Mobiles for Quality Improvement Pilot in Uganda

(November 2011)

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MOBILES FOR QUALITY IMPROVEMENT PILOT IN UGANDA

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ACRONYMS

FP/RH	Family Planning/Reproductive Health
m4QI	Mobiles for Quality Improvement
MSI	Marie Stopes International
MSU	Marie Stopes Uganda
QTA	Quality Technical Assistance
SHOPS	Strengthening Health Outcomes through the Private Sector
SMS	Short Message Service
USAID	United States Agency for International Development

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EXECUTIVE SUMMARY

BACKGROUND

USAID's Strengthening Health Outcomes through the Private Sector (SHOPS) project seeks to increase the role of the private sector in the sustainable provision and use of quality family planning/reproductive health and other health products and services. One of the areas of technical focus of the SHOPS project is to identify, deploy, and scale up promising uses of mobile technologies to improve health outcomes. Many developing countries have a severe shortage of health providers, and many of the providers who are working have only limited access to up-to-date clinical protocols, or face-to-face trainings. Mobile phones offer an innovative channel through which to provide cost-effective approaches for clinical training and support for improving quality of care.

SHOPS' partners Abt Associates, Jhpiego, and Marie Stopes International (MSI), collaborated in a mobile learning and performance support pilot called Mobiles for Quality Improvement (m4QI) conducted in Uganda during the period September 2010–August 2011. The goal of m4QI was to demonstrate the potential for positive behavioral change in service delivery by reinforcing face-to-face induction training lessons provided to Marie Stopes staff. Research supports the theory that spaced reinforcement of training combined with testing can significantly improve long-term knowledge retention and facilitate behavioral change.

The objectives of m4QI were to develop and test a technology-supported approach to performance improvement including processes for identifying performance gaps in adherence to clinical protocols, a platform to manage and automate the delivery and receipt of text message reminders and quizzes to address the gaps, and production of actionable data to improve effectiveness of supportive supervision and follow-up. To support scalability and replicability, the pilot platform was designed for users of low-end phones, and those without Internet access.

METHODOLGY

Sample population: The pilot was conducted with 34 family planning staff working in six geographically dispersed service delivery sites owned and operated by Marie Stopes Uganda (MSU). These sites included three MSU Health Centers offering affordable primary health care and family planning services, and three MSU Outreach Teams who perform free, long-acting and permanent method (LAPM) family planning services, targeting poor rural women, through public health facilities. All MSU staff at the six sites were participants in the pilot, with staff functions including receptionists, lab technicians, service providers, doctors, drivers, housekeepers, and managers.

Choice of indicators: Indicators for the pilot were selected through a review of quality assurance audits conducted regularly of all service sites, and input solicited from MSI and MSU clinical management team and field staff. Criteria included behaviors for which there was inconsistent adherence and that were required of all staff, observable daily, and addressable through messaging. Four target behaviors were selected: hand-washing, sharps disposal, instrument decontamination, and pain management techniques.

Message development and scheduling: Performance strengthening messages were developed for each of the four indicators utilizing a process to identify barriers to regular adherence, the importance of the indicator, provider and client motivations, and existing training content. For each indicator, a total of four messages were developed (two reinforcing tips/reminders/encouragement and two assessment questions to trigger and test recall of knowledge). A schedule of one message per day, four days per week, for eight weeks was established, allowing for each message to be repeated twice over an eight-week period, and a mix of topics to be covered throughout a week.

Technology platform development: A Uganda software development organization, Appfrica, was selected through a Request-for-Proposal process to develop FrontlineSMS:Learn, supported by the FrontlineSMS headquarters staff in the United Kingdom. FrontlineSMS was chosen as the underlying platform because it is free and open source, widely used by nongovernmental organizations with limited technical expertise to send and receive a large number of text messages, and does not require Internet access. Pilot funding was used to develop the software code for a ―plug-in" module called FrontlineSMS:Learn to provide training-specific features. The functionality added by FrontlineSMS:Learn includes a databank of messages that can be stored by topic, quiz functionality with automated responses and remediation, ability to schedule in advance the delivery of messages, and reporting to identify knowledge gaps for targeted follow-up and support.

Deployment: The m4QI platform was hosted and managed by staff of MSU's research department, who were responsible for locating a computer dedicated for the project, acquiring a modem and SIM card to attach to the computer for sending and receiving text messages, downloading and installing the FrontlineSMS:Learn software, entering the participants phone numbers, adding messages and scheduling their delivery, and monitoring the software operation.

Monitoring & evaluation: A process evaluation was conducted in July to document project development and implementation processes aimed at generating key lessons and recommendations to inform scale-up of the application and approach. Structured interviews

were conducted with key local personnel involved in the implementation, including all staff at four of the pilot sites, followed by analysis of key themes and sub-themes. Monitoring throughout the pilot consisted of intermittent downloading of the raw database contents for analysis and troubleshooting facilitated by weekly phone calls and Skype chats.

RESULTS

A vetted process and software tool for improving provider performance: A replicable intervention has been developed for identifying addressable performance gaps and developing text message content to target service delivery improvement. A software platform, FrontlineSMS:Learn, has been developed that allows trainers and staff to manage the delivery of reinforcement and assessment messages to providers and make data-driven programmatic decisions for supportive supervision and follow-up training.

Messages were successfully sent and received although technical issues resulted in intermittent periods of non-delivery: During the pilot period, a total of 3,449 messages were sent to project participants, with an 86.5 percent success rate of receipt. These included both the behavioral messages as well as messages of welcome, instruction, and notification, with some attributed repetitious resending of messages caused by a software bug. Technical problems related to modem operation, airtime loading, and message scheduling resulted in several periods of failed message delivery, which were later resolved. The eight-week pilot period, which began on April 27, 2011, was extended until August 12, 2011, to compensate for the periods of non-delivery.

Participants were consistently responsive, but not in large numbers: Post-pilot interviews with participants suggested high acceptability of text messages for performance improvement, with generally positive comments balanced by some negative feedback about message clarity and frustration with technical problems. A total of 251 incoming messages were received from participants in response to questions delivered, with a decrease in response rates observed while modem issues were being resolved at the beginning of the project as well as when participants were notified toward the end that evaluations were beginning and the project would soon be coming to an end. The average response rate was 19 percent, which remained relatively constant during the pilot duration. There was a wide variation in response rates by location and by cadre, varying from average of 11 responses per provider at the most active site to an average of 1.3 messages per provider at the least active site.

Participants reported changes in knowledge, practice, and motivation: Through structured interviews conducted at the end of the pilot, providers reported the following:

- ✓ ***Being motivated*** *by reminders to adhere to hand-washing rules*
- ✓ ***Referring to training manuals*** *when receiving a quiz question about treatment protocols*
- ✓ ***Re-learning steps*** *in instrument sterilization they had forgotten*
- ✓ ***Using tips*** *about pain management to more closely attend to clients*

The evaluation produced specific examples of how clinic practices had changed for each of the four indicators as a result of the intervention, including practices not directly addressed in the messages. These included the distribution of more IEC (Information, Education and Communication) materials throughout the clinic to remind staff about proper hand-washing, the placing of chlorine solution at more locations in treatment and procedure rooms, and a new ban on phone calls during procedures.

Positive increases in information-sharing on service standards: In addition to the self-reported behavior changes aligned with the four indicators, the project also recorded outcomes related to increased team interaction on issues related to quality of service. Pilot participants mentioned more staff consultation regarding the text topics, instilling a culture of inquisitiveness. The pilot was described as promoting team learning and research on questions related to the text questions, and increased use of training reference manuals and clinical guideline documents.

LESSONS LEARNED

Need for troubleshooting resources: Consistent with the purpose of a pilot, the m4QI project exposed various operational and technical challenges, which are instructive events for future deployment. Technical challenges that occurred during the pilot included failure of messages to be delivered due to incompatibility of a community-developed software feature with a common operating system, purchase of an incompatible modem, software bugs introduced during development that resulted in multiple deliveries of the same message, message delivery failures due to length beyond 160 characters, and incorrect scheduling due to selection of AM instead of PM for message delivery.. The extensive troubleshooting required more resources than had been budgeted. Part-time MSU staff resources allocated to support the pilot, already stretched by heavy workloads, were further impacted by turnover of key positions, protracted illnesses by several key personnel, and initial lack of clarity regarding programmer‘s role in supporting the pilot. When conducting beta tests of new software programs, or implementing technology-supported interventions, there is need for dedicated human resources to provide on-going support and solve problems.

Weaknesses in planning and stakeholder communications: Them4QI pilot would have benefitted from more formal communications among a broader group of stakeholders within

MSU, including wider circulation of project work plans, budgets, and pilot overview materials. This resulted in missed opportunities for building internal champions and support for the pilot. This was particularly true for MSU's regional managers, who were in regular contact with pilot participants, but had limited understanding of and participation in the pilot. Changes made during pilot implementation were not well-communicated, such as switching from a quantitative evaluation to a qualitative evaluation, and prepayment of airtime subsidies for response texts.

Insufficient participant training and orientation: Plans to orient pilot participants—involving face-to-face orientation for Center and Outreach Team managers from pilot sites who would then cascade the training to their staff—were not implemented as intended due to scheduling challenges. At this point, the pilot schedule should have been revised, to allow this crucial phase to occur. Instead the pilot was launched, with many participants receiving messages before being briefed on their purpose and what was expected of them. Formatting errors in sending reply messages could have been reduced by ensuring users were informed before receiving messages, delivering automated feedback for incorrectly formatted answers, and providing regular reminders of correct formatting.

Need for prepaid airtime subsidies: Lack of prepaid airtime likely contributed to low response rates on the assessment texts. The plan had been to reimburse participants for the 16 text messages (two per week) at the end of the pilot, but lack of prepaid airtime was in fact a barrier to participation. The project explored the options of procuring reverse billing services but the mobile service provider indicated that it was not available. The issue was solved by making individual cash transfers to the Center and Outreach Team Managers for weekly distribution to their staff for use in purchasing airtime to cover the costs of the SMS replies.

IMPLICATIONS FOR THE FUTURE

The promising results of the m4QI pilot have important implications for health programmers. Text messages provide a novel and cost-efficient way to raise awareness, promote behavior change, address common myths, identify performance gaps, incentivize new practices, refresh skills, and increase cohesion among peers. The positive user feedback supports expanded applications with larger-scale populations, in additional countries and across a range of provider training needs.

The FrontlineSMS:Learn software will be made available through the main FrontlineSMS website for free access to any organization seeking to deploy text-based performance improvement interventions. The platform is well-suited for use by organizations working in limited-resource environments to address any content area, with any size group of ‐learners."

Because FrontlineSMS:Learn is an open source project, the code can be adapted to add functionality to suit education/training, performance improvement and behavior change needs in other programs. Among the new features identified during the pilot for future enhancements to

FrontlineSMS:Learn are creation of a peer-to peer network that can facilitate the sending and receiving of texts to specific cohorts within a larger population, additional and more robust reporting features, and the ability to create a course template with predefined message schedules that could be assigned to groups of users or that a user could register for via text message.

The mobile learning platform and process developed in this pilot is not designed for large data collection or data management needs better served by higher-end phones or SMS tools using structured forms. The platform is designed to build on existing training or educational programs, as the 160 character limitation of text messages is not suited to presentation of comprehensive content such as would be available through web-based elearning tools.

The SHOPS project is currently identifying an appropriate market in which to scale up the mobile learning platform, to target loosely networked family planning providers with limited access to clinical skills-development resources. This will address the additional challenges—and greater need—in maintaining quality standards when there is not an employer-employee relationship to motivate adherence to protocols. A key objective of the next iteration will be a more rigorous outcome evaluation to measure effectiveness on provider performance. This phase will also examine the cost-effectiveness of the intervention to support sustainability.

1. BACKGROUND

1.1 THE SHOPS PROJECT

The Strengthening Health Outcomes through the Private Sector (SHOPS) project is USAID's flagship project in private sector health. SHOPS focuses on increasing availability, improving quality, and expanding coverage of essential health products and services in family planning and reproductive health (FP/RH), maternal and child health, HIV/AIDS, and other health areas through the private sector. Abt Associates leads the SHOPS team, which comprises five other partners: Banyan Global, Jhpiego, Marie Stopes International (MSI), Monitor Group, and O'Hanlon Health Consulting.

One of the areas of technical focus of the SHOPS project is to identify, deploy, and scale up promising uses of mobile technologies to improve health outcomes. The use of mobile technologies to achieve health outcomes, or mhealth, provides promising opportunities to engage new private sector resources for and to strengthen private sector provision of FP/RH services.[1]The SHOPS partners are working to identify existing and emerging mhealth best practices and build the evidence base for application and scale-up.

1.2 ADDRESSING THE NEEDS OF THE HEALTH WORKFORCE

The production and support of a competent workforce—in the public or private sectors—are some of the most pressing challenges facing developing countries in providing access to care and reaching the Millennium Development Goals.[2]The World Health Organization reports that a majority of sub-Saharan African countries currently face a critical shortage of health workers.[3]

Training of health care providers is one of the most common interventions used in development strategies to improve the quality of FP/RH services in developing countries, but most resources

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[1]See for example, Vital Wave Consulting.(2009). *mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World*. Washington, DC and Berkshire, UK: UN Foundation-Vodafone Foundation; Kahn, J.G., Yang, J.S, & Kahn, J.S. 'Mobile' health needs and opportunities in developing countries. *Health Affairs* 29(2): 252-258; World Health Organization. (2011). *mHealth: New horizons for health through mobile technologies: second global survey on eHealth*. Geneva, Switzerland. (http://www.who.int/goe/publications/goe_mhealth_web.pdf, accessed September 17, 2011).

[2]Kinoti, S.N. & Livesley, N. (n.d.) Overcoming human-resources- for-health challenges at the service delivery level. Retrieved October 1, 2011 from http://ftguonline.org/ftgu-232/index.php/ftgu/article/view/1941/3878.

[3]Kumar, P. (2007). Providing the providers – Remedying Africa's shortage of health care workers. *New England Journal of Medicine* 356 (June 21):2564-2567.

and best practices on effective training relate to public sector providers.[4]In recent years, private sector providers have been recognized increasingly as an important source for delivery of FP/RH and other health services in developing countries, even for the poor. Yet the inclusion of private providers in training interventions or even the acknowledgement of their unique needs in discussion forums on training are still not common practices.[5]

Within this context, mobile phones offer an innovative channel through which to provide cost-effective approaches for clinical training and support to improve quality of care. This pilot was designed to addresses these human resource challenges by: 1) facilitating the transfer of clinical training into practice and 2) supporting quality improvement and quality assurance in the workplace.

1.3 PILOT INCEPTION

Uganda was identified as a good candidate for exploring mhealth applications due to its robust mobile ecosystem. An exploratory landscaping of mhealth activities in Uganda was conducted in May 2010. More than 25 separate pilots were identified, with applications ranging from commercial heath messaging services for consumers, to government-led mobile data collection for community health workers and clinic-based voucher programs utilizing mobile payment systems for subsidy transfers. No pilots were identified addressing provider training needs through mobile short message service (SMS) applications.

SHOPS local partner Marie Stopes Uganda (MSU) expressed interest in exploring how to leverage the mobile phone infrastructure to improve its operations and increase the use of modern family planning methods. MSU owns and operates 14 health centers offering affordable primary health care and family planning services. MSU also manages 16 outreach teams who perform free long-acting and permanent method (LAPM) family planning services, targeting poor rural women, through public health facilities in all districts of the country. In addition, MSU runs several independent projects including a social marketing program and an output-based aid voucher program for safe delivery, STI prevention and treatment, and family planning. MSU had experience using mobiles to improve program management, such as its introduction of an innovative mobile platform to improve voucher management.[6]

During a project planning trip in August 2010, agreement was reached among SHOPS partners Abt Associates, Jhpiego, MSI, and MSU to pilot a mhealth application designed to reinforce key training areas and improve adherence to approved clinical protocols for local MSU FP/RH staff.

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[4]Averbug, D. and M.Segall. December 2008. *Best Practices in Training Private Providers*. Bethesda, MD: Private Sector Partnerships-*One*, Abt Associates Inc. Retrieved September 7, 2011from http://www.shopsproject.org/sites/default/files/resources/5240_file_FINAL_Best_Practices_in_Training_Private_Providers_Primer.pdf

[5] Ibid.

[6]Ho, M, Owusu, E and Aoki, P. (2009). Claim Mobile: Engaging conflicting stakeholder requirements in healthcare in Uganda, 2009. Retrieved November 18, 2011 at http://www.melissadensmore.com/papers/ictd09-mho-stakeholder.pdf.

