenda (GSGDA)
The MOTECH initiative and its goals align with the National Priorities in the Ghana Shared Growth and Development Agenda. Not only is the program aiding the work to “bridge the equity gaps in access to healthcare and nutrition services,” but it is also “improving access to quality maternal and child health services.” (21, GSGDA Costing Framework). In addition, the technology is improving the skills and knowledge of the Community Health Workers, allowing them to electronically upload information about their patients, and more readily track those women that are due for care. The information entered by nurses is used not only to identify when pregnant women and children have missed care, but is also used to generate reports to enable Ghana Health Service management to compare diagnosis, treatment, and outcome rates across multiple health regions.

**BACKGROUND ANALYSIS AND RATIONALE FOR INNOVATION**

Ghana Health Service and Grameen Foundation began work by collaborating with the Dodowa Health Research Center to conduct detailed research to assess the issues faced by pregnant women, children, and the health care workers in the Dangme West District in the Greater Accra Region. Through this ethnographic project, Ghana Health Service and Grameen Foundation discovered numerous challenges that face these women, their children, and the medical staff who hope to serve them. These challenges correlate to those addressed in the Millennium Development Goals with regard to health. A report provided by the Dodowa Health Research Center provides general information on maternal health worldwide, as well as general health conditions within Dodowa itself, and the Dangme West District.

*The Dangme West district is very poor and representative of disadvantaged rural districts throughout Ghana. Most of the inhabitants are subsistence farmers or fishermen. Some are petty traders and others are trained artisans, craftsmen and a few civil servants, mainly migrant employees from government ministries, departments, and agencies.*

*Poor health status and poverty are closely interrelated in Dangme West. Unhealthy living environments compounded by limited education, illiteracy, and cultural taboos cause much ill health. Such decreased health status exacerbates household poverty due to the cost of health care and income loss, all of which cause a vicious poverty trap in which poverty causes poor health and poor health keeps people in poverty.*

According to the UN, only 1 in 3 women in developing regions receive adequate care during their pregnancies; in Sub-Saharan Africa, the majority of pregnant mothers deliver without skilled care. Many of the maternal deaths are avoidable, and are the result of direct causes which include hemorrhage, sepsis, hypertensive disorders of pregnancy, complications of unsafe abortion, and obstructed and/or prolonged labor. By reducing the number of general pregnancies and high-risk pregnancies, while increasing the quantity and quality of prenatal care, many of these maternal deaths are avoidable.

The following data from the World Bank, also demonstrates the need for additional maternal and child health services in Ghana:

- In 2008, the mortality rate for children under 5 years old was 79 per 1,000
- In 2008, the maternal mortality rate was 350 per 100,000
- In 2008, the percentage of births attended by skilled staff was 57%, while the world average was 65% in 2009.
- In 2008, the adolescent (ages 15-19) fertility rate was 69 per 1,000 births.
The report from the Dodowa Health Research Center spoke to general health treatment practices, prenatal care practices, labor and delivery practices, and newborn care practices. For general health treatment, people reported a preference for going to the health facility, but reported that the rainy season made it difficult to access, as did financial constraints. Instead, people would go to hawkers, pharmacies, herbalists, or to prayer camps. In terms of prenatal care, many of those interviewed reported that they attempted to access prenatal care, eat better, and exercise in order to have a healthy baby. When the time came to deliver the baby, women reported that they preferred to deliver in a health facility, but if finances were difficult, they would deliver at home, or with a relative. Newborn care was provided in the home, with the mother, and respondents reported only going to a health facility if there was a problem.

**Objectives of the Innovation**

MOTECH is focused on determining how mobile phones can improve health outcomes for pregnant women and children under five years of age in rural Ghana. The detailed ethnographic research conducted at the outset highlighted the issues faced by pregnant women, children, and the healthcare workers who serve them. Ghana Health Service and Grameen Foundation learned about common myths, typical health seeking practices, challenges during pregnancy and, most importantly, the tremendous lack of relevant health information that is typically available to pregnant women. They identified and confirmed systemic challenges that include a lack of accurate health information for women, damaging health practices endorsed by traditional beliefs and myths, low demand for and low awareness of the importance of critical care services, patchy delivery of postnatal care, and onerous paper-based systems in health facilities that take workers away from patients and obstruct patient follow-up.

