GRAMEEN FOUNDATION

*Empowering people. Changing lives.
Innovating for the world's poor.*

MOTECH
MOBILE TECHNOLOGY FOR COMMUNITY HEALTH

MOBILE TECHNOLOGY FOR COMMUNITY HEALTH IN GHANA

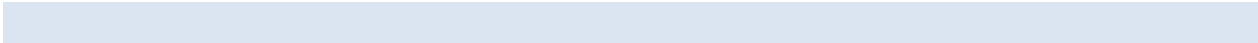WHAT IT IS AND WHAT GRAMEEN FOUNDATION HAS LEARNED SO FAR

March 2011

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INTRODUCTION

Grameen Foundation's experience of designing and implementing a mobile health program in Ghana can provide insights for the broader field and specific projects that are in early phases of planning and implementation.   A fundamental tenet of Grameen Foundation's work is to share information broadly, from program designs to management plans to source code to lessons learned - both successes and failures. To that end, this document is intended to provide:

1) A comprehensive overview of the Mobile Technology for Community Health (MOTECH) project in Ghana and how it works.
2) An insight into strategic decisions and design approaches made by the project team throughout the course of the implementation.
3) Information on lessons learned during the project and implications of decisions on future scale.

The first draft of this document was created approximately 18 months into the project and six months after the service was deployed. We plan to update this document periodically as we continue to learn – please check our website: http://www.grameenfoundation.org.

Photos from the field can be viewed at http://picasaweb.google.com/motechghana. A short video describing the project can be seen at http://www.youtube.com/watch?v=3ZsufOqpK74

This document is written from the perspective of Grameen Foundation's team and does not endeavor to speak for the other partners who were instrumental in the planning and implementation of MOTECH in Ghana.

PROJECT BACKGROUND

Can information delivered over a mobile phone improve someone's health? Can it improve the quality of care received in a rural clinic? The Mobile Technology for Community Health (MOTECH) initiative in Ghana is a partnership between Ghana Health Service, Grameen Foundation and Columbia University's Mailman School of Public Health. Funded by a grant from the Bill & Melinda Gates Foundation, the project aims to determine how to use mobile phones to increase the quantity and quality of prenatal and neonatal care in rural Ghana, with a goal of improving health outcomes for mothers and their newborns. The MOTECH system was launched in July 2010 in the Upper East Region; a replication in Awutu Senya district in Central Region will happen in April 2011. Further opportunities for scale across Ghana will be assessed in the second half of 2011. If successful, it is intended that MOTECH will be launched nationally in Ghana, and that this will become a showcase for replications throughout Africa and the world. The software system used in Ghana is available via OpenSource license and can be used for implementing a wide range of mobile health applications.

WHAT IS MOTECH?

MOTECH in Ghana has developed two interrelated mobile health services:

"Mobile Midwife" application: This service enables pregnant women and their families to receive SMS or voice messages that provide time-specific information about their pregnancy each week in their own language. This information is a mixture of:

- **Alerts and reminders** for care seeking (e.g., reminders to go for specific treatments, such as prenatal care or a tetanus vaccination)
- **Actionable information and advice** to help deal with challenges during pregnancy (e.g., tips for saving money for transportation to deliver at a health facility, what is needed for a birthing kit, nutrition information)
- **Educational information,** including milestones in fetal development, promotion of good health practices, and songs about breastfeeding

Voice messages are delivered in English or local languages. Two languages of the Upper East Region, Kasem and Nakam, were supported for MOTECH's first implementation, and two languages of central region, Senya and Fante, will be supported in Awutu Senya. SMS messages are all delivered in English.

Nurses' Application: The MOTECH system helps community health workers to record and track the care delivered to women and newborns in their area. Each rural health facility is equipped with low-end mobile phones on which the MOTECH Java application for health workers is installed. Nurses enter data about patients' clinic visits into forms on the mobile phone and send this to the MOTECH servers. The MOTECH system then checks patients' healthcare information against the schedule of treatment recommended by Ghana Health Service for that care event. If the system sees that a patient has missed care that is part of the advised schedule, the Mobile Midwife service sends a message to remind the patient to go to the clinic for that particular service. Meanwhile, the healthcare worker is informed when the patient becomes overdue for treatment so that they can follow up with them and reduce the number of clients defaulting for recommended healthcare. Using the data nurses have submitted to the server, MOTECH also generates many of the monthly reports that facilities are required to submit to their district and regional management offices. Previously these reports had to be compiled by hand; a process that took three to four days. Healthcare workers can also use the MOTECH Nurses' Application to query the database , enabling them to retrieve lists of patients overdue for care, women due to deliver in the next week, or details about individual clients.

MOBILE-PHONE HEALTH EDUCATION FOR PREGNANT WOMEN AND RECENT MOTHERS (MOBILE MIDWIFE)

REGISTRATION

A woman can register for Mobile Midwife by speaking with a Community Health Worker who enters relevant information on a MOTECH registration form on the phone or by calling and speaking with the MOTECH call center. At registration, clients are asked to provide demographic and contact information and their expected date of delivery if they are pregnant, or the age of their newborns if they have given birth in the past year. They are also required to describe their options for phone access: if they own a personal phone, if they can access a phone in their household, or if they have neither personal nor household phone. This determines the methods through which the user will access their messages. When registering, the parent can also indicate whether they would like to receive messages via SMS or voice (99% choose voice), what language they would like to receive the messages in, and what day of the week and time of day is best for the messages. We also collect location information (district, community, and "address") so that the patient can be associated with the nearest health facility.

Upon registration, the patient receives a "MOTECH ID" number that can be used to retrieve messages. For those people that register in person with a Community Health Worker, the MOTECH ID is assigned from a list of preprinted stickers that has two copies of each unique ID. The patient receives a MOTECH ID card – one sticker is placed on this card and another is placed inside the mother's paper health record which she keeps at home.
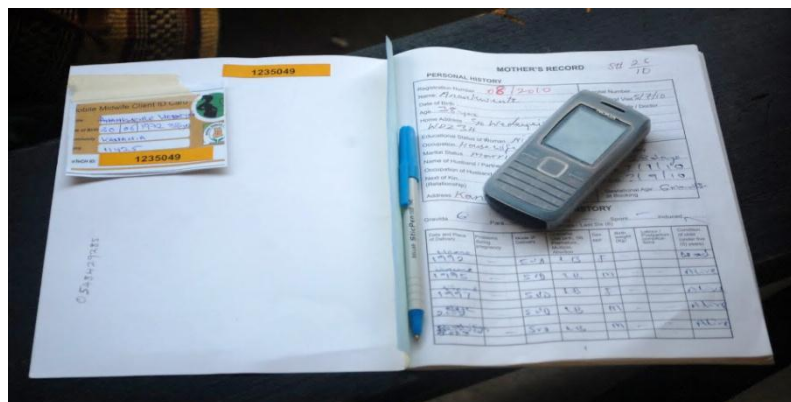
PERSONAL VS SHARED PHONES

Mobile phone ownership is not ubiquitous in rural Ghana. Some pregnant women own their own mobile phone, but it is more common for a phone to be shared in the family (in which case it is frequently controlled by the male in the household) or for there to be a single phone used by many members of the community. When registering, individuals can indicate if their mobile phone is a "personal phone," a "household phone" or a "public phone."

Users who do not have access to a personal or household phone access their messages by calling a toll-free "short code" number from any mobile phone using any telecommunications provider. Once connected to MOTECH, the user interacts with the Mobile Midwife Interactive Voice Response (IVR) system. Recorded messages will prompt the user to enter their MOTECH ID, which uniquely identifies the client and determines which messages should be played. This is especially useful if someone missed a call from the MOTECH service earlier in the day, or if they want to listen to their message subsequent times and/or share it with a friend or family member.

In testing we found that users liked being able to access their messages at any time and being able to play them as many times as they liked, allowing them to share messages with friends and relatives.

DELIVERING MESSAGES (FLASHING AND PERSISTENCE)

Our goal was to make the MOTECH service as widely available and easily accessible as possible. The Mobile Midwife service is therefore offered free of charge to users. We were unable to establish a toll free universal short code number in time for the initial launch of the service. So, we designed the system to respond to a "flash" from a client. In Ghana, the term "flashing" refers to the act of deliberately giving someone a missed call (by calling for a few seconds and then hanging up) with the intention of the other party returning (and paying for) the call. It is common in Africa for only the calling party to incur charges, not the receiving party. Some studies estimate that flashes make up 20%-30% of all calls made in Africa.

When the MOTECH system receives a "flash", it calls the user back, placing them in the IVR home menu. Although we intended this to be a temporary solution, from initial focus groups with users it was clear they really liked this functionality so it remained a part of the service. Since flashing is a widely-used mode of communication in Ghana, people are familiar with it and confident they will not be charged for accessing Mobile Midwife when accessing it this way. The toll free short code has since been implemented as well.

The MOTECH service is persistent when it is time to deliver a message. Although users can specify what time of day they would like to receive a call, there are a number of reasons they could be unavailable: the network could be down, their battery could be depleted, or they could simply be unavailable. Even if the user is available, unreliable networks often result in the call being dropped. To address these issues, MOTECH assumes that any message that has been listened to for less than five seconds was not received by the user and then calls again. The system calls back immediately and makes three attempts to connect. If those attempts fail, the system tries again the next day at the same time.

CLIENT CONSENT

All personnel involved in enrolling users into Mobile Midwife, including Ghana Health Service staff, have been trained in the importance of obtaining the client's consent for enrollment, as well as explaining options for refusal and how to opt out of the service once enrolled. When the user is registered for the service by MOTECH call center staff, field staff or health workers, they are reminded that joining the service is completely voluntary and that they can opt out at any time. This is communicated to them by reading the text below in their preferred language.

> Consent Text – English
> "Welcome, by joining the Mobile Midwife service you are agreeing to receive information about pregnancy and newborn health through a mobile phone, using the contact details that you have provided. This will enable you to get helpful information concerning your pregnancy and also get reminders for your next clinic visit. You can opt out of the service at any time by sending an SMS saying "STOP" and stating your ID number to XXX (short code), by calling the call center, or by seeking the assistance of a CHO. Any personal data that you provide in the process of registering for or taking part in this service will remain confidential and will not be shared in raw form with anyone outside of Ghana Health Service."

The patient is then asked to state verbally if they agree or disagree with this text (verbal consent). If they disagree, then the user will be told that they cannot be registered for the MOTECH service. If the user agrees, then they will be registered for the MOTECH service. Enrollment personnel are required to record in the registration form that the consent text was read to each potential user, and they note the user's response.

SAMPLE CONTENT

Anticipating that our messages will be listened to by both the pregnant woman and other family members, we refer to our users as "pregnant parents" and target messages for all members of the family. Some messages are intended for men and are read by men. Other messages, especially those designed to dispel myths and cultural practices, are intended to be heard broadly within the community. See below for more details about the content creation process.

For each week of pregnancy, the "pregnant parent" is played one primary message and has the option to listen to two further messages by using the phone's keypad in response to message prompts. On average, 42% of the people that listen to the primary message listen to the secondary message and 36% listen to the tertiary message.

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 can also be customized to address local myths and beliefs. This level of information tailoring and ease of access has not been available in these Ghanaian communities to date.

Week 5, primary message	Some women feel they want to hide their pregnancy at the early stages. Maybe because they fear the "the evil eye," miscarriages, the unknown or visiting a midwife. These fears are normal. Here are some tips to help you deal with them: Seek healthcare even before traditional rites are performed. Nothing should prevent you from going to see a midwife at the early stages of your pregnancy. - Remember that it is not the "evil eye" that brings complications in pregnancy. Rather these are often brought about by medical conditions which can usually be treated if you go to a health facility early in your pregnancy. See a midwife as soon as you miss your period or when you feel you may be pregnant so that he or she can help prevent complications such as miscarriages and stillbirth. Remember that antenatal care is available at your nearest clinic every day so you don't need to worry about those around you knowing your reason for going there. The healthcare worker deals with you in private and whatever you discuss is kept secret. - Do not be afraid of your midwife or doctor. They are always ready to help you. The midwife needs to check you at the time you have been scheduled, so don't be discouraged even when the waiting time at the clinic turns to be long. Your health is worth spending time on! - If you fear that you may struggle to pay for healthcare during pregnancy, don't worry. National Health Insurance is free for a year for pregnant women. Register as soon as you know you are pregnant so that you can benefit!
Week 5, second message	In the past our ancestors did not know the effects of certain foods on the unborn baby and pregnant mother, so they prevented pregnant women from indulging in them. Nowadays, health professionals have looked into these and seen that they are not harmful to the pregnant woman or the baby. For example, people may have told you not to eat eggs, meat, fruits, okro, and other foods during pregnancy, otherwise the child would become a thief. Yet, there are no proven harmful effects on a baby's life from eating these foods. Rather they contain nutrients that are very important for the healthy development of your baby and you should eat lots of these foods.
Week 13 primary message	Most Ghanaian women begin their pregnancy with low iron levels, so the midwife usually prescribes iron pills to correct that. You need iron because it keeps your blood doing its job of carrying food and oxygen around your body to keep it well. When you don't have enough iron you may feel tired and breathless too often. You could also get a condition called anemia, which can be dangerous for you and your baby. A baby who does not have enough iron is often born too small and so they face a lot of risks. To avoid this, it is important that you take the tablets given to you by your midwife. Iron is also found in many foods including liver, red meat, green leafy vegetables such as ayoyo, ademe, gboma, kontomire, spinach, bokoboko, bitter leaf, and eggs. Try to also take fruits such as orange, guava or baobab fruit these help the iron to enter your blood more easily. At this stage your baby is still small enough to fit into the palm of your hand. He or she is becoming more active – maybe even playing with the umbilical cord – grabbing it and letting it go. You might start feeling your baby move soon. This is called 'quickening'. At first, you might feel a slight movement low down in your belly. Some women feel their baby move later. If you haven't noticed anything yet, there is no need to worry but if you feel your baby moving, tell your midwife at your next appointment – share the good news!

Week 16 primary message	By this week you should have had at least one antenatal care visit. You are also due to take a medicine called SP. SP is a drug that prevents pregnant women from getting malaria. It is given to you at antenatal visits. If you haven't already taken this, make sure you go to the clinic compound this week for your first dose. Later you will need 2 more doses – we will try to help you remember when so look out for our reminder messages. Always listen to advice from your midwife as well. Malaria can harm you and your baby. It can lead to anemia which is shortage of blood in the mother – this is one of the causes of death in pregnancy and delivery. The baby can be born with a shortage of blood, too small, or born dead. As well as taking your SP, there are other steps which help prevent malaria: 1. Sleep under insecticide treated bed nets even if the weather is hot. Sleep under the net wearing fewer clothes during hot weather. Your midwife may be able to get a net for you at a reduced price. 2. Stop mosquitoes getting to your skin by wearing long sleeves and full length clothes if you can. You can also try burning neem or orange peels. Also, use indoor spray to help keep mosquitoes away. 3. Avoid hanging too many clothes in your room for they provide hiding places for mosquitoes. Fold your clothes up always. If you have any signs of malaria such as fever, chills, shivering, bad headaches or severe pain in your joints, speak to your midwife immediately. Get medical help early and you will reduce the risk to you and your baby.
Week 31 primary message	Men! Nurture the seed you planted. Your wife is like mother earth and the baby she is carrying is like the seed, so nurture and nourish mother earth and care for her, to enable the seed to grow strong. Support the seed you have sown so that you get a good harvest. Remember always that pregnancy is a gift so take good care of it - you may be having the next president of Ghana! Support your pregnant partner to deliver safely. This includes financial support, which can be difficult for those of us with little income. Lots of support you can give your pregnant wife does not cost you anything, but can help a lot. Health insurance is free for pregnant women and gives your wife the care she needs to help her have a perfect baby. You can also help with household chores – it is dangerous for your wife to be overworked at this stage in pregnancy. Most importantly, show your wife that you care, show your love and support. Be involved In making the preparations for the baby yet to be born. If it is possible accompany your partner to antenatal care to learn things at first hand. The health workers love to see you come with your partner. You can discuss your concerns with the midwife or doctor.
Week 34 primary message	Long labor does not mean you have been cheating on your husband. It may mean several things but the midwives have the skills to help if there are problems. Some reasons can be the cord has wrapped around the baby's neck. Waiting may cause death to the baby, but at a health facility quick action can be taken to save to baby. Long labor may mean the baby is too big and cannot pass though the hip bones. Delay at home can cause the mother to end up with the urine diseases, leg problems or a tearing of the uterus…resulting in death! But the most important thing to remember is that the sun must not set on any labor twice. The life and well-being of the innocent unborn baby depends on it. The health and life of the mother depends on this. Report to the hospital IMMEDIATELY when labor starts. The midwife will monitor you and know when something is not going right. Each pregnancy is different; each labor may be also different.

MOTECH uses low-cost GSM mobile phones to capture, transmit and treat health data collected by community health workers during client encounters. The system uses a Java 2 Platform Micro Edition (J2ME) application to capture client data and store it on a mobile phone. GPRS[1] is then used to transfer this data from the phone to a central patient electronic medical records system (based on OpenMRS) that is stored on the MOTECH server. The MOTECH system analyses this client data against proper care regimens to determine due dates for certain care events and sends reminders to healthcare workers and clients for these events. The client data collected is also aggregated to automatically generate nurses' monthly reports. The figure below illustrates the flow of client and reporting data in MOTECH:

Main Flows of Client and Reporting Data for MOTECH
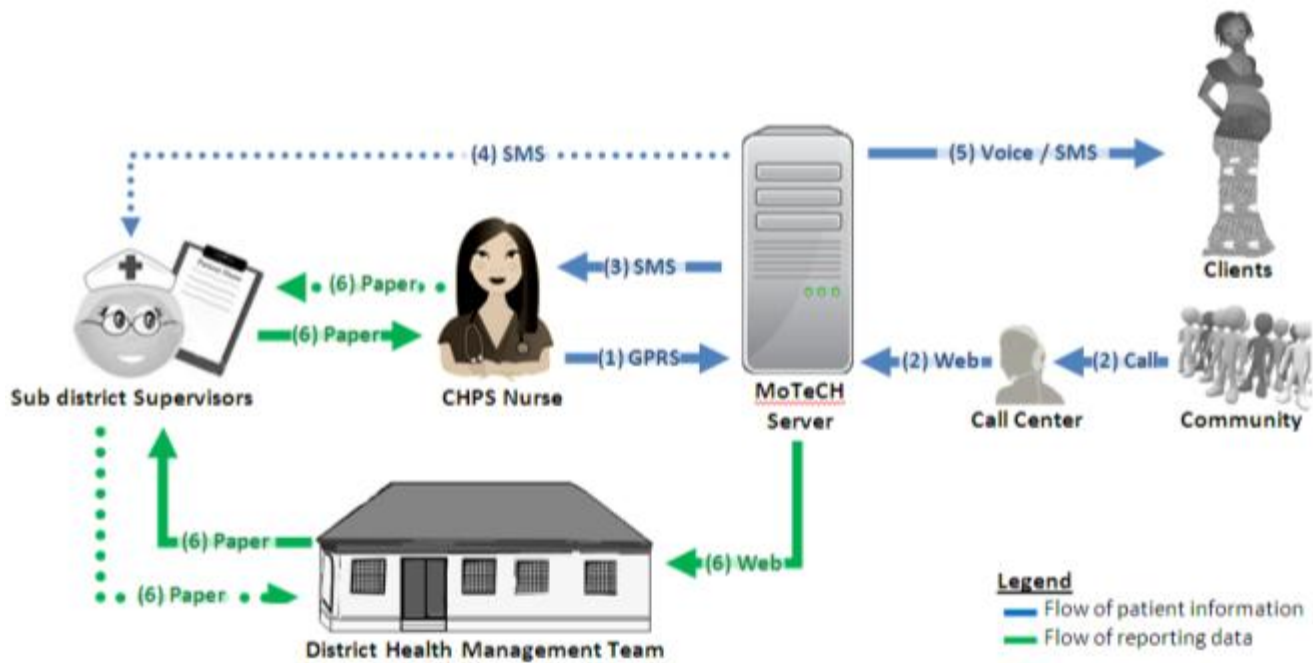
MOTECH requires that pregnant women and children under five years of age must be registered in the system before their encounter information can be submitted to the database. When clients are registered in the system, they are issued a MOTECH ID to uniquely identify them. Forms for encounter types involving pregnant women and children under five have a mandatory MOTECH ID field. This enables encounter information to be submitted to individual patient records in the database, developing a client history and enabling tailored and accurate reminders for both caregivers and recipients. There are two possible ways

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[1] General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication systems global system for mobile communications (GSM). The service is available to users in over 200 countries worldwide. http://en.wikipedia.org/wiki/General_Packet_Radio_Service

to issue MOTECH IDs: first, by entering the ID number from pre-printed stickers that are provided to each facility into the registration form; second, by requesting an "auto-generated ID" in the registration form. This option prompts MOTECH to send an ID to the nurse by SMS. For ease of identification in the future, a client's MOTECH ID is indicated in the Simplified Registers, the maternal or child health book, on a MOTECH ID card, and on the national health insurance card, if applicable. The server will not allow the same ID to be used twice, and will reject forms containing invalid or unassigned IDs.

