Use of an Interactive Voice Response System to Deliver Refresher Training in Senegal:

Findings from Pilot Implementation and Assessment

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Executive Summary

In-service training reinforces and updates health care providers' knowledge, but it is often expensive and requires providers to leave their posts. When health workers are away for training, there may be no one else to deliver health services in their stead. Most mHealth applications to train health workers require smartphones or digital tablets and Internet connectivity or use short message service (SMS) text systems to provide training, guidance, and updates. Interactive voice response (IVR) is a technology—possible with any type of phone—that delivers information via audio recordings and allows users to provide feedback by pressing a number key. IVR allows for the delivery of more robust information than SMS text but does not require smartphones, Internet connectivity, or even full literacy.

The USAD-funded Capacity*Plus* project, led by IntraHealth International, developed, deployed, and assessed an innovative mLearning system that used a combination of IVR and SMS text messaging to deliver refresher training to family planning providers in Senegal, focusing on management of contraceptive side effects and counseling to dispel misconceptions. The course content, informed by initial training content and aligned with Senegal's national family planning policies and international guidelines, was delivered using spaced education. Spaced education is a distance learning approach in which content is spaced and repeated over time and which has been found to increase retention of clinical knowledge and skills.

The IVR mLearning training system used a set of custom scripts that manage interactions between open source IVR software tools and learning solutions, including Gammu, FreeSWITCH, and Moodle. The project prioritized open source technologies because of their low cost and ability to undergo local adaptation more easily.

The training content (20 multiple-choice questions and accompanying detailed explanations) was delivered to the trainees' mobile phones and was compatible with all basic phone models. Each trainee specified a preferred time of day to receive a daily SMS text reminder to prompt a call. Whenever the trainee was available and ready—even if hours or days after the initial reminder—the trainee texted the mLearning system to prompt a call, then responded to audio-recorded questions using the phone's keypad. The system indicated whether the answer was correct or incorrect and provided a detailed explanation via audio recording.

After trainees answered all 20 questions, they received the same questions and explanations a second time. During the second round, trainees received the questions they had previously answered incorrectly every day until they answered each of those questions correctly twice in a row. Once a trainee answered a question correctly twice, the question was retired and not asked again. Successful completion of the course occurred when all questions were retired.

A group of 20 midwives, nurses, nursing assistants, and health agents, chosen in coordination with the Ministry of Health, participated in the pilot application. It took place in two districts in Thiès Region of Senegal. Capacity*Plus* carried out this exploratory pilot of a new mHealth

innovation among a limited number of participants to allow for careful assessment and modifications before larger-scale implementation.

The project used administrative data from the system's database to assess the feasibility of the IVR mLearning system. Indicators available from the database included number of text messages sent and duration and time of each call. To assess acceptability, trained data collectors visited trainees at their posts within five weeks of course completion to administer a post-training survey about participants' opinions and experiences. To assess changes in knowledge, a written test administered once before and twice after the intervention comprised 20 multiple-choice and true/false questions. Participants completed the written tests at an orientation to the system (pre-test), at the same time as the post-training survey (post-test), and again during a supervision visit ten months after the training. Data analysis was carried out using Excel and Stata version 13.

IVR mLearning system feasible to implement: All 20 participants completed the course, with the majority completing it within five weeks. One participant required nine weeks for completion. The system worked as planned for the duration of the course, as indicated by the following:

- The IVR mLearning system sent 620 prompt texts
- Trainees texted the system 640 times to prompt a call
- The system made 619 calls using IVR, although only 496 (80%) of these calls resulted in successful administration of the spaced-education questions to participants. About 30% of participants reported dropped calls, often due to poor network reception.

All trainees owned the mobile phones used for the course, and all had previously used their phones for other work-related activities. Issues with the telephone network contract caused some delays.

Few disruptions during normal service delivery hours: Trainees prompted the majority of calls to deliver in-service training outside of normal working hours (median time=5:16 p.m.). The average call duration was 13 minutes. Although all but four participants originally requested that they not be contacted by the system after 8:00 p.m., participants initiated approximately one-third of the IVR calls (through SMS text) after 8:00 p.m.

mLearning system convenient and well received: Participants reported that the overall experience of using a mobile phone to complete in-service training was either good (35%) or very good (65%). Participants greatly appreciated the convenience and flexibility of the mLearning system: 60% liked the ability to determine the course's pace and 55% liked being able to access the course when convenient. The largest criticism (35%) was poor network reception. Participants highly rated the training content, including the orientation, instructions, and explanations. A large majority strongly agreed that the course improved their knowledge and helped them provide better services to their clients. In open-ended questions, participants' most common recommendation was to expand the contraceptive side effects and misconceptions course to other providers and extend the mLearning format to other health topics.

Significant and sustained changes in knowledge of contraceptive side effects and misconceptions: Overall, participants' knowledge of contraceptive side effects and misconceptions was relatively high at baseline and significantly increased ($p<0.01$) from an average of 12.6 questions correct (out of 20) before the training to 16 out of 20 after the training. In the absence of any further trainings, there was a slight decline in average knowledge scores ten months after the post-test (14.8), but the gains in knowledge were still significantly higher than before the training ($p<0.01$). Participants showed significant improvements on questions related to side effects of condoms, emergency contraceptive pills, and injectables.

This pilot showed that an mLearning system that delivers refresher training to family planning providers via simple mobile phones using IVR and SMS text is appropriate, feasible, acceptable, and associated with sustained gains in knowledge. Participants appreciated the convenience of the system—the ability to determine when and where to access the training and to set their own pace for completing the course. The fact that trainees prompted the majority of IVR calls during nonregular working hours, with an average call time of about 13 minutes, suggests that the IVR mLearning system training avoided disrupting health workers' service delivery schedules. Improving health workers' knowledge through in-service training has the potential to improve health workers' ability to meet client needs and provide clients with a high-quality experience.

The pilot experience suggests that the following would be helpful in improving future implementation:

1. Progress updates: Incorporate a progress report feature to text participants their daily or weekly progress.
2. Interactivity: Provide written materials and incorporate exercises to enhance learners' experiences.
3. Cellular network: Allow sufficient time and financial resources for testing of airtime and contract mechanisms to avoid service provider issues.

The IVR mLearning platform using a spaced-education approach has the potential to be an effective, efficient, and low-cost means of providing refresher training and/or updates to national guidelines, policies, and protocols. The IVR mLearning system is especially well suited to reach health workers posted in rural and remote settings. Moreover, because the system is almost text-free, it can be adapted to reach illiterate or semiliterate health workers. The voice-based system also allows for recording training content in nonmajority languages to tailor training to different ethnic and cultural subgroups.

The pilot experience provides compelling evidence that the mLearning system should be scaled up to other family planning and health topics and geographic areas in Senegal and beyond. Close monitoring and rigorous effectiveness evaluation of larger-scale implementation can provide robust evidence that the IVR mLearning system is feasible and effective at scale.

BACKGROUND

In-Service Training to Improve the Health Workforce

Numerous countries face significant health workforce challenges, including a shortage of trained and qualified health workers to provide needed services (Chen et al. 2004). Strengthening training programs for health workers plays a pivotal role in increasing the number of qualified health providers and improving quality of service delivery. In-service training reinforces and updates health care providers' knowledge and can improve the quality of services offered to patients and clients (Bluestone et al. 2013). Effective, efficient and sustainable training of health workers is an on-going challenge globally and will become even more crucial in the post-Millennium Development Goals era of universal health coverage (HCI and ASSIST 2013).

In-service training is often expensive and requires health workers to leave their posts to train at offsite educational facilities. Health facilities may need to pay for additional health worker coverage when employees are absent for training. Health workers leaving their posts for training are particularly problematic in small health facilities and rural areas, where a single health worker may provide all health services and his/her health facility remains empty for the duration of the training (WHO 2006). Thus, there is the increasing recognition of the need to expand continuing education of health workers beyond the classroom (Bluestone 2013; Bollinger et al. 2013). Distance learning can improve access to training opportunities and allow health workers to continue their professional activities while receiving continuing education, often without leaving their place of work (Joynes 2011). Continuing health professional education can be offered via the Internet using different didactic and interactive approaches (Curran and Fleet 2005), and studies have found similar gains in knowledge in computer-based training as compared to live instruction (Harrington and Walker 2004; Gega, Norman, and Marks 2007; Kulier et al. 2009).