MOTECH’s interrelated mobile phone services provide pregnant women with detailed health information about pregnancy, encourage them to seek antenatal and postnatal care, promote delivery in a health facility, notify nurses of pending and past due dates to increase the number of newborns seen in the first 48 hours of life, and identify women and children who have not received the standard of care (from antenatal checkups to child immunizations). The Ghana Health Service and Grameen Foundation worked together to ensure that the content was created specifically for the Ghanaian context and addressed locally relevant issues such as foods to eat during pregnancy, cultural practices, and misconceptions about pregnancy. These services are tightly integrated into the current Ghana Health Service system and are beginning the process of nationwide scale-up.

The MOTECH system was launched in July 2010 in the Upper East Region of Ghana, one of the poorest and most remote areas of the country. In April 2011, the service was successfully expanded to the Awutu Senya district in Central Region, validating the replicability of the system and operations.1 To date, MOTECH has registered over 17,631 of which the greatest proportion are pregnant women and children under one. The system delivers up to three messages each week to “pregnant parents” via voice in their local language.2 The messages are tailored to the individual – their stage in pregnancy, care history, location, local value system and preferences for when and where they access advice. Based on where a “pregnant parent” is located and the language they prefer to speak, messages have also been customized to address local myths and beliefs. This level of information tailoring and ease of access has not been available to women in rural communities before and clearly resonate with users, as 94% listen to the complete message. During pregnancy, MOTECH’s weekly messages cover a range of topics from

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1 A video summarizing the MOTECH program is online at [http://www.youtube.com/watch?v=3ZsufOqpK74](http://www.youtube.com/watch?v=3ZsufOqpK74).
2 Messages can be sent via voice or SMS, but 99% of users have opted for voice.
fetal development to good nutrition; to improve pregnancy outcomes, however, a special emphasis is placed on the importance of antenatal care (with time-based reminders) and giving birth with a skilled birth attendant. The messages continue through the first week of life for the newborn.

All of the software developed for MOTECH is available via OpenSource license. A detailed summary of the project and “early lessons learned” during the pilot phase has been published by Grameen Foundation and can be found online. This document also discusses many of the challenges encountered during the pilot phase – from content development to registering users to business sustainability analysis of providing nurses with dedicated mobile phones – and the solutions found.

THE INNOVATION

MOTECH was created by Grameen Foundation in direct collaboration with the Ghana Health Service. Currently, the Ghana Health Service oversees the operation of the clinics and nurses, while Grameen Foundation provides the nurse training in addition to the technology for the program. The ongoing collaboration between Ghana Health Service and Grameen Foundation is essential to the success of the MOTECH initiative. As the project moves into Phase Two, an essential feature is the ongoing transition of roles and responsibilities in management and implementation of MOTECH to the Ghana Health Service.

MOTECH’s Mobile Midwife service was created to send “pregnant parents” (as often times it is not the woman who controls access to the mobile phone) voice messages on a weekly basis to address basic questions about pregnancy and encourage appropriate-health seeking behavior. These messages are also tailored to catalyze demand for health care services, encouraging women to seek early antenatal care treatment and important vaccinations and treatments in line with Ghana Health Service maternal and child health policies. Additionally, some messages are targeted specifically to men, given their typical control of family finances, which can be vital for arranging transportation to the health clinic for antenatal care/delivery and access to healthy food to ensure appropriate nutrition.

Individuals register for Mobile Midwife by calling a toll-free number or providing information to a Community Health worker who can use a custom registration form on her mobile. For each person, MOTECH records their name, location, estimated due date (or age of their newborn), language and message-type preference (voice or SMS), preferred time of day to receive messages and mobile phone number. If a person does not own their own mobile phone, they can register a “shared access” phone number. Each person is assigned a MOTECH identification card that includes a MOTECH number which can be used to access messages.

The Mobile Midwife service is therefore offered free of charge to users. The system is designed to respond to a “flash” from a client. Although we initially intended this to be a temporary solution, flashing is a widely-used mode of communication in Ghana, so people are familiar with it and confident they will not be charged for accessing Mobile Midwife when accessing it this way. A toll free short code has been implemented as well.

Some services outside of Ghana deliver messages via SMS; given the literacy challenges in rural Ghana, it is essential to deliver messages via voice in local languages to effectively educate women and their

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families. To date, 99% of Mobile Midwife registrants have chosen to receive voice messages over text messages because they are easier to understand and easier to share with other members of their family. Women register into Mobile Midwife through their community health nurses, a community health volunteer or by calling a toll-free number to a staffed call center. At the time of registration, women indicate their preference for the day, time and language in which they want their messages to be delivered.