CLIENT DATA SENT TO MOTECH VIA GPRS

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 a 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 the Upper East Region 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.

TRACKING CARE ACROSS FACILITIES

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.

VOLUNTEERS SEND ALERTS TO MOTECH VIA CALL CENTER

Community Health Volunteers (CHVs) in non-MOTECH areas are currently tasked with reporting unattended and Traditional Birth Attendant-assisted births to Community Health Workers. This role remains with the MOTECH intervention, but the channel for reporting the births can change, as volunteers and other community members are encouraged to report them to MOTECH by phoning the call center through a toll-free number. The intention is that CHVs are likely to report such births more reliably when this is made easy through a free phone call, saving them the opportunity and transport costs associated with notifying the nurse in person. Call center operators use a web form to update the patient's record in the MOTECH database, which immediately generates postnatal care reminders for clients and nurses.

MOTECH SENDS SMS ALERTS AND REMINDERS TO NURSES AND ENABLES QUERIES

ALERTS AND REMINDERS

Once patient data is stored in the database the MOTECH system compares care received by pregnant women and children less than five years old with schedules recommended by Ghana Health Service policy. The system then calculates due dates for certain care events and sends alerts to nurses when an event is overdue. Alerts list defaulters for prenatal care, tetanus vaccination, postnatal care for babies and mothers, and childhood immunizations. They also identify clients with upcoming delivery dates, those who recently delivered and those whose estimated due dates have passed with no delivery. These messages attempt to increase compliance with standards for the continuum of care for pregnant women and newborns. With the exception of delivery alerts and postnatal care reminders, messages are sent every Monday at 8 a.m., enabling nurses to use the information to plan outreach and home-visit schedules for the week. Postnatal care for mother and child is extremely time-critical. Therefore, alerts about deliveries and

postnatal care are not sent along with Monday reminder messages, but rather sent as soon as the delivery occurs and within hours of the time that the postnatal encounter is due.

If the mobile network or recipient phone is unavailable when reminders and alerts are due to be sent, the MOTECH server continues attempting to push the messages until they send successfully.

QUERIES

In addition to pushed SMS reminders, 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.

MOTECH AUTOMATICALLY GENERATES SOME MONTHLY REPORTING

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.

FUTURE PLANS: DECISION-MAKING TOOLS AND DEFAULTER REFERRALS

Decision-Making Tools
In the coming months, MOTECH will implement tools to analyze clinical trends and data to develop alerts to help nurses make decisions about appropriate care. For example, abnormal blood pressure trends, hemoglobin results or growth development for babies could be alerted to the nurse, along with recommendations for next steps, such as closer observation or referral. Different reminder schedules could be used to encourage more care for high-risk clients, such as premature and low-birth-weight babies, pregnant women under five feet tall, those with previous caesarean section, or women under 18 years or over 35 years of age.

Referral of Defaulter Cases to Supervisors

If a client continuously defaults for the same care event, MOTECH escalates the case by sending an SMS alert to the supervisor for the sub-district in which the facility is situated. This enables supervisors to take action to encourage the health worker to provide care for the defaulting client. If the mobile network or recipient phone is unavailable when escalation messages are due to be sent, the MOTECH server continues to attempt to push the messages until they send successfully. Nurses will be able to notify the system about clients who default for reasons beyond their control, such as if a client has moved away from that facility's catchment area.

NURSE TRAINING MANUAL

A detailed training manual was produced for nurses, which describes:

- Tips for getting started with the mobile phone
- How to open the MOTECH application on the phone
- How to select a study
- How to enter data into the forms, including saving and uploading the forms
- How to submit a query
- How to register patients using the mobile phone
- Details about the Mobile Midwife program
- How to deal with errors
- How to estimate due date in a non-clinical setting

A few sample pages are shown below. The full training manual can be viewed and downloaded from http://picasaweb.google.com/motechghana/UserManualFinalV1#

Section Nine

Saving & Uploading Forms

a. Saving Forms
Once you have finished entering information into a form, you need to save it.

To save a form, look in the bottom left hand corner of the screen. Sometimes, **Save** will be written there, in which case you can press the button nearest to it.

Other times, **Options** will be written in the same place in the bottom left hand corner of the screen. In this case, select it by pressing the button nearest to it.

Then scroll to select **Save** on the next screen.

Once your forms are saved, you will see them listed under each form section. You can store hundreds of forms on the phone before uploading to **MoTeCH**, so if you have poor phone network coverage and cannot upload frequently, don't worry – just continue saving. However, it is advisable to upload forms frequently to avoid accidental loss (eg if the phone was stolen, any forms which were not uploaded would be lost). So, try to upload once per day if you are able to, or as often as possible.
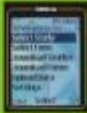
Section Four

Nurse Data Entry
This study contains forms which enable you to enter data about your patients when they have received health care.

1.Selecting the Study

Select **Select Study** from the **MoTeCH** home screen.

Scroll to **Nurse Data Entry** and press **Select.**

Now that you have selected your study, you will be returned to the home screen. Remember that you selected the study, **Nurse Data Entry**, so everything you do from now on relates to that study. To start entering patient information, we need to see a list of all the different kinds of **Forms** available for **Nurse Data Entry**. To see this list, scroll down to **Select Form** and press **Select.**

You will now see all the forms relating to **Nurse Data Entry** – entering patient data.

Section Ten

Dealing with Errors

As shown in the previous section (**Section 9b**), the **MoTCH** database will reject forms that have errors on it, and leave those forms on your phone. You need to go back to those forms to fix the errors. Here's how:

Go to the home screen and **Select Form**. This will bring up a list of all the forms available in the study that you're in. All the form types which have errors will have a red exclamation mark next to them. You need to go to each of those form types to fix the errors, so open a form type with the exclamation mark next to it.

When in the form type area, you will see a list of all the forms which failed to upload. A red exclamation mark will be next to each form containing errors.

You need to option each form to fix the errors, so select one of the forms. This will open the form again and show you all the data you entered into it previously. Now you need to know what error was made on the form. To find this out, go to **Options** in the bottom left hand corner of the screen and then scroll down to select **Show Errors**.

Next you will see a message telling you what is wrong with the form. In this example the **Staff ID** entered was invalid, so you need to go back to that field and check that it was entered correctly. Once the corrections are made to the form we need to save and upload it in the normal way (see **Section 9** of this manual) until all the errors are gone so that the form uploads successfully and is removed from the phone.

2. Signing in to MoTeCH

After following either of the steps above you will see the sign in menu which requests a **user name** and **password**.

In the **user name** space, enter **Motech**

In the **password** space, enter **ghs** . Then press **OK**

You will now see the **MoTCH** application home screen, listing the different things that you can do in the application. The menus that you will use mostly are **Select Study**, **Select Form and Upload Forms**, so take good note of these.

Section Five

Nurse Queries

This study contains forms which enable you to ask the **MoTCH** database certain questions about your clients.

1. Selecting the Study

To access the **nurse query forms** we first need to select the **Nurse Query Study**. Select **Select Study** from the **MoTeCH** home screen

Scroll to **Nurse Query** and press **Select**

Now that you have selected your study, you will be returned to the home screen. Remember that you selected the study, **Nurse Query**, so everything you do from now on relates to that study

To start sending queries, we need to see a list of all the different kinds of **forms** available for **nurse query.** To see this list, scroll down to **Select Form** and press **Select.** You will now see all the forms relating to **Nurse Query**.

2. Selecting the Form

There are 2 different forms which are used to send queries. The notes below explain which queries are available:

a. General Query

The general query form enables you to request different types of information by making selections in the **query type** field.

The information you request will be sent by text message to you a phone of your choice. Enter the phone number to which you want the text message to be sent in the **response phone number** field.

The following general query types are available:

- **ANC defaulters:** shows all ANC defaulters in your CHPS zone
- **TT defaulters:** shows all TT defaulters in your CHPS zone
- **PNC (baby) defaulters:** shows all PNC (baby) defaulters in your CHPS zone
- **PNC (mother) defaulters:** shows all PNC (mother) defaulters in your CHPS zone
- **CWC defaulters:** shows all CWC defaulters in your CHPS zone, including those who have defaulted for childhood immunization.
- **Upcoming deliveries:** shows all upcoming deliveries in your CHPS zone
- **Recent deliveries:** shows all deliveries that have happened recently in your CHPS zone
- **Past EDD/no delivery:** shows women who are overdue for delivery

KEY LESSONS LEARNED

The following section outlines major decisions that were made by the project team as the system was being designed, developed and implemented.

NURSE HANDSETS – SMS VS. JAVA

OVERVIEW

Initially, MOTECH was to be designed to utilize the personal phones that nurses already owned. The field team conducted a survey and found that while 99% of the nurses had access to a mobile phone, it was their personal phone, often shared with other family members. 85% of the phones could only transmit data via SMS and usually had worn-out batteries with limited charge life.

Hoping to be able to use existing phones, we did a brief field trial with an SMS-based system, which revealed a number of challenges. Older nurses in particular did not know how to send or retrieve SMS, so induction had to include basic SMS lessons in addition to data entry training. Even those nurses proficient with SMS struggled to follow the strict syntax required to compile a structured SMS – typos, missing spaces, and incorrect data order made data capture difficult. We tried to overcome this by saving SMS templates containing field titles on to the phone as SMS drafts. This did not work in many instances since the low memory capacity of many of the phones put a limit on the number of SMSs that could be saved as drafts, and yet there were around 10 different SMS types that were required for our purposes. Some phones did not even have a drafts folder. In these cases we saved the messages in the inbox, but again here we were met with the challenge of low SMS storage capacity. We also found that nurses accidentally edited the SMS templates, meaning that subsequent submissions were flawed. Some phones were not able to send SMS because Message Center settings were incorrect. Providing training to overcome these challenges was extremely difficult when supporting the many different handset types owned by nurses.

In addition to the data challenges, there were several social aspects which made using nurses' own phones impossible. Phone access and ownership seemed to be as fluid among nurses as it was among people in the community. Many nurses shared phones with family members so there would be times when no phone was available in the clinic, and the fact that phones were lent to non-Ghana Health Service staff risked the leak of patient data. Lack of charging solutions was also an issue, as not all facilities had reliable power. Providing a charging solution for the many different phone types that nurses were using would have been expensive, difficult, and cumbersome. Furthermore, nurses were unsatisfied with using personal phones for professional purposes; they felt that if they were required to do something for their work, their employers should provide the equipment deemed necessary to do it.

Given these results, the MOTECH team began a two-tiered assessment that sought to answer the following questions:

- **Handset:** Should MOTECH use the nurses' own phones or Java-enabled dedicated MOTECH phones provided by the project?

- **Data transmission method:** Should MOTECH send data using SMS or GPRS?

The reasons for our hesitance to provide dedicated MOTECH handsets to health facilities were in part financial; using nurses' own phones would eliminate the upfront cost of hardware provision thus making the project more accessible to and sustainable for government agencies in resource-limited settings. However, when we incorporated data transmission costs into our business model and calculated data transfer costs vs. SMS costs, we realized that using Java-enabled phones which could transfer information over GPRS would yield a lower total cost of ownership. GPRS data transmission is many times cheaper than SMS – an SMS message costs US$0.03 on average to send in Ghana, while GRPS rates are US$0.11 per megabyte. A single MOTECH form that requires 1-2 SMS messages can be transferred in less than 1KB of data, resulting in savings of approximately $11 per health facility per month. With this savings, the cost of the dedicated GPRS phone is easily offset by the savings in data expenditures in just over 5 months, making the financial sustainability of the project more feasible.

Crucially, investing in dedicated MOTECH phones for the nurses also eliminated our reliance on SMS as the "lowest common denominator" for data transmission. However, even low-end java phones unlocked opportunities that could not be realized with SMS:

- Java-enabled handsets are more suited to poor network areas than SMS because forms can easily be saved on the phone and uploaded when connectivity is restored. We had found network reliability to be a challenge in the rural areas in which we were working, so this was an extremely useful feature.
- Security features such as user authentication schemes can be built into java forms, but are not possible with SMS. This is an important aspect of a system that is transferring sensitive patient information.
- Leveraging java-enabled phones from the outset of the program better facilitates the development of more sophisticated applications, without needing to re-train users, re-distribute hardware and softcopy documentation, or change platforms. Therefore, we felt that java-enabled phones provided a stronger foundation for developing applications, providing more potential for supporting effective service delivery.

We selected the Nokia 1680 for our pilot because it was low cost, had a long battery life and was durable. Eighty percent of the nurses already owned Nokia phones of their own, so we expected them to be more familiar with how to use them than phones from other manufacturers.

Phones were issued to facilities with an equipment agreement that was developed together with Ghana Health Service. The agreement indicated that MOTECH handsets should remain in the clinic or any other place of service delivery at all times. It included a penalty for nurses in the case that a phone was lost or stolen owing to negligence. Levying a penalty for a lost or stolen phone is at the discretion of the District Director. Therefore, if s/he decides that the phone was lost or stolen not owing to any negligence on the part of the nurse, s/he can decide not to enforce the penalty. We ensured that the penalty was low enough and left enough room for discretion that it would not deter nurses from using the phones. Should the penalty be imposed, it is shared by all nurses at a facility, with the majority being paid by the nurse who lost the phone. This shared responsibility model was created in order to encourage nurses to accept joint

responsibility for the handsets and to support each other in keeping it safe. The full handset agreement is included in the Appendix.

ISSUES & CONSIDERATIONS

The following factors were considered when determining what type of handsets should be provided to nurses:

1. **Cost:** GPRS data transmission reduces the total cost of ownership
2. **Operations:** Supporting a dedicated MOTECH phone streamlines operations
3. **Functionality:** Java-enabled phones provide increased functionality
4. **Usability:** Java forms are more user-friendly and enable quicker data entry
5. **Data Quality:** Java forms are likely to yield more accurate data

Given the volume of data that was anticipated, there was a significant cost savings in sending data over GPRS vs. SMS. In less than six months, a new phone would pay for itself simply given the data-transmission cost difference. The field team ended up providing nurses with Nokia 1680 phones at a cost of about $40 per handset. A detailed analysis of this decision is in the Appendix.

LESSONS LEARNED

The following lessons were learned throughout this evaluation and as the team went into early implementation:

1. **Build on an existing policy** – Providing nurses with handsets required coordination with GHS management to coordinate a handset policy that addressed loss, theft and other issues related to the use and misuse of the phone. See the "Nurse Handset Policy and Incentives" section below for more detail.
2. **A lot needs to happen to deploy phones** – The logistics of purchasing and setting up more than 40 mobile phones with updated versions of the MOTECH forms, ensuring that they were charged, adding credits, deploying them, and training everyone on their use was an ongoing effort that required weeks of in-person field-staff visits, as well as a coordinated effort with the field staff to ensure that in the early days – when updates to the forms were frequent – all the phones were updated correctly, the time zone on the phone was set properly, and phones were labeled and tracked. However, we are sure that this requires less effort than managing the many different types of nurses' personal phones.
3. **Use the same handsets** – Having everyone use the same type of phone did prove to make the initial and ongoing training process easier to explain and understand. It also meant that nurses could be held more directly accountable for the phones than if they were using their own phones.
4. **Plan for network un-reliability** – The networks are often spotty and unreliable; even bad weather can result in lost coverage. With java forms nurses are able to upload their completed mobile forms and send them once they are in range of a functioning network.

IMPLICATIONS FOR FUTURE WORK

Scaling in this case will require:

1. **Cost Analysis** – An analysis of the cost should include providing basic handsets initially, supporting the handset use over time and replacing them approximately every two years. Data transmission costs for sending information over GPRS are extremely low and unlikely to significantly impact implementation budgets.
2. **Logistics Plan** – Scaling this to a larger set of users requires an aggressively proactive plan for handling how phones are ordered, how phones are set up initially (e.g., time and date, initial loading of forms, phone charging) and how they are distributed, updated and replaced over time.
3. **Policy Development** – It is imperative that a policy be developed (if working with a government health service, it must be in accordance with their policies) to address how loss, theft and misuse of phones will be handled. To date, the policy in place in the Upper East Region has been successful and we have had no phones stolen or lost.

NURSE HANDSET POLICY

OVERVIEW

A great deal of discussion occurred between the Ghana Health Service management and the MOTECH field team to determine how to develop a handset agreement for the nurses that would not be primarily punitive, would be in line with other equipment policies within the Ghana Health Service and would provide a reasonable approach to handling any loss, theft and misuse of MOTECH-issues mobile phones.

In the end, we decided to implement a policy that drew from other, recent Ghana Health Service equipment policies and had a less punitive tone than policies in the past. The idea was that the MOTECH policy would be implemented as a pilot agreement and, like other aspects of the project, would be monitored and adjusted as needed. This policy is included in the Appendix.

ISSUES & CONSIDERATIONS

The Ghana Health Service had learned through a recent deployment of motorbikes that if the punishment for loss or theft of a valuable piece of equipment is too severe, then nurses will not want to use the equipment for fear that the consequence for even something outside their control causing harm to the equipment would spell financial (loss of job) or societal (accusations and stigma) disaster for them and their families. The main point of discussion across the MOTECH team was how to incentivize nurses to take measures to ensure against loss and theft of the phones without making the consequences of losing a phone so severe that nurses would not want to use them. As such, a policy was developed with the following key points:

1. **First-time loss/theft without negligence**: No punitive measures carried out for loss or theft of the phone or accessories occurring without negligence, except for cases in which more than one handset or accessory under a person's care has been lost or stolen within any one-year period.

2. **Subsequent loss/theft within a 1 year period:** If more than one handset or accessory within a person's care has been lost or stolen within any one-year period, even when negligence cannot be proven, Ghana Health Service reserves the right to charge the person for a percentage of the full replacement cost, at the discretion of the immediate supervisor.

3. **Loss/theft resulting in negligence:** The person whom the phone is registered to and their colleagues at their facility will be charged with replacement of the mobile phone and/or accessories if any one of the employees at a facility are found to have negligently contributed to its loss or theft. Rate of payment will be as follows:
   - 75% to be paid by nurse possessing phone when lost or stolen due to negligence
   - 25% to be paid by other Ghana Health Service staff based at the facility

LESSONS LEARNED

1. **The policy should be created by the employer –** Projects in developing countries are frequently viewed as transitory. For the handset policy to have credibility, coordination with Ghana Health Service was essential. The policy was created and supported by the Ghana Health Service, in accordance with similar policies. Further, the policy itself is written and distributed on Ghana Health Service letterhead, signed by a Ghana Health Service officer, and the process is managed by the Ghana Health Service District Supply Officer and the manager of each facility that received phones. The risk of not providing a policy in this manner ranges from nurses simply not using the phones to an inability to enforce the policies put in place.

2. **Allow for accidents and create broad accountability** – This policy is based on the assumption that sometimes, even with the greatest care, phones can be lost or stolen. Provided neglect is not found, it allows for one incident of this type per year. This helps reduce the anxiety for nurses that they will be held responsible for replacing an expensive piece of equipment that they were not at fault for losing or having stolen. However, it also puts in place a system that encourages other staff to help each other with keeping phones safe by putting a small, but still significant part of the

replacement cost of a phone that is lost or stolen due to negligence onto the entire staff of a facility. This way, if a nurse leaves her phone on a table and leaves for an outreach, another nurse, manager or midwife would be more likely to remind them they've put their phone at risk and remind them to keep it close at hand in the future.