Spaced education is an approach to distance learning in which content is spaced and repeated over time in the form of multiple choice questions and detailed explanations. Multiple studies have found this approach increases retention of clinical knowledge (Kerfoot, Baker, et al. 2007; Kerfoot, DeWolf, et al. 2007; Kerfoot 2009) and diagnostic skills (Kerfoot, Fu, et al. 2010) and improves clinical screening practices (Kerfoot, Lawler, et al. 2010). A small-scale pilot study in Ethiopia found that using the spaced-education approach to deliver an Internet-based course on the feeding of infants of HIV-positive mothers was feasible and associated with modest gains in content knowledge, although Internet access and reliable connectivity were challenges for some users (Tulenko and Bailey 2013).

mHealth and In-Service Training

Public health professionals are increasingly taking advantage of the drastic increases in mobile phone ownership and network coverage in Africa (Rao 2011). mHealth applications use mobile phones and other mobile devices to deliver health information, collect health information, diagnose disease, and improve adherence to clinical protocols (WHO 2011; McQueen et al. 2012; Labrique et al. 2013; Mendoza et al. 2013). Mobile technologies can also improve health worker performance through the provision of information and training (Callan et al. 2011); these

types of mHealth applications are also known as mHealth education or mLearning (see Appendix A for definitions). Programs can provide distant education using these types of mobile applications in rural and remote settings, where health workers have less experience with and access to computers or may have less connectivity to the Internet.

A review of mHealth initiatives targeting health worker training postulates that expansion of mHealth education could increase training opportunities to existing health workers, accelerate training of new workers, reduce attrition rates, and lower training costs (Callan et al. 2011). The majority of mHealth education or mLearning initiatives are early in their implementation and operating at relatively small scale. Most reported experiences have been positive, although the evidence of effectiveness of mHealth education on provider practices or health outcomes is relatively sparse. Current applications of mHealth education usually aim to enhance, support, and reinforce training rather than replace more traditional methods of learning (Callan et al. 2011).

Most mHealth applications for training health workers use smartphones or digital tablets and require Internet connectivity (Callan et al. 2011). For example, the Millenium Villages Project provides continuing education and refresher learning—including modules, quizzes, and case studies—to community health workers via Java-enabled mobile phones in ten countries (Earth Institute 2011). TulaSalud (2013) in Guatemala provides distance education, including digital downloads and teleconferencing, to community auxilliary nurses through the Internet and mobile phones. Professional and paraprofessional health workers are given personal digital assistants (PDAs) with digital medical libraries in the Uganda Health Information Network (UHIN); the project also delivers continuing medical education and information to health workers via the PDAs (Ministry of Health, Uganda 2010). A similar approach in South Africa gave nurses smartphones with digitized medical information and access to the Internet in order to improve access to clinical information at their service sites (AED SATELLIFE 2010).

Other mHealth applications to improve health worker skills have used short message service (SMS) text systems to provide simple training, guidance, and updates. A pilot study in Uganda used SMS text message reminders and assessment questions to improve family planning health workers' adherence to clinical protocols for hand washing, sharps disposal, instrument decontamination, and pain management (Riley and BonTempo 2011). A pilot program in Malawi used SMS texts to foster exchange of family planning, reproductive health, and HIV/AIDS information among frontline workers (Lemay 2012). Although few rigorous evaluations of mHealth applications exist, a randomized control trial in Kenya found that SMS text messages about malaria case-management guidelines were effective at improving health workers' routine management of malaria in children (Zurovac et al. 2011). An accompanying qualitative study found that the intervention was acceptable and created an enabling environment for health workers (Jones et al. 2012).

Family Planning and mHealth

Over 220 million women in the developing world have an unmet need for modern contraception (Singh and Darroch 2012). In response to this staggering statistic, the London Summit on Family

Planning called for "global political commitments and resources that will enable 120 million more women and girls to use contraceptives by 2020" (Family Planning 2020 2012). Increasing access to quality family planning services, especially in underserved rural and periurban areas, is essential to meet this goal, as well as to achieve universal health coverage. In-service training of health workers can improve the quality of family planning services (Kim et al. 1992; Costello et al. 2001). In turn, the quality of family planning services has been shown to influence continuation of contraceptive use (RamaRao et al. 2003).

Similar to other public health programs, family planning programs are increasingly taking advantage of technological advances and incorporating mobile technologies to improve logistics and supply chain management, support health workers in everyday work, track and refer patients, reimburse costs to health workers and family members, and collect and report data (Patierno and Morgan 2012; HIP 2013). Many programs use mobile technologies—such as call lines, SMS text messages, and social media—to deliver behavior change messages and information related to family planning and sexual and reproductive health (Lim et al. 2008; McQueen et al. 2012; Mendoza et al. 2013).

Pilot programs in Malawi and Uganda, described above, provide support and information to health workers about reproductive health and family planning using SMS text messaging (Riley and BonTempo 2011; Lemay et al. 2012). The CommCare (2013) platform uses text and images delivered via Java-enabled phones or smartphones to provide support and on-site training to health workers in a number of countries. To our knowledge, few other programs use mobile applications to deliver training to health workers providing family planning services. A recent review of family planning research called for more evidence in "the role of electronic and mobile information and communication technology for training, monitoring and supervising health workers," adding that "no rigorous evidence of the feasibility, acceptability, effectiveness and cost-effectiveness exists" (Askew and Brady 2013, 11).

Interactive Voice Response

Interactive voice response (IVR) is a technology that uses any type of phone to deliver information by voice via audio recordings and allows users to provide feedback by pressing a number key that corresponds to their selected choice. Users can also leave a recorded response for more extensive feedback. Financial institutions and other organizations frequently use IVR for customer service over the phone. IVR technology predates the massive expansion worldwide of mobile phones and Internet connectivity; it has been used for many years in a variety of health care applications in the developed world. For example, IVR systems have been used to assist in the management of chronic illnesses (Friedman et al. 1996; Piette 2000; Piette et al. 2013), screen for nicotine dependence (McDaniel et al. 2005) and dementia (Mundt, Moore, and Greist 2005), and collect research data (Abu-Hasaballah, James, and Aseltine 2007), among other applications.

IVR technologies are not as common in low and middle-income countries; however, public health programs are increasingly using IVR in mHealth applications to reach populations with high penetration of mobile phone ownership, but with low levels of literacy and Internet

connectivity (Green and Bellows 2013; Piette, Datwani, et al. 2012; Chamberlain 2014; Dimagi n.d.). IVR messages can be easily recorded and delivered in any language or dialect. An IVR system with automated calls to monitor and deliver behavior change messages to high blood pressure patients in rural Honduras and Mexico was associated with improved health outcomes (Piette, Datwani et al. 2012). Baby Monitor, an IVR-based system recently pilot tested in Kenya, calls pregnant and postpartum women to screen for maternal and neonatal risk factors and refers them to necessary care (Green and Bellows 2013).

Using IVR systems to provide training and support to health workers is less common. However, the Mobile Academy, implemented by BBC Media Action as part of the Ananya project in Bihar, India, has used IVR technology to deliver training to over 27,000 remote community health workers in preventative behaviors related to maternal and child health (Ananya 2013).

Rationale and Objectives

In response to calls to explore and evaluate more effective and efficient ways to deliver in-service training (Bluestone et al. 2013) and support family planning health workers with mHealth applications (Askew and Brady 2013), we developed, deployed, and assessed an mLearning system that uses a combination of IVR and SMS text messaging to deliver refresher training on contraceptive side effects and misconceptions to health workers in Senegal. The course topic was chosen in coordination with the Ministry of Health in Senegal. Our review of mHealth initiatives and mobile applications to support health workers revealed that IVR can deliver longer and more complex information than SMS text, but does not require the use of smartphones or Internet connectivity that are more expensive and can be unreliable in rural Africa. This pilot study of the IVR mLearning system comprised three primary objectives:

1. To develop and deploy an mLearning system using IVR and SMS text technologies to deliver a family planning refresher training
2. To assess the feasibility and acceptability of the IVR mLearning system for the provision of refresher training
3. To assess changes among health workers in family planning knowledge and perceived ability to counsel family planning clients associated with the deployment of the IVR mLearning system.

Although not one of the three original study objectives above, an additional data collection activity sought to examine the quality of family planning counseling ten months after the training and explore the routine use of family planning services before and after the IVR mLearning training.

METHODS

Study Site: Senegal

Senegal's contraceptive prevalence rate for modern methods remains low at just over 16% in 2012, with about one third of married women having an unmet need for contraception (ANSD

and ICF International 2012), in spite of significant efforts by the government and nongovernmental organizations to improve access to and demand for contraception. IntraHealth International has been working with the Senegalese government and local partners for over a decade to improve health behaviors and outcomes, including contraceptive use. Through the USAID-funded Senegal Maternal, Neonatal, and Child Health/Family Planning/ Malaria Project, IntraHealth International has trained providers in family planning counseling and contraceptives, encouraged facilities to integrate mother-and-child health services with other reproductive health services, and engaged and educated communities through public campaigns.