The partners agreed that the intervention would not disrupt the service delivery workflow, would integrate easily with existing technology and capacity, would be replicable in other countries and markets, and would function in a non-Internet environment.

The pilot objectives for the project, called Mobiles for Quality Improvement (m4QI), were to develop and test a mobile technology-supported approach to performance improvement. Deliverables included processes and tools for identifying gaps in performance that can be addressed effectively through messaging; developing learning and performance support content targeted to identified gaps; managing and automating the delivery and receipt of mobile phone-based messages and reporting; and doing monitoring and evaluation (M&E) of the effects of the intervention. The ultimate goal is to improve the quality of health service provision by effecting positive behavioral change in health care providers and clinical staff and also by improving the effectiveness of supportive supervision and follow-up.

1.4 THEORETICAL SUPPORT FOR BEHAVIOR CHANGE

There are several reasons why competencies gained through training may not be maintained and transferred into practice: one of the simplest is the natural psychological effect of forgetting. Research on the process of forgetting and the effects of spaced reinforcement, or "distributed practice," over time on retention of knowledge and skills stretches back more than 100 years.[7] Recent work has demonstrated that distributed practice combined with testing can significantly improve long-term knowledge retention in medical students[8] and facilitate behavioral change in surgical residents.[9]

A recent study in Kenya has discovered a link between text message reminders and adherence to malaria treatment guidelines[10]. Based on this growing body of research, the hypothesis for the pilot is that learning reinforcement and assessment via text message would lead to the successful transfer of FP/RH training into on-the-job performance and adherence to clinical protocols.

[7]Cepeda, N.J., Pashler, H., Vul, E., &Wixted, J.T. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin*. 132(3), 354-380.
[8]Kerfoot, B.P. (2009). Learning benefits of on-line spaced education persist for 2 years. *Journal of Urology,* 181(6): 2671-3.
[9]Matzie, K.A., Kefoot, B.P. Hafler, J.P., & Barren, E.M. (2009).Spaced education improves the feedback that surgical residents give to medical students: a randomized trial. *American Journal of Surgery*. 197(2): 252-7.
[10]Zurovac, D., Sudoi, R.K., Akhwale, W.S., Ndiritu, M., Hamer, D.H., Rowe, A.K., & Snow, R.W. (2011). The effect of mobile phone text-message reminders on Kenyan health workers' adherence to malaria treatment guidelines: a cluster randomized trial. *The Lancet* 378(9793): 795-803.

1.5 CONCEPTUALFRAMEWORK

Figure1 (below) portrays the logical link between the development and delivery of text messages, the outcomes of increased adherence and identification of competencies in need of strengthening, and the ultimate goal of improved quality of health services delivered. This represents the aim of a full-scale, long-term deployment envisioned for a future stage.

Figure 1: m4QI ConceptualFramework

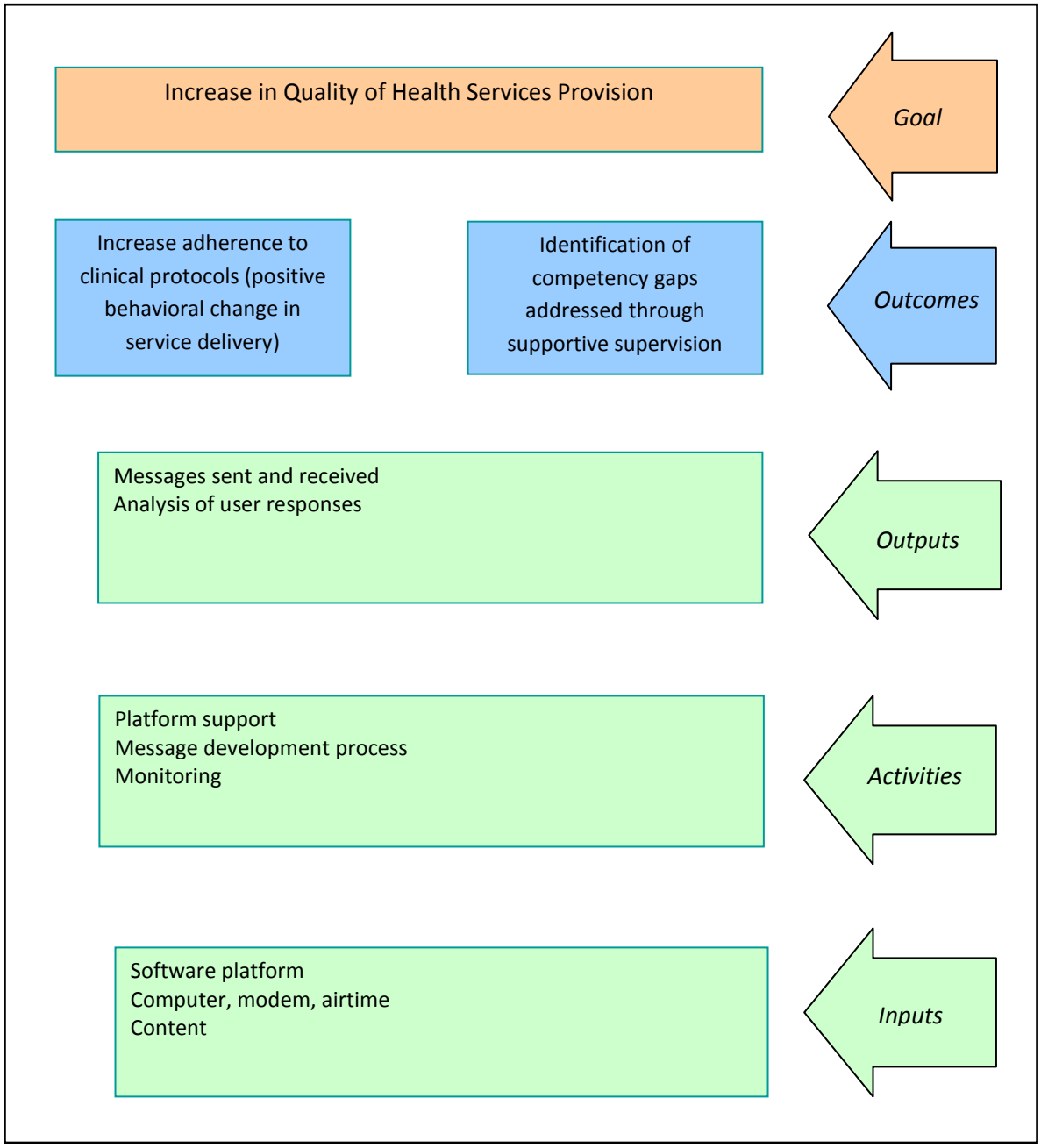
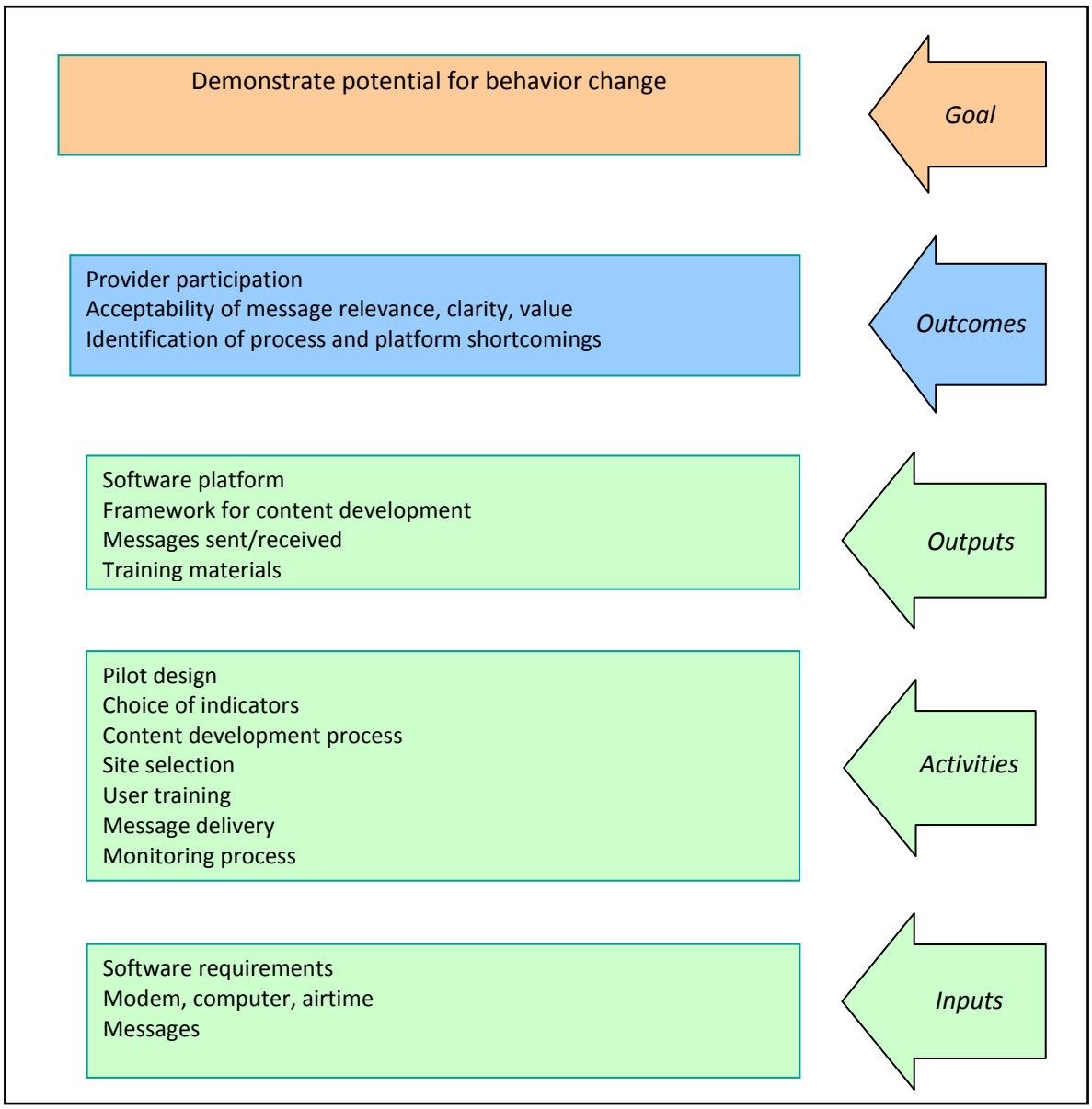


Figure 2 portrays the framework for the more operational goals of this pilot, which are intended to create the intervention, test assumptions, refine inputs, and disseminate lessons. The pilot is designed to determine whether the intervention has the potential to produce impacts on provider behavior, and to expose shortcomings that could impede success of a full-scale program.

Figure 2: m4QI Pilot Logical Framework



2. METHODOLOGY

2.1 FORMATIVE RESEARCH

During the planning phase, MSU field staff input was sought to inform design of an intervention that would be useful to staff members in their work, not just to assist with management oversight. Interviews were conducted with four staff at Jinja Outreach and six staff at Masaka Health Center. Each person was introduced to the purpose of the pilot, and asked about its relevance and value to them, as well as any concerns or issues raised. Each was invited to identify topics about which they would particularly welcome additional information, updates, and reminders.

These interviews confirmed that MSU staff members owned mobile phones, brought them to the office, and were frequent users of text messages. There was much enthusiasm expressed for the purpose of the pilot and their possible participation. Sample responses included:

"Everyone on the team provides family planning counseling, but everyone does it differently. We need refreshers on what to say about each of the methods, everything that should be covered, not just focus on their initial method request. Vocal local techniques are not effectively used, staff need more instruction of what, how, why, and when to use. Very specific instructions should be provided about when to scrub, what gloves to use." **Medical Officer**

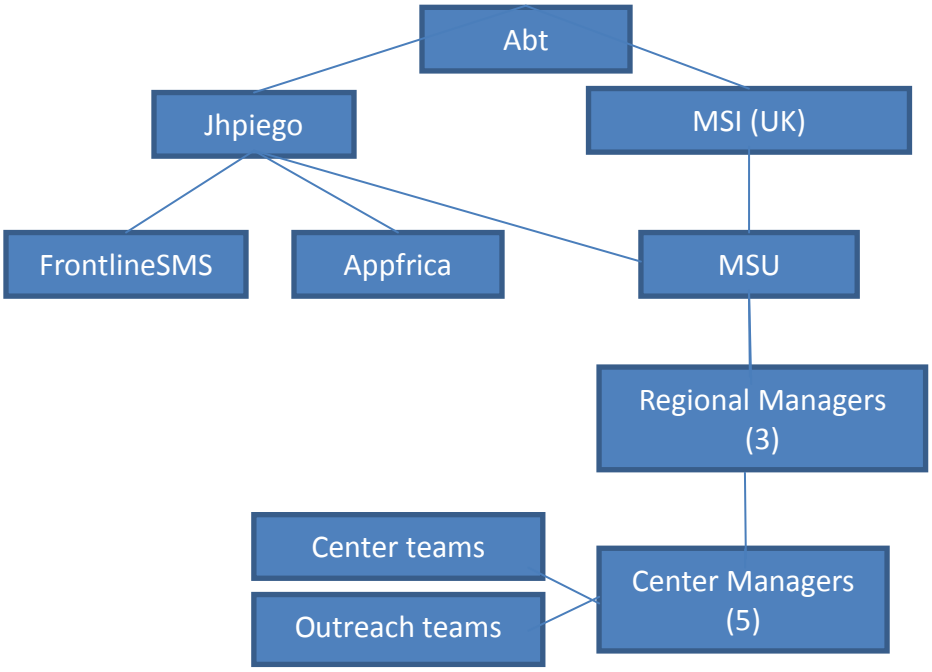
"I use text messages with family and friends when need to get information to someone quickly. Decontamination is very important; it would be helpful to be reminded how long to sterilize, what portions are needed to dilute solutions. Reminders on hand-washing are needed often. One idea for Vocal Local is to suggest singing when talking doesn't seem to work, also to encourage client to talk using open-ended questions that require them to describe something. Client support is not just for the procedure, from the beginning we need to talk and have client relax."
Service Provider

"My jobs are to keep areas clean, do laundry, go to bank, and support center activities. Reminders on infection prevention in the procedure rooms would be helpful. I would like reminders that the client is my boss; no matter what else I am doing, if a client has a question, I will answer it or tell them who can answer for them." **Center Assistant**

2.2 PROJECT MANAGEMENT

The planning phase took place during the fall of 2010. A core team was established consisting of MSU (M&E Manager, Research Director, Operations Director, Clinical Director), MSI (Technical Advisor Innovations Team), Abt Associates (mHealth Senior Advisor),and Jhpiego (Learning Technology Advisor). A work plan and budget was circulated by the SHOPS Project Director to core pilot team.

Figure 3:m4QI Project Organogram



2.3 CHOICE OF INDICATORS

The identification of performance indicators for the pilot (Table 1) was based upon interviews with the MSI Medical Development Team, and the MSU Operation Director, Clinical Director, and regional training managers. A sampling of past audit reports was also conducted. The following considerations and criteria were taken into account in selecting the indicators:

- Behaviors observed through routine audit: MSI conducts regular audits utilizing Quality Technical Assistance (QTA) checklists with a total of 332 service delivery standards that are specific and measurable. Behaviors were identified that were likely to be observed on a daily basis.

- Standards with routine poor performance: A list was generated of performance areas in which there was inconsistent or weak adherence.

- Behaviors that were required of all center or outreach staff: To maximize clinic-wide participation in the pilot, behaviors were chosen in which all staff were expected to perform, not just specific cadres such as doctors or lab technicians.

- Limited number of target behaviors: A small number of topic areas (maximum four) were chosen to ensure that an adequate dose (messages per topic) could be provided within the pilot timeframe.

Table 1: Pilot Indicators

Indicators selected for pilot	Comments on why chosen
Indicator 1: **Team members wash their hands BEFORE and AFTER examining or providing a service for every client and after work.**	Hand-washing takes time and during busy days with long client queues, staff may shortchange full adherence to the MSI standards.
Indicator 2: **Sharps are disposed of in a sharps container immediately following use.**	Proper sharps disposal is key to infection prevention, and regional managers noted deficits in protocol compliance.
Indicator 3: **The 0.5% chlorine solution is prepared according to recommendations.**	Government supply of chlorine solution is sold in various concentration levels but staff often assume they know the amount of water needed to dilute without reading the package.
Indicator 4: **Vocal local is maintained throughout the procedure.**	―Vocal local" is a pain management technique using distracting conversation to increase client cooperation during procedure. Staff often stop engaging if they sense the client is not in discomfort, and lack appreciation for importance of vocal local in maintaining client ease.