3. **Monitor and adjust –** Like all policies, this one also needs to be monitored closely to determine any of the unintended consequences of its structure. Adjustments should be made to ensure it is keeping up with the intent of keeping equipment lost, damage and theft at a minimum while also encouraging the nurses to actively use it.

IMPLICATIONS FOR FUTURE WORK

The handset policy works very well in the pilot as all recipients of phones are employees of Ghana Health Service. If the service scales to environments where individuals from outside Ghana Health Service are provided with phones, an appropriate policy will need to be put in place for those users. For example, if equipment is provided through a private or NGO-based system of care, the parties involved will need to come to a consensus on how to handle this aspect, based on the norms and issues specific to the situation.

NURSE INCENTIVES

OVERVIEW

During the early testing of the applications we found in situ testing to be extremely important for maximizing the quality of the feedback for system design. We held several workshops in which nurses tried out applications in role play. These were useful for highlighting issues with navigating the application or training challenges, but had limited value for inviting discussion on which additional features would be most useful, how the application would alter or integrate with existing workflow, or potential benefits and annoyances of the application in the nurses' daily routine. Therefore, we switched tactics and requested nurses to use the prototype of the application with real patients in their facilities for one month, as if the service were already live. This enabled nurses to really experience the effect of the application on their work, to the extent that they were able to suggest improvements and new features that they believed would help them. This was invaluable as we were then able to modify existing parts of the application and even spec out new features in direct response to the suggestions of the nurses.

In this prototyping stage nurses identified that they thought the application would result in time savings and better information flow. They anticipated that time savings would come from the automation of monthly reports. In the design of the system this was intended to be the main incentive for nurses to enter data into MOTECH.

ISSUES & CONSIDERATIONS

When MOTECH was ultimately deployed, we found that, as in our original testing, initially nurses did not recognize automated reports as an incentive. In fact, nurses were requesting us to buy lunch for them in

return for the extra work MOTECH was making them do, and some even asked for money. We think that this originated from two aspects of how the project was implemented:

1. The benefits of automated reporting cannot be realized until data is submitted for every single client seen in a month. Unless all data is entered, reports are inaccurate, so the automated reports cannot be accepted as they are; nurses are required to add in the data for those clients whose information was not submitted to MOTECH. Therefore, in the ramp-up stage of the project when nurses are becoming used to the application and figuring out how to effectively integrate it into their workflow, reports are unlikely to be complete and accurate, meaning that nurses do not actually save time on reporting at all. Nurses in some facilities seemed to also struggle to realize that they would only see time savings when they consistently entered all client data. We tried calling nurses to encourage them to enter all forms, and monitored their daily uploads so that we could prompt them when no data had been sent. We set up competitions in which the most active facilities would receive small gifts such as radios. Finally, we brought all nurses together for a meeting in which they shared experiences of MOTECH and how to make it work. At this meeting, three facilities were able to explain how their data uploads were consistent enough that they no longer had to manually aggregate data for their reports, and they offered tips to their colleagues on how they too could reach this point. These methods of encouragement seemed to be quite effective and we are seeing successful use of MOTECH in the facilities, with nurses now realizing its benefits. We were surprised by how constant this encouragement needs to be (literally daily), and how time-intensive it is to support this. We have come to realize how using new technology in these setting is a really significant shift in work practices and culture, and so its integration will take time. It will be interesting to see the extent to which this constant monitoring and encouragement needs to be maintained once MOTECH is more established in these facilities.

2. MOTECH was being seen as a "project" by nurses; that is, instead of seeing MOTECH as an element of their normal responsibilities as an employee of Ghana Health Service, nurses regarded it as something extra brought to them by an external organization that would one day go away. This meant that they did not feel the obligations of an employee to perform the work and since they did not consider this an initiative of their employer, they did not feel that they were recompensed for it as part of their normal salary. Therefore, we tried to encourage Ghana Health Service staff to be more *visibly* active in the project, to reinforce the fact that MOTECH is their initiative. The regional deputy director became a clinical monitor for MOTECH (investigating the clinical impact of the intervention), with a very perceptible presence in the field. District level staff became MOTECH supervisors who frequently visited facilities to monitor performance. A Technical Working Group was set up to ensure closer liaison between MOTECH staff and Ghana Health Service staff to ensure seamless coordination in the field. These steps improved the seriousness with which nurses undertook MOTECH work, which in turn improved the consistency with which they submitted data to the system and better enabling them to see the benefits of automated reporting.

LESSONS LEARNED

1. **Constant encouragement is required for successful adoption:** Regular reinforced encouragement, particularly from peers, is a critical part of adopting new tools and practices. Encouragement messages in SMS messages are also a really effective way of keeping nurses motivated, as well as a useful channel for reminding them of certain practices such as uploading all forms before the end of the month. These messages are especially effective if they demonstrate effective monitoring of nurses' work and are tailored to that. For example, saying "We have noticed that you have uploaded 100 forms today. Congratulations on all the hard work. Enjoy the evening" shows the nurse that you see the work they are doing and it is valued. Similarly, messages notifying nurses that their uploads for the day look low lets them know that someone is monitoring that they are using the application reliably. These personalized messages are currently generated by support center staff and are well worth the effort. Over time, as the system scales, the messages can be generated automatically.

2. **Integrate the project into responsibilities set by the employer, not the project.** Having an intervention introduced by the users' employer makes them more likely to adopt it as part of their existing work and accept it as a change to their existing work, rather than additional work for an outside entity. This is important in encouraging adoption and compliance. We also noticed a change in the dynamics when district directors were including in project steering committee meetings. Frequent visits by the district directors, regional director, and national Ghana health Service staff at site visits each month created a visible sense of the importance and priority of the project for senior Ghana Health Service staff and therefore amongst the community health staff.

IMPLICATIONS FOR FUTURE WORK

Scaling such an intense system of monitoring and encouragement requires real time access to meaningfully presented data. The creation of effective monitoring tools needs to be one of the software development deliverables. In addition, manageable and efficient processes for communicating regularly with users need to be in place. For example, a process for quickly analyzing data and determining appropriate monitoring messages, the means of easily broadcasting messages (we use a web to SMS interface), a team which is proficient in accessing and interpreting usage data, staff who can communicate with users appropriately, and who understand government structures enough to know when and how to appropriately escalate issues within the system.

To avoid implementations such as MOTECH being seen as a temporary project, visible ownership by the local implementation partner needs to be built in from the outset. Involvement of the local partner needs to be not only in decision-making at the top but also in day-to-day management in the field.

CONTENT CREATION PROCESS

OVERVIEW

Developing and adjusting the content for MOTECH's Mobile Midwife service was perhaps the most essential part of the success of the service overall. Creating content that we were confident was "remarkably right", actionable, simple, localized and medically sound, took many rounds of consultations with potential end users, health practitioners, policy makers and local and global development partners. We were surprised by how many people are influential in a single pregnancy: mothers-in-law, grandmothers, husbands and even landlords are significant in decision-making during a woman's pregnancy in the Upper East Region of Ghana, with the opinions of pregnant woman herself often being relegated. This made us realize that we needed to target a broader range of actors as recipients of "Mobile Midwife" and the information it delivers. We needed to explain the experiences of the pregnant woman in order to reinforce her voice in the household, and provide actionable advice that was targeted not only to the pregnant woman and her husband, but also to others in the household. Also, we realized that we would not only need to translate content into the different Ghanaian languages, but we would also need to localize content for different cultures within the country, since myths and dietary practices in particular are highly variable between regions.

From the beginning, the Mobile Midwife content was developed with target audience relevance, accessibility and timeliness in mind. The process of creating the content included:

1. **Field Inquiries –** To understand current attitudes and understandings around pregnancies, we conducted simple field research. These activities included:
   a. **Pregnancy Question Box** – A temporary call center was set up in the Upper East Region while teams canvassed local villages to connect with mothers, village elders, and others who might have questions about pregnancy. We provided them with a mobile phone to call the call center and ask questions about their pregnancy and early childcare. The calls were answered by clinicians from the Ghana Health Service. The field team gathered these questions and assessed them to determine what information mothers in the Upper East Region were most interested in having answers to, what common myths were present, and were there were misunderstandings about pregnancy. Additional details are in the Appendix.
   b. **Pregnancy Diaries** – A group of expectant parents (both mothers and fathers) in the Upper East Region were selected to keep "diaries" of their pregnancies. The parents were supported by the MOTECH field team who visited them regularly and prompted them for updates regarding the issues and concerns they had during their pregnancies. Each participant was provided with a recording device so they could simply record themselves talking about their questions and experiences (removing issues around literacy). The information gathered during this process was a key part of the overall content localization and the women involved ended up being important resources for

the field team to test content, voices and other concepts with before rolling out on a larger scale. Additional details are in the Appendix.

    c. **Informal Focus Groups –** Focus groups were held with all those groups who have influence on a pregnancy: mothers, pregnant women, mothers-in-law, village chiefs, landlords, husbands and Community Health Volunteers. These focus groups aimed to find out the effects of a pregnancy and newborn on each group, the challenges and worries that each experiences, how decisions are made and by who during such times, existing support networks and information sources for each group, roles and priority shifts which happen as a result of the pregnancy, and traditions / beliefs surrounding pregnancy and childbirth, as well as knowledge gaps. This information enabled us to develop messages which addressed the concerns of each participant, and create content that appreciated the significance of these groups for a pregnant woman.

2. **Base Content** – BabyCenter.com, the highest volume web-based pregnancy and parenting destination worldwide, provided a free license to MOTECH for its basic content on the 40 weeks of pregnancy and first year of life. Additionally, the MOTECH team reviewed UNICEF and other major NGOs' content on basic pregnancy and newborn information.

3. **Initial Content Creation** - With understandings from the field and a preliminary set of messages in hand, a series of workshops were held with Ghanaian healthcare experts from the government and NGO sectors to review, refine, and ultimately rewrite all of the content for Mobile Midwife. We worked at multiple levels within the government including:

    a. National level with the Family Health Division and Health Promotion Unit

    b. Regional level with CHPS coordinators, maternal and child health experts, and health information officers

    c. District level with nurses, midwives, health promotion officers, and public health nurses

Multiple NGO and international development partners at the national and regional level were also included to incorporate the depth of their experience working on the ground addressing maternal and child health issues. Throughout this process, special attention was paid to make sure the messages were accurate, concise, timely, respectful to local traditions and culture, and actionable so that the advice could be put into practice. For example, sending a message to a woman who is eight months pregnant about issues surrounding breast feeding is likely to be more impactful than a woman receiving that message when she is two months pregnant.

4. **Translation, Localization and Recording** – Once the content was developed, it was translated from English into Kassim and Nankam. Ultimately, it was recorded in voice format in each local language. The cost of recording and translating the 170 messages was US$22,000 per language.

5. **Field testing of messages** - When the initial translations and recordings were complete, focus groups were convened to test various voices (older women, younger women, men, various accents and dialects) to be used for recording of the final content as well as testing of the content itself. We asked participants to tell us in their own words what the message had told them, so that we could check the accuracy of translation and the sufficiency of explanations of difficult concepts. Some messages were then re-recorded to address issues.

We are now determining scalable ways of localizing through identifying a core curriculum of content which remains the same between regions into which localized content is inserted at predetermined points, and developing light and efficient mechanisms for gathering localization information for each area of the country.

ISSUES & CONSIDERATIONS

The most important consideration in developing the content was understanding the knowledge gaps in the communities we were targeting, and having a good understanding of the beliefs and traditions affecting a pregnancy and child development. Developing the content with potential users, and testing it frequently with them area was essential in ensuring that the content was suitable for the region. Additionally, bringing in public health experts from Ghana Health Service and other NGOs was pivotal in ensuring adherence to Ghana Health Service protocol and broadening the base of knowledge required to put together content that would be relevant, accessible and timely to the women and communities of the Upper East Region.

LESSONS LEARNED

Translations and Voices
Once we had developed our content, the process of translating and recording it brought out some interesting lessons. We knew from previous projects and our own experiences as users that for voice applications the sound of the voice is important. Therefore we tested different voices with many different users. Surprisingly we found that women were quite open to receiving information from a male voice for certain topics. Indeed many said they were happy about that since their husbands might be encouraged to become equally knowledgeable and supportive as the man reading the message. We also found that people wanted to hear an older, soft voice, like a trusted, experienced and sympathetic "auntie". We did not anticipate that, once we had found actors who spoke the appropriate languages, there would be concern from users about the "depth" of their accent. Voices who sounded too educated were not accepted as they were not seen as being from a place that would enable them to fully understand the daily struggles of life in the users' area. Meanwhile, users disliked voices with accents from "deep in the village" as they were not trusted as being knowledgeable enough. The field team also found that people preferred for the background to be quiet, versus typical village noises (e.g., children, chickens) being heard in the message. The team also understood that music is a powerful form of communication in Ghana and generated messages using a local singing group who created songs about breastfeeding and other topics.

Messages were diligently translated and back translated, and we even spent time finding symbols in the word processor which were needed to express the local languages in written form. However, when it came to recording these messages, we were not able to find anyone – across all levels of education – who could read the translations, except for professional translators and local language linguistics experts. Looking back it makes perfect sense: these are deeply oral languages whose written forms have not been developed. After weeks dedicated to obtaining the perfect written translations, we had to abandon the

written local language scripts and resort to impromptu translations from the English text by the voice actors themselves. Qualified health workers fluent in the language were consulted to check for accuracy**.**

The translation and recording process took longer and was more expensive than anticipated. It was especially difficult to find competent voices and translators for the languages spoken in the Upper East Region – a region that is the furthest from the capital Accra and the poorest in the country,

Message Format

We had learned from previous projects that a system based on SMS for information dissemination would not allow us to reach the target we desired – the poorest of the poor – who are often not literate in any language. Nevertheless, we did some testing to verify this in rural Ghana. We sent a random sample of people across all age groups an SMS in both English and their local language. We then asked the person to tell us what the message said. We found that 50% of the participants could not read either English or their local language. Of those participants who were literate, 86% chose to read in English rather than the local language. Of the people who were able to read the English message, their understanding of the message was accurate in all cases, but often only the main message was deduced, with some details missing. This testing enabled us to conclude that:

- Illiteracy is prevalent amongst our target demographic, so there was value in supporting voice.
- Literacy mainly relates to English (local languages are oratory in origin and rarely written).
- The level of understanding of written messages is quite rudimentary.

Therefore, an emphasis was placed on the creation of messages delivered via an Interactive Voice Response (IVR) system that allows users to listen to messages in their local language. Information is offered in SMS also, for which English is the only language supported for the above reasons. Only 1% of users to date have chosen SMS as their preferred method of message delivery.

Collaborative Content Development Process

Key to the success of the Mobile Midwife content was the process that provided multiple opportunities for stakeholders from government, NGOs and the public to provide input in a variety of formats to the content development process. This enabled us to maximize the relevance of the information provided in the limited time allotted within the Mobile Midwife context. Each woman receives one primary message and has the option to receive a secondary and tertiary message for each of the 40 weeks of pregnancy and for each week during the first year of her baby's life. By using a multi-stakeholder process for understanding what issues were most important, the MOTECH team was able to create content based on what seemed to be the most relevant and useful information to the women we were trying to impact.

IMPLICATIONS FOR FUTURE WORK

While the base content can be scaled easily, the MOTECH team has found that for the content to be relevant and therefore trusted and used by people in a particular area, certain elements of it needs to be localized. The elements that require localization include:

- **Diet** – Food availability and cultural preferences vary not just by country but also by region. Some of the messages refer to foods that women should eat during their pregnancy as well as "starter

foods" for their babies as they are weaning from breastfeeding. It is important that any references to foods are ones that people can easily obtain in their area and are accessible to the demographic

- **Where and how to obtain care** – Mobile Midwife encourages women to seek care at local healthcare facilities. Adjusting content for scale will require that references regarding how and where to obtain care be localized for the country, region or even district where the messages will be deployed. The level of specificity of where to obtain care (e.g., go to your local Ghana Health Service facility vs. go to the XYZ clinic in ABC village) will depend on the desire of the specific project to scale, and content will need to be adjusted accordingly.

- **Cultural myths** – Myths surrounding pregnancy, birth and newborn care abound in many rural areas. It is critical to understand the myths so they can be addressed in a way that understands its origin and is respectful of the culture and community. Content can be developed to address the myth and present the appropriate medical information that respectfully addresses the myth and why following it may not only not be in the best interest of the mother or baby, it may in fact be dangerous.

- **Slang** – When dealing with issues related to health, often local slang terms are the most widely accepted and understood ways to refer to body parts and certain behaviors. Sometimes these terms are not accurate – for example, in the Upper East Region people refer to anemia as "not having enough blood". In the translations, we use accurate medical terms but also associate that with a local reference and description.

MARKETING MOTECH

OVERVIEW

MOTECH – and "mobile health" – represents an approach to development that is new and different from many of the existing projects. As such, the MOTECH team approached the marketing and registering of users for MOTECH in a way that strove to distinguish it from the myriad other NGO health messages while still being familiar to the target population.

The field team found that engaging all the people in the community who have an impact on others' health decisions was important to the success of the adoption of MOTECH. The field team uses a multi-dimensional approach to reaching various stakeholder groups, including:

- **Healthcare workers:** nurses are provided with Mobile Midwife marketing collateral and trained on its use so they can actively recruit users in their communities. See sample posters later in this document.

- **Community Health Volunteers (CHVs):** Ghana Health Service has a system through which each community has Health Volunteers who are responsible for liaising between health facilities and community members. For example they alert communities when there will be outreaches and do health promotion activities. As part of their Ghana Health Service responsibilities, these volunteers have also become ambassadors for MOTECH. They are tasked with assisting new clients to register into the system, helping existing clients to access their messages, and reporting recent unattended child births into the system. When the project was launched, these volunteers were invited for

  Front   Back

  T-Shirt for Motech Registrars

  T-Shirt for Mothers

  training and issued with T-shirts and promotional flyers and posters. We had heard other projects say that the community status gained from working with projects was a sufficient incentive to keep volunteers involved. We have found this assertion to be overrated and have discovered that volunteers seek an opportunity for income generation or rewards such as bikes, radios and phones.

- **MOTECH Field Staff:** MOTECH's own field staff is responsible for training others involved in direct marketing for MOTECH (e.g., Community Health workers and volunteers). They are also responsible for actively raising awareness of the service by educating users at outreach events, village events, market days and through door-to-door recruitment in target communities. The field staff show up at these community-wide events wearing brightly colored MOTECH T-shirts and discuss the service with women of child-bearing age and anyone else who expresses an interest. They have phones available to be able to provide a hands-on demonstration of the service and to sign users up on the spot.

- **Non-Governmental Organizations:** NGOs working in the same geographical and topic area are being educated on Mobile Midwife and being provided with marketing collateral so they can direct potential users to the call center for enrollment in the service.

- **Community Leaders:** Community leaders, such as village chiefs, are briefed on MOTECH and Mobile Midwife so they can educate their community on the service.

- **Durbars:** Community durbars, or entry ceremonies, are held in the treatment area to educate communities about the concept and advantages of Mobile Midwife, and to seek formal community approval of MOTECH.

MARKETING MESSAGES

In searching for a marketing firm to help develop the MOTECH marketing campaign, it became clear that communities in Ghana, and particularly the Upper East Region, have been inundated with cartoon-like health message campaigns from myriad NGOs and government agencies. On the other hand, if campaigns were seen as "too slick," people would not think the messages were relevant to them. The MOTECH team decided to pursue an approach that sought to provide "aspirational" images that were differentiated from the typical "NGO cartoon" campaign but still were relevant to the UER population. This included using real photographs instead of drawings, and ensuring that the people in the photographs were wearing clothes in the style of those worn in the UER. Part of the aspirational message was dressing the models in new, clean clothing which proved to be effective. When field testing the marketing styles, many people said they "liked the lady in the pictures and it made them feel good as one day they would like to be dressed well too". The team also decided to create some messaging that was targeted specifically to men in an effort to respect their roles as decision makers in the family, get them to listen to the messages with their partners and be a part of making positive health choices throughout pregnancy, birth and early childhood.

Posters and flyers were distributed in treatment communities to educate users about the system. In our replication district of Awutu Senya, public announcement rounds showing infomercials on market days are planned to raise awareness of the system. As the campaign broadens, we are considering branding buildings with the Mobile Midwife logo. Given that a randomized control trial is being conducted to evaluate the effectiveness of MOTECH, "below the line" advertising methods, which target a limited and specific group, have been selected to ensure that the geographical reach of marketing efforts remains within the treatment zone so as not to impact the control group of our impact assessment.