For the Capacity*Plus*-supported pilot application of the IVR mLearning system as a potential tool to deliver a family planning refresher-training course, we purposely selected 20 midwives, nurses, and auxiliary nurses posted at 20 facilities in Meckhé and Tivouane districts in Thiès Region. The selection of districts and providers was made in close coordination with the Department of Reproductive Health and Child Survival and the Direction of Studies and Training. The health workers selected: 1) provided informed consent; 2) had participated in an initial family planning training course conducted by IntraHealth in 2008 and 2009; and 3) had access to a mobile phone for the duration of the course. We limited the sample size to facilitate the resolution of any unforeseen technical and logistics issues associated with the first-time application of an IVR mLearning training system.

Development and Deployment of the IVR mLearning System

Course content

We designed a refresher-training course that covered the management of contraceptive side effects and misconceptions, based on feedback from national and regional stakeholders. Appendix B summarizes the course content, which was based on an initial family planning training conducted by IntraHealth in 2008–2009 and in direct alignment with the Senegal family planning national training curricula and protocol. External resources were also used to ensure that the content included the most accurate and up-to-date information (USAID, WHO, and UNFPA 2012; JHSPH/CCP and WHO 2011; WHO 2012). We developed the course in English and translated the content into French. Stakeholders in Senegal reviewed the content to ensure it was appropriate for the local context. The content was delivered using the spaced-education approach (Kerfoot, DeWolf et al. 2007; QStream 2012; Kerfoot and Baker 2012), with 17 multiple-choice questions and three true-false questions and detailed explanations spaced and repeated over time. Box 1 provides an example of a question and explanation used in the course. A health professional from Dakar, Senegal recorded the audio questions and explanations in French.

Box 1: Example of Management of Contraceptive Side Effects and Misconceptions Refresher Training Question and Explanation

Question

Which of the following statements on side effects is important to tell a woman who has decided to have an IUD inserted?

1. She can expect to have heavy bleeding and severe abdominal pain during the first week after insertion, and ibuprofen can be taken to alleviate the discomfort.
2. She can expect to have severe headaches, especially in the first few days after insertion, and aspirin can be taken to alleviate the pain.
3. She can expect some cramping and mild pain, especially in the first few days after insertion, and ibuprofen can be taken to alleviate the discomfort. ***(Correct answer)***
4. She can expect to have fever, chills, and unusual vaginal discharge during the first week after insertion. This is normal and will go away with time.

*Detailed explanation**

Cramping and MILD pain are common side effects experienced during the first few days after insertion by women who have an IUD. Heavy bleeding, severe abdominal pain, severe headaches, fever, chills, and unusual vaginal discharge are NOT common side effects and may in fact be signs of complications that require medical attention.

If a woman has an IUD inserted, reassure her that cramping and mild pain are common, especially in the first few days after insertion. Explain to her that cramping and mild pain are also common in the first 3 to 6 months, particularly during menses. These are not harmful and usually decrease over time.

To alleviate discomfort from cramping and mild pain, suggest that the woman take 200 to 400 milligrams of ibuprofen or take another painkiller. Do NOT offer her aspirin. Women who have an IUD often experience heavier menstrual bleeding and should not take aspirin, because it inhibits clotting and thus can increase bleeding.

If cramping continues or occurs outside of menstruation, evaluate for underlying health conditions, treat and/or refer the woman for treatment. If no underlying condition is found but cramping continues and client finds it unacceptable, discuss removing the IUD with the woman and switching methods. Discuss alternative methods with the woman.

**Learner hears this detailed explanation after selecting a correct or incorrect answer*

IVR mLearning training system

We developed a mLearning system using IVR and SMS text applications to deliver the refresher-training course of 20 spaced questions and explanations. Box 2 explains the mLearning system processes and notes the accompanying technology. Participants use their personal mobile phones for the training. Their phone numbers are set up in the mLearning system before starting the course. The mLearning system sends a daily prompt via SMS text to participants' phones to see if they are available and ready to engage with the course questions and explanations. Once the participant is ready, s/he texts the mLearning system and the system immediately calls with recorded voice questions and explanations. The participant selects the answer to each question using the phone keypad, and hears the detailed explanation whether

s/he selects the correct or incorrect answer. Participants can opt to answer between zero to four questions a day based on preference and availability.

Participants can send SMS texts to the system at any point during the day and receive a call as long as they have not already answered four questions that day. This feature was included in case a participant wants to access the questions earlier than the predetermined prompt time, has issues with a call, has to hang up for other reasons, or wants to answer additional questions. If a participant reaches his/her daily limit of questions, then s/he receives a text noting this.

After participants answer all 20 questions once, they receive the same questions and explanations for a second time. Participants receive questions they have answered incorrectly every day until they answer each question correctly twice in a row. The same question is never asked more than once per day. Once a participant answers a question correctly twice, it is retired and not asked again. Participants successfully complete the course when all questions have been retired.

Box 2: Overview of IVR mLearning Training System

Preliminary set-up

- Participants' phone numbers set-up in Moodle by administrative user*
- Participant indicates preferred time for text prompt

Ongoing system	**Technology and software**
▪ Participant receives a daily SMS text prompt that training questions are ready to be answered	➔ Every five minutes a programming script checks if a participant 1) is available to be texted, 2) has not yet been texted that day, and 3) has not already completed a call that day. If parameters are met, system sends out daily text.
▪ Participant replies to prompt via SMS text when ready to access training	➔ Every minute a programming script uses ***Gammu*** to check for incoming texts
▪ System calls participant with up to four questions (read out-loud) daily ▪ Participant answers question (via keypad) ▪ System responds if answer is correct, followed by prerecorded response providing detailed information related to question topic	➔ ***FreeSWITCH and a custom programming script*** used for making call, managing recordings, accessing questions, processing keypad answers ***Moodle*** manages course content and order of questions

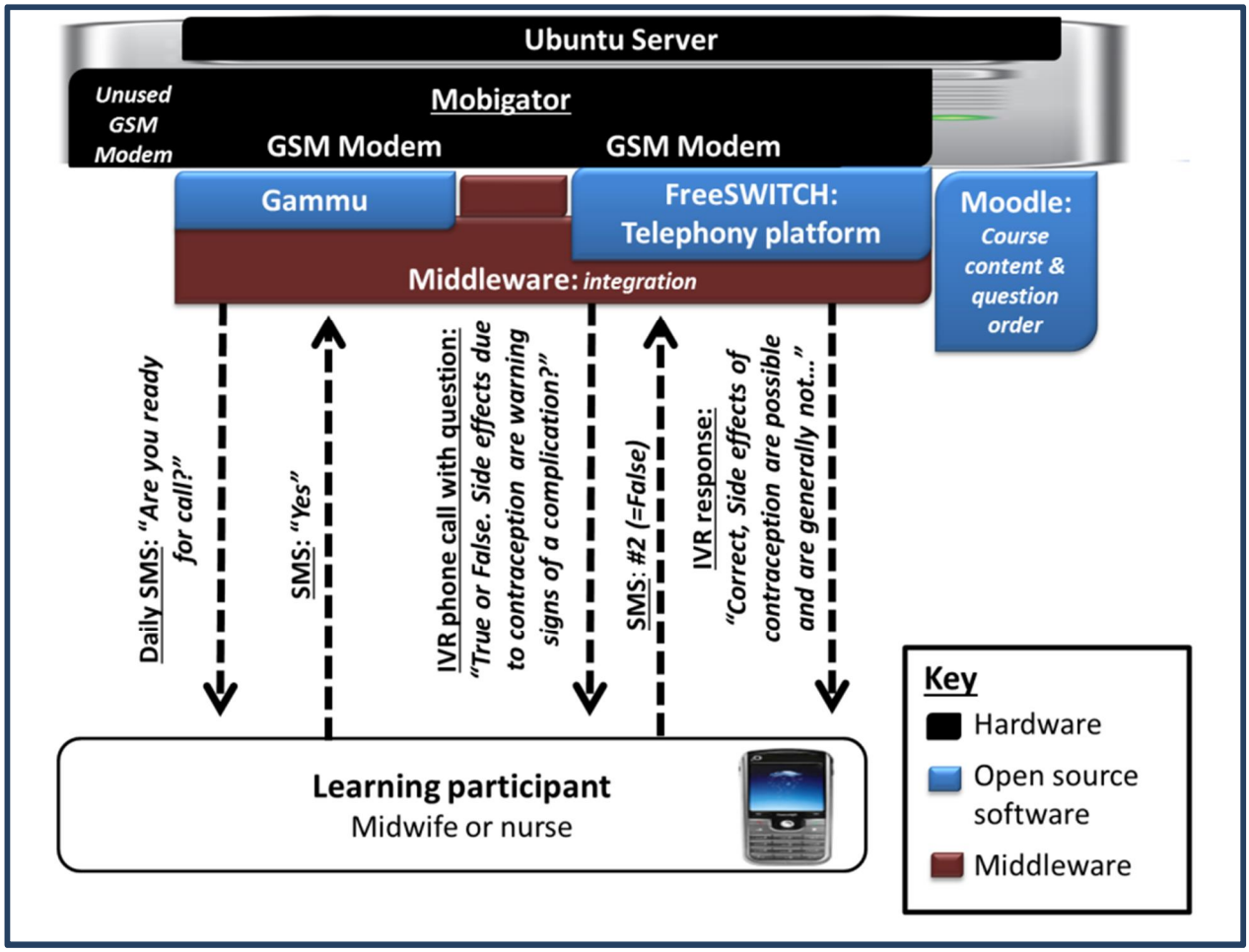
**Administrator has ability to change phone numbers as necessary*