2.4 CONTENT DEVELOPMENT

For each indicator, the team analyzed the behavior targeted and developed a framework for understanding why adherence is not regularly met, and why the indicator was important to the

provider and the client (attached in Annex A). Messages were developed utilizing existing content from MSI manuals, to reinforce previous training.

A total of four messages for each indicator were developed, two in the format of tips or reminders, and two in the format of questions. Replies for question answers were also prepared, to support learning and encourage attention to quality of service. These messages were vetted with several managers within MSU, with final approval provided by the MSI Medical Development Team. (Full set of messages is attached in Annex B). Below is a sample question and the automated response for an incorrect answer:

> ***4. Mixed chlorine solution must be kept in a closed container. True(F) or False(F). Reply 4T or 4F.***
>
> *Incorrect answer: (False). That is not correct. The chlorine solution needs to be stored in a closed container because it loses concentration when left open.*

A message delivery schedule was established, with each of the 16 messages (total) sent twice to each participant based on the evidence that repetition is a critical factor in knowledge retention.[11]Pilot participants were scheduled to receive one message per day, four days a week, for eight weeks. Messages related to one topic were spread over a period of weeks, so that the topics would change day to day within any given week. It was also decided to send different messages to staff members at the same site on any given day, to encourage individual learning.

2.5 SOFTWARE DEVELOPMENT

In order to implement m4QI, hardware and software was needed that would allow the team to manage the delivery and receipt of several thousand text messages. In addition, the solution needed to be able to identify incoming messages as answers to quiz questions, determine whether or not the answer was correct, log that in a database, and then respond to the provider with a remedial message (or a congratulatory one if the answer was correct). To meet the needs of most health service organizations, the platform solution was designed to ensure there was little need for technological capacity or expertise, for maximum sustainability.

FrontlineSMS is free and open source software that turns a computer and a mobile phone (or USB modem) into an SMS hub, allowing users to send and receive text messages with individuals and groups of people. The software does not require an Internet connection and works with the SIM cards that are readily available from local mobile providers. It allows a user

[11]Cepeda, op. cit.

to manage contact information and assign individuals to groups in order to target outgoing messages. The software does not require significant technological capacity to use—no servers or special databases are required. Finally, being open source, anyone can modify the software code to add or modify functionality to suit their needs.

For these reasons, the decision was made to adapt the FrontlineSMS code and develop a plug-in module called FrontlineSMS:Learn.[12]Use of FrontlineSMS met project criteria for maximum replicability. The new plug-in would extend the core functions of the software and add the specific features needed, including:

- A bank of reinforcement messages that could be categorized by topic;
- Multiple choice and True/False assessment messages with automated remedial responses that could be categorized by topic;
- Assignment and scheduling of reinforcement and assessment messages for groups (an scheduling plug-in had already been developed under another project);
- Generation of grades based on assessment results for identifying knowledge gaps; and
- Calculation of item difficulty to determine what specific questions were challenging for participants

Appfrica, a Ugandan software developer, was selected through a Request for Proposal (RFP) process to write the code and support the platform during the pilot. The choice of Appfrica was guided in part by the ‐coded in country" philosophy[13], committed to supporting local economic development and capacity building, and ensuring ongoing local support. The code was developed over an eight-week period, with collaboration among Appfrica, FrontlineSMS, and the Jhpiego technology advisor.

2.6 SAMPLE SIZE AND PILOT SITE SELECTION

Initially, the pilot intended to conduct a quantitative evaluation comparing performance on indicators control and intervention sites with an estimated need of 30 participants in each group, at a total of 12 locations. Although there was a change in evaluation design, described below, the six intervention sites originally identified were selected to participate in the trial. These locations included a mix of outreach teams and health centers, with geographic and urban/rural diversity: Jinja Outreach, Masaka Outreach, Hoima Outreach, Masaka Center, Hoima Center, and Bweyogerere Center. Each site averages 5–6 staff, for a total of 34 individual staff participating in the pilot.

[12] The precedent on naming was set by other sector-specific projects including FrontlineSMS:Medic, which supports community health workers, and FrontlineSMS:Credit, which supports microfinance institutions.
[13]See discussion http://www.codedincountry.org/

2.7 TESTING

Messages were tested with five staff members at the MSU Kavule Health Center in Kampala to identify bugs, and solicit feedback on message clarity, delivery, and process. Although three days of message delivery were planned, due to unanticipated power outages, all the test messages were sent in a single day.

The test confirmed that the platform delivered and received messages. Problems were reported by some responders in receiving replies to their responses. Several messages were identified that ended in mid-sentence. There was also feedback on provider concerns about using their own airtime to respond to project messages, even if later reimbursed.

2.8 PARTICIPANT TRAINING AND ORIENTATION

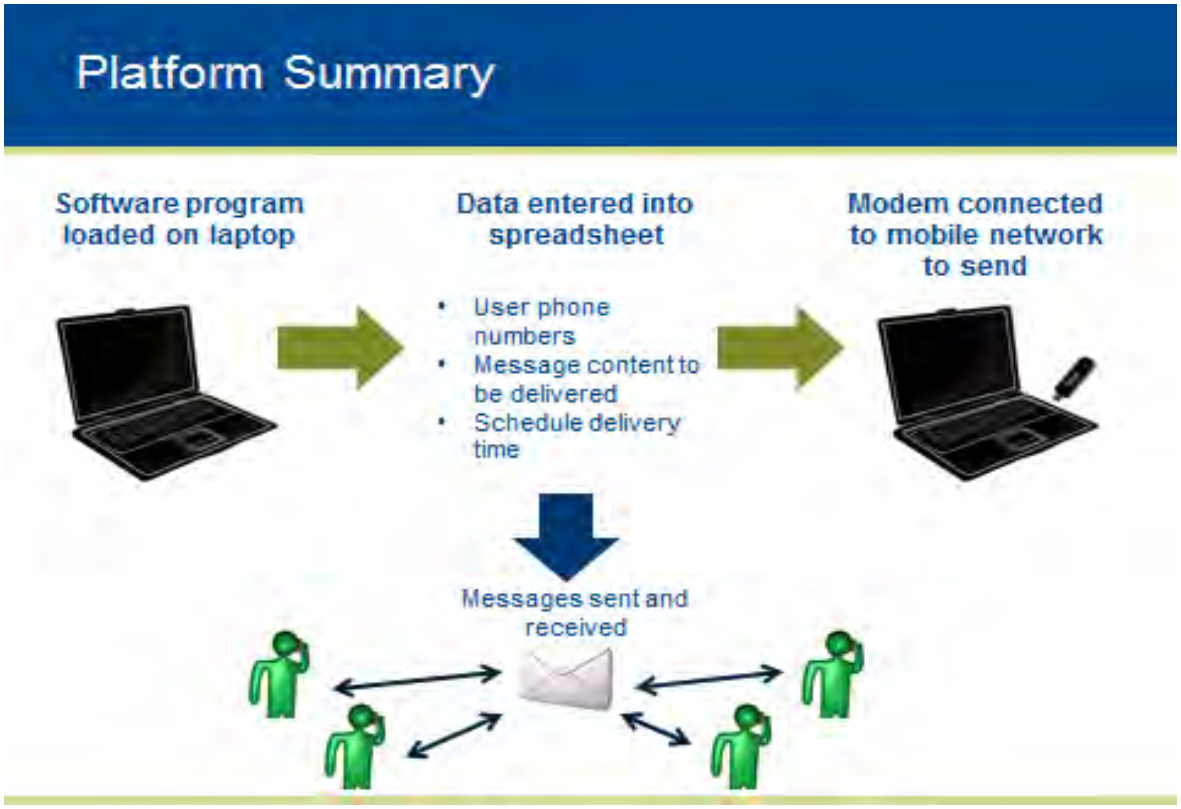
A process was established to introduce the background, purpose and mechanics of the intervention to participating sites. The MSU M&E manager was prepared to conduct a brief orientation with managers at each of the pilot sites, explaining the purpose of the text message program, its importance, the mechanics and expectations of pilot participants. Orientation materials were prepared as hand-outs for participants (Annex C).

Due to time constraints and scheduling conflicts, the managers from the pilot sites were not briefed in person. Follow-up instruction was conducted through email and phone calls to the managers, but in a number of cases, managers had not been briefed prior to the start of message delivery, and others did not have time to communicate about the pilot to their staffs. As a result, some pilot participants reported having no idea why they were receiving work-related text messages, who they were from, or what they were expected to do.

2.9 DEPLOYMENT

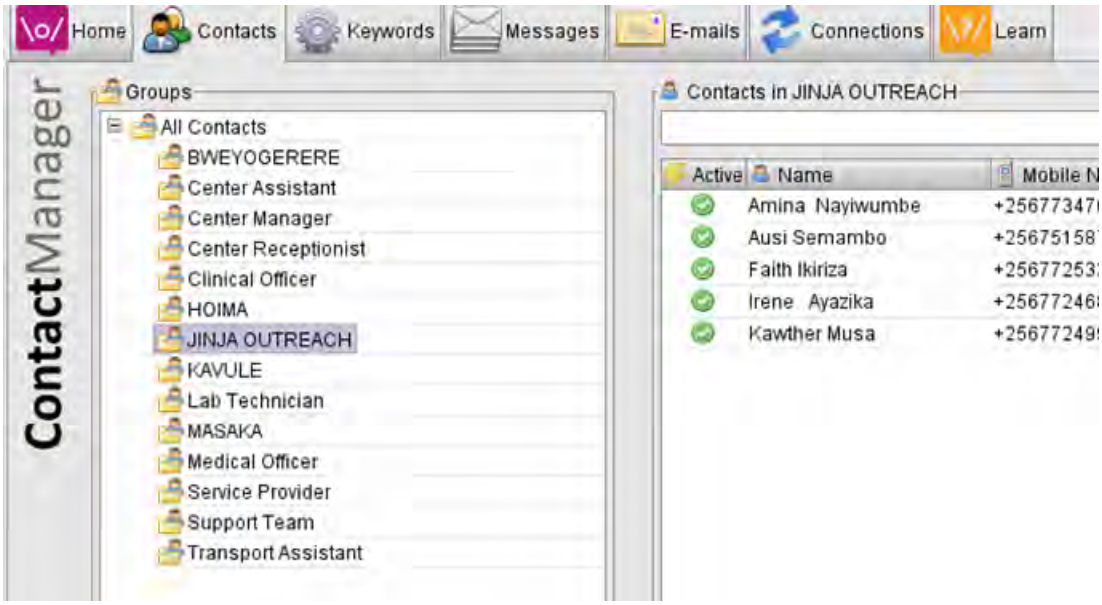
The m4QI platform (Figure 4) was hosted and managed by staff of MSU's research department, who were responsible for locating a computer for the project, downloading the FrontlineSMS:Learn software and installing it, entering the participants phone numbers and grouping them by site and cadre, entering the messages, setting up the delivery schedule, acquiring a modem to attach to the computer for sending and receiving SMS messages for the pilot, and monitoring the platform's operation. Initially a staff laptop was expected to host the software but because staff were required to travel frequently to the field, a dedicated computer was located for the pilot.

Figure 4: m4QI Platform.



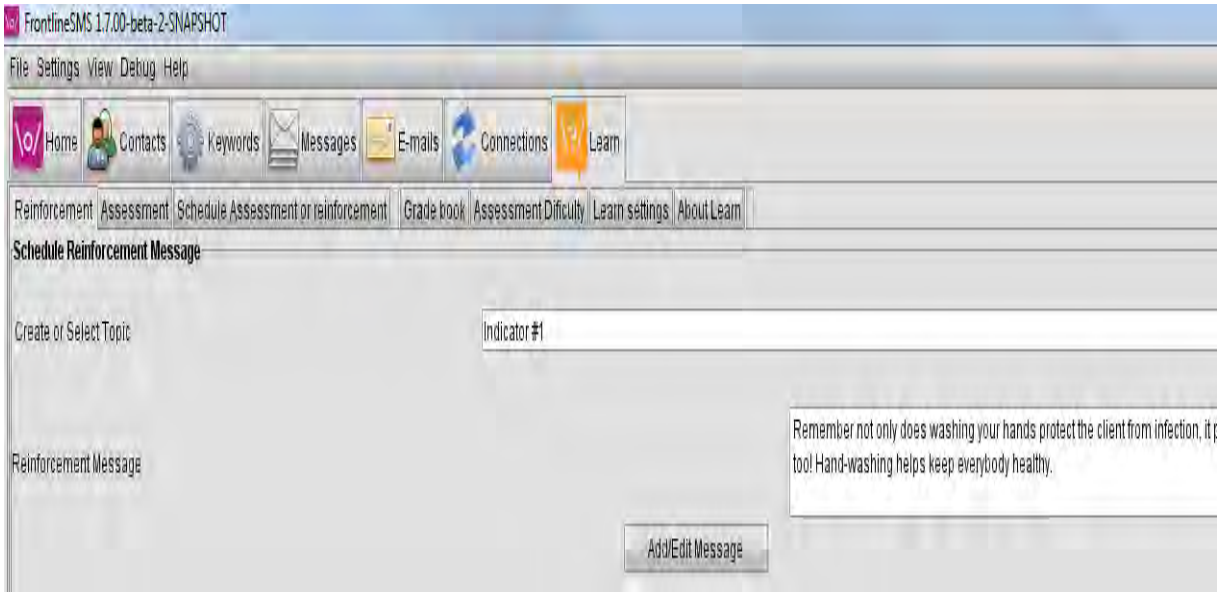
Figures 5–7 are representative screenshots of FrontlineSMS:Learn windows for entering information. Figure 5 shows how phone numbers for learners are added and then grouped in order to target learners with reinforcement and assessment messages. In this example, groups have been created for sites (Jinja Outreach currently selected) and cadres of health workers.

Figure 5: Illustrative Screenshot Entering Participant Phone Numbers



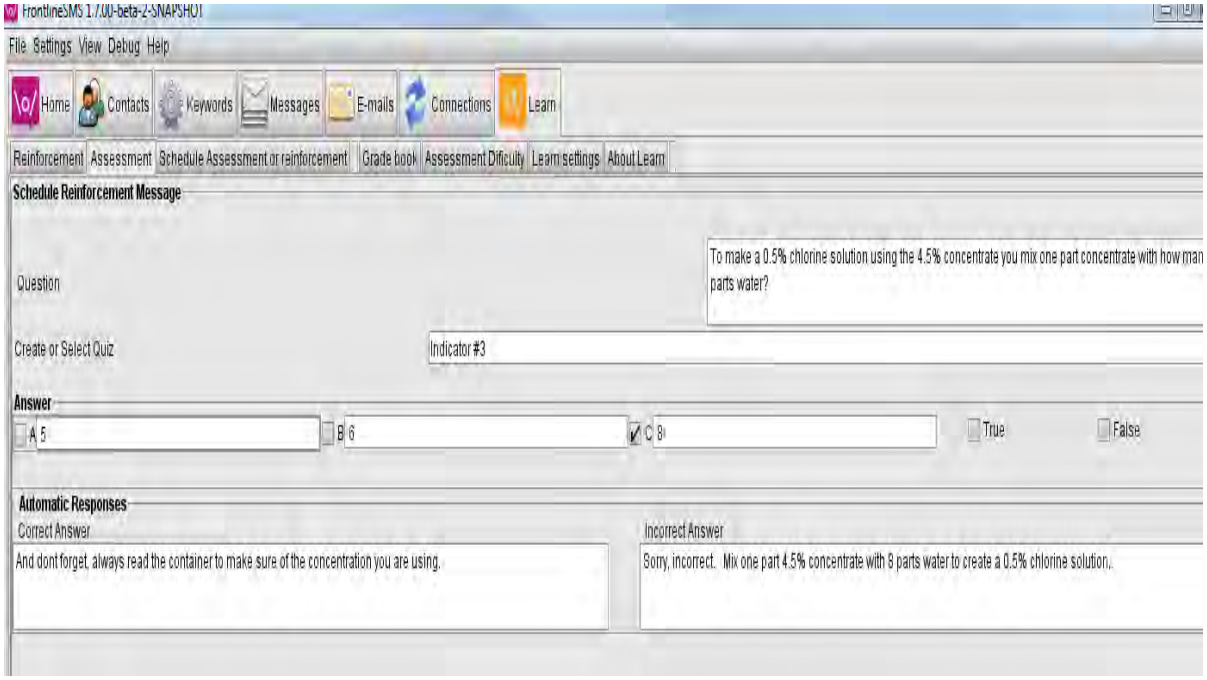
As illustrated in Figure 6, the ―Reinforcement" tab is used to enter reinforcement messages and group them by topic. In this case, the topics are identified by indicator number.

Figure 6: Illustrative Screenshot Reinforcement Tab



As shown in Figure 7, the -Assessment" tab is used to enter quiz questions—either multiple choice or true/false—and group them by topic (in this case, by indicator number). Automated responses are entered for correct and incorrect answers. The correct answer is identified with a check mark.