SELECTING THE NAME

There was a tremendous amount of discussion around selecting the name "Mobile Midwife" for the service. We considered a name that would be in a local language (as many people do not speak English), but with an eye towards long-term national scale of the service realized that any name would need to be relevant across multiple languages. Names in Twi were suggested, but were not understood by people in the Upper

East Region. As the official language of Ghana is English, choosing an English name was less politically contentious than a name in Twi or any other language.

To our surprise, when we field tested the "Mobile Midwife" name in the Upper East Region, we found that while English is not commonly spoken, the terms "mobile" and "midwife" were all understood and had been incorporated into local languages.

There was some concern about the word "mobile" being confused with mobility rather than mobile phones, and we found that this actually did happen in some testing. To address this, visuals were used in posters to emphasize phones, people on phones, and pregnant individuals. In follow-up testing with these images, people were clear about what type of "mobile" the service focuses on.

LESSONS LEARNED

1. **Message familiarity** –We realized that for the MOTECH message to be heard, we needed to develop an approach to marketing that was familiar enough that it wouldn't feel "foreign" yet edgy enough that it would get people's attention. This formed the foundation of our approach to selecting a marketing firm and developing a marketing campaign.
2. **Trust Factor** – Whether people trusted Mobile Midwife messages or not had a lot to do with having field agents who knew the communities, and getting community health volunteers, nurses and other key community members informed and engaged. The close association between Mobile Midwife and Ghana Health Service was also very important as Ghana Health Service is well respected in the communities. We also conducted "durbars" (community entry ceremonies) in every community where MOTECH was being rolled out. This was another way for the community to be presented with MOTECH and officially "accept" MOTECH.
3. **Hand-to-Hand Marketing Key** – We found that there was no substitution to having community volunteers in the field, wearing MOTECH t-shirts and helping people understand and register for MOTECH. As we expand the work to other districts, we may also work with people distributing health commodities and have them carry mobile midwife information and provide registration services. Also, people liked to get things like ID cards, stickers and T-shirts that showed they had registered for the program.

IMPLICATIONS FOR FUTURE WORK

The awareness and registration campaigns in the Upper East Region have been fairly "high touch" and labor intensive, but have also been constrained so as not to adversely affect the impact assessment research. Other strategies will be utilized in the replication in Awutu Senya such as community radio, experiential marketing, branding of container shops, and community mobilization. Deploying at a national scale will likely require considering and testing of other high-reach strategies.

OVERVIEW

The marketing campaign described above was designed to get people interested in registering for and actively using the Mobile Midwife service. The next challenge was to register people in the service.

The issue of how to uniquely identify clients was challenging to resolve as there is no National Identification scheme in Ghana and no unique identification numbers used in the health system. After some investigation to look at using other existing identification numbers, we realized that developing an ID scheme for MOTECH would be necessary for accurate data and ease of access. For Mobile Midwife we needed an identifier or combination of identifiers that could be easily remembered or located by the patient, and easily entered onto a phone keypad and processed by an IVR-type system to identify the patient uniquely when they call in to retrieve messages.

We considered using phone number as a way to identify clients calling in to MOTECH, but realized that this would not work owing to the high turnover of different SIM cards and the widespread practice of sharing phones meaning that more than one MOTECH client may be relying on a single SIM. This impelled us to develop a new ID system for MOTECH, through which all clients registered in the system are issued with a 9 digit numeric code at registration. We selected a numeric code to enable easy input using a phone keypad. The client is provided with this number through an ID card which is issued at registration, or over the phone for call center registrations. This ID number is also noted by health workers by the client's record in their registers. The ID number is used from then on by both the nurse and the client. When nurses enter information about a particular patient into the MOTECH system, they use the patient's ID number. When a patient calls in to MOTECH to retrieve their messages they are first requested to select their language, and then they are asked, in their selected language, to enter their MOTECH ID number. Entering the ID number tells the system who the client is, enabling their personalized message to be played.

Another challenge was designing a methodology for identifying duplicate registrations in the MOTECH database, or uniquely identifying patients in the case that their MOTECH ID has been lost. Using simple demographic fields such as name and date of birth seemed unreliable since our clients often go by several different names and are not so concerned with accurate spelling of them. Also, many people in rural areas do not know their date of birth. The only solution to this issue has been to rely on a triangulation of fields to try to identify patients: a broad search in enabled when trying to locate a patient in the database by name, and a combination of address, date of birth (where possible), National Insurance Number (where possible) and relation to other family members (e.g. children) in the database are all relied upon for unique identification.

For the mechanics of registration, we used two strategies:

1. **Registering in Person**: At any time, Community Health workers and MOTECH field staff can enroll users into Mobile Midwife by completing a registration form in the MOTECH mobile application on their phone and sending it to the system via GPRS. The registration process requires that women answer several questions; we found it was optimal to have a process where women were supported in initial registration into the system. Grameen Foundation staff worked alongside GHS nurses, community health volunteers and others at regularly schedule Child Welfare (CWC) and Antenatal Care Clinics (ANC) to register every woman and child that showed up for care. This allowed for capture of about 90% of the CWC and ANC clients within a month of launching MOTECH, which left a much smaller burden for clinic staff to enter new clients or clients who were not at a CWC or ANC during the weeks the field staff conducted registration.

2. **Registering through the Call Center:** Users can enroll for Mobile Midwife by calling the MOTECH call center. The call center is based in Accra and staffed by an English-speaker who addresses nurse calls and a Nankam/Kasem speaker who answers Mobile Midwife client calls. Call center operators ask the client questions that enable them to complete a registration web form, which they submit to the MOTECH system using the Internet. Potential users can access the call center by calling or flashing the same toll free number that they use to access their Mobile Midwife messages and selecting the appropriate option from the IVR menu. We used the same number for new registrations as for accessing messages as we wanted a clear marketing campaign which advertised a single phone number. The call center has developed a set of service-level agreements that they work to maintain throughout their operations. These can be found in the appendices.

The Call Center, while originally envisioned as a tool for registration, became a useful hub for customer support. When people have questions or encounter problems with the Mobile Midwife service, they can talk to a "live person" at the call center to have their issue addressed. This also enables cases to be raised and assigned to relevant staff so that there is a constant flow of feedback to those involved directly in designing the system. For instance we have received feedback from users about content that they would like to have heard, and this has informed future rounds of content creation.

Call center staff can also generate messages to nurses, which has proven to be an effective way to reward nurses who have met their targets and prompt under-performing nurses to meet their goals.

ISSUES & CONSIDERATIONS

Call Center Location – It was important to balance the need for field-based support and for having a call center in a location that had reliable Internet, phone and power supply, and also would be extensible once MOTECH scales beyond the Upper East Region. Therefore, the field team continued to provide in-person support in the field. However, the call center is located in Grameen Foundation's Accra office. This helps ensure the technical stability needed and also allows for easier expansion when other sites are added. See Appendix for a detailed analysis of Call Center Requirements.

Call Center Data Analysis – The call center established for the MOTECH pilot is very simple. As a result, we are not currently able to capture data about the performance of the call center and how it is performing. In order to operate a call center at scale, dedicated hardware and software will likely be required to do operate effectively. A set of requirements for a call center that can operate at scale is included in the Appendix.

Call Center Lowers Barriers to Access – The primary goal of the call center is to enable anyone to easily register for the Mobile Midwife service, particularly those that are not currently participating in the health system. Many of our marketing efforts occur away from health clinics or nurses, so we needed a mechanism for people to register without going through a nurse. Given literacy challenges, a phone call with a "live person" was considered the best way to assure the lowest possible barriers to registration.

Local Language Support – Although most GHS nurses speak English well, most Mobile Midwife users do not. Therefore, it was necessary to have call center support in the languages supported by Mobile Midwife.

LESSONS LEARNED

Call center does not replace need for field staff – Initial mass registration was achieved by working alongside GHS nurses to register as many women and children as possible at prenatal and child-welfare outreach clinics. However, once mass registration was complete, the need for field staff remained. We found that nurses and community health volunteers had direct relationships with MOTECH field staff and relied on those relationships to report issues and request assistance. Field staff have continued to be required to troubleshoot issues both raised to them directly and those dispatched by the call center. Their

presence has been invaluable in keeping up momentum and nurse morale, particularly during the start-up phase when the number and types of system issues were at the highest. As the system matures, we expect to lower the reliance on field staff and shift more field support to Ghana Health Service staff.

IMPLICATIONS FOR FUTURE WORK

Create an extensible call center – If there are any plans for future scale, the call center needs to be located in a place where you have the best chance of recruiting staff with the skills required to run the call center. It is also important to be in a place that allows for the best possible technical infrastructure and to procure equipment that meets not just immediate needs but is expandable for future capacity. For Ghana, we had to constantly balance the need to keep costs low and provide very localized, language-specific support with an eye for future expansion. This meant being housed in Accra, where staffing and technical resources were greater, and selecting equipment that was moderately priced but that could expand as the pilot expanded to one or two more regions.

Plan for long-term field staff – Thus far, it seems that having a competent, local field team is important throughout at least the first year of operations. These individuals need to be technology savvy, understand the organizational culture of the local health service, and know the protocol for community entry. After that, depending on local adaptation, field staff may be able to be reduced, but it is advisable to have some sort of field presence on a regular basis (e.g., monthly check-ins at a clinics) for at least the first 2+ years of the project, with active planning to transition a specific MOTECH field-support role to the local healthcare provider (in this case GHS) over time.

ESTIMATING DUE DATE

OVERVIEW

When registering a pregnant woman, a number of challenges present themselves when determining the estimated due date. Individuals registering by phone do not have a healthcare worker present who can calculate estimated due date based on clinical signs. Our target audience is quite out of tune with their menstrual cycle. Without a clear grasp of what their cycle should be, we found they struggle to determine when they have missed a period – Ghana Health Service nurses tell us it is not uncommon for a woman to come to the clinic as late as the second trimester wondering if she might be pregnant. A related challenge is that many rural individuals struggle with counting, especially regarding dates in the past. If you ask how many days, weeks, or months ago something happened (even an event as simple as "the last time it rained" or "the last religious festival"), it is difficult for them to determine the answer.

LESSONS LEARNED

To address this problem, in partnership with BabyCenter we developed a simple decision tree which asks easily answered questions and guides towards an estimated due date. For example, we ask "have you been

feeling nauseous" or "have you felt the baby move" or "when you put two fingers on top of your bump are your fingers at your navel". Based on the answers to these questions, we estimate the due date. See the decision tree below.
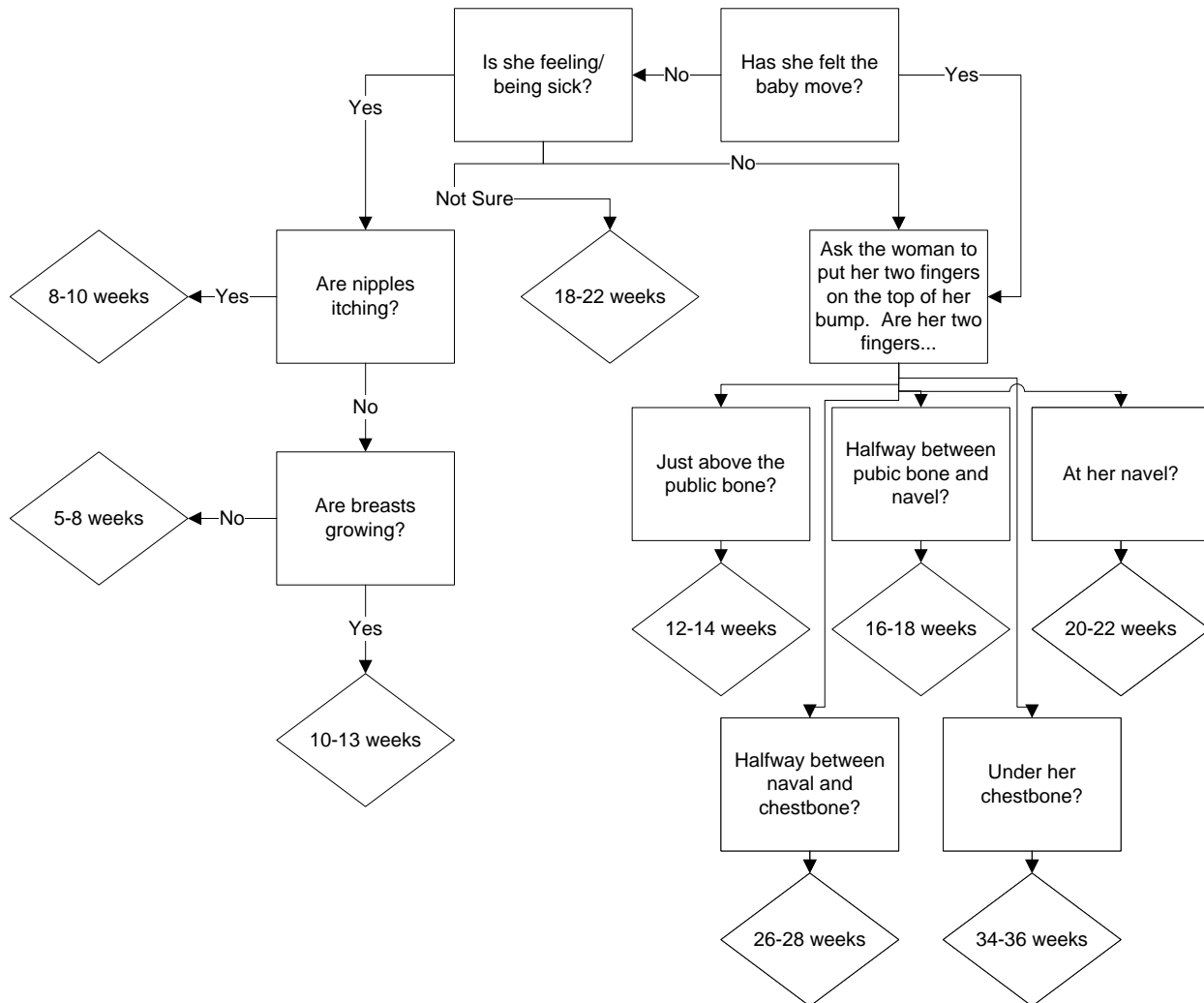
SOFTWARE DEVELOPMENT

OVERVIEW

The software development responsibilities for the MOTECH Ghana project were split between two teams. A group from the University of Southern Maine Computer Science department (also associated with Columbia University) was responsible for the server-side components. A Ghanaian software development called DreamOval was responsible for the mobile phone components. A Grameen Technical Program Manager was located in Ghana and was responsible for writing technical specifications for the software functionality and coordinating efforts between the development teams.

The high-level system architecture is pictured below:

MoTeCH System Diagram
Version 1.3 – June 17th, 2009
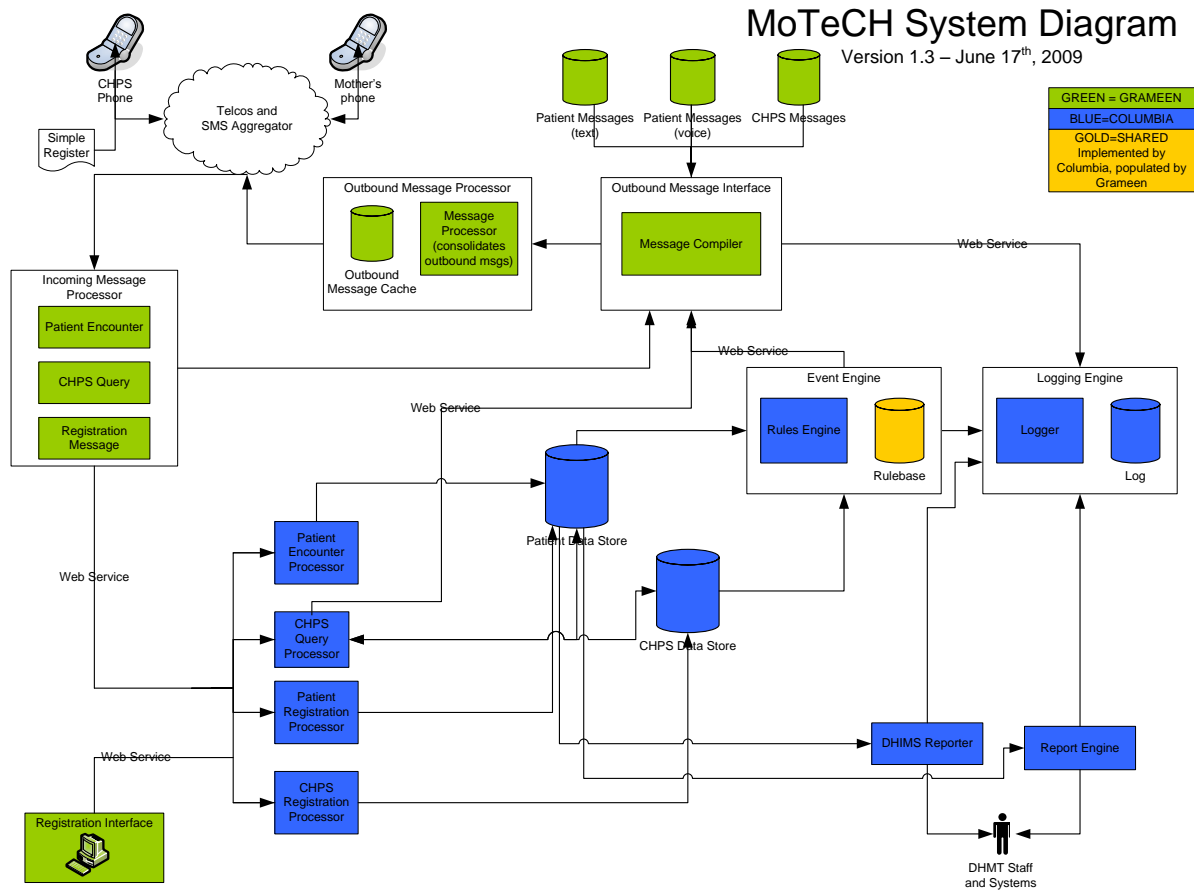
LESSONS LEARNED

The MOTECH project confronted issues that are typical of most software development efforts, ranging from fluctuating requirements, to mid-stream architecture changes, to cross-team/cross-continent coordination. Some lessons that were unique to the MOTECH experience were:

Mentoring needed for local developers: Software development is an inherently complicated endeavor. Organizations and individuals that have been doing it for a long time develop strong internal processes and structures that go a long way toward producing high-quality code in a timely manner. Young software developers that enter these organizations have the benefit of learning from more experienced colleagues and work an environment with strong structure and methodology. We made a strategic decision to try to work with a local software development company so we could have a team closer to the actual implementation and build local capacity that could support the project well into the future. The software development company we chose to work with in Ghana was populated with enthusiastic developers with a moderate amount of experience – but they were a new organization and lacked the "senior experience"

that would have helped establish strong software development processes. As a result, we struggled with timely deliverables and had issues with the quality of the code. This seems to be a common phenomenon in developing countries where the software industry is relatively new. Our project would have benefited greatly if a senior and experienced software development manager was present at the local development company, even temporarily. As the complexity of the software development effort grew, the local developers were pushed beyond their capabilities, and the team from University of Southern Maine ultimately had to re-write much of their code after performance issues were discovered in the production environment.

Establishing local infrastructure is extremely time-consuming: The MOTECH software platform is hosted at a local Internet Service Provider where we rent rack space. Our service requires connectivity to multiple local telecommunications companies in order to enable access to it by subscribers of all mobile networks. Establishing the physical connection between our servers and the different telecommunications companies was extremely time-consuming and arduous, taking many months to establish a connection that we thought would take a couple of days. We had to deal with issues including:

- hardware compatibility with the network interface cards (E1 cards)
- hardware compatibility with network signaling systems. Specifically, our IVR system could only handle ISDN PRI protocol, yet the telecommunications companies use SS7. This required placing a SS7 to ISDN PRI converter into our architecture.
- slow customer-service response time at the telecommunications companies to establish connections
- mounting RF equipment to connect to some telecommunications providers
- negotiation of contracts and Service Level Agreements

Performance test in the production environment: In an attempt to meet schedule requirements, we elected to skip performance tests of the software in the production environment. When the service was launched, we discovered significant memory leaks and performance issues, which caused the development team to scramble to fix issues while the service simultaneously tried to register customers. A couple additional weeks of time to test the service would have made a significant impact.