IVR mLearning system technologies

Figure 1 shows the overall hardware and software infrastructure used in the IVR mLearning system. The system runs on an Ubuntu server and two of the three Global System for Mobile

Communication (GSM) modems in a Mobigator. We developed a set of custom scripts ("middleware") to manage interactions between open source IVR software tools and an open source learning solution. FreeSWITCH—an open source telephony platform—handles the voice interactions via one modem and Gammu software interfaces with the other modem to administer the SMS texting. Moodle, the predominant open source eLearning system, manages the quiz interactions. We prioritized open source technologies because of their low cost and ability for local adaptation and innovation with other products and solutions in the future. Future applications would require middleware, but could potentially use a different mix of software solutions, depending on the requirements and scale of the system. For example, FreeSWITCH could manage SMS interactions and Gammu could be excluded from the system.

Figure 1: Infrastructure of the IVR mLearning System



Deployment of the IVR mLearning system course

We provided a three-hour orientation at the regional medical office in Thiès to introduce participants to the refresher training and describe how to use the IVR mLearning system on their mobile phones. The pilot course began on March 4, 2013 and ended on April 30, 2013.

A training system database was set up to log all texts that were sent and received, as well as monitor what questions were asked and answered in each call on a daily basis. The project coordinator monitored the system and contacted any participants who had not accessed the training system in over a week to address any problems. All issues identified were resolved as quickly as possible.

The project assumed all costs related to the training. Participants were enrolled in a two-month contract with Sonatel, a telecommunications provider in Senegal, for the duration of the training. The contract provided unlimited calling from IVR mLearning training system to participants and gave the IVR mLearning system and participants a set amount of credit to send and receive SMS text messages. Because the IVR mLearning training system calls the participant, the training provider pays the larger cost of airtime for phone calls centrally. The credit for individual participants is only required to pay for the SMS texts used to trigger the IVR phone call.

Involvement of the Ministry of Health in the IVR course development and implementation

The Ministry of Health facilitated the development and implementation of the IVR mLearning training. The Ministry's Directorate of Reproductive Health and Child Survival collaborated on the choice of training content to deliver using the IVR system, and the curriculum—based on national policies—was reviewed and validated by a representative from the Family Planning Bureau within the Directorate. The Ministry made the decision to implement the pilot in Thiès Region and facilitated collaboration with the Thiès regional health officer. The regional coordinator for reproductive health served as the point person for the pilot, coordinating all discussions with the targeted districts, providing substantial assistance in recruiting health workers, and coordinating the overall training in collaboration with IntraHealth's regional coordinator.

Assessment Methods

Assessment of feasibility and acceptability

To assess feasibility, we monitored the implementation of the IVR mLearning training using the system's database. Administrative information collected from the system included: 1) the number and content of text messages sent and received by the IVR mLearning system; 2) the number, duration, and time of each call made by the system to participants; and 3) the number of questions answered correctly and incorrectly per day. We also report the direct costs associated with the development of the IVR mLearning system, the course content, and the implementation of the refresher training.

Trained data collectors visited participants at their posts within five weeks of course completion to administer a survey about participants' opinions and experiences with the IVR mLearning system. The data collectors read the structured surveys to participants and recorded their responses. The project coordinator trained the data collectors for two days and supervised them. In a few cases where the trained data collectors were not available, project staff conducted the post-course survey.

Assessment of changes in providers' knowledge and perceptions of abilities

In order to assess changes in knowledge of the management of contraceptive side effects and misconceptions and perceived counseling ability, we used a pre/post-intervention study design with no comparison group. Participants were given 45 minutes to complete a written, 30-question pre-test at the course orientation. The test included multiple choice and true/false questions that covered aspects of contraceptive side effects, rumors, and myths. Questions related to perceptions of providers' ability asked participants to rate their level of agreement with statements of ability on a scale of one to five. Just after the IVR mLearning course was completed, we asked participants to complete the same 30-question written test in 45 minutes at their health posts. In order to assess knowledge retention over time, we administered the same core 20 knowledge questions of the test to participants in February 2014 (ten months after completion of the course) during an additional supervision exercise.

Service utilization and the quality of family planning counseling

We collected additional information in February 2014, ten months after the IVR training, in order to explore the utilization of family planning services and quality of counseling provided by IVR mLearning trainees. We extracted routine family planning service statistics for the period of July 2012 to December 2013 retrospectively from existing registers and monthly and quarterly reports kept at the facilities of participating health workers. Information extracted included the numbers of new, continuing, and discontinuing family planning clients, contraceptive stocks distributed, and stockouts.

Two supervision teams comprised of Ministry of Health officials and IntraHealth staff from the central, regional, and district levels were trained to extract the registers and reports. During the assessment, it was found that a health worker strike that started in 2012 and ended in mid-2013 affected the quality and completeness of the routine service and stock data at the point of service (e.g., registers, patient files, and reports). During the strike, health workers refused to report data to higher levels and supervisors did not check registers or quarterly reports. After data quality checks and discussion with the local health authorities, it was determined that data on stock distribution (and calculation of couple years protection) and new family planning clients were complete and consistent enough to present in this analysis, while other data were not, and thus are not presented.

The supervision teams visited each health worker's post for a half day and where possible, directly observed the IVR training participants' counseling of new and returning family planning clients using a standardized checklist. Standardized checklists were adapted from routine Ministry of Health supervision checklists and the continuous Senegal Service Provision Assessment (ANSD and ICF International 2013).

Data entry and analysis

The research team in Washington, DC, entered the data and assessed for errors or discrepancies; data collectors were informed of any discrepancies and when possible, contacted the participants to resolve and/or clarify these issues. The IVR mLearning system may not have accurately logged participants' progress on occasion. For example, the course log shows that

one participant never received question #2 but the system registered the participant's course completion. For the most conservative estimates, in the rare instances of missing administrative data, we imputed missing information to "0."

We calculated trends and patterns in participants and system activity. The opinions and experiences of providers are expressed as proportions. We used McNemar's exact chi-square statistic for paired binomial outcomes with small sample sizes (Siegel and Castellan 1988; Lachenbruch and Lynch 1998) to determine any significant changes in correct answers to individual knowledge questions between the pre- and post-tests. Given the non-normal distribution of scores, we used the Wilcoxon signed rank test, a nonparametric test, to assess the significance of change in the overall knowledge scores (out of 20 questions) and perceived counseling ability on the pre-test and post-test.

For additional data collected in February 2014, we reviewed and entered data in Thiès and Dakar, Senegal, and checked for errors or discrepancies with the teams collecting the data where possible. We present counts and proportions. To examine trends in utilization, we present the number of new clients and commodities distributed over time. Couple-years protection (CYP) was calculated using the standard conversion (MEASURE Evaluation PRH 2014). All data analysis was carried out using Microsoft Excel and Stata version 13.

Research ethics

The study protocol and instruments underwent institutional review and approval by the director of monitoring, evaluation, and research at IntraHealth. The protocol, consent forms, and instruments were reviewed and approved by the national review board for research ethics in Senegal (*Comité National d'Ethique Pour la Recherche en Santé*). All participants provided voluntary and informed consent.

RESULTS

Description of Participants

Table 1 provides a description of the participants in the IVR mLearning course. Most of the participants were midwives and nurses, followed by nursing assistants and health agents. All participants were 30 or older and six participants were 45 or older. The sample was almost evenly split male to female. The vast majority provide services in health posts and seven participants work in urban facilities (either health posts or district hospitals). The 20 health workers had worked at their current facility from less than a year to 31 years, with about a third reporting zero to three years' service at their current facility, a third four to six years' service, and a third six or more years' service. The majority reported providing family planning services multiple times a day, with injectables as the most often requested contraceptive method, similar to other data regarding method mix in Senegal (ANSD and ICF International 2012). The majority taking the IVR mLearning course had received refresher training in family planning in the three years previous to the IVR course and three participants had received three or more refresher trainings in family planning.