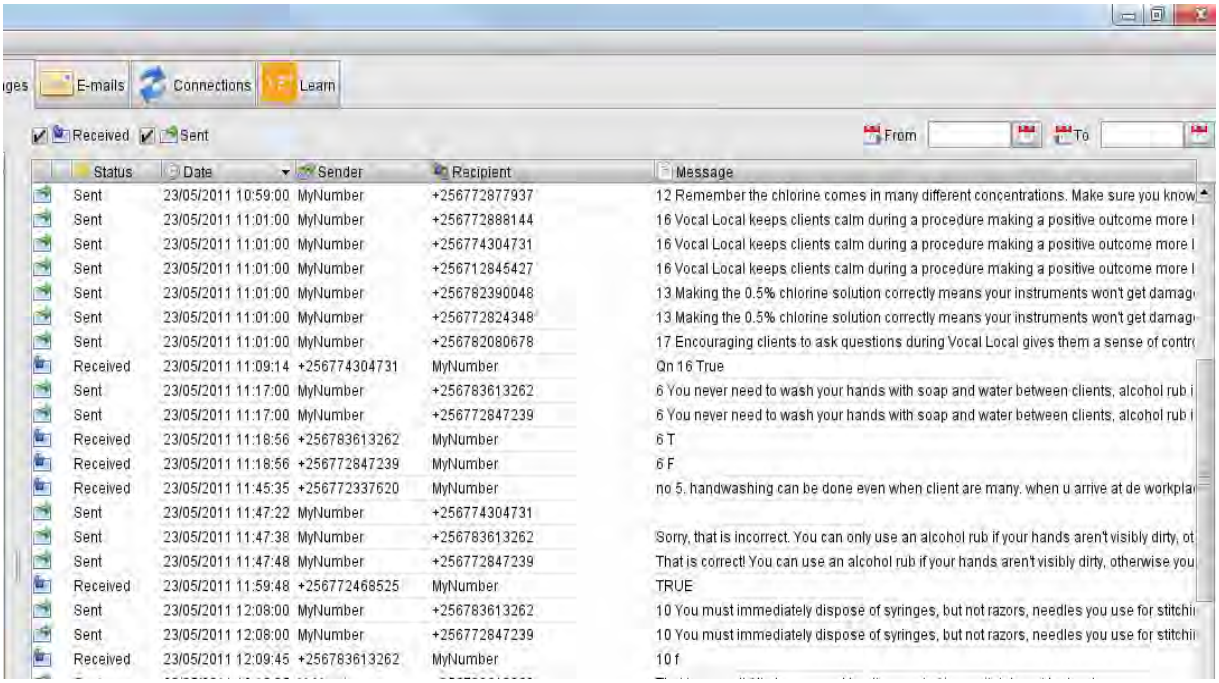
Figure 7: Illustrative Screenshot Assessment Tab



2.10 MONITORING

FrontlineSMS:Learn, like other FrontlineSMS applications, is designed to provide real-time access to information in a dashboard format that shows message status, date, recipient's mobile number, and the content of the message (Figure 8). The MSU M&E Manager reviewed the data on a daily basis to ensure messages were being sent and received as scheduled. Several times over the course of the pilot, the database was downloaded and sent to the U.S.-based project team for analysis. Monitoring activities for the pilot were largely focused on the operational and technical challenges experienced during deployment.

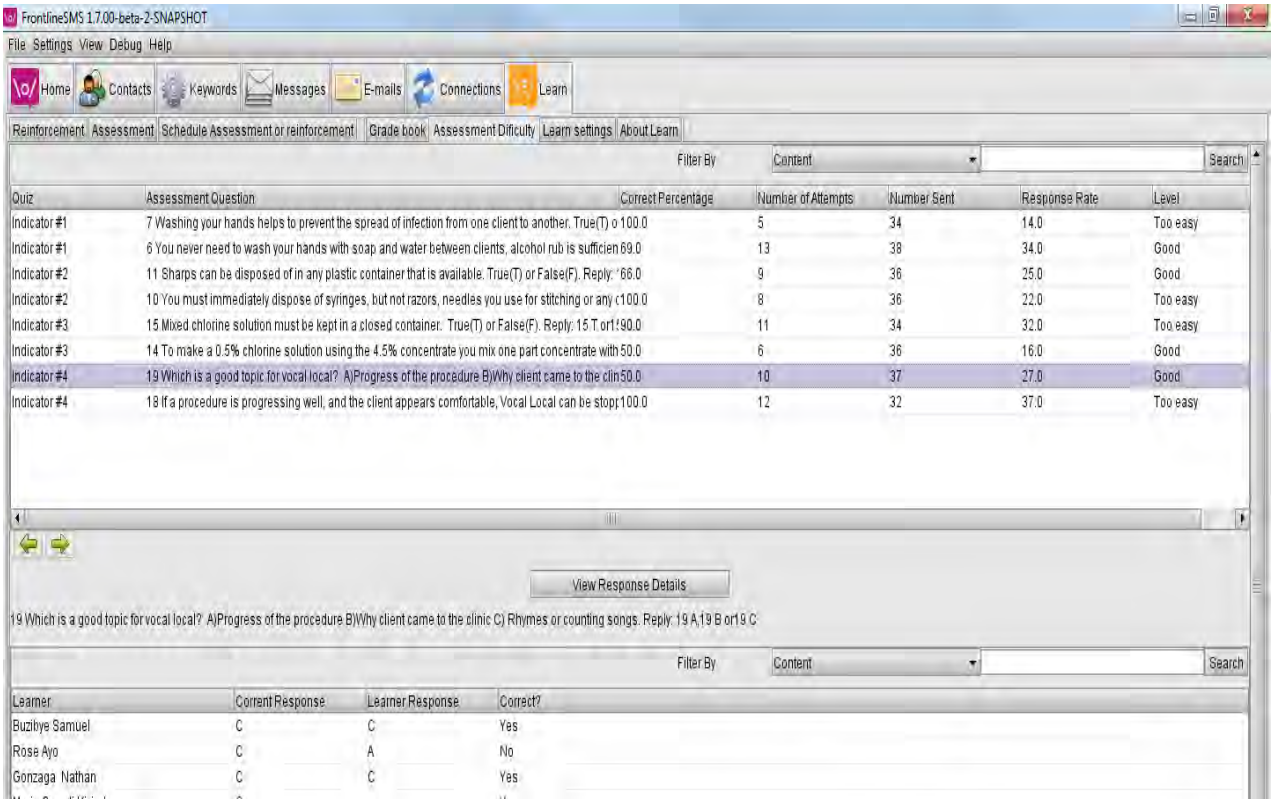
Figure 8: FrontlineSMS Dashboard



FrontlineSMS:Learn is conceived as a tool to not only reinforce learning but also to give supervisors timely access to knowledge gaps among supervisees. This functionality has been developed; the ‒Grade book" report shows an individual learner‘s performance on sets of assessment items grouped by category, and allows one to pull up the details on the questions included in the category and the learner‘s specific responses to them. However, as a beta test of the platform, in an eight-week pilot, there was no monitoring by supervisors of the assessment responses. Future implementations of the platform would include provisions for monitoring the substantive outputs of the assessments, enabling supervisors to identify and target specific topical areas in need of reinforcement or additional training. The platform also provides managers with ability to assess the difficulty of questions, automatically calculated by the software, in order to determine if questions are in need of revision.

Figure 9, the ―Assessment Difficulty" report, allows a user to identify how all learners are performing on specific questions, as well as whether the question may be too easy or too difficult. It also includes detail on the specific answers learners have submitted so trainers know not only what questions learners are getting wrong but also *how* they are getting them wrong.

Figure 9: Assessment Difficulty Report



2.11 EVALUATION

2.11.1 Background

It was the initial intent of the pilot team to conduct a quantitative evaluation of the pilot using existing MSI audit tools to measure the impact of the text message intervention. MSI has instituted a QTA process in all of its country programs, in which regional managers conduct regular audits of clinics and outreach centers using standardized checklists and on-the-job training. During a visit, auditors observe service delivery practices and assign scores of ―0" (not in compliance), ―1" (standard achieved at the end of the visit), or ―2" (in compliance) for each element on the QTA checklist. Categories or indicators include center appearance and upkeep; administration of client records and bookkeeping; team management; adherence to clinical standards; counseling and history-taking; client satisfaction; emergency preparedness; and stock control. In order to minimize the resources necessary to conduct the evaluation of the

SMS intervention and to limit the interference with existing workflows and processes, we sought to leverage the QTA process and data collection procedures.

The original evaluation design included a set of six control and six intervention sites with a mix of center and outreach teams in each. Baseline and endline measures of staff performance would come from the QTA scores. The hypothesis was that improvements in QTA scores would be detected in the intervention sites when compared to the control teams. QTAs were scheduled in January 2011 for the 12 pilot sites to ensure that baseline data were gathered prior to the pilot launch, and were planned to be scheduled immediately following the intervention for collecting the comparison endline data.

Due to several factors, this evaluation approach was reconsidered and revised. Given the scope of the pilot objectives—to field test the concept over an eight-week period—it would have been premature to compare performance of pilot versus control sites. It also became clear that the QTA data would not be usable for an m4QI evaluation. There were delays in obtaining the pre-pilot assessments due to scheduling challenges, the indicators of interest were not fully scored in all the forms, no notes were provided for sites receiving unsatisfactory scores, and the sample number was determined to be too small to detect an effect. Immediately before pilot launch, the team decided to shift instead to a process and implementation evaluation—more practical given the limitations of a small pilot—quantitative analyses of the data generated by the software platform itself were planned.

2.11.2 Qualitative evaluation

The process and implementation evaluation was conducted in July 2011 by Kenwill Consultants, a local firm selected through an RFP process. The purpose of the evaluation was to document project development and implementation processes aimed at generating key lessons and recommendations to inform scaling up processes of the application. For each of the pilot stages, the evaluation answered the following questions:

- What was planned?
- What was actually implemented, and why was it different from what was planned?
- What challenges were faced, and how were these challenges resolved?
- What unexpected opportunities presented themselves, and how did the project capitalize on these opportunities?
- What recommendations are made with regard to scaling out this intervention in other settings?

Finally, the evaluation documented self-reported behavior change related to the text messages received over the pilot period.

2.11.3 Evaluation methodology

A mixed evaluation design was adopted because it offers the most appropriate framework for generating lessons about the project and also showing any behavior change between pilot and control sites as a result of the project. This entailed adopting a case study design (one shot) and a quasi-experimental evaluation design. The one-shot design entailed examining different phases of the pilot project drawing from experiences and insights of staff at pilot sites. In addition, the quasi-experimental design entailed a comparison of the study sites with one control site on the project indicators. It was assumed that the level of knowledge on training topics was the same in all sites, thus selection of four pilot sites and one control/comparison sites was based purely on the basis of convenient access to the researchers.

A total of 37 persons participated in the evaluation, all purposively selected due to their involvement in pilot activities and role played in project implementation. Structured interview tools were developed to solicit feedback from all of the key local stakeholders including:

- MSU Support Office staff (including the country director, training coordinator, regional advisors, and M&E staff);
- Clinical staff at the center and outreach sites (those that participated in the site as well as a single site whose staff were not included in the pilot); and
- The local technology partner that developed and supported the SMS hardware and software.

To draw insights from the project, content analysis of the interviews was carried out using data capture matrices of participant responses to categorize key themes and sub-themes. Observations were also made for physical verification of some of the infection prevention practices and ability of message recipient to use phones to access SMS.

2.11.4 Limiting factors

Qualitative evaluations are valuable inputs to document knowledge acquired from programs, with particular focus on planning requirements, implementation challenges, user experience, and lessons learned. The reliance on qualitative interviews alone without baseline data, which was not available for this pilot, eliminates the ability to draw any conclusions about the effect of the intervention on target indicators. The evaluation was designed to capture provider feedback on how they received, processed, and acted upon the messages in relation to the indicators of interest, to inform future scale-up and implementation.

In addition, the process and implementation evaluation did not include interviews with the SHOPS technical advisor or project management and thus did not have complete information about the pilot conceptualization, technical requirements of the platform, or planning process.

3. RESULTS

3.1 QUANTITATIVE ANALYSIS OF PILOT DATA[14]

This section contains several analyses of the data generated by the use of FrontlineSMS:Learn and collected in its backend database. These are presented for the purpose of illustration, to provide a glimpse into the type of detailed and useful analysis that is made possible through the use of the software platform. However, due to inconsistencies introduced through software bugs as well as a relatively small sample size and dataset, these results do not allow statistically significant conclusions to be drawn.

3.1.1 Message delivery and receipt

From May 19 through July 27, 3,449 messages were sent to project participants with a noticeable spike in deliveries at the beginning of June due to a software bug (Figure10)[15]; 539 messages failed to be sent (a 13.5 percent failure rate) due mainly to a modem incompatibility issue—a ~~-d~~ata-optimized" modem was originally purchased—and insufficient airtime (Figure 11). A total of 251 incoming messages were received from providers with a decrease in rates observed while modem issues were being resolved at the beginning of the project as well as when participants were notified toward the end that evaluations were beginning and the project would soon be coming to an end (Figure12).

[14] Data from pilot locations at Hoima Center and Hoima Outreach were combined in the local dataset, as were data from Masaka Center and Masaka Outreach. Analyses in this section show the combined data for these locations. Results are still representative and comparable to other sites as they are calculated in the aggregate across all staff at a site or within a cadre.

[15] Messages were sent to participants beginning April 27 but it took the team several weeks to identify the computer's operating system (Windows 7) as problematic for platform operations. Once the new operating system (Microsoft Vista) was installed, all previous data from the pilot were lost.