Don't forget the history: The MOTECH application is designed to send reminders to patients if they have missed scheduled care. For example, a woman should have received her second tetanus shot by her 24th week of pregnancy. When this care is delivered at a health clinic, the nurse enters the encounter on the mobile phone and the medical record for the patient is updated. If the care is not delivered, both the patient and the nurse receive a message telling them that care is needed. In our system design, we neglected to consider what would happen when a woman registers for MOTECH late in her pregnancy. When actual registrations began coming in, women were registered who were fairly far along in their pregnancy. For example, a woman registering at 30 weeks would immediately be viewed by the system as being "in default" for missing the tetanus shot due at 24 weeks. Even though she may have received that care, it was not reflected in her medical record, a condition which resulted in many erroneous reminder messages being unnecessarily sent. The team had to spend a couple of months updating medical records

using mobile forms after people had been registered to ensure that accurate reminder messages would be sent.

RESEARCH, RAPID INNOVATION AND PARTNERSHIPS

OVERVIEW

Grameen Foundation has been built on a culture of social entrepreneurship and rapid innovation. As an emerging technology project, MOTECH is, by its very nature, a rapidly innovating, entrepreneurial project. However, particularly with new interventions, evaluating the impact of the intervention is important to understand if, how and why it is working – or not. From the start, there has been an ongoing tension, which requires constant management and balancing, between the need to rapidly innovate and try out new approaches to the technology and its various aspects of innovation, and the need to create a static environment for the sake of the very necessary impact assessment conducted by Columbia University.

The tension between research and rapid innovation was increased by the fact that the project is made up of an equal partnership between Columbia University, Ghana Health Service and Grameen Foundation. Clear lines of accountability across the project team or clear agreements of commitments from each partner were not established and communicated at the outset of the project. This made it difficult to enforce agreements made later at the field-team level and led to an atmosphere of misunderstanding and distrust in the early stages of the project.

The pace and style with which these organizations typically operate was also very different. For example, Grameen Foundation's desire to have rapid innovation and an iterative design process is quite different from the "gradual consensus building" model typically employed in health systems. Adjustment was required by Grameen Foundation both in the pace of development and the amount of communication required with partners to make this collaboration successful.

LESSONS LEARNED

1. **Develop – and document – clear agreements:** Early on, we found that both teams had a lot of assumptions about the most basic elements of the project, including what MOTECH is, how it would be developed and deployed, and what activities were and were not open for change from the base project design. The teams operated best when we were able to maintain consistent weekly team meetings using an agreed-upon tool for documenting and talking through the various development and implementation issues and the impact of the study design.
2. **Educate each other:** In hindsight, it would have been helpful for each team – Grameen, Columbia and Ghana Health Service – to have spent some time in the earliest phases of the project articulating to each other how each team envisioned the overall success of the project, their own role and the roles of the other partners.
3. **Create clear accountability:** Partnerships require clear agreements from the earliest stages about who is accountable to whom, how work will be managed, and how staff will be incentivized and penalized as appropriate. The success of MOTECH relies on the success of each partner's part in

the project, and the lack of clear accountability made it difficult to address issues in a timely and effective manner.

4. **Have a single grant:** There were two separate grants from the Gates Foundation for the MOTECH work in Ghana, one to Columbia and one to Grameen. As a result, Ghana Health Service received disparate amounts of funding from the two organizations for different aspects of the project. While the distinctions between the source of these payments were clear to Grameen and Columbia, it was difficult to communicate that there was a single MOTECH project to Ghana Health Service in the context of separate financial transactions. This had a negative impact on perceptions of how much Grameen and Columbia were truly collaborating and made the project's initial interactions with Ghana Health Service more challenging than they needed to be.

5. **Designate a single project owner** – It is important for overall accountability and effectiveness for all partners to agree on a single project owner. Future contracts should clearly delineate partner roles, responsibility and accountability, as well as ownership of project data, equipment and related products.

6. **Build a team that understands the health system** – Given the importance of local implementation partners, particularly government health agencies, it is vital to populate a team with people who know how to navigate and work with the local health system.

IMPLICATIONS FOR FUTURE WORK

1. **Use the grant agreement phase to create project agreements:** Build agreements around partner roles, responsibilities, accountability and an issue resolution/escalation process into the original grant agreement. Then, hand those agreements over to the field team to create the day-to-day work structure that best aligns with the higher-level agreements made during the grant phase. This lays the foundation for the project to start with common agreements and clear roles.

2. **Develop regular team review sessions** – If the research team and implementation team can work together at every juncture – from study design, to software development, to implementation and data collection – it is more likely that the tension between the need to rapidly innovate can be balanced with the need to collect solid data for impact analysis. However, if either team goes too far down the road of study design creation or product development without constant input from the other team and understanding the impact on the work of the other team, it then becomes more difficult to align the needs of each to get their work done.

FULLY OPERATIONAL ISSUES

OVERVIEW

As the teams moved closer to final deployment of the MOTECH service, it was clear that we needed clear benchmarks for what "fully operational" meant for the MOTECH platform, operations, and impact

assessment preparation. Grameen Foundation and Columbia 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. The categories assessed included:

- Simplified Registers
- CHPS Standardization
- In Service Training
- Nurse Mobile Application
- Mobile Midwife
- Technical

The manager responsible for each area was required to show evidence that specific targets had been met. This enabled the teams to regularly discuss and assess whether the system was operational enough for the impact assessment to start and meet the deadlines required to allow enough time before the end of the project for data to be collected.

LESSONS LEARNED

1. **Targets tool was invaluable** – Developing a three-page document that outlined the fully operational targets ended up being an invaluable tool for the team to objectively assess whether the system was in place and ready for evaluation. It also gave managers a way to prioritize areas that needed to be focused on, given the many competing priorities.
2. **Buy-in** – For the tool to work, all stakeholder teams have to be a part of developing and agreeing to the benchmarks. The tool also has to be updated and reviewed regularly across the team for it to be effective.

IMPLICATIONS FOR FUTURE WORK

Make the development of fully operational agreements a key deliverable in the project agreement and use it as an on-going management tool.

HEALTH SYSTEM IMPLICATIONS

OVERVIEW

Mobile phones are NOT a solution to poor health; rather, they are a tool that aims to facilitate more effective execution of solutions. They also can be a catalyst for providing insight and information into clinical systems that don't currently exist or areas where the current system is falling short. In Ghana, we found that the introduction of MOTECH affected the clinical system in a variety of ways and brought up a number of political and cultural issues that can be difficult to navigate.

LESSONS LEARNED

1. **More educated consumers = more clinical system demand:** As women were receiving information about when they were due for care, they began to show up at their local health clinic and ask for prenatal care and immunizations. The problem was that the clinic wasn't always ready for the clients. Sometimes, nurses weren't available; at other times, vaccines and medications were not readily accessible.

2. **Clinical system gaps are more visible:** With mobile phones present in each of the clinics and mobile forms that aggregate data quickly, gaps in the clinical system were more visible and easy to report. For example, immediately upon the introduction of MOTECH, we found that a key barrier to getting nurses out to give care to babies within 48 hours of birth was not so much the lack of knowing that a baby had been born as the fact that the nurse often did not have the fuel required to ride his or her motorcycle to the woman's location. MOTECH also showed that getting people to come in for immunizations was relatively easy but having the immunizations stocked and properly refrigerated was not; many facilities lacked in fact lacked refrigerators and so did not have vaccinations in stock. Further, basic newborn procedures were required when a baby was seen at its first child welfare check. The mobile forms filled out by the nurses required certain information to be entered. However, upon observation, it became clear that sometimes the nurses had not been trained in the procedures or lacked the basic equipment required to conduct the check. In many cases, although the nurses had been trained on how to deliver postnatal care, they did not feel empowered to do so and felt that this should be the work of the more-qualified midwives. Owing to the severe shortage of midwives, this meant that many women and babies were not receiving postnatal care. The field presence, monitoring structures, and data real-time data visibility that MOTECH enabled meant that such deficiencies in the health delivery system were very quickly identified and escalated within Ghana Health Service for resolution.

3. **Position the mobile phone as a tool to support a functional clinical system:** The phone can only do so much. If adequate equipment and training are not in place, the mobile phone hits its limitations as a tool quickly. It is important to reinforce the need for strong clinical training and adequate supplies at the same time the mobile phone is introduced to remain practical about the potential impact of mobile phones in the health setting.

IMPLICATIONS FOR FUTURE WORK

1. **Couple mHealth interventions with assessments of clinical care**– When introducing a mHealth application, be sure that all of the appropriate clinical interventions (training, equipment) that relate to the clinical care that the mobile phone intervention is encouraging are already in place. This is an area which requires strong partnerships with organizations focused on clinical care improvements.

2. **Anticipate clinical implications** – Work with health officials to set the common understanding that gaps in the clinical system will likely be highlighted by a mHealth implementation. Develop agreements and processes early on that will proactively address the clinical issues in a constructive way, rather than wait for them to arise and potentially put the local health officials in an

embarrassing situation that may put them on the defensive and be less likely to cooperate and find solutions.

3. **Use data as a motivator, not a stick** – As data collected by the MOTECH service begins to highlight gaps in care and service, we believe it is important to position the mobile intervention as a positive tool that "helps to improve health care delivery" to fully incorporate mobile phones into the system, rather than using data as a punitive "stick" and casting the mobile phone tool in a negative light.

MOBILE MIDWIFE DEMAND

OVERVIEW

Although developed-world newsflashes tell us that the whole world is "wired" and that people in the farthest reaches globally are able to surf the 'net, the reality is that the poorest of the poor do not have access to even the most basic of health information. Even if there is Internet connectivity in a local village, the poorest are often able to speak only an indigenous language, not able to read at all, and have not been exposed to how to synthesize complex information.

Once people in our pilot area began to hear that free information was available to them about an important health topic, provided in their language and accessible on a mobile phone, we found there was high demand for the information – and it wasn't only pregnant women who wanted to sign up for the service. At community-entry celebrations we had young men asking if they could sign up. We had older women, traditional birth attendants, midwives, fathers and young women not yet pregnant wanting to sign up. It highlighted how limited information flow is for people who are not literate and do not have access to the Internet, and how important it is to present information that is localized, trustworthy, relevant and accessible.

LESSONS LEARNED

1. **Develop messages relevant to the decision makers around pregnant women** – Mothers-in-law, fathers, elder women and others in the community all are instrumental in making decisions about work allocation during pregnancy (e.g., carrying heavy loads of water or firewood), saving money for birth transport, allowing exclusive breastfeeding and other key decisions. We found that it was important to the care of the woman and baby that some messages be targeted to fathers and others, and to encourage women to share messages with family members.

2. **Localization is imperative**– One of the reasons the messages were relevant is because they were localized and included information on where to get local healthcare, what local foods to eat and information on local myths. Any content delivery must be localized or it becomes less relevant and therefore less likely to lead to behavior change.

IMPLICATIONS FOR FUTURE WORK

Opportunity for broadening content – There is a real opportunity to use the current MOTECH content base and localization process to develop content for a range of health issues. This may include family planning, birth control, puberty, sexuality and childhood healthcare.

ELEMENTS OF SUSTAINABILITY

OVERVIEW

Although a long-term sustainability model has yet to be developed, we have already begun to observe several factors that will be important to sustaining MOTECH over time.

1. **Cost of sending messages** – The people we are trying to target – the poorest – cannot afford even very small charges to receive messages. During the pilot phase, the cost of sending messages was covered by the project. However, at the end of the grant-funded project, it is unclear how the Mobile Midwife service will be able to continue without charging users. We are exploring a range of collaborative efforts to provide private sector support for the service.
2. **Integration into Ghana Health Service** – The project team has done a good job of working with Ghana Health Service staff, particularly at the local clinic and the national information system department levels. Ghana Health Service staff will ultimately have to take over maintenance of the MOTECH system for the project to be sustained beyond the life of the grant. It is not certain how any additional positions in GHS will be funded or if maintenance of MOTECH can occur as functions within currently funded positions.
3. **Cost of repairing and replacing handsets** – As noted earlier, a clear decision was made to distribute handsets to nurses for use with the mForms component. Low-end, less-expensive handsets were chosen in part to make it more likely that GHS would be able to cover the cost of expansion and/or replacement of the handsets over time.

IMPLICATIONS FOR FUTURE WORK

1. **A broader country strategy for mHealth will help with sustainability** – At the time MOTECH entered Ghana, there was no comprehensive government approach to mHealth. There were a few, disparate projects happening within the government and being rolled out by NGOs, but with little coordination between them and no connection to a broader, longer-term strategy. If the Ministry of Health and Ghana Health Service could develop a comprehensive strategy for how mHealth will be approached, it would facilitate NGOs and other stakeholders coming together to design programs that fit together. For example, the handsets provided for one mHealth project should provide other functionality the nurses will need, so they do not end up with a different handset for every mHealth project that comes along. Further, if the Ministry of Health and Ghana Health Service could facilitate an agreement between the major telecommunications providers in the

country to allocate some percentage of airtime for public health messaging, this could help ensure the financial sustainability of projects like MOTECH. However, this will no doubt take a comprehensive, coordinated effort between the government, NGOs and telecommunications providers to have a common goal and understand how a partnership between them could contribute significantly to the health of the people of Ghana.

2. **Understand the strategic objectives for technology in health** – When entering a new country or region, first find out what the strategic objectives are for the health system and whether information technology is part of the government's aspirations for achieving those goals. In that context, examine how mobile health applications can help achieve those goals. If there is not a strategy, discuss with local officials how MOTECH might be an impetus for developing a strategy, identify the various other systems MOTECH may interface or overlap with, and plan project goals accordingly.

CONCLUSION

MOTECH in Ghana has been and continues to be a project with great potential to make a difference in the lives of the poorest. While the first year was fraught with an array of unforeseen challenges, these all have the opportunity to be lessons for future projects. It is important to note that although MOTECH in Ghana is viewed as a "technology project," the vast majority of the lessons learned were around operational issues, cultural components and operating with partners to make the project successful. We will share additional information about the project, including the impact-assessment results, outcome of scaling to a second region and planning for national-scale distribution of the service, in subsequent updates to this document.

SMS/VOICE COST MODEL

Note: Excel Workbooks available for download – see website

COST MODEL

Data Type	per user / CHC per month	per user / CHC per year	All users / CHCs		
			per month	per year	pilot
Incoming SMS			**0.83**	**9.94**	**9.94**
Registration & opt out requests			0.83	9.94	9.94
Outgoing SMS			**460.95**	**5,531.41**	**8,267.00**
Reminders for patients	0.01	0.18	1.97	23.68	23.68
PP messages for patients	0.53	6.42	20.72	248.69	2,984.28
Reminders for nurses	2.70	32.45	37.86	454.31	454.31
Query responses for nurses	27.46	329.50	384.42	4,613.02	4,613.02
Decision making messages for nurses	1.14	13.69	15.98	191.71	191.71
GPRS (KB)		**7**	**8.16**	**97.91**	**97.91**
Patient Encounter Forms	0.46	5.53	6.46	77.48	77.48
Forms Error Exchanges	0.09	1.11	1.29	15.50	15.50
Nurse Queries	0.03	0.35	0.41	4.94	4.94
Voice: incoming & outgoing (minutes)			**3,052**	**36,623**	**36,623**
PP messages	0.70	8.36	2,912.75	34,952.96	34,952.96
Call center registrations			32.34	388.08	388.08
Nurses' Support	1.86	22.28	26.00	311.95	311.95
User Support		0.23	80.85	970.20	970.20
Voice Incoming (minutes)					*14,649*
Voice Outgoing (minutes)					*21,974*
TOTAL COST			**3,522**	**42,262**	**44,998**

Assumptions

		GHS	USD
Average Cost of SMS	Incoming	0.042	0.03
	Outgoing	0.042	0.03

Average Cost of GPRS	per MB	0.16	0.11
Average Cost of Voice	per minute	0.11	0.08

DATA USAGE MODEL

Data Type	per user / CHC per month	per user / CHC per year	All users / CHCs		
			per month	per year	pilot
Incoming SMS			**28**	**334**	**334**
Registration & opt out requests			28	334	334
Outgoing SMS			**15,511**	**186,137**	**278,192**
Reminders for patients	1	6	66	797	797
PP messages for patients	18	216	697	8,369	100,423
Reminders for nurses	91	1,092	1,274	15,288	15,288
Query responses for nurses	924	11,088	12,936	155,232	155,232
Decision making messages for nurses	38	461	538	6,451	6,451
GPRS (MB)			**71.5**	**858.0**	**858.0**
Patient Encounter Forms	4.041	48.492	56.574	678.894	678.894
Forms Error Exchanges	0.808	9.698	11.315	135.779	135.779
Nurse Queries	0.258	3.094	3.609	43.313	43.313
Voice: incoming & outgoing (minutes)			**39,446**	**473,354**	**473,354**
PP messages	9	108	37,647	451,767	451,767
Call center registrations			418	5,016	5,016
Nurses' Support	24	288	336	4,032	4,032
User Support		3	1,045	12,540	12,540
Voice Incoming (minutes)					*189,342*
Voice Outgoing (minutes)					*284,013*

Assumptions

Population (KND/W)	Total population (2004 DSS)	144184
	Total deliveries per year	4000
	Total number women pregnant in a year	6021
	Phone ownership (i.e. pushed PP calls)	40%
Catchment (treatment	Total population	72092

zones)		
	Total deliveries per year	2000
	Total number women pregnant in a year	3011
	CHCs	14
Pilot	Months	12

NURSES' PHONE SURVEY

A survey of nurses' phones was conducted to ascertain the proportion of those with Java-enabled phones. This information informs us about the feasibility of nurses being able to use a Java application on their phones. Data regarding telecommunications operator use is also informative as a proxy indicator for network reliability in the area, pricing and popularity. Information regarding handset manufacturer shows us something about which handsets nurses might easily and quickly adapt to, if new phones are introduced to them.

Main findings:
- **89% of nurses have MTN lines**
- **60% of nurses have Nokia phones**
- **20% of nurses have Java-enabled phones**

Full Report

Sample

95 nurses in KND and KNDW

Results
Java

For 76 of the nurses surveyed we were able to ascertain if their phone is Java-enabled. Of those 76, 20% have Java-enabled phones, 80% do not.

Lines
89%: MTN
7%: Vodafone
1%: Tigo
1%: Stolen
1%: No phone
Make
For 85 of the nurses surveyed we were able to ascertain phone make and model. 60% of the sample had Nokia phones, making it the most popular by far. The Vodafone promotion phone was the second most-common make (11%). Breakdown of nurses phones by make are as follows:

Make	%
Nokia	60
Multimex (Vodafone promo)	11
Motorola	6
Acatel	4
Sony Ericsson	4
NEC	2
Other (mixed)	12

SELECTING HANDSETS FOR CHPS WORKERS (SMS VS JAVA)

EXECUTIVE SUMMARY

Investigation and field testing of mobile data transfer mechanisms for CHPS workers involved with the Mobile Technology for Community Health (MOTECH) pilot has revealed two intertwined factors for consideration:

Handset: Should MOTECH use the nurses' own phones or Java-enabled dedicated MOTECH phones?

Data transmission method: Should MOTECH send data using SMS or GPRS?

This paper outlines the main issues influencing these factors, and concludes that using Java forms on GPRS-enabled dedicated MOTECH handsets is favorable for the following reasons:
6. **Cost:** GPRS data transmission reduces the total cost of ownership (TCO)
7. **Operations:** Supporting a dedicated MOTECH phone streamlines operations
8. **Functionality:** Java-enabled phones provide increased functionality
9. **Usability:** Java forms are more user-friendly
10. **Data Quality:** Java forms are likely to yield more accurate data

EVALUATION

Cost: GPRS data transmission reduces the total cost of ownership (TCO)

Ninety-nine percent of CHPS nurses in the MOTECH pilot area own a mobile phone. More than 80% of these are basic phones with simple SMS functionality[2]. On the surface, it seems possible to leverage nurses' own phones for mobile data transfer, employing simple structured SMS messages for data entry and submission. However, investing in slightly higher-end phones that can transfer information using GPRS actually reduces the total cost of ownership of MOTECH, since GPRS data transfer is many times cheaper than SMS. A MOTECH form that requires 1-2 SMS messages can be transferred in less than 1KB of data,

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[2] Based on a survey of 95 CHPS workers in KND and KNDW in October 2009

resulting in savings of approximately $11 per CHPS facility per month[3]. The cost of the dedicated GPRS phone is offset by the savings in data expenditures in just more than 5 months, making the financial sustainability of the project more feasible. Determining a funding source to cover the upfront cost of the phones will require further exploration. A possibility includes adding phones to the required CHPS inventory provided by GHS through tapering donor support and/or partnership with telecommunications companies (telcos) or handset manufacturers.