A separate set of tools was created for the Community Health Nurses that work in the rural facilities that provide health care. Nurses are provided with a low-end Nokia 1680 phone to use for entering data into MOTECH. These phones have the “MOTECH Nurse Application” pre-installed, which is a collection of Java forms that can be used to register patients and record treatment that those patients receive. The decision to provide phones was driven by a business analysis where we realized it would be less expensive over time to provide Java enabled phones and transmit data over GPRS than it would be to pay for nurses to send information via text messages. All of the Community Health Workers and nurses were given training on how to use the MOTECH application, and a training manual was also produced which they could reference if needed. Ongoing training was also provided to keep nurses up to date and engaged in the initiative. The information entered by nurses is used not only to identify when pregnant women and children have missed care, but is also used to generate reports to enable Ghana Health Service management to compare diagnosis, treatment, and outcome rates across multiple health regions.

To streamline data collection for the health workers in rural health facilities, the MOTECH team created a “simplified register” that gathers the most essential patient data. The simplified registers are a condensed version of the longer prenatal and child welfare-related registers that the nurses were using prior to MOTECH. As part of the MOTECH project, the existing registers were analyzed and condensed for efficiency, maintaining only the most relevant fields and reformatted for ease of use. This was to ensure that the mobile interface was being modeled after an efficient patient registration system. The simplified registers also served to consolidate information to better track patients over time. For example, the new maternal health register tracks antenatal care, delivery, and post natal care for mother and child on one row, making it simple to view patient care history. Previously, this data was spread across four separate registers (antenatal care, delivery, post natal care-mother, post natal care-child) making it very difficult to review.

After recording clinical information in the paper simplified register, health workers enter some of this data into the MOTECH mobile application, which runs on the Nokia 1680 handset provided to each facility. The application contains forms for each relevant patient encounter. The use of structured data entry through check boxes, radio buttons, lists and number fields has been maximized to speed up documentation and increase accuracy.

Each completed form is saved onto the phone and uploaded to the MOTECH server via GPRS. Network coverage is spotty in rural areas of Ghana and connection problems are frequent. The MOTECH application has been developed to handle these challenges. Completed forms are less than 1KB each so many forms (up to several thousand) can be stored on the mobile phone until the network becomes available and they can be uploaded to the server. Additionally, the nurses’ application can utilize any mobile network for sending data, so the network with the best coverage at each facility can be selected. Data recorded on the simplified register provides back-up for reference or verification of data stored electronically, if needed. Each facility is provided with the prepaid airtime units required to send mobile
forms to MOTECH on a monthly basis (expected cost is less than 1 cedi, or approximately 60 cents, per month).

Once transmitted to the MOTECH server, data is stored in a central patient electronic medical-records system. The MOTECH system generates individual health records, continuously updating event data for pregnancies, births, deaths and morbidity.

One of the challenges in rural healthcare delivery in Ghana is tracking patient history when individuals are referred to (or seek care from) different types of health facilities. Often clients are referred and there is no way for the referring clinic to know what care the client received previously, or for the referral clinic to be sure that clients receive the appropriate follow up care from referring clinics once they return to communities. MOTECH enables all data about the patient, wherever care was given, to be captured in one place – even when clients receive care at different facilities. It also enables better follow-up for clients who sought care outside of their area. For example, if a woman has an antenatal care visit at a district Health Center but lives in an area where there is a Community Health clinic, MOTECH uses the information about care given at the health center, and sends the reminder for missed care to the Community Health Worker so that the nurse nearest the client is able to go out and find her to provide the overdue care.

MOTECH also enables nurses to query the database whenever they like by using a form in the mobile application. Nurses can use this function to request lists of defaulters in their catchment area, those due or overdue for delivery, or those who recently gave birth. They can also request information about individual clients, such as the care they are due for soon, their contact details, address and estimated due date for pregnant women. If a MOTECH client ID has been lost, nurses can use the query form to search for it by entering the client’s name and any other information known, such as date of birth or NHIS number.

Client information sent to MOTECH’s centralized database is automatically aggregated and tabulated for the generation of many of the monthly facility caseload reports required by Ghana Health Service. These completed reports are emailed to, or downloaded by, Information Officers on the District Health Management Team (DHMT). The reports are then printed and circulated to community health clinics by sub-district supervisors, in the same way that report forms were distributed before MOTECH existed. When health workers receive the reports they fill in any fields that MOTECH was unable to generate and return the completed report to the DHMT via the sub district supervisor. Workers are expected to verify MOTECH generated data by comparing it with data that is manually aggregated from information recorded in their paper registers. Once a nurse is successfully able to enter data with an 80% degree of accuracy for three consecutive months, they are no longer required to manually produce written reports and can rely on the MOTECH generated reports. The reason for requiring only an 80% degree of similarity between MOTECH and manual reports (rather than a target closer to 100%) is that manually-aggregated reports have such a high degree of inaccuracy, there is natural deviation from the MOTECH reports.