Figure 10: Number of Messages Successfully Sent by Date

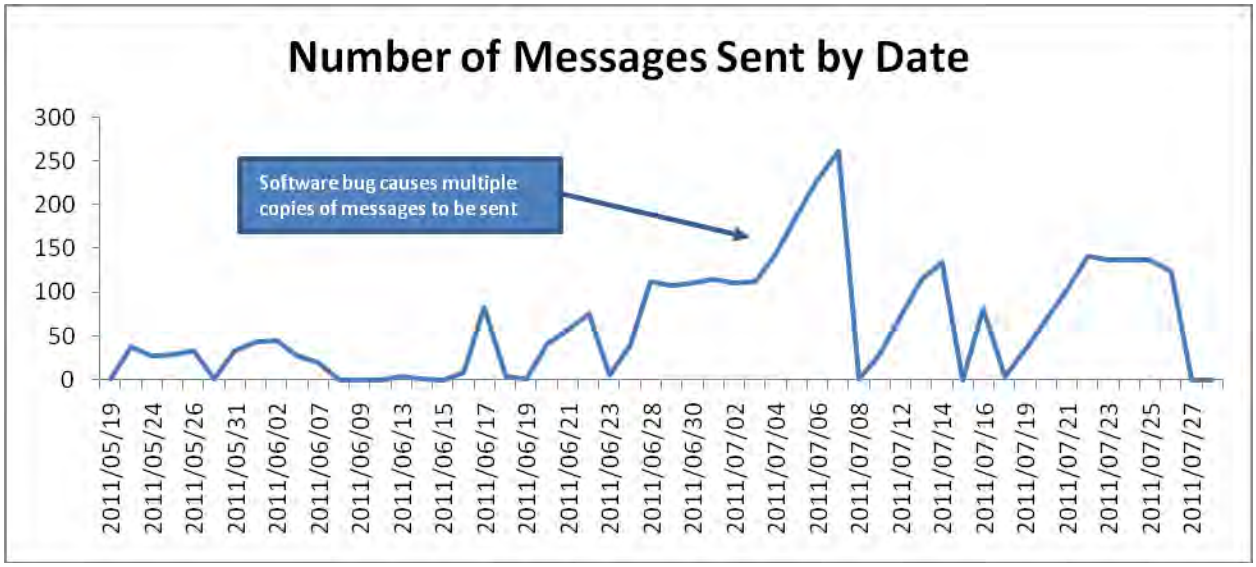


Figure 11: Number of Messages Failed by Date

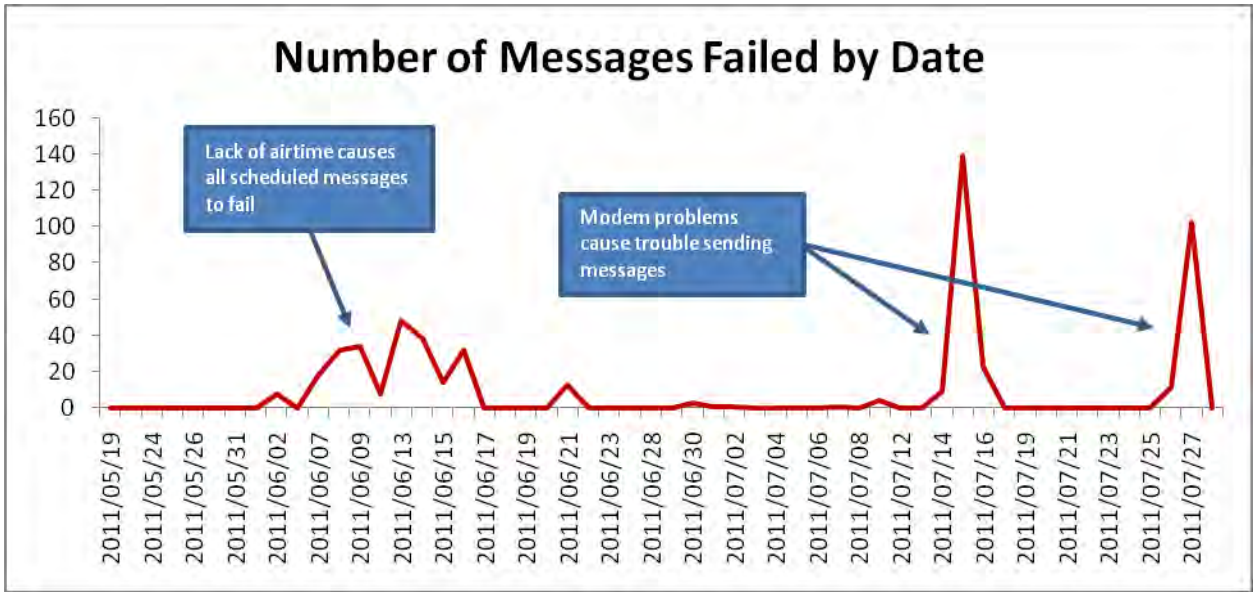
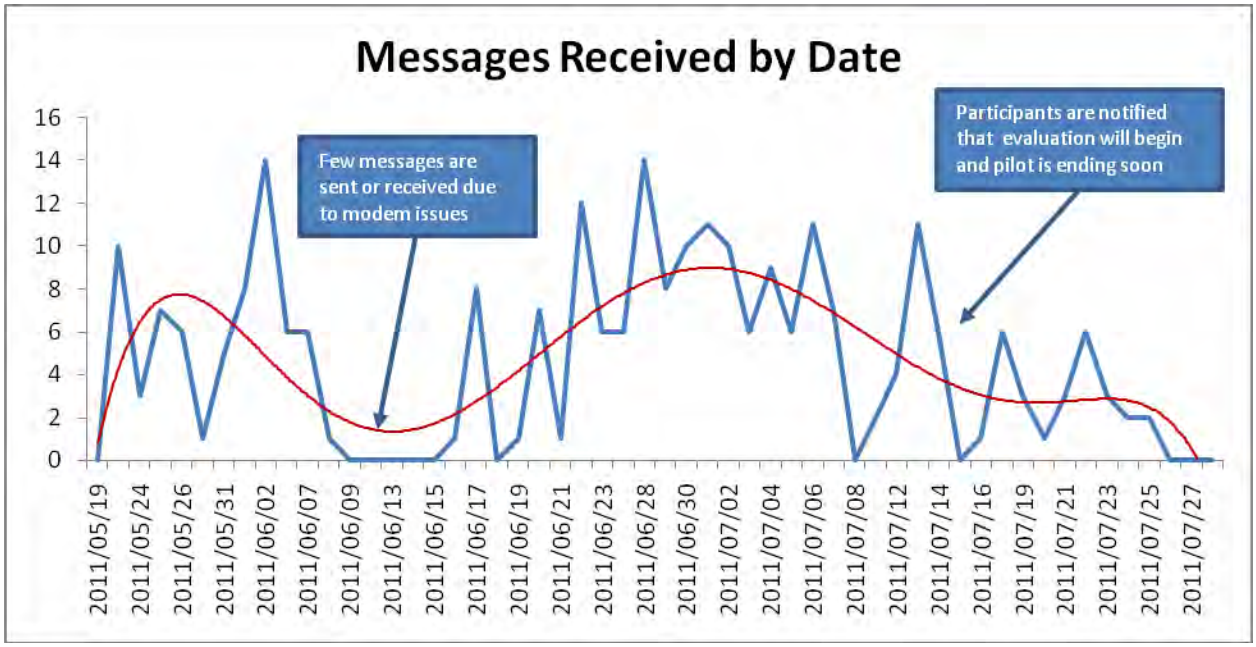


Figure 12: Messages Received from Participants by Date

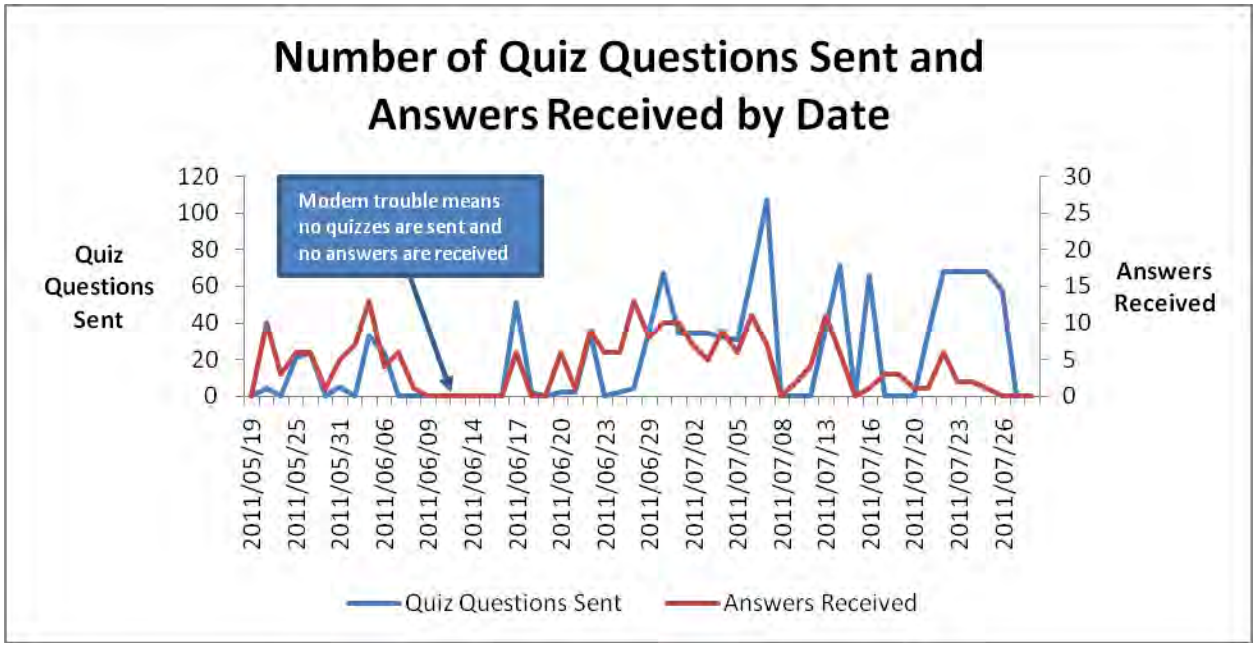


Note: Includes general messages submitted that were not answers to quiz questions.

3.1.2 Message response rate

Active participation is critical to successful learning; however, ensuring engagement in text messaging projects can be a challenge. Figure13 shows the trends over time in quiz questions delivered and answers received. The overall response rate for the pilot was 19 percent. While relatively low, this could potentially be related to learners not always receiving automated feedback—congratulatory for correct answers or remedial for incorrect ones—or repeated quiz questions being received due to software bugs. The common pattern of high initial involvement followed by a rapid decline was not observed in this pilot. In fact, with the exception of periods of inactivity due to technical issues, participation was relatively consistent. When controlling for days when message delivery was problematic, there was no significant difference between the average number of answers submitted per day between the first and second halves of the pilot period (4.7 and 4.8 messages per day, respectively).

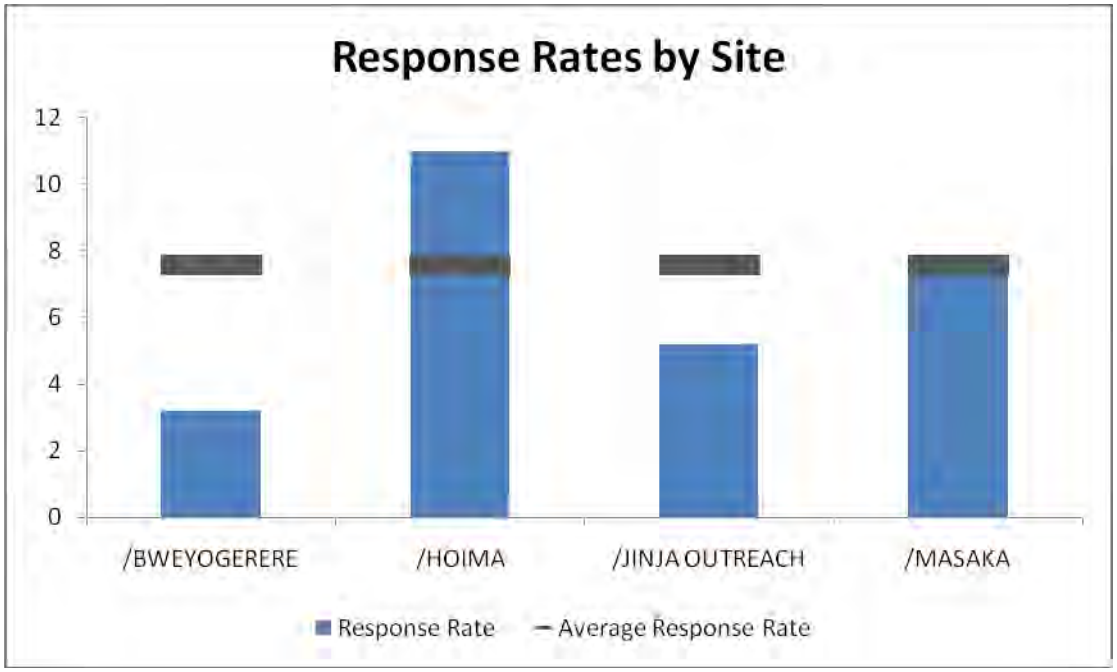
Figure 13: Quiz Questions Sent and Answers Received by Date



Note: The scales for the two value sets are not equal and have been adjusted to facilitate optimal visualization.

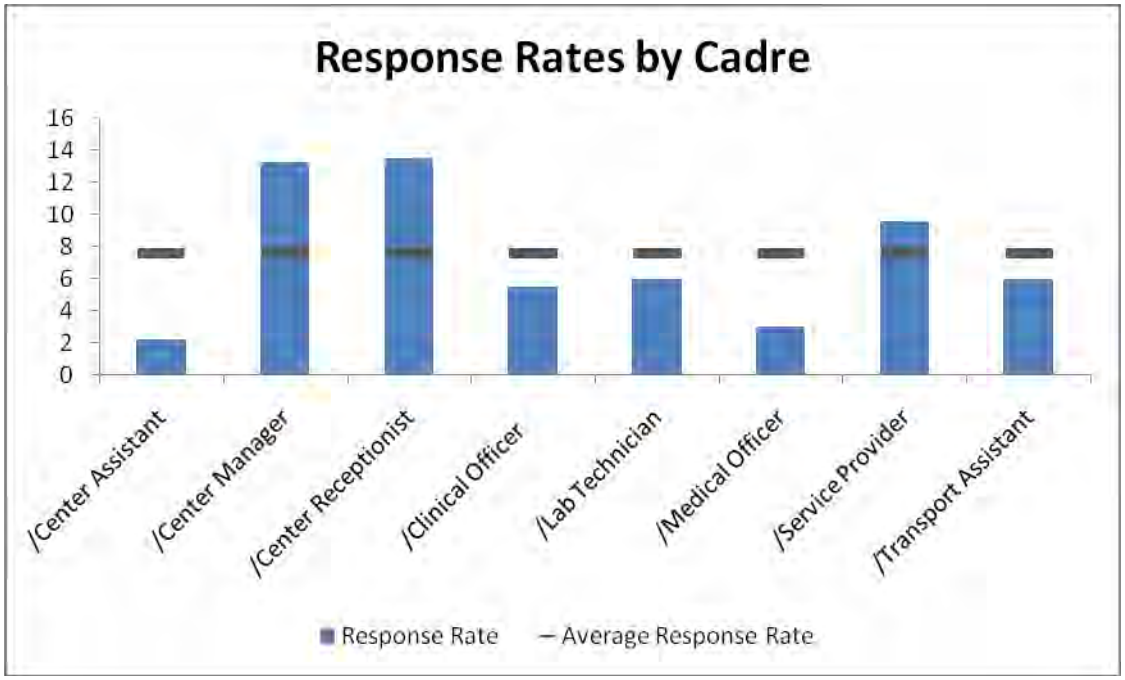
While the average number of sent and failed messages per person remained fairly constant across sites and cadres, the average number of responses—both answers to assessment items as well as general responses to project update messages (e.g., information on the upcoming evaluation)—received from participants showed more variation (Figures 14 and 15). The participants in Hoima were the most active respondents (11 messages per provider), with the receptionists and managers the most active cadres (13.5 and 13.25 messages per participant, respectively). The staff at Bweyogerere were the least active respondents (3.2 messages per participant), with the assistants and medical officers the least active cadres (2.25 and 3 messages per person, respectively).

Figure14: Average Number of Responses Submitted per Person by Project Site



Note: The average across all sites is provided to indicate sites with relatively high or low response rates.

Figure 15: Average Number of Responses Submitted Per Person by Cadre



Note: The average across all cadres is provided to indicate cadres with relatively high or low response rates.

3.1.3 Response message formatting

In order for the automated functions of FrontlineSMS:Learn to work properly (e.g., responses to correct or incorrect answers and generating reports) answers submitted by learners must be specially formatted using the number of the question and the letter corresponding to the answer (A, B, or C for a multiple choice question or T or F for a true/false one). Given that there is only one way to correctly format a response[16] compared to the large number of ways that a message can be incorrectly formatted, the expected percentage based on chance alone would be incredibly small; however, 66 percent of all assessment responses were correctly formatted despite participants not having received any formal orientation or training. In fact, the five-period moving average (chosen to reflect the five-day work week) was consistently above 50 percent for the entire second half of the project, rising to 80 percent at the very end (Figure 16). A number of steps were taken to reduce formatting errors including revising the code to accommodate more response variations (e.g., ~~6~~ True" or ~~6~~.T" in addition to the expected ~~6~~ T"), and sending out several mass messages calling attention to the need to type the question number first in the reply.

The percentage of correctly formatted assessment responses varied significantly across sites and cadres as shown in Figures 17 and 18. The Hoima teams achieved the highest rate of correct formatting at 83 percent, calculated from a reliable sample size (the staff were active responders with an average of 11 answers submitted per staff).

[16]As originally designed, correct responses begin with a number, are followed by a space, and then contain the letter corresponding to an answer choice. The software was later modified to accept a range of potential variations (e.g., submitting the word False instead of simply the letter F).