It is possible that SMS can become an equally low-cost option by negotiating reduced or free SMS prices from a telecommunications operator. However, supporting MOTECH at a single CHPS facility for one year requires a total of approximately 4,500 SMS messages; because SMS is a highly profitable revenue stream for carriers, it seems unlikely that a telecommunications operator would agree to support such a high-volume nationwide program. Furthermore, it is unlikely that such an arrangement would be long-term. Based on these factors, it appears that providing nurses with GPRS-enabled phones is a more sustainable, scalable and replicable option, as it can be run at low cost without the need for a carrier relationship.

Operations: Supporting a dedicated MOTECH phone streamlines operations

For MOTECH, the constant and reliable existence of a functioning phone at the facility is critical. It is unrealistic to expect that nurses' own phones will be available at the facility at all times, for the following reasons:

- **Mobile phone ownership and use is very fluid in Ghana**: Phones are habitually lent and borrowed. If the nurse lends his/her phone to someone, or if a nurse is away from the clinic on personal business, the facility would be left without a phone. Because a dedicated MOTECH phone would exist in addition to the nurses' personal phone, it should never leave the confines of the CHPS zone and the reach of nurses.

- **Older handsets have reduced battery life**: nurses' phones are often charged using poor power sources, which cause the batteries to wear out prematurely. Therefore, it is unlikely that the nurses' own phones will reliably function for a whole day's work every day. This is not only problematic for MOTECH but also inconvenient for the nurse, because of the frequency with which s/he needs to recharge the phone will increase because of MOTECH. The burden of this is not insignificant considering that, for some, power sources are distant. MOTECH could provide charging solutions (which will likely be necessary even for dedicated MOTECH phones) but finding a solution that is compatible with the wide variety of handsets that the nurses have is challenging. Dedicated handsets eliminate the power drain on nurses' phones and make a standardized charging solution possible.

It is also challenging for nurses to interact with MOTECH using their own phones because:

- **Nurses' own phones are often old**: damaged screens and keypads make it difficult to enter data accurately. Older and low-cost handsets, which are common among the nurses, have unwieldy user

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[3] An SMS on MTN, Ghana's leading mobile carrier, costs 0.045 GHS per message. 1 KB of GPRS data costs 0.000195 per KB. On average, CHPS compounds in the KND district send 360 messages per month, based on 2009 DHIMS reports.

interfaces, reducing usability. Sometimes these handsets also have limited SMS formatting capabilities, limiting the options for creating templates that can ease data entry.

- **Training and troubleshooting is more challenging:** Using the nurses' own phones precludes handset standardization. Teaching users how to write, edit, forward and save messages to drafts on many different handsets is cumbersome and would require multiple different explanations in user manuals. Remote assistance becomes more complex as support operators would require familiarity with various SMS interfaces. These factors increase the time and cost of program support. Providing dedicated MOTECH phones enables streamlining of operational processes.

Functionality: Java-enabled phones provide increased functionality

Using Java-enabled handsets, even low-end ones, unlocks applications and features not possible on simple phones that only allow SMS.

Firstly, Java-enabled handsets are more suited to poor network areas than SMS, because forms can easily be saved on the phone and uploaded when connectivity is restored[4].

Secondly, security features such as user authentication schemes can be built into Java forms, but are not possible with SMS. This is an important aspect of a system that is transferring sensitive patient information. In some scenarios MOTECH may require nurses to save patient information on their phone (e.g., saving a message that needs to be sent later if the network is down). Because an SMS-based system does not enable user authentication, this data could be seen by anyone with access to the nurse's phone. Furthermore, anyone with access to the phone could send queries to MOTECH to find out patient information. These factors compromise the confidentiality of patient data. Cultural taboos, which cause many women in Ghana to conceal their pregnancies, and the sensitive nature of ANC data, including HIV status, highlight the need for adequate security.

Finally, leveraging Java-enabled phones from the outset of the program better facilitates the development of more sophisticated applications, without the need to re-train users, re-distribute hardware and softcopy documentation, or change platforms. Therefore, Java-enabled phones provide a stronger foundation for developing applications in the future, which can further promote effective service delivery.

Usability: Java forms are more user-friendly

Field testing an SMS application for MOTECH revealed that approximately 25% of nurses had never used SMS[5]. Training nurses to write, save, edit and send messages is time-consuming. Even for those nurses who are familiar with SMS, managing structured data entry via SMS proved cumbersome and error-prone, particularly on older and low-budget handsets. In field testing, nurses with all levels of SMS aptitude could more easily enter accurate data using Java forms, and with less training. Ease of use is an important factor

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[4] Because using Java-enabled handsets requires providing nurses with dedicated phones, MOTECH can choose a network provider with expansive GPRS coverage.

[5] Based on findings from Simplified Register Mobile Data Entry Workshops in Navrongo, December 2009.

when attempting to integrate the mobile application into the nurses' existing workflow in a manner that does not increase their administrative burden. A cumbersome system risks diverting the nurses' attention from the patient, prolonging consultation times. Nurses who used both SMS applications and Java forms reported preference for Java forms, noting speed and ease of use. Developing a system that is liked by users is critical to its widespread adoption.

Data Quality: Java Forms are likely to yield more accurate data

Because Java forms enable menu selection and real-time error checking, they more effectively minimize data entry errors. Data accuracy for SMS could be improved with more training and error messages. However, increased training and resubmitting messages incurs higher costs. Because accurate data is an essential component of effective healthcare, it is important to select a solution that maximizes data quality.

CONCLUSION

Considering all of these factors, providing nurses with dedicated Java-enabled handsets and using GPRS transmission is more likely to result in an effective, scalable mHealth solution that will improve health outcomes in Ghana and beyond.

Summary Table

Factor	Nurse's Own Phones with SMS	Dedicated Java Phones with GPRS
Cost		
	- Lower startup costs - Higher operational expenses due to high SMS costs	- Higher startup costs - Lower operational expenses due to low GPRS costs - Lower total cost of ownership (payback period ~5 months)

Factor	Nurse's Own Phones with SMS	Dedicated Java Phones with GPRS
Operations		

	▪ Phone is not always reliably available in clinic
	  - Nurse lends phone
	  - Nurse away from clinic
	  - Poor battery quality
	
	▪ Poor usability:
	  - Old handsets are not user-friendly
	  - Multiple handset types prevent operational standardization
		▪ Phones remain at clinic
		▪ User friendly handsets selected
		▪ Standardized operations

Functionality		
Handling Poor Network Quality	▪ Not suited to poor network environments	▪ Stores data for later uploads when network connectivity is restored
Security	▪ Does not allow for password protection ▪ Shared phone	▪ Password protection ▪ Dedicated phone
Extensibility	▪ Limited applications possible	▪ Sophisticated applications possible
Usability		
	▪ Cumbersome ▪ Adds administrative burden ▪ Longer consultation times	▪ Quick and easy to use ▪ Preferred by nurses
Data Quality		
	▪ Greater likelihood of data entry errors	▪ Data entry errors reduced

OVERVIEW

The mForms MOTECH application runs on a Java-enabled handset. In view of this, a low-end Java-enabled handset from a good brand is required. Nokia was identified as a renowned brand that can serve the purpose.

Other requirements were:

- MIDP 2.0 or higher
- GPRS connectivity
- Long battery life
- High durability
- High usability
- Low cost

PHONES IDENTIFIED

The following phones were identified as meeting the above requirements:

a. Nokia 1680
b. Nokia 2330
c. Nokia 2220
d. Nokia 2680

Model	Java	GPRS	Battery life	Durability	Usability	Price GHS
Nokia 1680	MIDP 2.1	Yes	SB – 424h TT – 7h 40mins	Subject to testing	Difficult to press keys	60
Nokia 2330	MIDP 2.1 MForms app not working, testing needed	Yes	SB – 528h TT – 4h	Subject to testing	Subject to testing	80
Nokia 2220	MIDP 2.1	Yes	SB – 480h	Slider prone to breaking	Subject to testing	80

			TT – 5h 20mins			
Nokia 2680	MIDP 2.0 MForms app not working, testing needed	Yes	SB – 400h TT – 3h 30mins	Subject to testing	Subject to testing	100

DECISION

The Nokia 1680 seemed the most suitable from the above research.

Cons of Nokia 1680 as compared to the other models:

- Nokia 1680 is in a ramp-down phase so supply may become difficult.
- The keyboard is difficult to press.
- It is a bit sluggish.

Pros of Nokia 1680 as compared to the other models

- Cheapest Java-enabled phone that could be found readily available. This is important for the scalability of MOTECH.
- Good battery life. Models such as the 2330 have almost half of the battery life of the 1680.
- More durable. The slider used for the 2220 makes it a less durable option. Durability is an important consideration as the phones will be used every day in dusty conditions.

Handset model changes post-launch

Recommended alternatives that meet MOTECH requirements are the Nokia 2220, Nokia 2330, Nokia 2680 and Nokia 2690 (a new model). The mForms application is currently not working on the Nokia 2330 and Nokia 2220 when tested. Developers can work on this in the future, at which point using those models could be a possibility. A test was not run on Nokia 2680.

The first MOTECH implementation in Upper East Region in June 2010 was a pilot. This phase was used to monitor the performance of the selected handset. Important issues were flagged and recommendations made for future handset selections.

GHS HANDSET AGREEMENT

Handsets should be collected & signed for by facility in-charges.

About You		About the Phone	
Name		**Make**	
		Model	
Designation		**IMEI Number**	
Division		**MOTECH Number**	
Facility		**SIM Serial Number**	
Date		**Phone Number**	
Contact Tel Number		**Accessories provided with phone (circle all that apply)**	mains charger solar panel protective case spare battery other, specify _____

I declare that I have received the above handset and accessories from the Ghana Health Service for the execution of my official duties. In receiving this equipment, and by signing this document, I agree to the following:

1. **Ownership**
   1.1 The mobile phone will be used for official duties and it will remain the property of the Ghana Health Service.
   1.2 I understand that the mobile phone and all the items supplied with it are the property of Ghana Health Service and are not to be sold or given away. All items must be returned when requested.

2. **Use**
   2.1 The mobile phone will be used only by me and other Ghana Health Service staff in the course of official duties.
   2.2 In the event of my absence on leave or for any other reason the phone will be entrusted to another member of staff at my facility, so that they can continue to use it for their work.
   2.3 The mobile phone will not be used while driving or riding any vehicle.
   2.4 I will endeavor to protect misuse of the phone by activating lock codes, as described in the handset manual.

3. **Maintenance**
   3.1 The mobile phone and accessories will only be maintained by approved Ghana Health Service staff.

4. **Loss and Theft**
   4.1 I will report loss or theft of the phone or accessories *immediately* to my sub district and/or DHMT supervisor and an incident assessment form will be completed.
   4.2 I understand that colleagues at my facility and I will be charged with replacement of the mobile phone and/or accessories if any one of us is found to have negligently contributed to its loss or theft. Rate of payment will be as follows:
      - 75% to be paid by nurse possessing phone when lost or stolen due to negligence
      - 25% to be paid by other Ghana Health Service staff based at my facility

      Investigation of negligence and determination of methods of repayment are at the discretion of my supervisor.
   4.3 I understand that there will be no punitive measures carried out for loss or theft of the phone or accessories occurring without negligence, except for cases in which more than one handset or accessory under my care has been lost or stolen within any one year period (see clause 4.4).
   4.4 If more than one handset or accessory within my care has been lost or stolen within any one-year period, even when negligence cannot be proven, Ghana Health Service reserves the right to charge the me for a percentage of the full replacement cost, at the discretion of the my immediate supervisor.

5. **Damage**

5.1 I will report damage of the phone or accessories *immediately* to my sub district and/or DHMT supervisor and an incident assessment form will be completed.

5.2 The district will be responsible for handling repairs and I will not attempt to have the phone repaired by anyone except approved Ghana Health Service personnel.

5.3 I understand that if the phone or any accessories are broken beyond repair through negligence, the nurse in possession of the equipment at that time will be liable to pay 25% of the cost of replacement. Investigation of negligence and determination of methods of repayment are at the discretion of my supervisor.

5.4 I understand that there will be no punitive measures carried out for damage to the phone or accessories that occurs through normal wear and tear or without negligence, except for cases in which more than one handset or accessory under my care has been lost or stolen within any one year period (see clause 5.5).

5.5 If more than one handset or accessory within my care has been damaged beyond repair within any one-year period, even when negligence cannot be proven, Ghana Health Service reserves the right to charge the me for a percentage of the full replacement cost, at the discretion of my immediate supervisor.

Signed: _____   Signed: _____

Name: _____   Name of GHS Officer:
_____

Date: _____   Date:
_____

PREGNANT PARENTS APPLICATION RAPID PROTOTYPING

Bongo District, October 2009

Aims

The exercise aimed to test a rough prototype of the pregnant parents' application by setting up a hotline to collect and answer more than 200 pregnancy- and newborn-related queries in three days, to:

1. Test user willingness to receive maternal and child health information through a mobile phone
2. Assess the preferred mode for receiving this information (calls versus SMS)
3. Understand more about potential user profiles and demographics
4. Get indications of user language preferences
5. Get a deeper understanding of information demands and knowledge gaps
6. Understand more about operational challenges to delivering a mobile-based information service in rural Ghana

Method

A basic hotline was set up, with qualified health professionals manning lines between 9 a.m. and 5 p.m. on the days of field testing. Three field teams went out on each day to broadcast awareness of the service, assess user satisfaction and profile potential users. Field teams were made up of MOTECH field staff, GHS stakeholders and Community Health Volunteers from the communities visited. See Appendix I for fliers used and Appendix II for field-data collection forms. Random sampling was employed; the gender of those approached was approximately equal. Services were offered at no cost to users, either using their own phones or those provided by us.

Findings

1. Test user willingness to receive maternal and child health information through a mobile phone

236 queries from more than 220 participants were received in three days. The demand for information and level of interest in the service was far greater than expected and over-stretched the capacity of the three operators to answer calls quickly enough. Participants wrote down the hotline number and tried to call through the night, although opening hours were clearly communicated. Some participants were willing to spend their own units on making calls to the hotline. Because news of the hotline spread, calls were received from communities outside of the prototyping area. On the whole, participants were delighted to receive this information and seemed comfortable obtaining it through a mobile phone.

In conclusion, there seemed to be a great demand for maternal and child health information and participants seemed very comfortable receiving this information via a mobile phone.

2. Assess preferred mode for receiving this information (calls versus SMS)

216 queries were received through voice calls. A single query was received through SMS. 19 callers were not able to access the service because of poor telephone network coverage.

In conclusion, it seemed that participants favored receiving information through a live operator. Further testing is required to assess user comfort with an audio recording, and their level of interest in the service and understanding of the information if delivered through SMS, in the absence of a voice offering.

### 3. Understand more about potential user profiles and demographics

More women than men used the service.
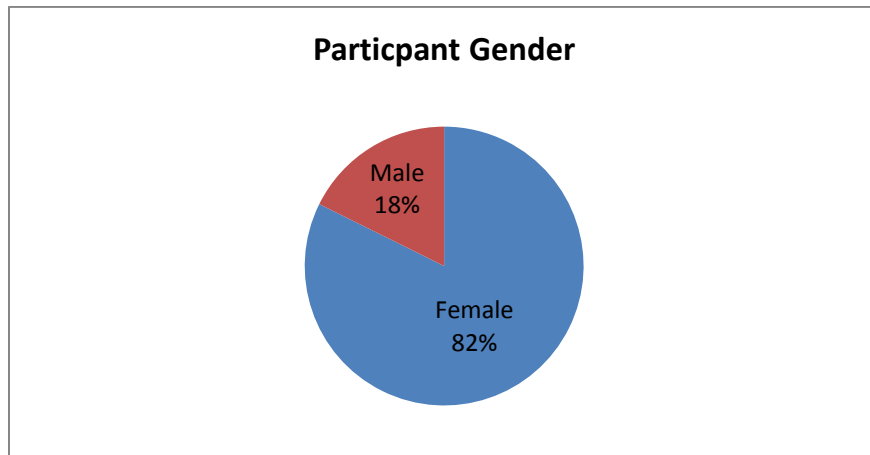
Most users of the service were aged 18 to 30, and 30 to 40. The gender split was more even in the 30 to 40 age group. Note that this may not solely reflect the age ranges of people interested in these health issues or a phone-based information service, but rather may be a reflection of the demographics of the people who were available to take part.
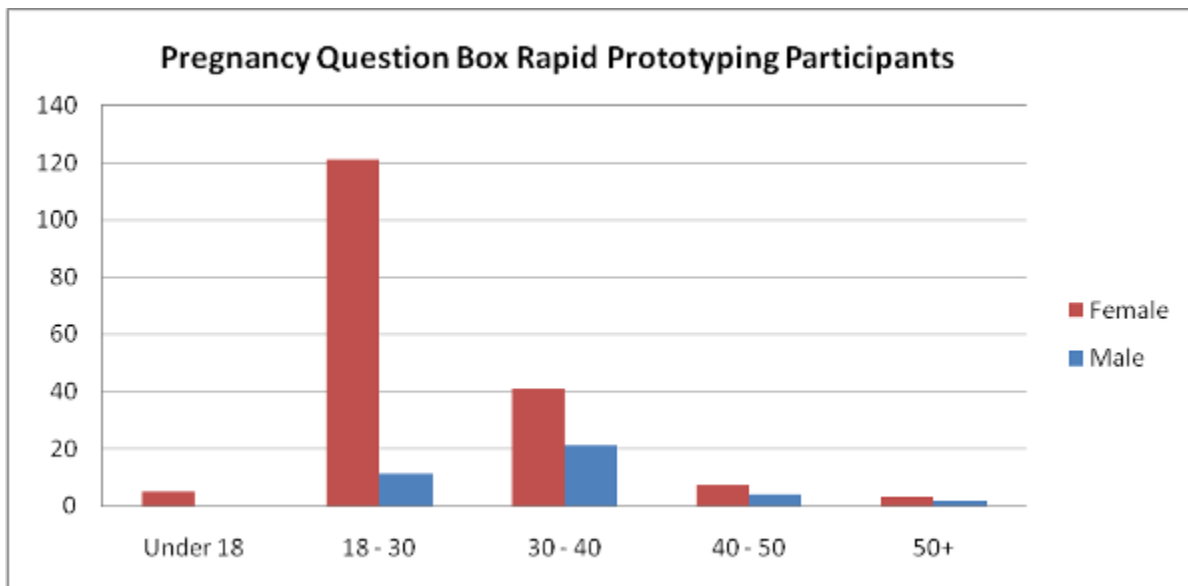
A bit more than 50% of the participants own a mobile phone. Of those who have their own phones, almost all of them have MTN SIMs.
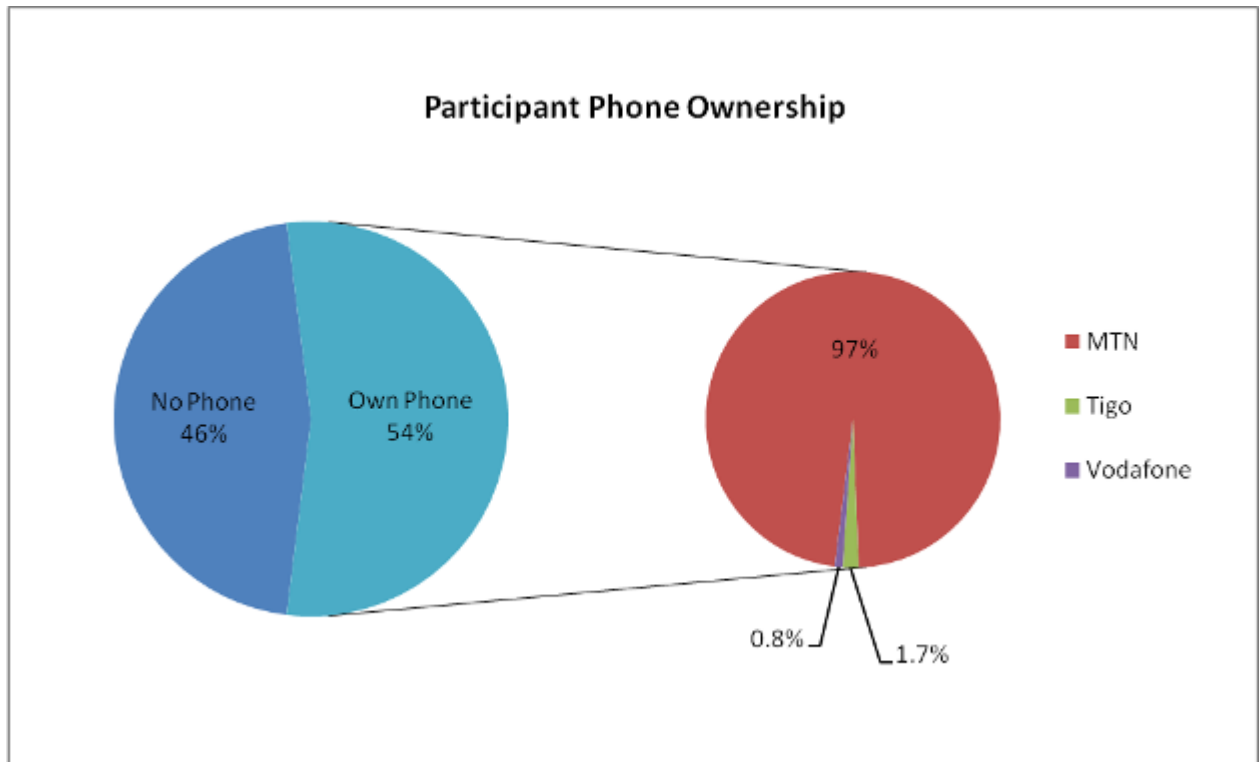
The service appealed to more women than men, although the level of male interest was higher than anticipated. The age groups 18 to 30 and 30 to 40 (i.e., those of reproductive age) were most interested in the service, with the younger group showing more interest. Approximately half of our target population in this area owns a phone. Of those who have their own phones, MTN was almost exclusively the most popular network provider.