Table 1: Description of mLearning Participants, Senegal 2013

Characteristic	n (N=20)	%
Diplome/post		
Midwife	7	35%
Nurse	6	30%
Nursing assistant	5	25%
Health agent	2	10%
Age		
30-34	9	45%
35-44	5	25%
45-56	6	30%
Sex		
Male	11	55%
Female	9	45%
Type of facility		
Health post	18	90%
District hospital	2	10%
Facility urban/rural		
Urban	7	35%
Rural	13	65%
Years in service at facility		
0-3	7	35%
4-6	7	35%
6 or more	6	30%
Frequency of provision of family planning service (*as reported by provider)*		
Multiple times a day	15	75%
Once a day	3	15%
Once a week	2	10%
Method of family planning most often requested by clients (*as reported by provider)*Injectable contraceptives	17	85%
Contraceptive pills	3	15%
Previous refresher trainings in last 3 years *(1 case missing)*		
0 trainings	2	10%
1-2 trainings	7	35%
3-5 trainings	3	15%
6-10 trainings	5	25%
More than 10	2	10%
Previous family planning refresher trainings in last 3 years		
0	5	25%
1-2 trainings	12	60%
3-5 trainings	3	15%

All the participants owned the mobile phone used in the course and 100% reported having used their mobile phones in the past for other work related activities, such as referring patients and requesting stock (Table 2).

Table 2: mLearning Participants' Previous Use of Mobile Phones, Senegal 2013

Characteristic	n (N=20)	%
Own mobile cell phone used in course [a]	20	100%
Any work-related activities with mobile phone	20	100%
Refer a patient	16	80%
Call an ambulance for a patient	16	80%
Request stock	13	65%
Receive work-related information/guidance	11	55%
Submit service data to government or other stakeholders/partners	7	35%
Schedule work hours	4	20%
Training[b]	2	10%
Other[c]	5	25%

[a] 4 participants shared the phone with someone else, although only one reported that it made it difficult at times to complete the course
[b] Patient management, vaccination follow-up
[c] Coordination of vaccination outreach (2), communicate with parents of unaccompanied child patients (1), work meetings (1), communication with communities (1)

Feasibility of Implementation

All participants completed the course, with the majority completing the course within five weeks (Figure 2). We extended the course for one week longer than initially planned (to week nine) to allow one participant the opportunity to complete the course in full. The participant was receiving daily SMS text prompts and had not received a message of completion; however, this participant mistakenly believed that he had finished the course and ceased accessing the IVR mLearning system for two weeks.

Functioning of the IVR mLearning system

We experienced some challenges during the course implementation, especially during the first week. The start date of the contract with the telephone network (Sonatel) was delayed by a couple of days, resulting in the need to manually upload credit to the IVR mLearning system to enable calling participants. We underestimated the amount of credit needed during this period, and as a result the system stopped responding to participants' SMS text messages until more credit was uploaded. Once credit was uploaded, we were required to reboot the IVR mLearning system, causing additional delays. Most of these issues were resolved once the contract with Sonatel was finalized during the first week of the course.

Throughout the nine-week duration of the course, the IVR mLearning system sent 620 prompt texts and participating health workers texted the system a total of 640 times to prompt a call. The system made 619 calls using IVR, although only 496 (80%) of these calls resulted in the successful administration of the spaced-education questions to participants. Dropped calls likely accounted for many of the unsuccessful calls, with 30% of participants reporting some dropped calls. On average, the IVR mLearning system called participants in less than ten seconds of receiving an SMS text to prompt a call (median duration logged between participant SMS text and IVR call=seven seconds). During the first week when there were issues with the system

(described above), in 17 cases the system took from two to 18 hours to respond to participants with an IVR call. On 39 occasions throughout the duration of the course, participants sent the system a prompt text and did not receive a return IVR call.

Figure 2: Timing of IVR mLearning Course Completion, Senegal 2013

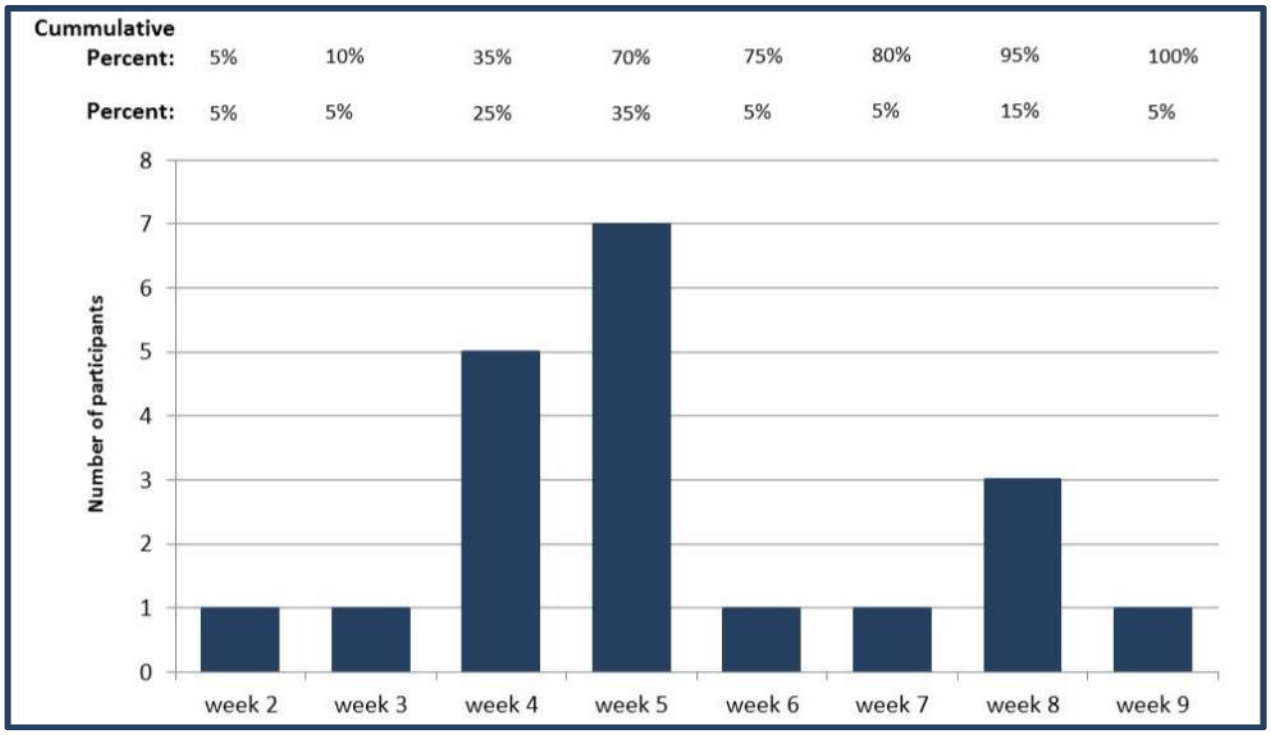


Figure 3: Average Number of Texts and IVR Phone Calls per mLearning Participant per Week, Senegal 2013