Figure 16: Percentage of Assessment Answers Formatted Correctly by Date, with Five-Day Moving Average

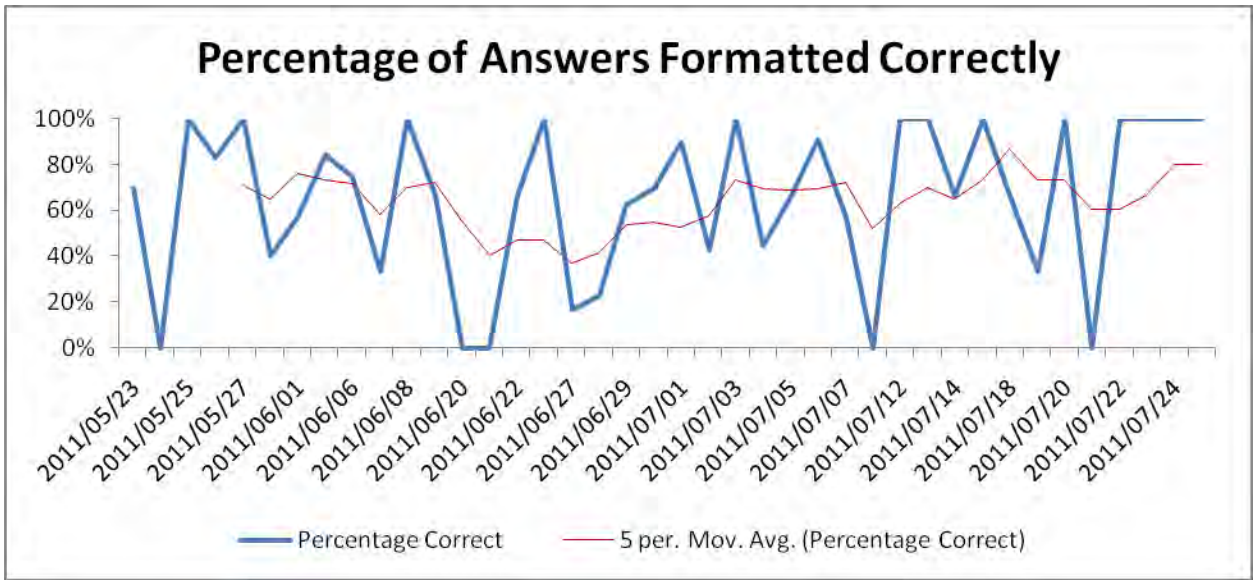
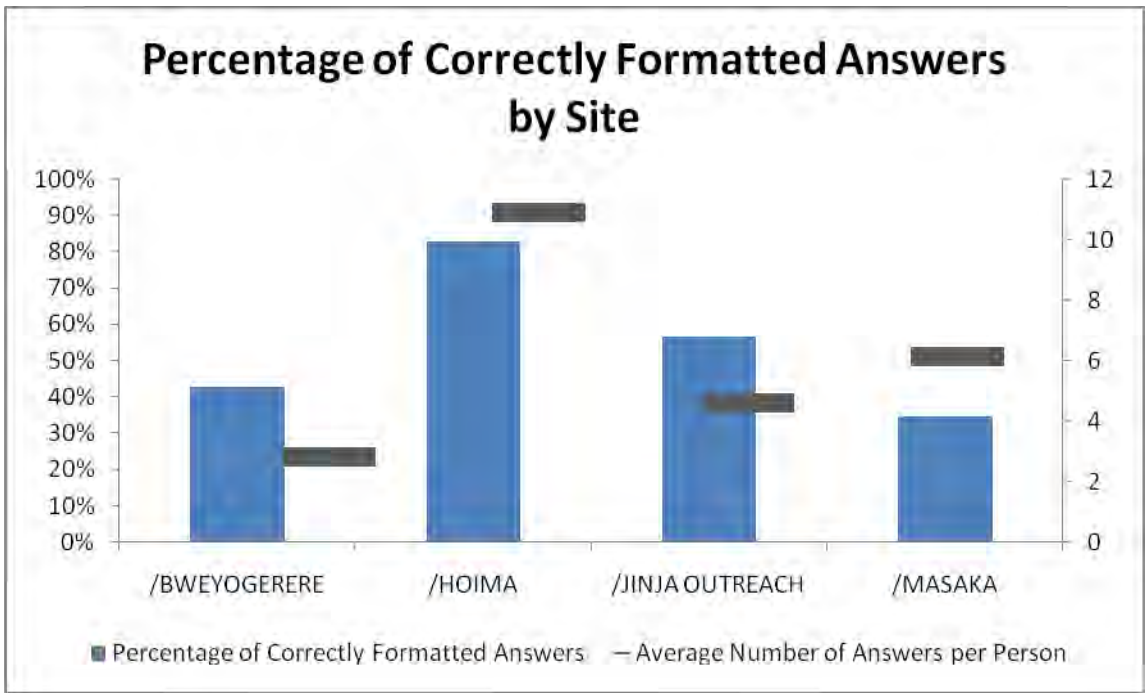
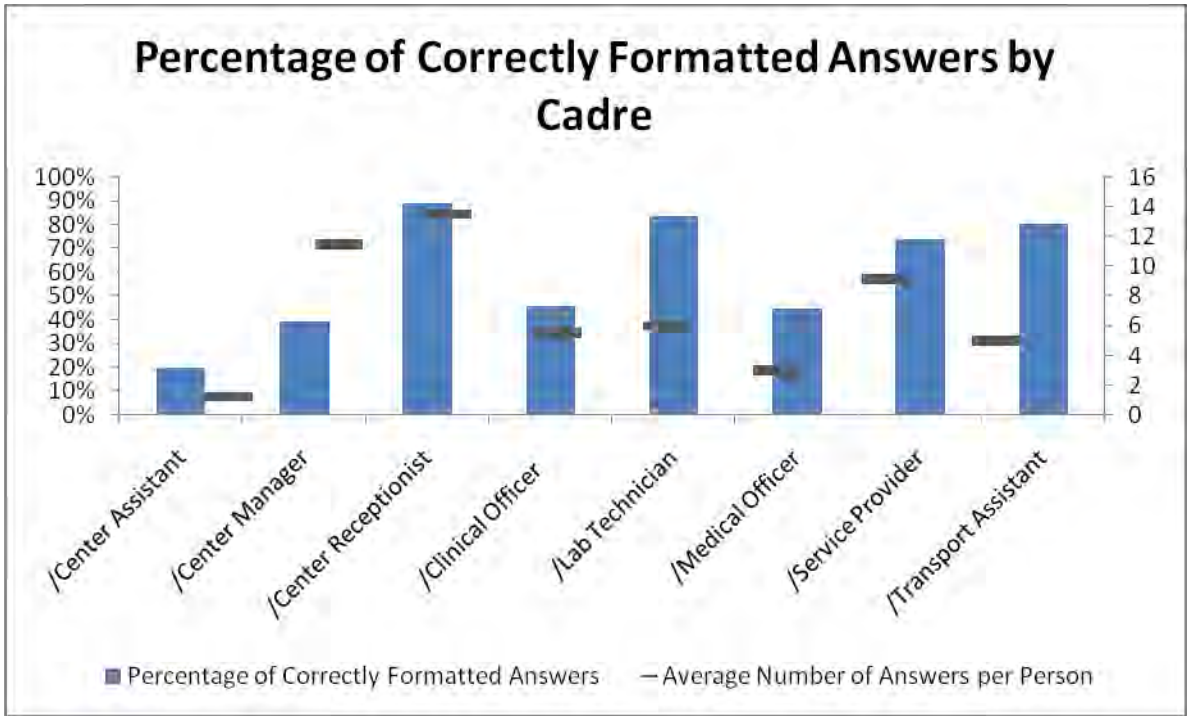


Figure17: Percentage of Correctly Formatted Assessment Responses by Project Site



Note: Secondary axis shows average number of responses per person to indicate sample size for calculating each percentage and confidence measure.

Figure 18: Percentage of Correctly Formatted Assessment Responses per Person by Cadre



Note: Secondary axis shows average number of responses per person to indicate sample size for calculating each percentage and confidence measure.

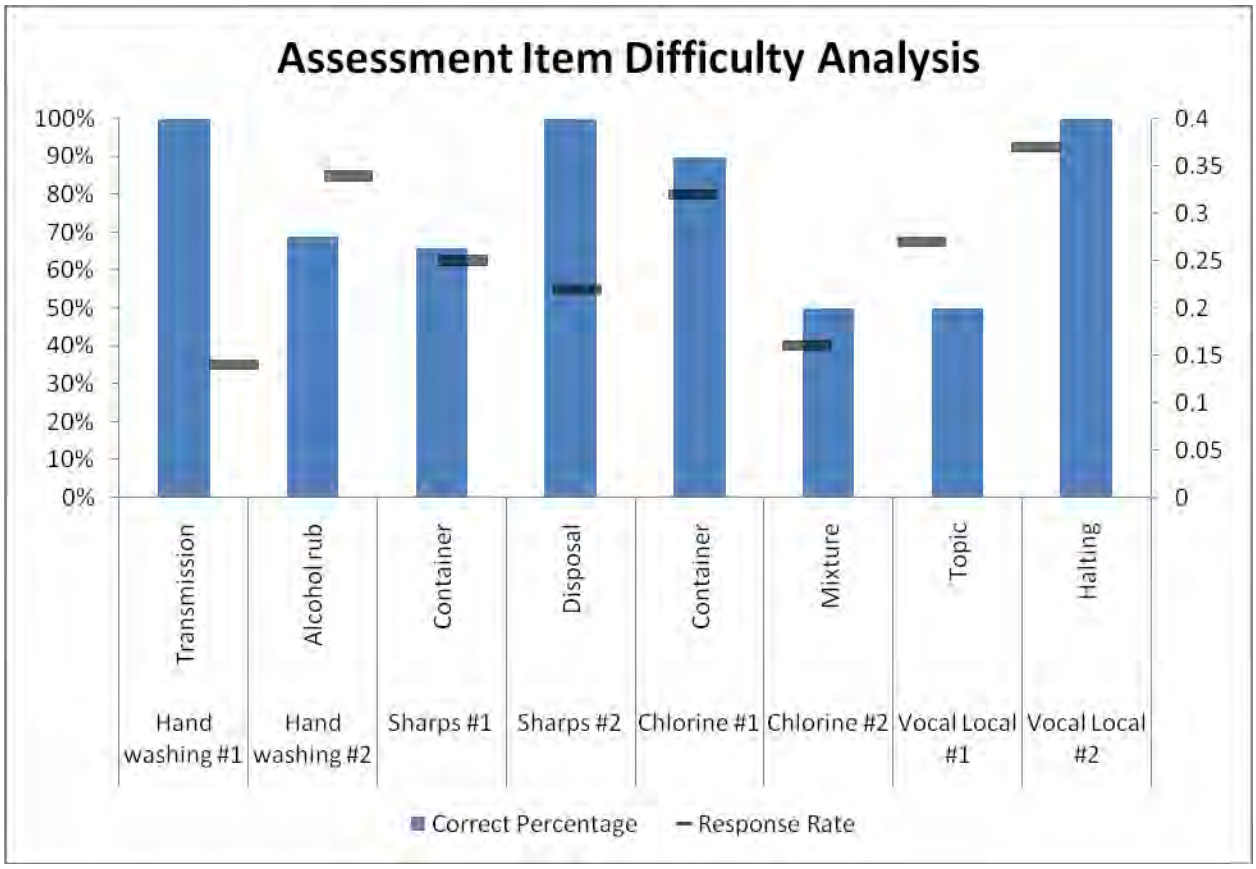
3.1.4 Knowledge gaps and question difficulty

Given the limitations mentioned previously, the data do not support strong conclusions about knowledge gaps among pilot participants; however, the general pattern of responses may point to underlying trends. Those learners who did respond and did so incorrectly likely did not have mastery of the content, or found the questions confusing. The participants who did not respond may not have done so due to unfamiliarity with the topic and a reluctance to answer.

The item difficulty analysis for each of the eight assessment questions is presented in Figure 19. Figures 20 – 23 provide the grades and average number of responses for each indicator across all project sites and cadres. All responses were correct for four of the questions, demonstrating knowledge that vocal local should not be stopped during the procedure; that chlorine solution should be kept in a closed container; that washing hands interrupts the disease transmission cycle; and that all sharps must be immediately disposed regardless of the kind. As for incorrect responses, providers were not completely certain when it was appropriate to use alcohol hand rub versus washing hands with soap and water; appropriate topics for vocal local; what made for an appropriate sharps container; or how to properly mix the chlorine solution to get the required concentration.

Based on this analysis, those questions on which participants did well could either be removed or edited to be made more difficult or to target a different element of the indicator. For those items that caused difficulties for providers, there are two potential next steps: training coordinators could follow up with the provider directly (via phone or during a supportive supervision visit) to reinforce the correct knowledge and behaviors, and instructional designers could modify existing course content to place more emphasis on these areas for future training.

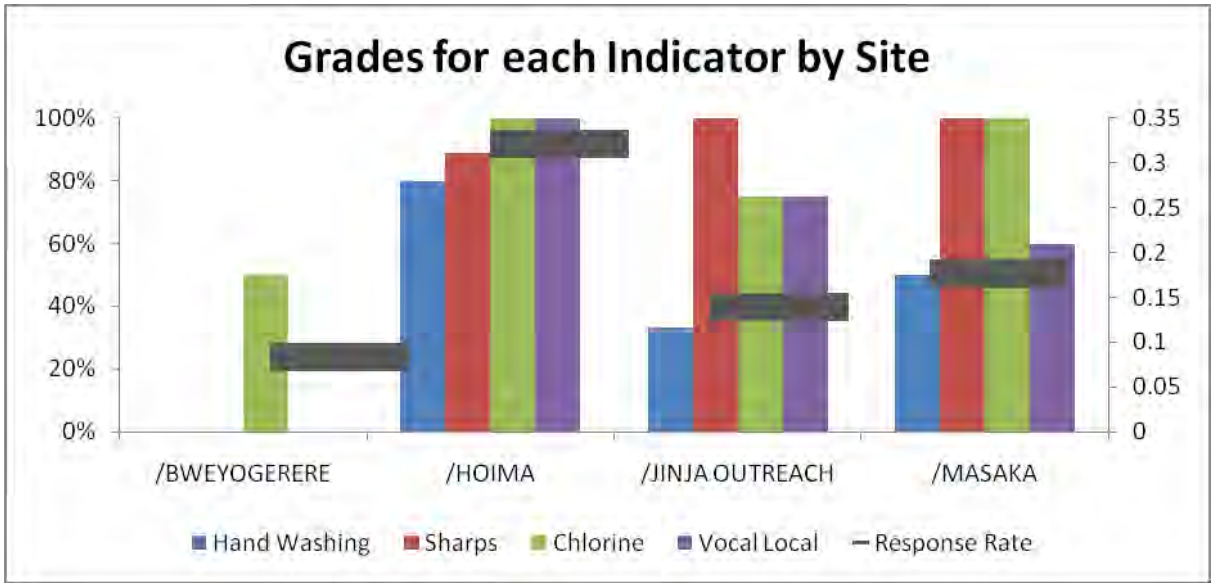
Figure 19: Difficulty of Assessment Items Represented by the Percentage of Correct Answers Received



Note: Response rates are shown to indicate sample size for calculations and confidence measure.

In Figure 20, grades are shown for each indicator giving a high-level indication of performance across all project sites. Both questions for an indicator are combined in the analysis so responses to individual questions are not reflected. Only submitted answers are included in the analysis (i.e., a lack of an answer does not affect the grade). The secondary axis shows the response rate to indicate sample size and confidence level.

Figure 20: Grades for Each Indicator by Project Site



In Figure 21, grades for each indicator are displayed to give a high-level indication of performance across all cadres. Both questions for an indicator are combined in the analysis so responses to individual questions are not reflected. Only submitted answers are included in the analysis (i.e., a lack of an answer does not affect the grade). The secondary axis shows the response rate to indicate sample size and confidence level.