4. Get indications of user language preferences

Almost all queries were received in the local language prevalent in Bongo District (Gruni), with just seven queries received in a different language (English). Field teams reported that very few participants were able to understand English.
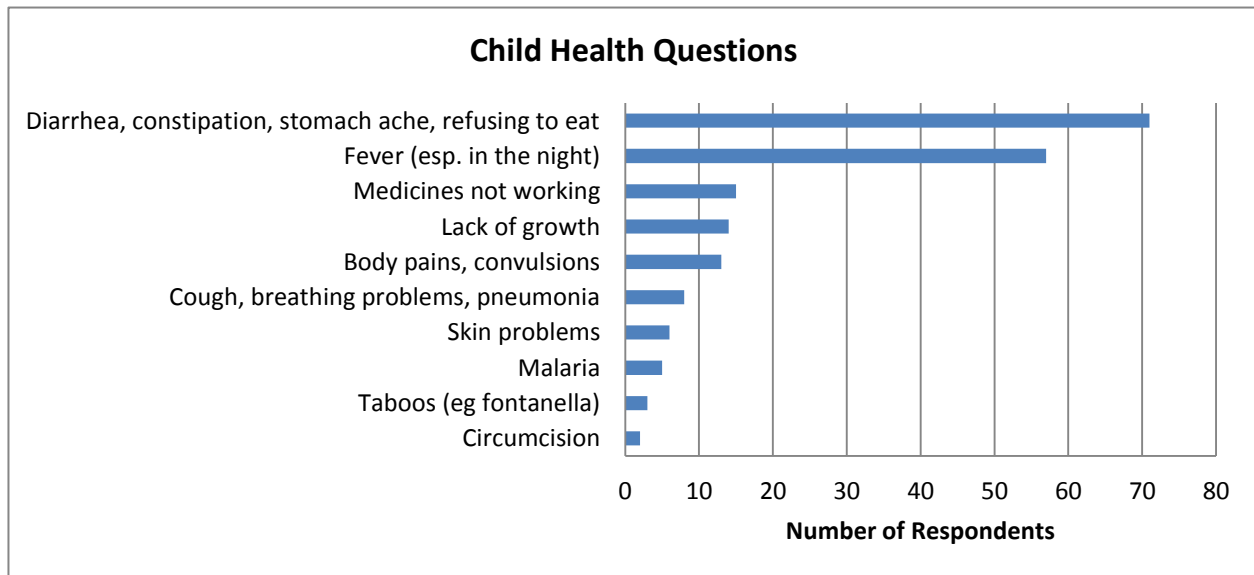
Users overwhelmingly opt to receive information in their local languages.

5. Get a deeper understanding of information demands and knowledge gaps
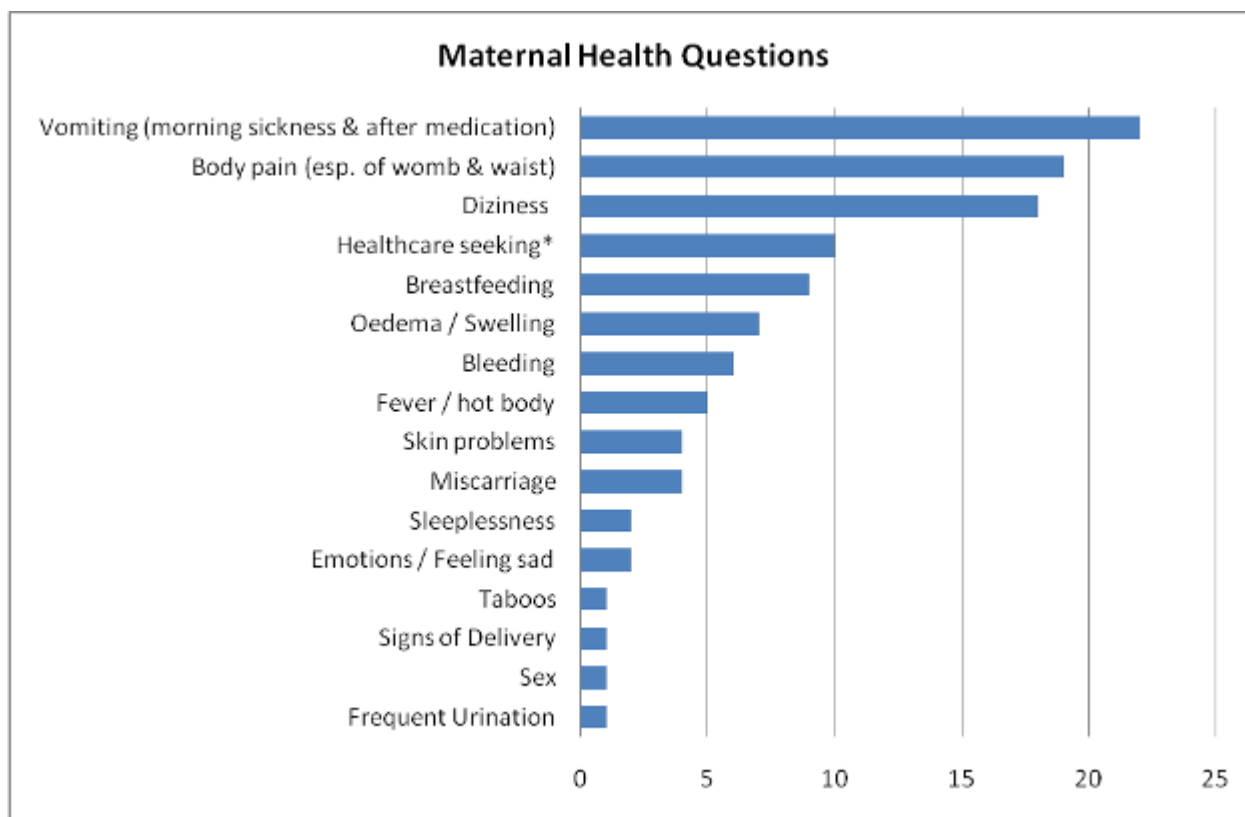
Participants asked more questions related to child health than maternal health. Note that this may be because of the more private nature of some pregnancy-related questions as compared with child health issues.

Pregnancy Question Box: Questions Asked - Maternal or Child Health

Maternal Health 38%
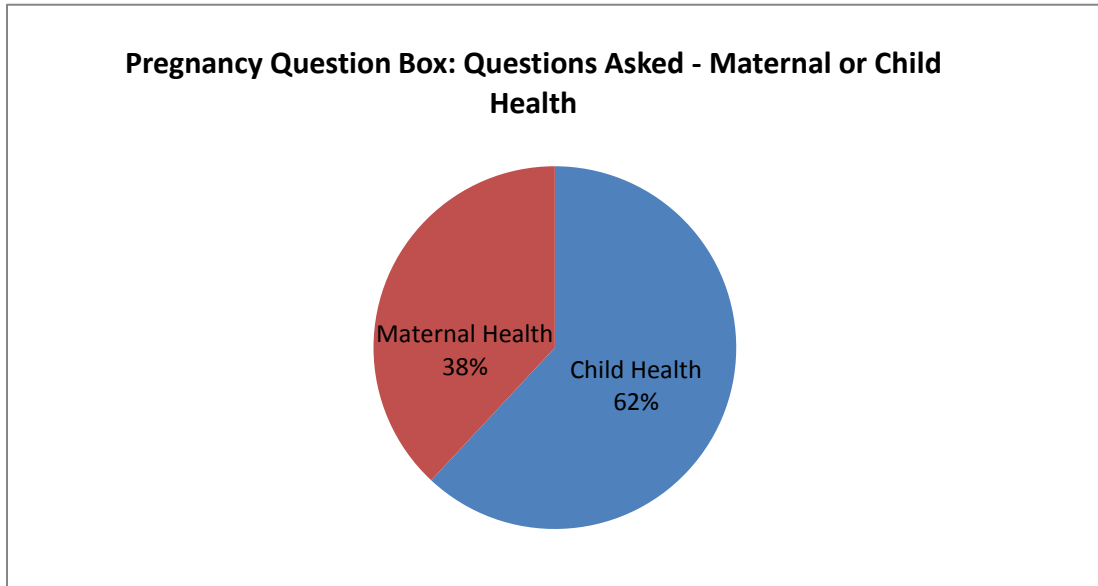
Child Health 62%

Child health-related questions fell into the following categories, with diarrhea and fever being by far the most common areas.

Child Health Questions

Category	Number of Respondents
Diarrhea, constipation, stomach ache, refusing to eat	71
Fever (esp. in the night)	57
Medicines not working	15
Lack of growth	14
Body pains, convulsions	13
Cough, breathing problems, pneumonia	8
Skin problems	6
Malaria	5
Taboos (eg fontanella)	3
Circumcision	2

Number of Respondents

Maternal health questions fell into the following categories:

Maternal Health Questions

*ANC / reasons for medications and vaccinations / deciding where to deliver

Some feedback from participants who used the helpline included the following:

- People wanted referrals to specific places, not just "your nearest facility."
- Users wanted to be advised about specific questions they should ask their CHPS worker, what information they should provide to the doctor and how to engage with the health facility in general.
- Users liked actionable information, as well as explanations of why certain problems occur.
- It was interesting to receive questions about NHIS, the role of ANC and other issues related to health-seeking practices in general, in addition to those about health complaints.

6. **Understand more about operational challenges to delivering a mobile-based information service in rural Ghana**

Teams had the following takeaways:

- Many calls were dropped mid-conversation (implications - need to enable caller to dial back in).

- Some calls were bumped to Burkina base stations so that calls either didn't go through or were subject to international dialing rates.
- People liked cartoon style of images in flyers, but thought that one of the women was a man, and did not like that a man was holding a baby – thought it should be woman holding a baby and man supporting her.
- Roads were challenging, with some passable only by bike.
- Distances to nearest CHPS facility are long for some communities.
- Few people able to speak English; strong preference for local languages.
- Huge demand for this information.
- Some people who were not currently pregnant or with children wanted information about these issues anyway – implications for our service as need to make it available to those who are not pregnant.
- Phone networks and roads were terrible after rain.

PREGNANT WOMEN'S DIARIES

To better understand the issues and questions faced by pregnant women in rural Ghana, we asked 10 women to keep diaries for a month (December 2009). The diaries by women for December had questions ranging from child health and pregnancy to general health of the mother and father. The men wanted to know more about general health problems. Some of these questions were not answered immediately, but will be answered in the next visit, for diaries kept for January 2010. One question that came up from all women keeping diaries was how long they still had to keep these diaries; the questions they asked were reducing by the day. Below are the various questions and concerns from women and men for the month of December.

A. **Faustina**

1. Why is it that a pregnant woman will vomit seriously in the labor ward even though she did not vomit during pregnancy?
2. Sometimes after delivery, some babies vomit the same as the mother did

B. **Doris**
1. Why is it that when you are pregnant, you are not allowed to lie on your back?
2. When a baby gets to eight months, you are not allowed to give him or her T.Z because they say it will make him or her not able to walk

C. **Abena**
1. Why is it that during the month of December, there is always a lot of wind and dust all over the place?
2. Why is it that there is a lot of cold during this period?
3. I have noticed that during the months of December to April, a lot of people get disease like CSM, T.B. and whooping cough and people end up losing their lives. Why is it so?

D. Hellen
1. What is the new flu, what are the signs and how can one protect him/herself from getting it?
2. What can I do so other people don't get it?
3. In our local communities, people say it not advisable for a pregnant woman to eat fresh meat for the child will grow fat and will have to be operated upon during labor. Is this true or not in your own view, and is it good for the pregnant woman to eat fresh meat and why?
4. What is night blindness and what can one do so that I don't get it?

E. Mavis
1. Why would a pregnant woman have swollen face and legs?
2. Why is it that when a woman is pregnant, she experiences severe abdominal pains?
3. My child had convulsion when I gave birth. Why is it so?
4. My baby had sores in the tongue and mouth, but the drug given at the clinic did not work and I had to use local treatment (i.e., burn Neri, grind it apply it on the sores).

F. Ruby
1. What causes high fever? Is it a lot of thinking?

G. Monica
1. There is a pregnant woman in my community who complains of joint pains and swollen legs. What is the cause of those pains?
2. There is a nursing mother here who complains of her baby having hot body, malaria and stomach pains. Can you tell me the cause?

H. Songoti
1. What causes elephantiasis?
2. Has catarrh got a treatment?
3. What causes high blood pressure?
4. What are some of the food for one who has low sperm count?
5. Is it true that a man can have intercourse with an HIV woman without getting the disease?
6. People like taking paracetamol if they are to drink a lot of alcoholic drinks so as to reduce the effect of the alcohol. Is it right? What advice can you give?
7. People say that there are no drugs for the treatment of jaundice. Is that true?
8. How long does it take to show that one has HIV even if the person did not go for testing? I mean what are the sign and symptoms of it?

I. Oliver
1. Why do children usually have convulsion and the locals give marks on the baby's body and face to stop it?

2. Why is it that when a child gets convulsion, a woman or the baby's mother is not allowed to handle or hold the child?

PREGNANCY MYTHS

Our interviews with women in the Upper East Region revealed a number of myths about pregnancy:

- Swollen feet during pregnancy means the baby is a boy.
- Long or complicated labor means the woman has been cheating on her husband.
- First milk after birth is dirty.
- Eating eggs or meat during pregnancy will make the child a thief (as they will get a taste for eggs and meat, both of which are expensive, and be forced to steal for them).
- Eating certain foods (proteins mostly) makes the child very big and difficult to deliver.
- Evil people can cast spells on your pregnancy, causing you to lose it (the evil eye). This causes many women to hide their pregnancy for as long as they can, which delays them going for ANC.
- Having sex during baby causes a skin infection in the newborn. (The myth is that it causes white flaking of the skin, a damage caused by semen).
- Eating eggs during pregnancy may cause a baby's skull to be too soft, which will cause headaches in the future.
- Eating too many apples during pregnancy will cause the baby to grow too fat for birth.
- Having intercourse during pregnancy may cause blindness; it is believed that semen will be deposited on the fetus' eyes and cause blindness.
- Women use vaginal and anal herb enemas to "clean" the passages, to prevent the "dirt" in them from damaging the baby.
- At birth, hot compresses may be applied to a baby's skull to deliberately mold the baby's skull to give them a "special" shape.
- At birth, hot compresses and herbal concoctions may be placed on a baby's skull to close the fontanel; it is believed that the open fontanel is caused by sickness.
- Female babies are douched with warm water, sometimes hot water, because it is believed that the vulva is sore after birth.
- Because women do not know how to properly position and attach babies on the breast, infants often suffer from marasmus, or starvation; women believe that this condition is a spiritual affliction given to the baby while in utero.
- Many women, even those who intend to breastfeed exclusively, believe that when a baby hiccups he or she needs water to stop the hiccups.
- During labor, when a mother's body is massaged, the blood vessels in the baby's eyes may rupture, causing blood to collect in his or her eyes.
- It is believed that at eight months the fetus dissolves into blood. At nine months the fetus reforms before birth. Therefore, some women believe that it is safe to have an abortion at eight months. This practice often results in death.
- Women have expressed the belief that when they vomit during labor that they are vomiting amniotic fluid.

- Many women insert herbs into the vagina to deliberately dry the natural vaginal secretions with the view that men will enjoy intercourse more; this practice increases the risk of lacerations and therefore transmission of HIV.
- Some women have expressed the belief that when they use an IUD for family planning, the device may travel to your heart and cause heart problems.
- Women often believe that the symptoms of menopause are caused by a spiritual curse.
- Some HIV-infected men will seek out sexual relations with virgins; it is believed that HIV can be cured through intercourse with a virgin.
- Men often believe that the gender of their baby is determined by the mother, which causes conflict when his desires are not met.
- Some women believe that their fertile vaginal mucous secretions, which appear during ovulation, are a sign of infection and therefore make a conscious effort to wash and dry away the secretions. This results in some women finding it difficult to conceive.

MARKETING CAMPAIGN TESTING

Field photographic and cartoon approach testing

Overview

We tested both approaches with 11 women and 9 men at Wagliga CHPS compound and Chaina health center. These were divided in two separate groups, to enable both genders share their views more comfortably. In general, men seemed to interpret the pictures more accurately as opposed to the women. Men also seemed more literate and could read a few words, unlike their female counterparts.

Cartoon vs. Photos

Photos were preferred to the cartoons and were interpreted more accurately. Photograph (d) below, "Helping baby grow," was preferred by both genders. Women liked it because they admired the healthy, smiling babies, while men said they liked it because they learned from the picture what they need to provide for their own babies. Men also mentioned that the children in the picture are well taken care of by their parents, from the way they look. Women wanted their children to be like them.

Most disliked by the women was the 080 020 6001 picture, because they were seeing people making their own phone calls (in an environment where many people need to borrow a mobile phone or ask someone to make the call for them). Men disliked the 6001 picture most because to them all the people in it looked sick!

Documented below are responses got to each picture. Male responses are in italics.