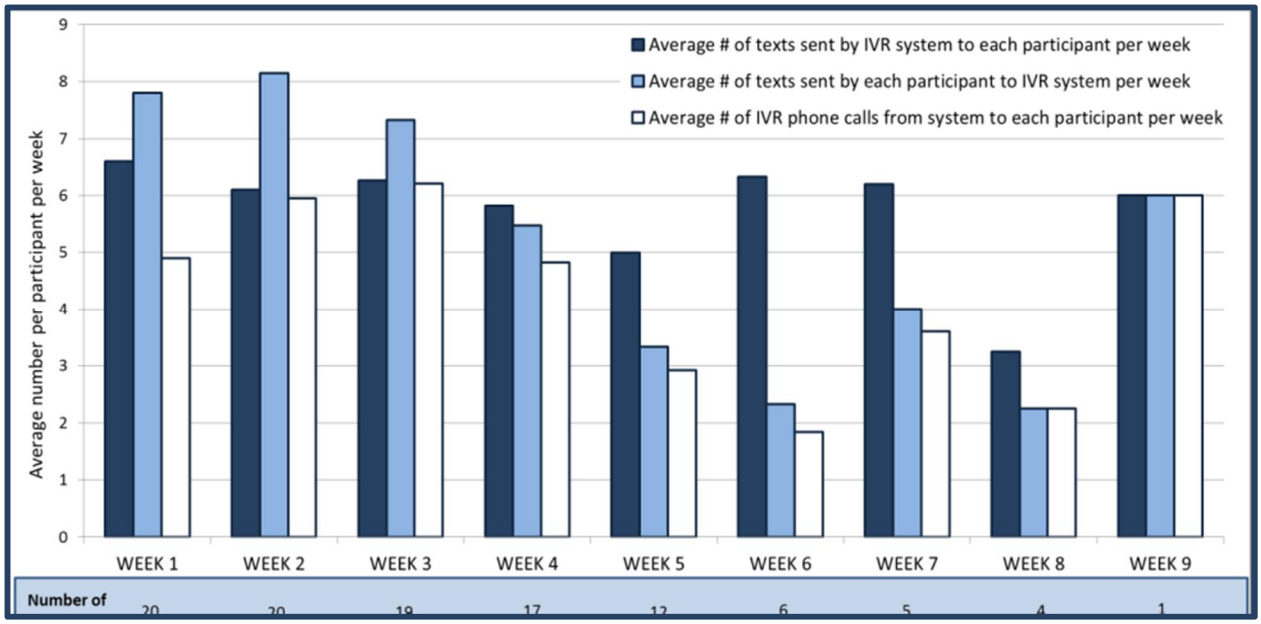


Table 3: Participants' Reported Experiences with mLearning System Technologies

Participants report	n (N=20)	%
Receipt of text message every day	15	75%
Frequency of receipt of IVR call after texting training system as ready		
Always (100%)	13	65%
Frequently (75%)	5	25%
Sometimes (50%)	2	10%
Average time of receipt of IVR phone call after texting system		
Less than 15 minutes	16	80%
Between 15 and 30 minutes	4	20%
More than 30 minutes	0	0%
Any IVR phone calls dropped		
Never	14	70%
Infrequently (1-4 times)	4	20%
Sometimes (5-9 times)	2	10%
Receipt of training questions		
Always able to receive	9	45%
Unable to receive infrequently (1-4 times)	8	40%
Unable to receive sometimes (5-9 times)	3	15%
Reasons cited for not being able to receive questions		
Poor reception	5	25%
No call from system after SMS text	4	20%
Couldn't hear audio	1	5%
Issues with phone number	1	5%
Issue with airtime credit	1	5%
Unable to charge phone	1	5%
IVR voice recording was easy to understand	20	100%
Ability to hear the audio recordings		
Very well	8	40%
Well	7	35%
Adequately	5	25%
Poorly/very poorly	0	0

Figure 3 shows the average number of reminder texts sent by the IVR mLearning system to each participant each week, the average number of texts sent by each participant to the system, and the number of IVR calls to each participant each week. The IVR system was designed to send a text each day to participants, and on average participants received about six texts per week (slightly less than one per day) throughout the duration of the course. There were a few instances during the course implementation when some participants experienced problems and were unable to receive text messages and/or access their questions for several days. The issues were due to diverse reasons and thus required different solutions including contacting Sonatel,

changing phone numbers in the system, and using a different phone. All issues were resolved as quickly as possible.

Participants texted the system to a prompt a call between seven and eight times per week, on average, in the first three weeks of the course, and correspondingly the IVR system called participants more often in the first three weeks of the course (Figure 3). Health workers who were still completing the course in weeks five through eight accessed the system less often, and finally the one participant who believed he had finished the course before he actually had, accessed it on average once a day in week nine.

Table 3 shows that the participants' reported experiences with the mLearning system technologies reflect the information logged by the system reported above. Three-quarters of participants reported receiving a prompt text from the system every day and most (18/20) reported always or frequently receiving an IVR call after they texted the mLearning system to prompt the IVR call. Sixteen (80%) participants reported that the system always called them within 15 minutes of texting the system, and four participants reported it took between 15 and 30 minutes to receive a call. Just over half of participants reported not being able to receive the training questions sometimes (15%) or infrequently (40%), with participants citing poor reception and no call from the system after their SMS text prompt as the most common reasons. All participants reported that the IVR voice was easy to understand and the majority reported they could hear the recorded voice well or very well.

Figure 4: Timing of IVR Calls throughout the Duration of Course

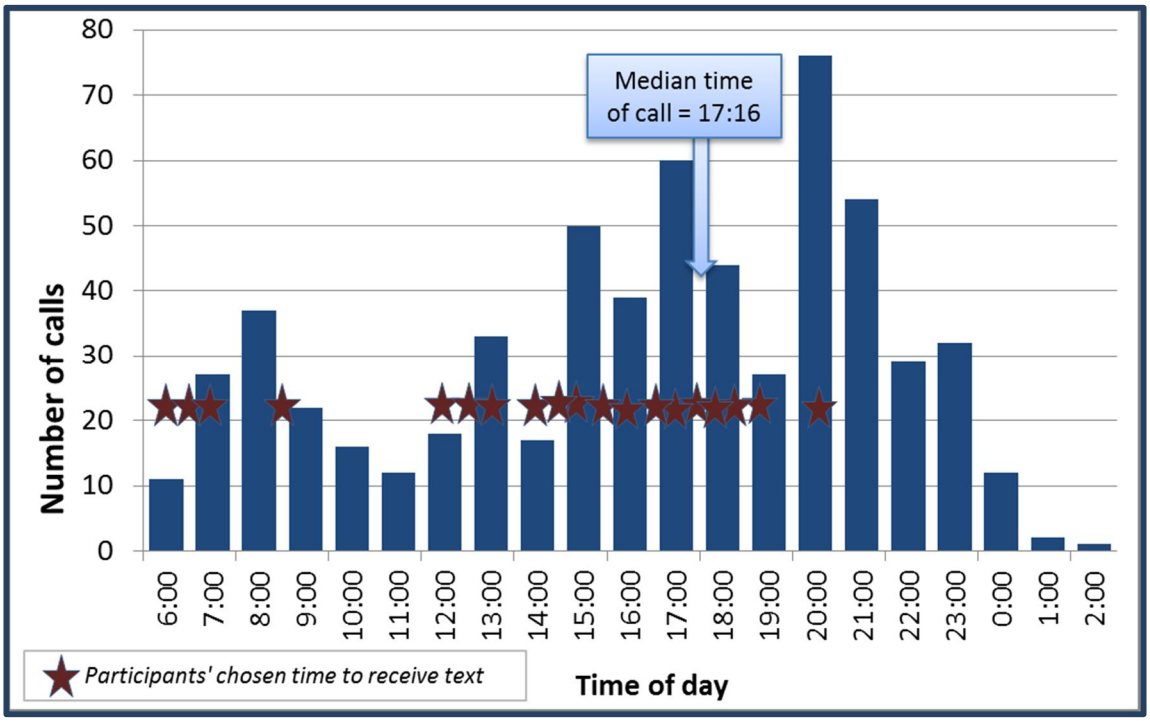


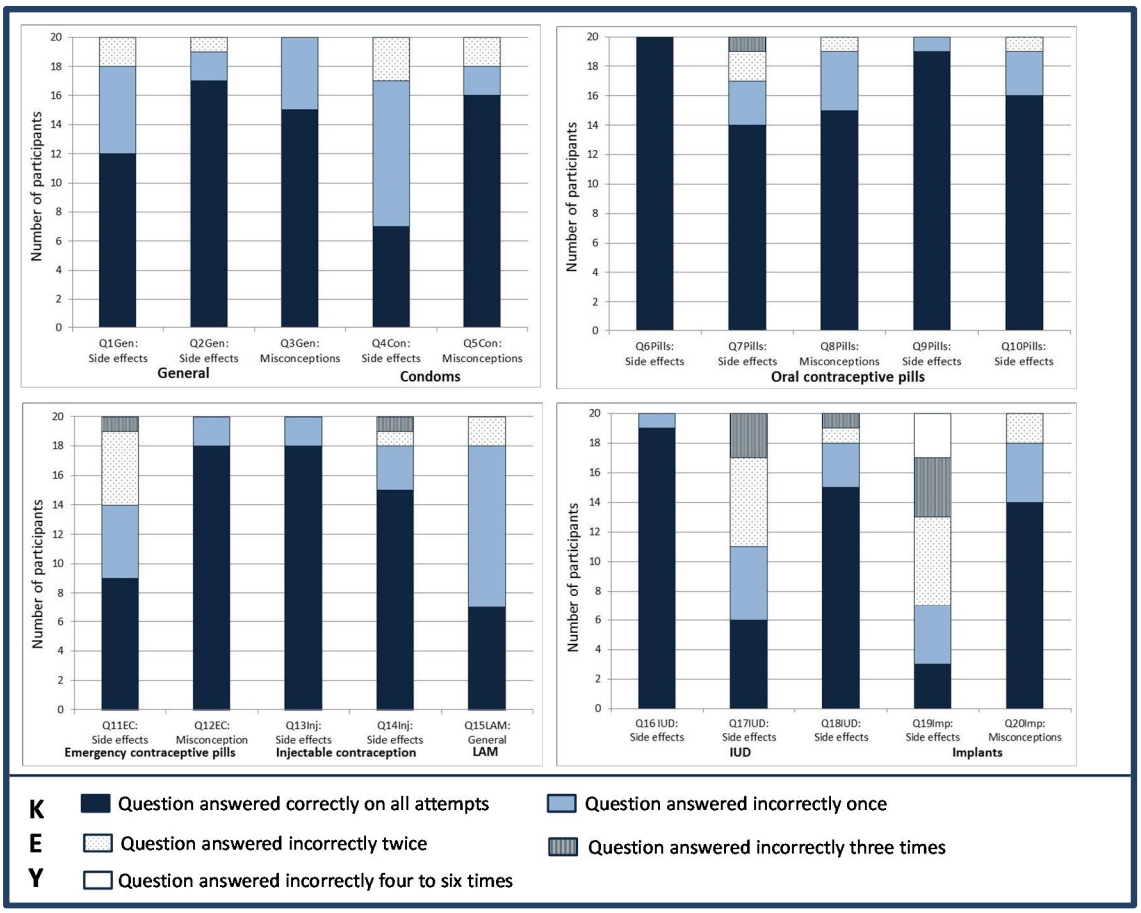
Figure 4 shows the most common time of day for calls was in the late afternoon and evenings (median call time=5:16 p.m.), and the participants' selected times to receive SMS reminders. Although all but four participants requested not to be contacted by the system after 8:00 p.m., approximately one-third of the IVR calls were initiated by participants (through SMS text) after 8:00 p.m. The majority of IVR calls were outside normal working hours.