**Mobile Midwife and the Nurse Application: Tightly Linked**

The two applications function together to enable appointment reminders for patients and nurses. Mapping patient data stored in MOTECH’s electronic Medical Records System against Ghana Health Service care protocols allows for easy identification of clients who have missed health care appointments (e.g. vaccinations or postnatal visits). The MOTECH system detects when someone is due
or overdue for care and sends the patient a reminder through the Mobile Midwife application. On a weekly basis, nurses also receive lists of clients whose care is overdue on their MOTECH phones, enabling them to plan their outreach and home visiting schedules in a way that can maximize care coverage. Owing to the time-critical nature of postnatal care, these alerts are delivered to both the client and the nurse the moment that the appointment is due. This is especially useful in the case that a client delivers at home or in a referral facility which may not be responsible for delivery of postnatal care. If a client delivers at home, Mobile Midwife messages encourage her to notify the toll-free call center of the delivery.

Community Health Volunteers are also incentivized to inform the call center of deliveries happening in their communities. As soon as the call center is notified of the birth, they add this event to the client’s MOTECH medical record which immediately triggers a schedule of postnatal reminders for the client and her nearest health facility, prompting the nurse to follow up with postnatal care at a home visit. If a client delivers in a referral facility (often quite far from a woman’s home), nurses there enter data about the birth into the MOTECH application. As soon as this is submitted to MOTECH’s server it triggers a schedule of postnatal alerts for the facility closest to the woman’s home, enabling her to trace the client to provide the care.

**The Basis for MOTECH**

MOTECH is based on the belief that delivering relevant and actionable information over mobile phones will encourage individuals (either patients or providers) to take action that will improve health outcomes, which can manifest itself in many different ways. At the patient level, for example, it could be pregnant women seeking prophylactic treatment for malaria at a health clinic because of an educational message they received during the rainy season. At the healthcare-provider level, it could be a focus on postnatal care in the first 48 hours of life, with the nurse receiving a report on her phone showing when a woman in her catchment area is close to her due date or has in fact delivered and should be visited for PNC.

The leadership of Ghana Health Service at the national, regional, and district levels has been instrumental in the development and implementation of MOTECH and is an essential component of the continued success and sustainability of MOTECH. The data collection process created by MOTECH is designed to interface well with existing Ghana Health Service processes, and the data generated by MOTECH is exported to the existing health information management systems within Ghana Health Service.

The MOTECH software platform is an OpenSource platform designed by Grameen Foundation to enable organizations to build multiple mobile health solutions to identified problems. The long-term future for this platform looks promising, as multiple NGOs have committed to build solutions on top of it in multiple countries including India, Kenya, and Zambia. Grameen Foundation and Ghana Health Service expect the MOTECH service in Ghana to continue to pioneer new innovations that can be adapted in other mobile health efforts around the world.

**Budget**

MOTECH was started with a four-year, $4.3 million grant from the Bill & Melinda Gates Foundation and a grant to Columbia University’s Mailman School of Public Health. This initial funding ended in early 2012, and Grameen Foundation is continuing MOTECH in collaboration with Ghana Health Service with the support of a “transition grant” award from “Saving Lives at Birth” (one of only three initiatives chosen). This $2 million grant will enable Grameen Foundation and the Ghana Health Service to scale
the MOTECH initiative to two more districts in Ghana as part of plans to implement the program throughout the country. In addition, $2,750,000 has been awarded by the Bill & Melinda Gates Foundation to conduct a systematic health impact evaluation of this work while expanding to an additional district.

Performance Indicators and Monitoring and Evaluation Plans

The Ghana Health Service and Grameen Foundation measure the results of MOTECH on an ongoing basis and use a web-based dashboard to regularly monitor key indicators. The focus will continue to be on measuring changes in health outcomes for pregnant women and children under one, specifically:

- Rates of antenatal uptake amongst pregnant women
- Percentage of pregnant women who receive the complete “standard of care” during pregnancy
- Percentage of children who are seen within the first 48 hours of life by a skilled community health worker
- Immunization rates for pregnant women and children under one
- Awareness rates amongst women of positive newborn health-related behaviors, such as immediate breast feeding after delivery, proper diet and nutrition, and cessation of regular use of enemas
- Increased efficiency in community follow-up of defaulters by nurses. In the pilot district, to date the average time to follow with a defaulting client has dropped from over 20 days to just over a week for antenatal care visits and from 2 days to just over half a day for postnatal care visits.