Cartoon approach

080 020 6001
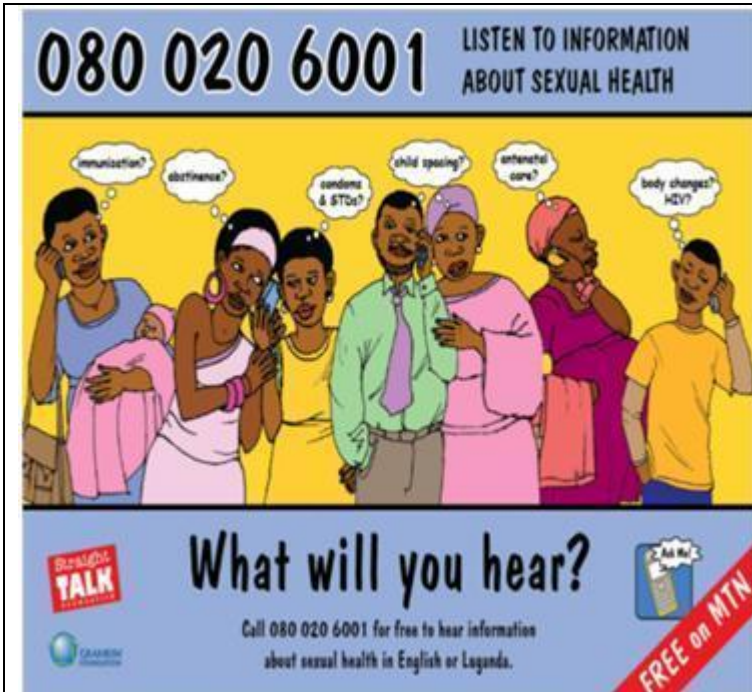
	• Not Ghanaians, according to the dress code • See people holding their phones • Don't know why they are calling and who it is • They see a number to call in case of an emergency (e.g., fire, ambulance) - *A boy standing holding his ears* - *People are standing in a queue* - *Pregnant woman making a call* - *A woman is sneaking into a man's phone call* - *There are 2 young unmarried ladies*

6001
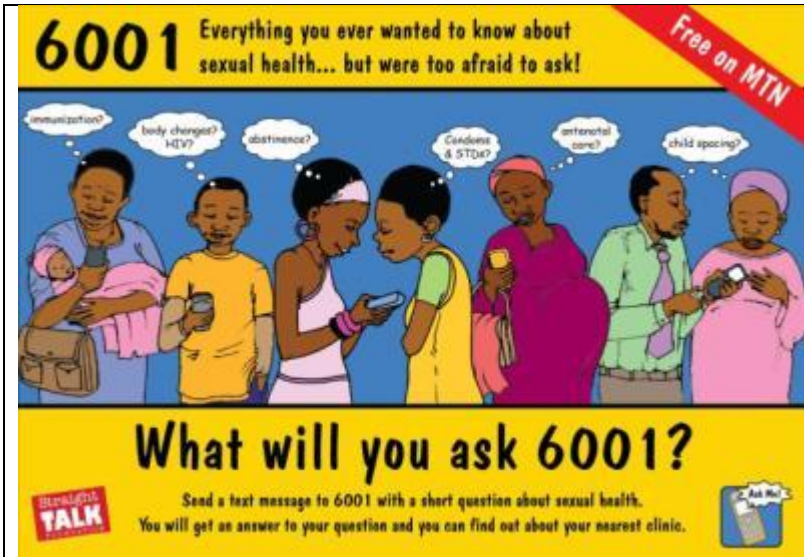
|	
	• They see a pregnant woman, a doctor, two friends and a mother • These are people at an outreach • Didn't seem to understand that people are using their phones to send text messages • Mother talking to her baby • Mother going for ANC • Mother calling for help because she is labor - *They are reading a text message* - *They look like modern Ghanaians* - *One of the girls feels shy to say something they want to say*

Hotline

	• Breastfeeding woman and mother trying to make a phone call • "Here most women don't have phones," said one of the women • Calling someone but they are not sure who; it could be a doctor or a nurse - *Pregnant woman is in labor* - *Mother with child is taking her child for immunization* - *"Maybe they are calling their husbands"*

Photographic approach

• **Breast milk**
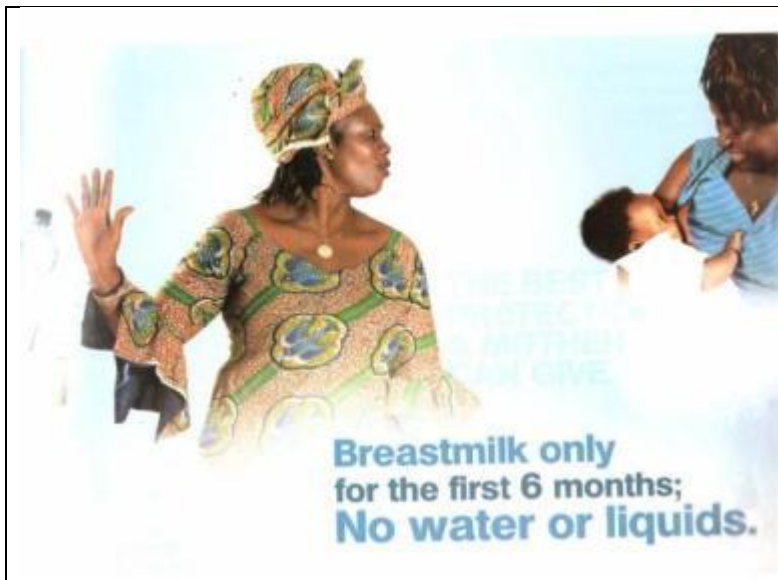
|	
	• They see a breastfeeding mother • A woman who wants to fight • A woman waving bye • Didn't see the water bottle - *Woman with baby looks happy* - *Woman waves hand to reject a message* - *Woman looks like she wants to take some water*

- **Start breast feeding baby**

- Mother lying down for a baby to suck
- Why is the mother lying down while sucking? She is supposed to sit.
- Baby is too old for a newborn
- They didn't see/notice the nurse in the picture nor the watch
- *Mother and child sleeping*
- *Child has breastfed and slept*
- *Woman's breast look heavy indicating that baby was not born long before*
- *Baby appears to be troublesome and mother has to breastfeed while sleeping*
- *Looks like there is a person supporting or examining mother's breast*

- **The best protection**
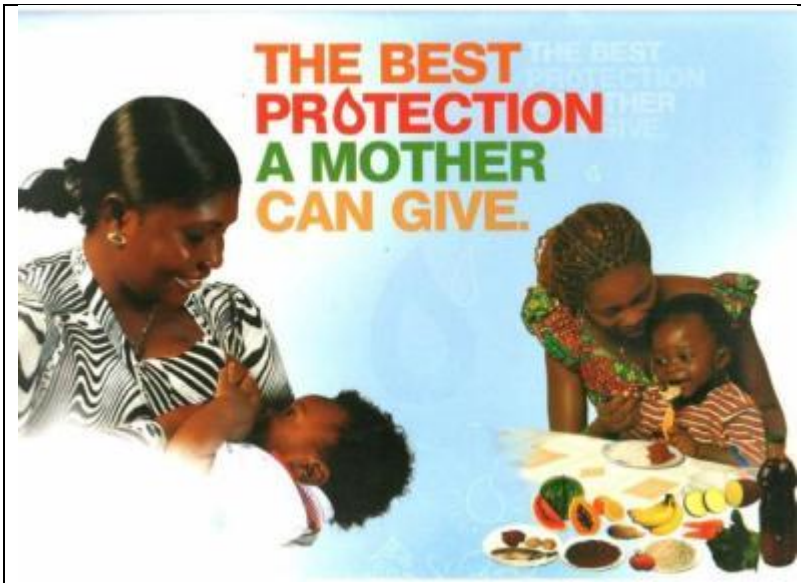
- Kind of food to give the baby
- Two healthy babies
- All this food is not available here
- "Poverty can't let us buy this food but it's good to know in case we get the money we can buy"
- These look like Ghanaian babies
- *One baby breastfeeding and the other eating because he is older*
- *Breastfeeding child is healthier; that's why the other mother is giving the baby food, so he becomes like the breastfeeding one*
- *Mother is feeding older child with other healthy foods*

- **Helping baby grow**

	- Very nice healthy babies - Babies playing together - Babies are fat because they eat healthy foods - "Our babies are not as healthy because of poverty" - "We have no time to buy these foods" - They can see fish, eggs, black tea, groundnuts, beans, palm oil - *Children are playing happily with their toys* - *There are different foods in front of the children* - *The children are satisfied and happy* - *It means the children are eating well* - *"It means we should give and healthy food to our children"*

MOTECH: CALL CENTER REQUIREMENTS

OVERVIEW

A call center is a centralized office used for the purpose of receiving and transmitting a large volume of requests by telephone. To enhance service access and support, MoTeCH is deploying a call center to handle account enquiries, support issues and customer complaints.

The call center requirements will be based on:

    i.   Infrastructure
    ii.   Traffic
    iii.   Agents
    iv.   Customer Service / Technical Support
    v.   Technology
    vi.   Scaling

INFRASTRUCTURE

A secure and well-developed infrastructure is critical in seeking the location of a call center for the following reasons:

- **Stable electricity source:** to ensure that hardware and internet is functioning at all times in order to be able to offer reliable and consistent access for MoTeCH customers.

- **Telecommunications Network:** reliable phone network is needed.

- **Security:** the call center should be located in a safe area with security in place.

- **Broadband connection:** reliable and fast internet connection is needed to support the call center's Customer Relationship Management System (CRM) and issue tracking tools which coordinate the logging and resolution of customer support issues. Constant internet connection is also required to enable constant access to the MoTeCH database so that client registrations and edits can be activated real time. VOIP (Voice Over Internet Protocol) technology will likely be used to reduce the cost of voice calls, again supporting the need for internet connectivity.

- **Convenient access to public transportation:** since the call center will likely be required to operate 24 hours, access to public transportation routes are important to enable safe and convenient access for staff.

- **Space:** the call center location needs to be able to accommodate 2 operators concurrently to support the initial launch in Upper East Region. There should be room to be able expand the center to host a further 4 operators within a year.

TRAFFIC

Expected call volumes are as follows:

Type of Call	Expected Volumes (calls)		Expected Total Duration (mins)	
	Per Day	Per Month	Per Day	Per Month
Nurses' Support	3	90	10	300
User Registrations (40% target population)	5	150	15	450
User Support	12	360	36	1080
Total	**20**	**600**	**61**	**1830**

These volumes will likely be much higher during the early pilot period.

CALL CENTER AGENTS

Two full time operators will be required to support the expected volume of traffic during business hours. To extend this into after business hours and into weekends would require two additional operators. Out-of-hours service will likely be enabled through on-call, off site operators.

The call center agents will be responsible for receiving and escalating service calls related to the mobile phone services being offered to nurses and pregnant parents. The call center agents will also be responsible for ensuring that the appropriate MoTeCH personnel are aware of each support issue and tracking this through to effective resolution.

Below is a list of what is expected from the agents:

- Experience in IT support and technical trouble shooting, ideally with mobile solutions
- Good communication and listening skills.
- Fluency in spoken and written English.
- Fluency in spoken Kassim / Fra Fra or Nankam / Gruni or both.
- Fluency in Hausa, Kusal, Twi, Ga, Dangme (optional).

CUSTOMER SERVICE

To ensure the call center is delivering good customer service and technical support, management will be:

- Training staff and having a plan to take the agents through refresher training programs and general MoTeCH changes.
- Ensuring that the call center is functioning 24/7.
- Ensuring that agents are monitoring servers and services, and proactively informing stakeholders on eventualities.

TECHNOLOGY

Technology is essential in building the call center. This includes a wide range of telecommunication hardware and software. Building the technology infrastructure mainly depends on the purpose of the call center.

For a call center to support the MoTeCH pilot in Upper East Region, the following are core:

- 2 desktop computers (Monitor, system unit, mouse, keyboard etc.)
- 2 headsets
- 3 trunk lines (toll free)
- Minimum 512Kbps Internet Connectivity
- CRM / Issue tracker
- Server monitoring tools
- Local Area Network
- IP PABX system (needs to be able to log all calls)
- VOIP system

- Interactive Voice Response (IVR) system
- One digital line

SCALING

MoTeCH intends to deploy in another district within six months of the Upper East Pilot launch. National scaling could commence within one year of the pilot launch. It is likely that a call center would always be required to support MoTeCH, but the extent of the support required from it will not be known until this has been assessed during the pilot phase. Therefore, the call center should be built with the requirements of a relatively small scale pilot in mind, but with the capacity for rapid and economical expansion to support future deployment locations. This issue particularly impacts the following factors:

- **Location:** a central location within the country provides access to a diverse population making it easier to recruit the best talent with an ability to serve customers in different languages.

- **Size of office:** locating the call center in a space which has room for expansion would be ideal, although relocation is a possibility.

- **Technology:** more trunk lines and higher end hardware (such as PABX, PCs) and software (CRM) would be required to support higher traffic volumes. To the extent possible, technology which can be easily upgraded should be selected.

- **Agents:** hiring multi-lingual agents now will better position MoTeCH during future expansion.

SELECTING CALL CENTER LOCATION

Call center requirements should be analyzed in order to select an appropriate call center location. The matrix below attempts to summarize the main opportunities and challenges for fulfilling requirements for a MoTeCH call center when comparing two different location options: the implementation region and Accra. Challenges appear in bold.

Factor	Implementation Region	Capital
Infrastructure		
	Unreliable main electricity supply **No broadband access** **Internet connectivity in erratic, has a higher latency and more expensive than in Accra** **Less public transportation available** **Telecommunication network is more erratic** - Office space is cheap	- More stable mains electricity, less reliance on generator, thus reducing running cost - Broadband connection - Availability of public transportation - Collocation options exist - Outsourcing options could reduce cost of infrastructure, human resources, technology upgrades, etc. **Office space is expensive**
Agents		
	Easy to recruit local language operators	- Higher population provides larger available skilled labor force **More challenging to find local language operators** **Finding local language operators may involve relocation**
Customer Service		
	Some staff monitoring is more challenging **Some refresher training may need to happen remotely, particularly if more field locations are added** - Field realities can be experienced firsthand, resulting in better customer service - Easier to liaise directly with field staff	- Monitoring and refresher training can happen face-to-face **More difficult to experience field realities** **More difficult to liaise directly with field staff**
Scalability		
	Hardware more expensive to purchase **Transportation of hardware is expensive and time consuming**	- Easier and cheaper to source hardware - Easier to liaise with service providers, e.g. telcos, VOIP

▪ **Difficult to find some service providers, e.g. VOIP**	▪ Easier to find speakers of various different languages
▪ **Paying rent and infrastructure for multiple offices is extremely costly**	▪ Office space is expensive, but supporting infrastructure for a single location is more cost effective
▪ **Purchasing hardware for multiple offices is costly**	▪ Training, retraining and monitoring staff in a single location is cost effective and logistically simpler, resulting making quality customer care more reliable.
▪ **Supporting hardware in multiple offices is costly, time consuming, and logistically challenging**	

From this analysis it seems that locating a call center in Accra poses fewer challenges and risks. Mitigation strategies for the various challenges of locating in Accra are considered below:

- **Office space is expensive**
  Office space in Accra is expensive, although a small center could be locating in the office space in Accra at no additional cost. When considering scale, paying rent in a single location is much more cost effective that supporting offices in multiple regions.

- **More challenging to find local language operators**
  The population is culturally diverse, so finding local language staff will not be impossible, although challenging. Advertising broadly will help to broadcast awareness of the positions among different language groups.

- **Finding local language operators may involve relocation**
  MoTeCH should be ready to absorb the cost of relocating call center staff to Accra, if necessary.

- **More difficult to experience field realities**
  Operators could engage in fieldwork for several weeks before starting work in the call center, in order to familiarize themselves with the target market and their challenges.

- **More difficult for operators to liaise directly with field staff**

Operators could engage in fieldwork for several weeks before starting work in the call center, in order to familiarize themselves with field staff and their daily work.

CALL CENTER SERVICE LEVEL AGREEMENTS

The MOTECH call center handles incoming calls to answer questions, register new patients by phone, and help address problems that customers are having. The service-level goals for the call center are:

- 90% of calls are answered
- Calls are answered within 1 minute
- Cases reported are logged in the CRM and assigned an owner within 3 hours during working hours; 60 hours outside working hours
- 2 minutes on hold
- Handle time: Registration, 5 minutes; Support, 5 minutes
- Occupancy (on support calls): 40%
- Maximum of 1 concurrent caller on hold
- Feedback to the client within 15 minutes if issue cannot be resolved on the initial call
- Resolution time for Tier 1 cases is 1 hour
- Resolution time for Tier 2 cases is 48 hours
- Resolution time for Tier 3 cases is 1 month
- Resolution time for P1 operational support issues is 1 day
- 70% of Tier 1 queries will be resolved at this level
- 70% of Tier 2 queries will be resolved at this level
- 100% of Tier 3 queries will be resolved at this level
- New application releases installed on client phones within 1 day of release
- Monthly CHPS reports sent to the DHMT by the second day of the month
- Monthly CHPS reports delivered to nurses the third day of the month
- Monthly CHPS reports verified by CHPS nurses by the fifth day of the month
- Verified monthly CHPS reports submitted to districts by the sixth day of the month

MOTECH: SELECTING CALL CENTER INFRASTRUCTURE FOR SCALE

REQUIREMENTS

- Ability to see caller's phone number in real time in order to return user's calls when they are dropped (this happens regularly in poor network areas).
- Ability to have our call center and server in different locations and still maintain access to caller ID.
- Ability to flash the system to trigger a call back (this functionality is currently enabled by our server).
- Integration with an E1 line to queue up to 15 callers concurrently.
- Functionality typical of a call center:
  - Ability to play customized announcements and estimated wait time for queued callers.
  - Automatic Call Distribution (ACD) to enable language and skill-based call routing and to prioritize available agents based on longest wait time, round robin, etc.
  - Voicemail functionality for clients who have been queued for too long or call out of hours.
  - Ability for real time monitoring and reporting on ACD queues, agent productivity, average queue and call durations, etc.
  - Call recording and retrieval capabilities for quality control and training purposes.

- o Ability to play customized greetings at different times of day (e.g. to indicate opening hours).
- o Integration with Salesforce CRM to automatically open caller information.
- o Multimedia management to enable management of phone, email and chat channels in one app.

CHALLENGES WITH EXISTING SET UP

Currently calls are routed to our call center directly from our server to mobile phones held by each operator. This set up presents a variety of challenges:

- No ability to see caller's phone number in real time in order to return user's calls when they are dropped (this happens regularly in poor network areas).
- Very limited ability to track monitoring data such as queuing or call duration.
- No queuing ability.
- No ability to enable language or skill based routing. Currently this is effected by forwarding to different mobile handsets, but this is not a scalable solution for instances when we would have more than one operator for each language supported.
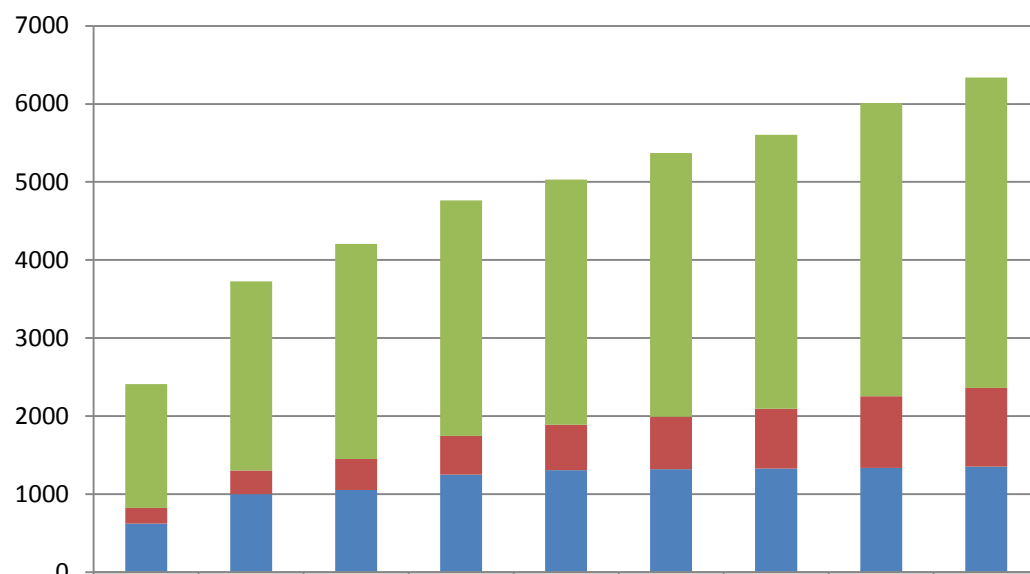
ADDITIONAL REQUIREMENTS FOR PBX/ IVR WHICH WE LEARNED OF THROUGH THIS PROCESS

- Software with ability to handle SS7 (see appendix I).
- Dynamic routing of outgoing calls; i.e. to push calls through E1 of same network as client's SIM. (See Appendix II)

MOTECH Registrants - Cumulative at Month End
July 2010 - March 2011

	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011
■ Children	1586	2423	2753	3018	3139	3375	3507	3754	3979
■ Pregnant Women	199	303	396	496	582	672	768	917	1005
■ Others	626	1000	1056	1250	1309	1322	1329	1339	1355