Administration of spaced-education course/questions

On average, participants attempted two questions per day, with the maximum of four questions attempted per day allowed by the system. The average call time was 12 minutes and 52 seconds, while the median was 11 minutes and six seconds. Calls ranged in duration from just a couple of minutes to a maximum of an hour and 30 minutes. (One call in the second week was logged as lasting two hours and 50 minutes; we excluded this from our analyses because we believe it may have been an error in the system.)

Figure 5 shows the number of times participants responded incorrectly to the spaced-education questions (administered through the mLearning IVR system) about family planning side effects and misconceptions, by question topic. The number of times trainees answered questions incorrectly varied by topic. For example, all participants correctly answered a question about the side effects of pills (Q6Pill) on all attempts, while participants answered incorrectly more often for IUDs and implants, with one participant answering a question (Q19Imp) on implant side effects incorrectly six times. This differential knowledge across methods is likely associated with the fact that participating health workers have many fewer clients using implants or IUDs (Table 1, Figure 10, and Figure 11).

Figure 5: Number of Incorrect Attempts to Answer Spaced-Education Questions, by Question



Cost of development and implementation

Box 3 presents the costs of developing and implementing the IVR mLearning system in Senegal. The most expensive element was the time of international technical assistance required to develop and install the system. The developers needed to ensure the system would work in the Senegalese context as well as customize the open-source software and create the middleware to enable the interactive system. Other substantial costs included: 1) the development and revision of the training content for the spaced-education approach (questions and detailed explanations); 2) orientation for participants on how to use the system; and 3) coordination with participants and troubleshooting the system during the eight weeks of the course. We chose to use a "friends and family" contract, in which calling was free to anyone in the network. Thus, participants received approximately $20 per month in mobile telephone airtime, which enabled participants to SMS the system and unlimited free calls from the system to participants.

We anticipate that all the substantial costs could be reduced in any future applications in Senegal and elsewhere. The system and software is now developed. Future applications could use the same course on contraceptive side effects, and new courses could adapt standard training modules or policies, procedures, and norms, lessening the cost of curriculum development. Orientation could take place during routine meetings of health staff and would be

unnecessary if participants took a second course using the same system. If implemented at scale, telephone contract and coordination costs could be lowered. Appendix D provides more details and assumptions used in estimating the costs.

Box 3: Costs of IVR mLearning System Development and Implementation*	
Development and installation of IVR mLearning system	**USD**
Technical assistance for the development and installation of the system	$ 38,400
Software (open source)	-
Equipment/hardware	$3,342
Subtotal	$41,835
Development and adaptation of training content	
Development, review, and revision of content	$10,765
Audio recordings	$1,482
Subtotal	$12,247
Implementation	
Orientation	$1,164
Telephone contract/systems costs**	$ 80
Contract for airtime for participants to SMS text	$ 800
Coordination	$1,993
Subtotal	$4,037
TOTAL	$58,199

* Direct cost estimates only (no overhead included); US and Senegal staff salaries calculated with fringe benefits; capital costs of building rental and vehicle use (for orientation) not included; no depreciation or rate of inflation taken into consideration
** Phone costs for system, which allowed unlimited free calls to anyone (participants) in the system

Acceptability of the mLearning System to Deliver Refresher Training

Participants' experiences of using a mobile phone for refresher training

Participants overall reported very positive experiences with using their mobile phones for training (Table 4). All participants would like to take another course using their mobile phones and 90% reported that they learned the same or more than they would have in an in-person course. Only two participants reported that using the mobile phone for training was difficult. Figure 6a-d presents what participants liked and disliked about the mLearning system and receiving the training on their mobile phones. The majority of participants expressed appreciation for the convenience of the course, both in accessing the course and the flexible pace (Figures 6a and 6b). Forty percent of participants liked everything about using their mobile phone for refresher training; the largest criticism was poor mobile network reception (Figures 6c and 6d). Participants noted not liking their inability to ask questions and interact with other participants.

Table 4: Participants' Opinions and Experiences about Using Mobile Phones for Training

Participants' opinions	n (N=20)	%
Overall experience using a mobile phone to complete training course		
Very good	13	65%
Good	7	35%
Neutral/bad/very bad	0	0%
Ease of using a mobile phone to complete training course		
Very easy	8	40%
Easy	10	50%
Difficult	2	10%
Learning in refresher course on mobile phone compared to in-person course		
Learned more	12	60%
Learned the same	6	30%
Participants' opinions	**n (N=20)**	**%**
Learned less	2	10%
Would like to take another course on mobile phone		
Yes	20	100%
In another course on mobile phone, prefer to receive questions via:		
Audio recordings	15	75%
SMS	5	25%
Preferred method of learning for refresher training (previously covered material)		
Mobile phone	12	60%
Internet	3	15%
In person	5	25%
Preferred method of learning for new material		
Mobile phone	10	50%
Internet	3	15%
In person	7	35%

Figure 6a-d. Participants' Likes and Dislikes about Using Mobile Phones in the mLearning Course