Figure 21: Grades for Each Indicator by Cadre

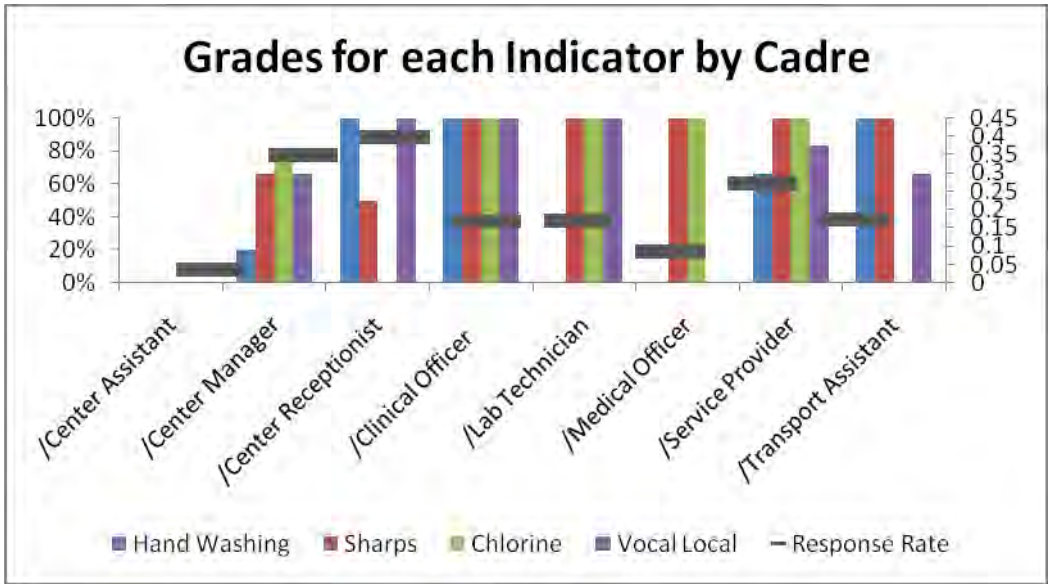
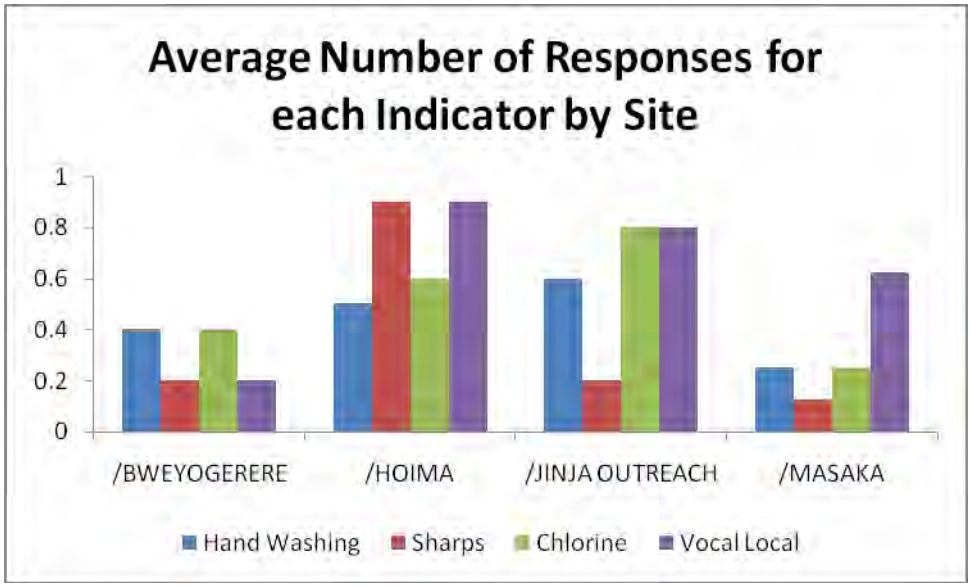


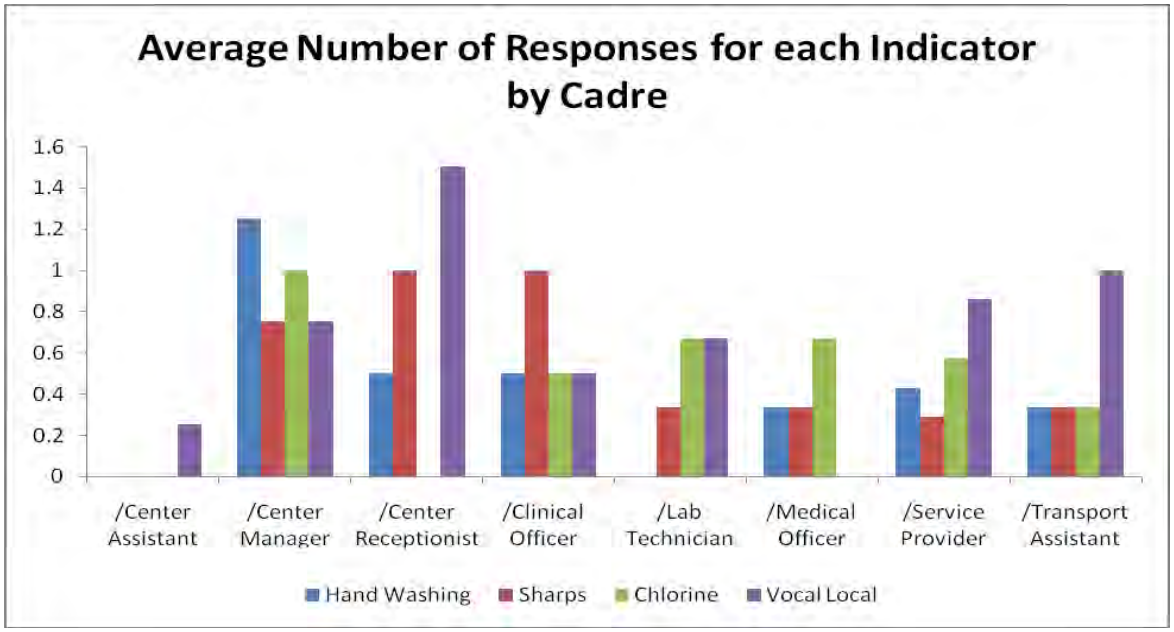
Figure 22 below provides the average number of responses for each indicator giving a high-level indication of participation across all project sites. Both questions for an indicator are combined in the analysis so responses to individual questions are not reflected. Low levels of participation can potentially suggest topics providers find difficult, or questions that are unclear.

Figure 22: Average Number of Responses for Each Indicator by Project Site



In Figure23, the average number of responses for each indicator are shown, giving a high-level indication of participation across all cadres. Both questions for an indicator are combined in the analysis so responses to individual questions are not reflected. Low levels of participation can potentially suggest topics providers struggle with or questions that are unclear.

Figure 23: Average Number of Responses for Each Indicator by Cadre



3.2 QUALITATIVE ANALYSIS OF PILOT

3.2.1 Message clarity and relevance

The process evaluation found that the messages were generally reported to have been clear, understandable, informative, and relevant to the recipients. Sample feedback from participants:

> *"The messages were very clear and understandable. If you had an answer you would just respond. I never received any staff seeking clarification on any particular message."* **Center Manager/Outreach Supervisor**

> *"Messages were educative and performance related…"* **Laboratory Technician**

> *"The messages were just reminders to what we already knew."* **Outreach Leader**

> *"Messages had good information since they were about what we do. Messages remind us of what must do to avoid infections and improve service quality."* **Transport Assistant**

> *"I gave a wrong response to one question and I received instant reply/feedback. The feedback was very clear."* **Transport Assistant**

Feedback also indicated areas for improvement, and instances where the content was confusing or dull. Users commented that the texts needed to be more captivating and engaging. Some of the factors contributing to lack of clarity were brevity of messages, and training and job orientation history of recipients. The quiz format with a need to recognize true and false statements was unfamiliar to some. Clarity of message content and purpose would be improved through stronger training orientation and/or follow-up by supervisor in future deployments. Although an effort was made to select content areas directly relevant to all staff positions, there were also instances in which a particular staff function had no such role, such as lab technician or property caretakers who are not involved in providing vocal local during procedures.

> *"Sometimes the messages were not clear. You could read the message and fail to understand its main issue due to the way it was presented (brief)."* **Service Provider**

> *"I did not understand other messages since I have not yet been inducted and therefore I am not knowledgeable on MSI quality standards."* **Transport Assistant, Outreach Team**

> *"These people have been sending messages but I have not been replying to them. They bore me."* **Pilot Participant**

> *"Some of the messages were confusing."* **Center Manager**

> *"One staff told me s/he turned away a client so that s/he could wash hands. This is not the type of action recommended through the messages; there might be some misunderstanding."* **MSU Support Office**

3.2.2 Self-reported behavior change

Pilot users self-reported better adherence to infection prevention protocols and vocal local pain management technique as a result of the text messages received; however, conclusions drawn should be tempered given the fact that there is no baseline available for comparison and there was no independent verification made through observation. Self-reported improvements in adherence to clinical standards could also be attributed to a social desirability bias in which respondents naturally tend to inflate their ‗good' behaviors. Nonetheless, interviewees shared promising statements what they learned from the messages.

3.2.2.1 HAND-WASHING PRACTICES

Pilot users stated that following receipt of the messages, they washed hands more frequently, including on arrival and departure, and after touching each client. Sample responses include the following:

> *People are more serious with hand-washing. The project remained as a constant motivator of hand washing."* **Outreach Manager**

> *"The messages helped me to value hand-washing because use of hand rubs does not completely eliminate germs."* **Outreach Service Provider**

3.2.2.2 CHLORINE SOLUTION PREPARATION

Pilot participants mentioned greater consistency in reading of the chlorine solution labels to ascertain concentration levels, changing their perception that "chlorine is chlorine." Improved practices were reported as follows:

> *"In most circumstances things are taken for granted when not reminded. I knew chlorine was mixed in a ratio of 1:6. I did not know that there was information on concentration and solution preparation guidelines."* **Health Center Receptionist**

> *"I now make sure that before I prepare the solution, I must ascertain concentration of the chlorine by reading on the manufacturer's label."* **Health Center Lab Technician**

3.2.2.3 SHARPS DISPOSAL

The messages on sharps disposal emphasized the importance of immediate and proper disposal. Staff at pilot sites self-reported higher levels of awareness and vigilance on the potential risks of infection resulting from improper sharps disposal. Feedback from the field is presented below:

> *"Messages have created awareness, though some of us may lack the culture of doing the right thing. Staff are now aware that different waste should disposed in different waste containers. We have different containers for different wasters (medical wastes, sharps, and general waste)."* **Lab Technician**

> *"We used to have boxes which were not puncture proof but now we have ones which are puncture proof."* **Clinical Officer**

3.2.2.4 VOCAL LOCAL

The majority of staff at pilot sites reported improved ability to conduct vocal local during procedures as result of deployed messages. Staff recounted having acquired different abilities such as generating and engaging clients on suitable stories/topic, keeping the client at ease, and non-attendance to phone calls/messages during the procedure.

> *"There are some topics which I am not supposed to bring up during vocal local."* **Clinical Officer**

> *"I used to continue with vocal local even when the client was feeling pain but now I pay attention to the response from the client."* **Service Provider**

> *"I see some changes during a procedure. The person who is doing VL [vocal local] normally acts as an assistant. The clients are fully engaged on vocal local until the procedure is complete. No receiving phone calls during VL."* **Clinic Manager**

3.2.2.5 INFORMATION-SHARING AND USE OF TRAINING REFERENCE MATERIALS

In addition to the self-reported behavior changes aligned with the four indicators, the project also recorded outcomes related to increased team interaction on issues related to quality of service. Pilot participants mentioned more staff consultation regarding the text topics, instilling a culture of inquisitiveness. The pilot was described as promoting

team learning and research on questions related to the texted questions, and increased use of training reference manuals and clinical guideline documents.

These reported changes in culture toward more inquisitiveness and appreciation for standards was reflected in reported changes in behaviors not directly addressed in the messages. Interviewees reported that as a result of the pilot, sharps cans were more clearly labeled, disposal towels were introduced instead of shared towels at hand-washing stations, and use of mobile phones during procedures ended. In other examples, clinical teams took actions to reduce barriers to adherence of the indicators. These included distributing more IEC (Information, Education and Communication) materials throughout the clinic to remind staff about proper hand-washing, and placing chlorine solution at more locations in treatment and procedure rooms. In one clinic, new hand-washing facilities were installed at more distribution points as a result of the text messages.

Photo Showing New Hand-washing Facility at Hoima Center

3.2.3 Pilot implementation

The pilot experienced numerous technical problems, resulting in several days of troubleshooting, interrupted service, reloading of content, and the need to keep pilot users informed. Below is a summary of these challenges and their resolution:

- **Choice of operating systems**: Problems occurred with the automated delivery of messages, particularly when the computer was in screensaver mode. The software developer collaborated online with the FrontlineSMS community and learned that others had experienced problems using computers with the Windows 7 operating system. Messages were sent manually for three weeks until a switch was made to Windows Vista. As a result of the switch in operating systems, all pilot data from April 25 to May 18 were lost; therefore, analysis of the results include data beginning with the restart of message delivery on May 19.

- **Modem, SIM and airtime challenges**: The pilot experienced numerous problems with the modem that transmits and receives the SMS texts. For a portion of the pilot, the system did not work because the modem used was installed with a data card instead of an SMS SIM card. Even after the SIM card was replaced, problems continued until it was determined that the modem itself was faulty. Once the proper modem and SIM card were in place, another round of missed messages occurred because the modem‘s airtime was scheduled to expire after 30 days, unbeknownst to the pilot team.

- **Software bugs**: Challenges with the scheduling function were identified and addressed throughout the pilot. A time verification step created problems when the computer was turned on or off, causing a millisecond gap in the software and computer clocks. This step was eliminated from the code. At the completion of the pilot, another bug was identified and fixed that had caused the same message to be sent (erroneously) on multiple consecutive days. MSU‘s Pilot Manager kept users informed about efforts to address technical problems during the pilot with text message apologies, but even these were unintentionally transmitted multiple times. This created frustration for some pilot participants:

> *“In less than 20 minutes, you could receive like five messages containing the same message.”* **Laboratory Technician**

> *“We could get same message four times. I would rather have different messages at different intervals. Some messages were too often. Why couldn’t they schedule different messages for different days.”* **Clinic Manager**

- **Reversal of AM and PM in message scheduling:** In a technical analysis conducted at the end of the pilot, it was discovered that many messages sent in the middle of the night were not due to a software bug but rather errors made in entering the scheduled delivery. A choice must be made for AM or PM of each scheduled batch, and these were inadvertently overlooked. As a result, providers were getting messages at 10 PM instead of 10 AM or at 2 AM instead of 2 PM. Several participants commented on how this was disruptive and annoyed their spouses.

> *"The mode was good. At first, receipt of messages at night was disturbing to my husband but I had to explain to him where the messages were coming from and the purpose."* **Service Provider**

4. LESSONS LEARNED

4.1 NEED FOR TROUBLESHOOTING RESOURCES

Consistent with the purpose of a pilot, the m4QI project exposed various operational and technical challenges. These were instructive events for future deployment. The challenges included failure of messages to be delivered due to incompatibility of the software with a common operating system, purchase of an incompatible modem, software bugs that resulted in multiple deliveries of the same message, incorrect scheduling due to selection of AM instead of PM for message delivery, and message failures due to length beyond 160 characters.

When conducting beta tests of new software programs or implementing any technology-supported intervention, there is need for dedicated human resources to provide support solve technical problems. The extensive troubleshooting required more resources than had been budgeted. Part-time MSU staff resources allocated to support the pilot, already stretched by heavy workloads, were further impacted by turnover of key positions, protracted illnesses by several key personnel, and lack of clarity regarding programmer‘s role in supporting the pilot.

The lesson learned is to expect the unexpected when implementing mobile applications. The m4QI pilot introduced new behaviors on a new technical platform among new partners working across three continents. Pretesting of the platform with a small group of providers was truncated from a week to a day due to unexpected office closures. Time cushions should have been planned to cover delays. During the eight weeks during which the service was implemented, there were unexpected office closures due to street protests that shut down parts of Kampala, and power outages on the days planned for pretesting the service.

4.2 WEAKNESSES IN PLANNING AND STAKEHOLDER COMMUNICATIONS

The m4QI pilot would have benefitted from more formal communications among a broader group of stakeholders within MSU, including wider circulation of project work plans, budgets, and pilot overview materials. There was no formal internal communications plan for the team, based on an expectation that, given the small number of m4QI core team members, informal use of emails and calls would best serve the project aims. This was a weakness of the pilot, especially given turnover in key staff positions (changes in MSU Operations Director and Research Director). The project Orientation Talking Points could have been better shared and made more widely available to project stakeholders, and additional background materials socialized with project stakeholders. .

This resulted in missed opportunities for building internal champions and support for the pilot. The Process Evaluation highlighted that other than the handful of MSU staff directly involved in pilot design and implementation, many support office staff had no understanding of and appreciation for the pilot‘s objectives and design. This was particularly true for MSU‘s regional managers, who were in regular contact with pilot participants, but had limited participation in or ownership of the pilot. Feedback from the regional managers highlighted this missed opportunity to get their input and support orienting staff during implementation.

> *“I would expect the regional manager to know more about the project, what it does, review the documents, and get involved such that I can support the pilot users.”* **Regional Manager**

One factor contributing to the isolation of the regional managers from the pilot was based on upon the decisions related to evaluation process. As described above, during initial pilot planning, the intent was to use routine MSI audit forms to collect baseline and endline quantitative data to compare pilot and control sites, which are conducted by the regional managers. To maintain maximum neutrality and objectivity in regional manager scores for targeted behaviors at the pilot and control sites, no effort was made to enlist them as advocates for the pilot objectives. This factor became moot when a quantitative evaluation was determined not to be useful for pilot evaluation and at that point, regional managers should have been given a detailed briefing.

Other communications-related problems occurred because of confusion over what expenditures were approved in the m4QI budget, leading to delays in acquiring airtime needed in the middle of the pilot. This highlighted the need for more frequent communications on budget and invoice processing procedures, which had not been fully clarified for the MSU finance staff. Changes made during pilot implementation were also not well-communicated, such as switching from a quantitative evaluation to a qualitative evaluation, and prepayment of airtime subsidies for response text messages.

The introduction of mobile learning initiatives should begin with an organization-wide orientation to the purpose and expectations. Efforts to mainstream new approaches to training and assessment require shared understanding and active input from all parts of an organization. An inclusive process for content development and analysis of SMS-based training programs particularly with quality assurance managers will improve program acceptability and success.