ACCOMPLISHMENTS OF THE INNOVATION

Since launching MOTECH in Ghana, it is estimated that approximately 70% of the pregnant parents have been reached in the Upper East Region. A randomized clinical trial is currently underway to measure changes in health outcomes, but anecdotally, there have been increases in prenatal care visits and more deliveries at health centers with skilled birth attendant. These anecdotal behavioral shifts are outlined below:

“The MOTECH messages encourage my clients to come on time. A pregnant woman came because she had a text message to tell her that she could go into labor at any time. So when she came, she actually said she was having pain. I examined her and labor had not yet commenced so I told her that she could go into labor at any time as [the message] had told her. So she came back at dawn and delivered [in the facility]. She did not know what labor was as this was her first delivery. So the message encouraged her to confess that it was labor. The message made her realize that delivering at the facility was important, [rather] than delivering at home, so that is why she came to deliver at the facility… Some months ago I used to get two or three, but last month I had ten deliveries [at the facility] because the clients get the messages and they come. For postnatal they come. Even if they deliver at home they get the messages [from MOTECH] which make them come for postnatal. So I have benefited from MOTECH a lot.” – Martha Issah, Community Health Nurse, Upper East Region

“I gave birth to my first two children at home, but Mobile Midwife told me about the importance of giving birth at the clinic. During my eighth month, I heard the message about preparing for delivery. I followed the advice and set aside money for transport to the clinic. When my labor came, I could go to the clinic. My third child was born at the clinic.” – Mother in Kurugu, Upper East Region
“I went to the clinic and was told that my iron level was low. At the same time people in the house were not allowing me to eat eggs or meat. The messages told me that eggs and meat are good during pregnancy. My family heard the messages too so then allowed me to eat eggs. Since then my iron levels have been better.” – pregnant woman in Mirigu, Upper East Region

“MOTECH has been good because it helps us with our reports. Sometimes our tallying gives us incorrect data. With the phones we know the data that we get at the end of the month is correct. We used to have to pick lots of forms in different places and take them elsewhere, now it’s much easier. With MOTECH we also get our clients easily because we get messages listing our defaulters. Some of them also come to access services because MOTECH sends them messages telling them to come. We get people coming here telling us that MOTECH has told them to come to the facility.” – Vida Abaskea Atepoka, Community Health Nurse, Upper East Region

As of April 29th, 2012, the total number of registrants reached 17,770 with 10,163 of those accessing the Mobile Midwife service. According to data taken in December 2011, of those “pregnant parents” who had their own phone, 63% of them listened to at least one message that month. (There is a minimum of 4 messages available.) Of those registered who were using a household phone, 61% of them listened to at least one message that month.

In January 2012, the MOTECH call center extended its opening hours in order to provide additional support to registrants. In 2011, they responded to 8,133 calls with information provided in Kassem (34%), English (24%), Nankem (24%), and Fanti (18%). Those calling in English were primarily the nurses, and Fanti was just added as a language in mid-August of 2011.

Mainstreaming of Innovation and Dependence on Local Resources

MOTECH is an intervention that has been designed to dovetail into and enhance the existing CHPS rural community health care system. Simplified registers developed as part of MOTECH are deployed as the first stage of a replication to a district. The simplified registers developed within MOTECH have been proposed for national adoption within all CHPS. In the districts where MOTECH is currently operating clinical monitoring of the intervention is led by the GHS and reported to the District Directors who chair local Technical Working groups at the district level. Women are registered into MOTECH by the community health nurses who then upload data using their mobile phones to the central server. Electronic reports are produced and disseminated by the district information officers. Key elements of the intervention are already mainstreamed into the GHS delivery system at the district and facility level. What will continue to be worked on over the next two years of this project is the full transition of the management of the technology support and the integration of MOTECH in totality into the district health information system.