4.3 INSUFFICIENT PARTICIPANT TRAINING AND ORIENTATION

Plans to orient pilot participants—involving face-to-face orientation for center and outreach team managers from pilot sites who would then cascade the training to their staff—were not implemented as intended due to scheduling challenges. Follow-up instruction through email and phone calls to the managers came after the pilot had started and provided insufficient understanding and detail about how to prepare staff for the pilot activity. As a result, many pilot participants reported having no idea why they were receiving work-related text messages, who they were from, or what they were expected to do.

> *"It was a great idea but they needed to talk to staff. The first messages were neglected or deleted immediately."* **Clinical Officer**

> *"The people involved did not understand the bigger picture. The level of conceptualization by service providers was very low."* **MSU Support Office**

The Project Manager should have revised the pilot schedule to allow adequate induction of the center managers. Instead the pilot was launched without this crucial phase, with many participants receiving messages before being briefed on their purpose and what was expected of them. The confusion of pilot participants as to why they were receiving messages likely contributed to low response rates, especially in early weeks. When encouraged by their center managers to reply to the messages, they did so, but they lacked the context of what the messages were intended to accomplish. Formatting errors in sending reply messages could have been reduced by ensuring users were informed before receiving messages, delivering automated feedback for incorrectly formatted answers, and providing regular reminders of correct formatting. Pilot orientation materials were needed well before the start of the pilot, by all those participating.

4.4 NEED FOR PREPAID AIRTIME SUBSIDIES

During pilot planning, it was assumed that due to the small scale of the pilot (requiring participants to reply to two SMS assessment questions per week for eight weeks), participants would use their own airtime for the 16 text messages, with the airtime to be reimbursed at the end of the pilot. Lack of prepaid airtime was in fact a barrier to participation. The lack of prepaid airtime was exacerbated by the gaps in participant orientation to the pilot, with some not aware that the project intended to reimburse them after the pilot. During a check-in call with random pilot participants, several commented that unless they were provided with airtime prior to receiving quiz questions, they were less likely to respond, although this attitude was not reflected in the quantitative response data.

The project explored the options of procuring reverse billing services for SMS received from the pilot participants but the service provider indicated that it was not available for the SMS service used by the project. The issue was solved by making individual cash transfers to the center and outreach team managers for weekly distribution to their staff for use in purchasing airtime to cover the costs of the SMS replies.

Recommendations for future applications include budgeting for airtime costs for worker participation, and prepayment in advance of use. Options offered by mobile operators, such as reverse billing (to charge the service host for incoming responses), should be explored if available or remote ~~to~~pping up" of airtime.

5. CONCLUSION AND IMPLICATIONS FOR FUTURE APPLICATIONS

The m4QI pilot produced a vetted process and software tool that can be replicated globally to improve service delivery in low-resource settings. It allows trainers to manage the delivery of reinforcement and assessment messages to providers, and to make data-driven programmatic decisions for supportive supervision and follow-up training. The promising results of the m4QI pilot regarding self-reported behavior change support expanded applications with larger-scale populations, in additional countries and across a range of provider training needs. The SHOPS project will actively disseminate the pilot process and lessons learned through its online channels and those of its partners, and promote key findings and generate new collaboration at global conferences and forums.

The SHOPS project is currently identifying an appropriate market in which to scale up the mobile learning platform, to target loosely networked family planning providers with limited access to clinical skills-development resources. A key objective of the next iteration will be a rigorous outcome evaluation to measure effectiveness on provider performance. This phase will also examine the cost-effectiveness of the intervention to support sustainability.

The FrontlineSMS:Learn software will be made available through the main FrontlineSMS website for free access to any organization seeking to deploy text-based performance improvement interventions. The platform is well-suited for use by organizations working in limited resource environments to address any content area, with any size group of learners. While designed for health workers in low-resource environments, the platform can be used for any population in which there is ongoing need for information and education. For example, patients could be automatically surveyed with text questions timed to their medication protocols, to target misinformation about dose and duration, and provide immediate remedial information and encouragement to adhere to the treatment prescribed.

The FrontlineSMS:Learn platform is designed to build on existing training or educational programs, as the 160-character limitation of text messages is not suited to presentation of comprehensive content such as would be available through web-based elearning tools. The mobile learning platform and process developed in this pilot is not designed for large data collection or data management needs better served by higher-end phones or SMS tools using structured forms.

The FrontlineSMS:Learn platform is intended to be an iterative platform that other organizations will utilize and adapt for a wide range of applications. It is expected that many current users of FrontlineSMS will be able to adapt the FrontlineSMS:Learn functions of assessment and targeted follow-up for their customized learning needs. Because FrontlineSMS:Learn is an open source project, the code can be adapted to add functionality to suit education/training, performance improvement, and behavior change needs in other programs. Among the new features identified during the pilot for future

enhancements to FrontlineSMS:Learn are creation of a peer-to peer network that can facilitate the sending and receiving of texts to specific cohorts within a larger population, additional and more robust reporting features, and the ability to create a course template with predefined message schedules that could be assigned to groups of users or that a user could register for via text message.

Annex A: Framework for message development

	Indicator #1 **Team members wash their hands BEFORE and AFTER examining or providing a service for every client.**	**Indicator #2** **Sharps are placed in a sharps container immediately following use.**	**Indicator #3** **The 0.5% chlorine solution is prepared according to recommendations.**	**Indicator #4** **Vocal local is maintained throughout the procedure.**
Why is this indicator important?	Reduces spread of infection	Pricking is number one source of blood-borne infections	Reduces spread of infection Destroy some micro organisms	Supports de-medicalized environment of MSI Diversion therapy
Why is this indicator not regularly met?	Too busy Too many clients, trail off over time Start on time, end on time Don‘t be afraid to turn away clients; tell them when you‘ll be returning (possibly on the weekend or maybe not until next week or month) People get tired and don‘t find it important	Sharps container gets too full, not emptied regularly Sometimes wrong type of container is used (not stiff enough material). If container is there, rare that won‘t be used. There are three kinds of sharps, needle with syringe is generally placed right away in container. The other two sharps are more the problem (surgical razor, needle for stitching).	Chlorine comes in many different concentrations but people assume they know Govt-issued concentrate changed its chlorine last year; sometimes it is 3.5%, sometimes 4.5%. Also, folks have forgotten why they need to read container, fact that government changed solution concentration they provide	Shy staff find it hard to maintain eye contact Need to help with procedure, other errands Can‘t think of things to talk about Providers think it is not important when procedure is going well, but when they stop, client becomes uncomfortable and less cooperative. Have to motivate team and communicate importance of continuing without disruption

	Alcohol rub is not a complete replacement for hand-washing, can use the rub in between clients but must start with hand-washing Lack of knowledge	Poor planning by the team The container is emptied when its ¼ full, not waiting till full	Size of container is a factor; staff may be used to mixing 1 to 5 parts water, but if you need 6 parts water, container may be too small. Sometimes they don‘t have a measuring jar which is very important	Staff shortage
Why should the provider care about this indicator?	Habit will keep providers healthier Prevents transmission of infection from client to provider Prevents other infections Risk of injury and transmission of infections	Provider is at risk of hepatitis, HIV Infection will result in Incurring more expenses	If solution too strong, instruments will be damaged, hurting center profitability Less time is spent	Helps keep client calm and compliant Satisfied client will refer others for business
Why should the client care about this indicator?	Reassures them that MSU utilizes safe practices Prevents infection from client to client	Patient at risk of accidental puncture and risk of acquiring infections	If solution too weak, instruments may transmit infections / micro organisms	Helps manage pain during procedure
What specific information is provided about this indicator in training manuals, job aids?	How often, how long, when alcohol rub is advised	How to label containers, how to dispose of containers	Formula for correct dilution, how often to change, what kind of container and label	Why, how, when to do vocal local, practice exercises

Annex B: m4QI Message Inventory

Indicators	M4QI text messages (160 character max)
Indicator #1 **Team members wash their hands BEFORE and AFTER examining or providing a service for every client and after work.**	1. Remember, not only does washing your hands protect the client from infection, it protects you and your family, too! Hand-washing helps keep everybody healthy. 2. Even when many clients are waiting, you can‘t skip washing hands. It‘s OK to tell some to return next time, so that you can take the time to do a good job. 3. True or False: You never need to wash your hands with soap and water between clients, alcohol rub is sufficient. Correct response (False) – That is correct! You can use an alcohol rub if your hands aren't visibly dirty, otherwise you must use soap and water. Incorrect response (True) – Sorry, that is incorrect. You can only use an alcohol rub if your hands aren't visibly dirty, otherwise you must use soap and water. 4. True or False: Washing your hands helps to prevent the spread of infection from one client to another. Correct answer (True): That is correct! Washing your hands is one way to interrupt the disease transmission cycle and prevent the spread of infection. Incorrect answer (False): Sorry, that is not correct. Washing your hands is one way to interrupt the disease transmission cycle and prevent the spread of infection.
Indicator #2 **Sharps are disposed of in a sharps container immediately following use.**	1. Sharps injuries are the primary cause of blood-borne infections like HIV and hepatitis. Immediately dispose of sharps to protect yourself and your clients. 2. Never set a used scalpel or needle on any surface after use; place IMMEDIATELY in sharps container. Risk of infection from an accidental puncture is high. 3. True or False: You must immediately dispose of syringes, but not razors, needles you use for stitching, or any other sharps.

	Correct response (False) – That is correct! All sharps must be disposed of immediately, not just syringes. Incorrect response (True) – Sorry, the correct answer is True. All sharps, not just syringes, must be disposed of immediately after use. And remember, doing so will help keep you healthy. 4. True or False: Sharps can be disposed of in any plastic container that is available. Correct response (False) – That is correct! Sharps must be disposed of in a puncture-proof container, like a Jerri can, clearly labeled SHARPS. Incorrect response (True) – Sorry, that is incorrect. Sharps must be disposed of in a puncture-proof container, like a Jerri can, clearly labeled SHARPS.
Indicator #3 **The 0.5% chlorine solution is prepared according to recommendations.**	1. Remember the chlorine comes in many different concentrations. Make sure you know the strength of the concentrate you're using before mixing the 0.5% solution. 2. Making the 0.5% chlorine solution correctly means your instruments won't get damaged and it will protect clients and others from infection. Both save you money. 3. To make a 0.5% chlorine solution using the 4.5% concentrate, you mix one part concentrate with how many parts water? Correct answer (8). And don‘t forget, always read the container to make sure of the concentration you are using. Incorrect response (5, 6, or 9) – Sorry, incorrect. Mix one part 4.5% concentrate with 8 parts water to create a 0.5% chlorine solution. 4. True or False: Mixed chlorine solution must be kept in a closed container. Correct answer: (True). That is correct. The chlorine solution loses concentration when left in an open container so must be kept in a closed one. Incorrect answer: (False) That is not correct. The chlorine solution needs to be stored in a closed container because it

	loses concentration when left open.
Indicator #4 **Vocal local is maintained throughout the procedure.**	1. Vocal local keeps clients calm during a procedure making a positive outcome more likely. VL reduces a client's discomfort and increases client satisfaction. 2. Encouraging clients to ask questions during vocal local gives them a sense of control, can reduce pain. Just remember to listen actively and be responsive. 3. True or False: If a procedure is progressing well, and the client appears comfortable, vocal local can be stopped. Correct response (False) – You are correct. Vocal local needs to be maintained throughout the entire procedure to maintain pain relief. Incorrect response (True) – Sorry, that is not correct. Remember, a break in vocal local is a break in pain relief. 4. Which is a good topic for vocal local? A) Progress of the procedure. B)Why client came to the clinic. C) Rhymes or counting songs. Correct response (C):That is correct. Engaging the client in reciting rhymes or singing counting songs are good distracting techniques. Incorrect responses (A, B): No. Distracting conversation should not include clients reasons for seeking the procedure, as this may increase anxiety and distress.

Annex C: m4QI Orientation Talking Points

m4QI Talking Points/Training Manual for MSU Intervention Sites

March 2011

What is m4QI

Mobiles for Quality Improvement (m4QI) is a mobile phone-based learning platform to reinforce training, assess knowledge, and provide performance support to services providers. In a pilot to be launched in April 2010, selected Marie Stopes Uganda (MSU) staff will receive text messages (one per day) intended to refresh knowledge and identify gaps in understanding and practice.

Background

This pilot is funded through USAID/Washington Strengthening Health Outcomes through the Private Sector (SHOPS) project. USAID supports the development of services and tools to improve health services for vulnerable populations, and mobile phones offer an innovative channel through which to provide these services (known as mHealth). In 2010, SHOPS partners Abt Associates, Jhpiego, and Marie Stopes Uganda identified m4QI as a tool with the potential for cost-effective support and quality improvement of clinic staff.

What are the objectives of the m4QI pilot

The objectives of m4QI are to design, deploy, and evaluate a mobile phone-based learning platform to increase adherence to clinical protocols, effect positive behavioral change in service delivery, identify competencies in need of strengthening, and improve effectiveness of supportive supervision and follow-up. The application is intended to be scalable and replicable, targeting users of low-end phone and those without access to the Internet.

For MSU, the pilot offers the opportunity to get hands-on experience determining how mobile messages can be most effectively used to improve retention, identify areas in need of support, and improve clinic practices.

What activities have been accomplished to date

- **Software development:** A software application called FrontlineSMS:Learn has been developed and is being installed on MSU computers in Kampala headquarters. It is based on FrontlineSMS, a free and open source text message platform used widely among NGOs in developing countries. A team including local software developer Appfrica, Jhpiego, and FrontlineSMS customized the basic platform to create FrontlineSMS:Learn, which will automatically send and receive text messages for participating staff, send immediate feedback to users on mini quiz questions, and track responses across all learners.
- **Content development:** SHOPS worked with the MSI medical development team and the MSU clinical training team to develop messages for the pilot. The final review process is underway. The content development process included:
    - Identifying required techniques, precautions, and skills in need of reinforcing and support.
    - Identifying factors underlying why performance requirements are not consistently met and reasons supporting the importance of adherence.
    - Crafting reinforcement messages and quizzes (in short text message format) that address these factors and that are consistent with the MSI Theory and Practice Course.
- **Pilot design**: A total of six MSU locations (Jinja, Masaka, and Hoima Outreach and Bweyogerere, Hoima, and Masaka Centers) will be used to test the platform and messages, with all staff members at those locations participating. Message content will be tied to four indicators, or distinct behaviors that every MSU staff member is expected to know and practice. Participating staff will be receiving one text message a day, four days a week, for eight weeks. If the text message is a quiz, they will be expected to respond with their answer in a text message response.
- **Evaluation plan**: At the end of the pilot, a researcher will conduct short structured interviews with some pilot participants, as well as selected staff who did not receive the messages. This will support the m4QI proof of concept by exploring whether the messages were relevant, welcome, informative, easy to access, and/or influential over self-reported knowledge, attitudes, and behaviors regarding the four indicators. This qualitative data will inform future scale-up of the m4QI approach. Selection and scheduling of interviewees for the evaluation will be coordinated through the MSU Operations Department.

What is required of participating pilot teams

Center/Outreach Managers: Using these Talking Points, explain to staff what the m4QI pilot is and why their support is important. They have been selected to ~~"fi~~eld test" an exciting new training and support tool, and to provide feedback on how it will be improved. Identify and forward to MSU Headquarters any questions or concerns raised by the staff.

Center/Outreach Staff: Agree to receive/send text messages on their personal phones over an eight-week period. Staff are encouraged to read/respond to the text first thing in the morning, before the start of work. Agree to participate in a short interview at the end of the pilot to learn whether they found m4QI useful in providing quality care for their clients.

What if there are questions, problems: Lois Nantayi, MSU M&E Manager is managing implementation of m4QI, supported by staff from platform developer Appfrica. Questions should be directed to Lois at (256) 414347129.

Timeline

Text messages currently scheduled to begin April 18–June 10. Follow-up interviews with selected staff will take place in June.

Frequently asked questions:

What if I do not have enough airtime on staff my SIM card: During the eight-week pilot, staff are asked to keep a small minimum on their phones, and bring them to work.

What if I forget or lose my phone: m4QI is not providing phones for this pilot. If you forget your phone one day, you can answer the question that night at home. If you lose your phone and do not replace it, then you will not be in the pilot. If you replace your phone or get a new SIM card please share your new number with Lois Nantayi.

Will I be reimbursed for charges: Yes, SHOPS will reimburse participating staff for costs of m4QI text message responses sent during the pilot.

What will MSU do with the answers to my quizzes: The purpose of the assessment questions is to identify areas where there might be gaps in knowledge and where staff may need additional training or support.

What plans does MSU have to use the FrontlineSMS:Learn platform after the pilot: At this time, MSU is waiting to pilot the application and evaluate the results in order to determine how the platform might used in the future.