Replication and Sustainability

The first pilot phase which involved Columbia University until January 2012 as the evaluation partner formally ended in March 2012. Led by Dr Frank Nyonator, the Acting Director General, Dr Frank Nyonotar, the Ghana Health Service and Grameen Foundation are now moving on to Phase Two, which will expand services to three additional districts while transitioning responsibility for critical operational components in the initial pilot sites to Ghana Health Service. Specifically, Phase Two will achieve the following:
• Scale to three more poor rural districts in Ghana in two different regions providing culturally appropriate content translated into two more languages. This will reach approximately 14,000 pregnant women, 46,000 children under five, and save approximately 3,600 days of nurse time.
• Sustain and transition the management of the service in the current two pilot districts entirely to the Ghana Health Service and document the process and support required for this transition.
• Transition the management of the computer servers, monthly reporting to the facilities, and MOTECH call center to the Ghana Health Service Centre for Community Health Information Services.
• Stress test the MOTECH software platform to ensure it can perform in a production environment at volumes and loads required for provision of nationwide service. Implement performance enhancements where necessary.
• Establish partnerships with other NGOs operating within the same geographical areas of Ghana, particularly World Vision and Millennium Villages Project, to harmonize activities in order to maximize impact and establish added value to the community. These partnerships will seek to strengthen health systems and improve service quality using supervision tools that utilize data from MOTECH about patients who have not received complete care.
• Research and develop a sustainable business model in order to create revenue for the cross-subsidization of the service to the poor and establish a public-private partnership with a major telecommunications operator (MTN Ghana) to take Mobile Midwife to scale in Phase Three. This is an essential component towards developing Mobile Midwife into a stand-alone service ready for national scale to all women in Ghana.
• Carry out a Health Impact Assessment within one district.

With successful deployment complete in four regions, the Third Phase will be for MOTECH to continue expansion across Ghana. This will include development and translation of content into the remaining two languages prevalent in Ghana and training/deployment of mobile phone data collection tools to all health facilities. As services are delivered to more affluent urban areas, new business models will be explored to evaluate if extra services to women in higher economic quintiles can subsidize the free service offered to the poorest women.

The single most challenging component for long-term sustainability of the mobile health implementations is the ongoing cost of airtime to send messages to pregnant parents. Grameen Foundation and Ghana Health Service are in active negotiations with MTN Ghana to define a partnership model for MOTECH which would ensure long-term sustainability. Conversations around sustainability of the project include talk of creating a monthly fee structure for Mobile Midwife, a fixed fee for Mobile Midwife, sending advertisements and surveys to clients and nurses to offset costs, and re-selling the short code, which is used to access MOTECH services.

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<th>CHALLENGES ENCOUNTERED</th>
<th>MEASURES ADOPTED TO MITIGATE CHALLENGES</th>
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| When Community Health Workers used their own phones, there were issues of privacy, or other members of the family needed to use the phone. | • Nokia 1680 phones were provided to each facility, with the nurse application already installed.  
• A policy was created in coordination with the GHS to minimize loss of phones.  
• Training proved to be easier when everyone used the same phone, as well. |
<p>| Estimating due date was difficult for those | • Coordination with the BabyCenter to create a |</p>
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<tr>
<th>Issue</th>
<th>Solution</th>
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<td>Registering for Mobile Midwife over the phone with no nurse present</td>
<td>Decision tree, which gave additional information for estimating due dates</td>
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| Poor network reception leads to either dropped calls to “pregnant families” or prevents nurses from uploading information to the central database. | • Continue dialogue with telecom companies regarding services in rural areas  
• Encourage uploading outside of the facility for better service coverage |
| Marketing the MOTECH services in the broader community                | • Messaging coming from a trusted source  
• Publicizing MOTECH on public announcement services  
• Widely distributing MOTECH branded materials in the communities.  
• Community Radio broadcasts |
| Determining when MOTECH was “fully operational”                       | • Teams worked to develop a concise document that outlined the key areas that needed to be assessed to determine whether the system was fully operational and therefore ready for the formal start of the impact assessment. |
| Promoting the nurse application for Community Health Workers (CHW). Many CHWs believe the nurse application makes more work for them. | • Development of a tiered incentive system, where the number of uploads in a given time period will lead to an incentive for the CHW.  
• SMS messages were also sent to nurses to provide encouragement.  
• Coordination with the GHS was also important, so that nurses felt they the work was not from an outside entity |
| Monthly reports generated by MOTECH, did not match with manually compiled reports from the nurses. | • Additional training was given to nurses on the common errors that were being made when entering information, as well as various terminologies. |
| Staffing levels low and field support is minimal                      | • Work to continue to get additional support for the Community Health Workers |