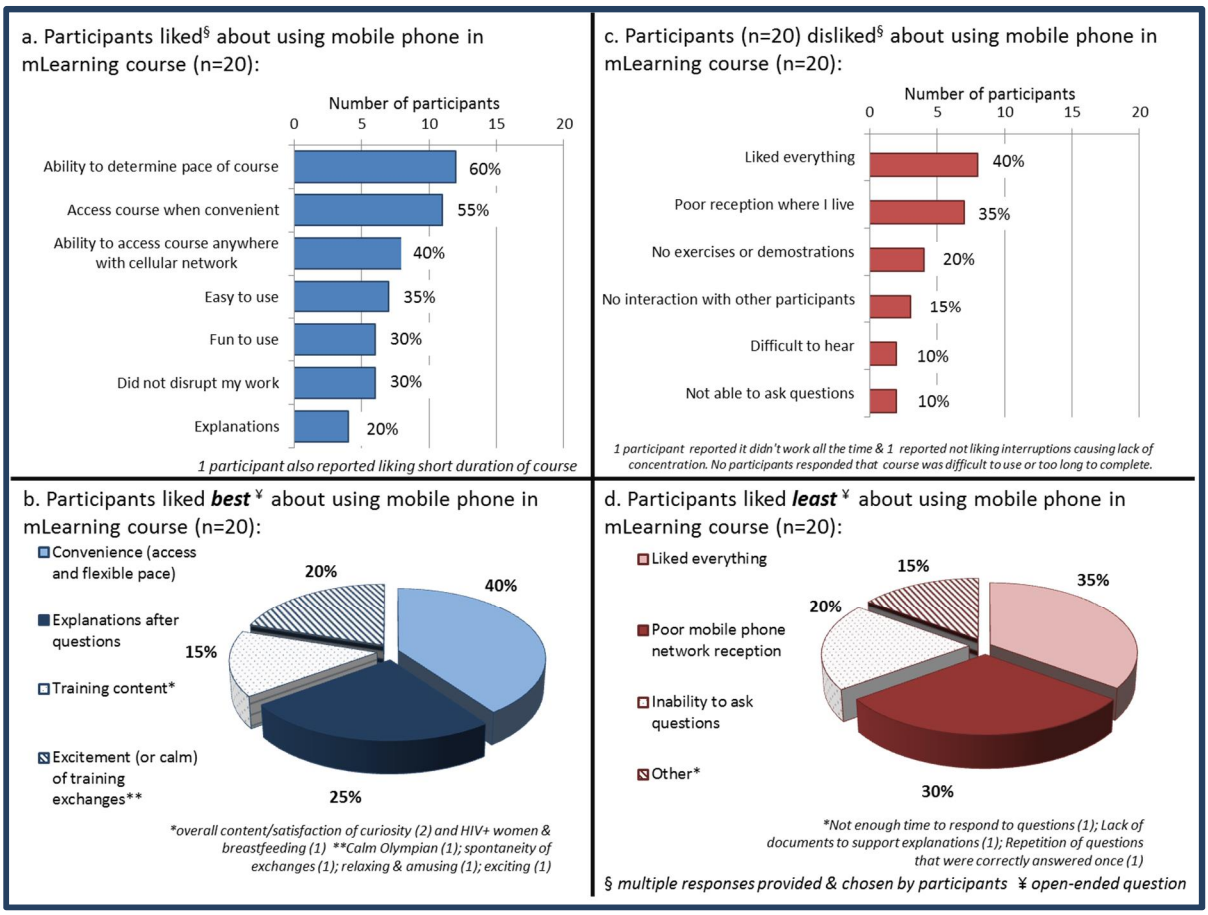


Table 5: Participants' Evaluation of Course Content

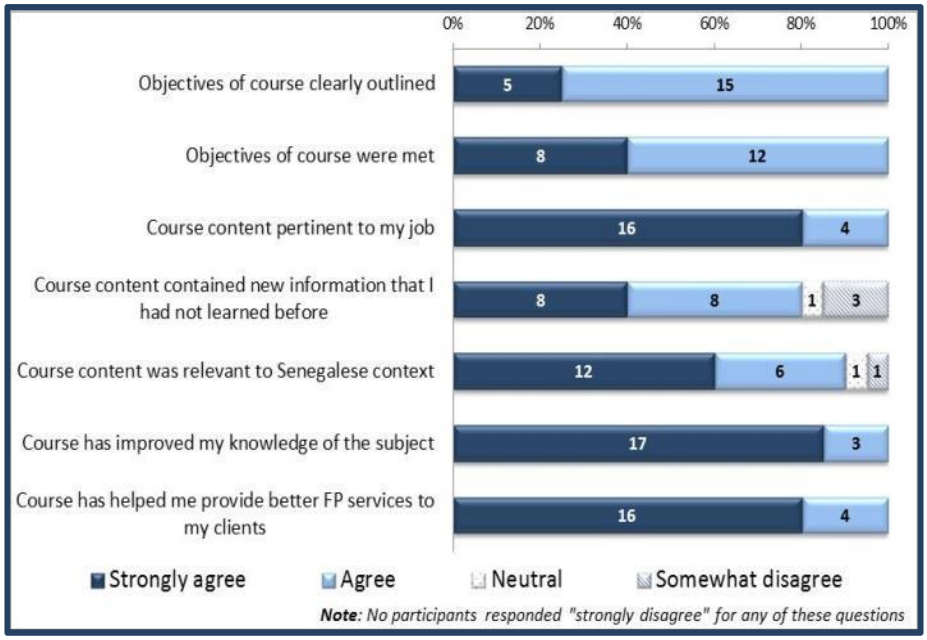
Participants' ratings of course content	n (N=20)	%
Orientation prepared me:[a]		
Very well	9	45%
Well	7	35%
Adequately	4	20%
Instructions were:[a]		
Very clear	9	45%
Clear	9	45%
Adequate	2	10%
Questions were:[a]		
Very easy	4	20%
Somewhat easy	2	10%
Neutral	13	65%
Explanations were:[a]		
Excellent, complete, clear, and concise	10	50%
Good, usually provided adequate and clear information	9	45%
Okay, many could have been clearer and more comprehensive	3	15%

[a] No participant reported that orientation prepared him/her poorly or very poorly, that instructions were unclear or very unclear, that questions were challenging or very challenging, or that explanations were poor.

Participants' evaluation of training content

Table 5 presents the participants' evaluation of the course content. Overall, participants highly rated the orientation, instructions, and explanations. Only four participants stated the questions were very easy, and no participant thought the questions were too challenging. Few participants (60%) reported consulting outside resources on family planning side effects and misconceptions, with six participants (30%) consulting a book, handout, or flyer and fewer consulting the Internet (15%) or a colleague (10%) (data not shown).

Figure 7: Participants' Ratings of the IVR mLearning Course Content



We asked participants to rate the IVR mLearning course content using a five-point Likert scale (Figure 7). All participants agreed—plainly or strongly—that the course objectives were clearly outlined, the objectives were met, and the course content was pertinent to their jobs. A large majority strongly agreed that the course improved their knowledge on the subject and helped them provide better services to their clients. Sixteen participants agreed that the course contained new information, although three participants disagreed with this statement. Most noted the course content was relevant to the Senegalese context, although one participant disagreed.

Participants' preferences and recommendations for the IVR mLearning course

Table 6 presents participants' stated preferences for delivery of training using the mLearning system. Most participants stated that they would prefer delivery of the course using similar frequency of prompt texts (once a day), number of questions allowed per day (up to four per day), and number of required correct responses (two correct responses before question is retired) as were used in the mLearning IVR pilot. Notably, nearly half of participants stated that 20 questions in the course were too few though a similar number (nine) thought the

explanations provided too much information and 11 participants noted that eight weeks for the course was too long in duration.

Table 6: Participants' Preferences for mLearning System

Participants' preferences		n (N=20)
Preferred frequency of prompt texts		
More than once a day	6	30%
Once a day*	13	65%
Every 2-3 days	1	5%
20 questions included in course was:		
Too many	1	5%
Right amount*	10	50%
Too few	9	45%
Preferred number of questions a participant allowed to answer per day		
1-2	3	15%
3-4*	13	65%
5-9	4	20%
Preferred number of times question must be answered correctly before being retired		
More than 2 times	6	30%
Two times*	12	60%
Only once	2	10%
Amount of information in explanations		
Too much information	9	45%
Right amount of information*	11	55%
Too little information	0	0%
Course duration of 8 weeks		
Too long	11	55%
Right amount*	9	45%
Too short	0	0%
*Frequency, amount, or duration used in the mLearning IVR course on family planning side effects and misconceptions		

During the post-course survey, we asked participants to provide any additional recommendations to improve the IVR mLearning system. Box 4 presents these recommendations. Participants most often recommended the extension of the IVR mLearning system to other health topics and the expansion of the family planning course to other health workers in their districts and beyond. A few participants mentioned increasing the number of questions, decreasing the duration of the course, maintaining contact with the participants, and fixing the network issues.

Box 4: Open-Ended Recommendations from Participants	
Expand the mobile training system to other topics*	8 recommendations
Train others health workers in department and beyond	7 recommendations
Increase the number of questions**	5 recommendations
Reduce the duration of course to less than 8 weeks	4 recommendations
Maintain permanent contact with/supervise participants	3 recommendations
Fix network problems/collaborate with Orange to fix problems	3 recommendations
Buy mobile phone for participants	2 recommendations
Fix start-up issues; provide credit before course start-up; create a sharing network to maintain the IVR system; share final documentation of course; conduct a midterm evaluation instead of final evaluation; use SMS for the explanations; improve vocal server because the echoes impede hearing well; provide the course in a slower manner; hold exchange workshops; allow participants to give their point of view; supplement the IVR course with documents that allow participants to refer to them as needed	1 recommendation each

*Topics specifically recommended include reproductive health, including prenatal and postnatal consultations and use of partogram, referral, and counter-referral.
**One participant suggested up to 50 questions and 3 participants noted that more questions would be more appropriate given the long duration of the course.

Changes in Knowledge and Providers' Perception of Ability

Figure 8 presents participants' knowledge of contraceptive side effects and misconceptions as measured by pre- and post-tests. Knowledge regarding management of side effects and misconceptions was relatively high at baseline, perhaps reflective of knowledge gained in the initial training four to five years previously. Overall, the average score on the test significantly increased from an average of 12.6 questions correctly answered (out of 20) before the training to 16.0 after the training. There was a slight decline in average knowledge scores ten months after the post-test (14.8), but levels of knowledge were still significantly higher than pre-test without any reinforcement in the intervening ten months. Participants showed significant improvements on questions related to the side effects of condoms, emergency contraceptive pills, and injectables, as well as a question on misconceptions related to the lactational amenorrhea method (LAM).

We asked participants to rate their perceptions of their ability to manage contraceptive side effects and misconceptions on a five-point Likert scale before and after the IVR mLearning training course. As expected with this more subjective assessment, participants reported high levels of perceived ability overall, first before the course, and subsequently slightly higher levels after taking the mLearning course (Figure 9). Overall scores on the six questions related to providers' perceptions of their abilities increased from 24.9 (out of 30) at pre-test to 27.8 at post-test ($p=0.05$).

Figure 8: Participants' Knowledge of Family Planning Side Effects and Misconceptions Before (Pre-Test) and After (Post-Test) mLearning Course

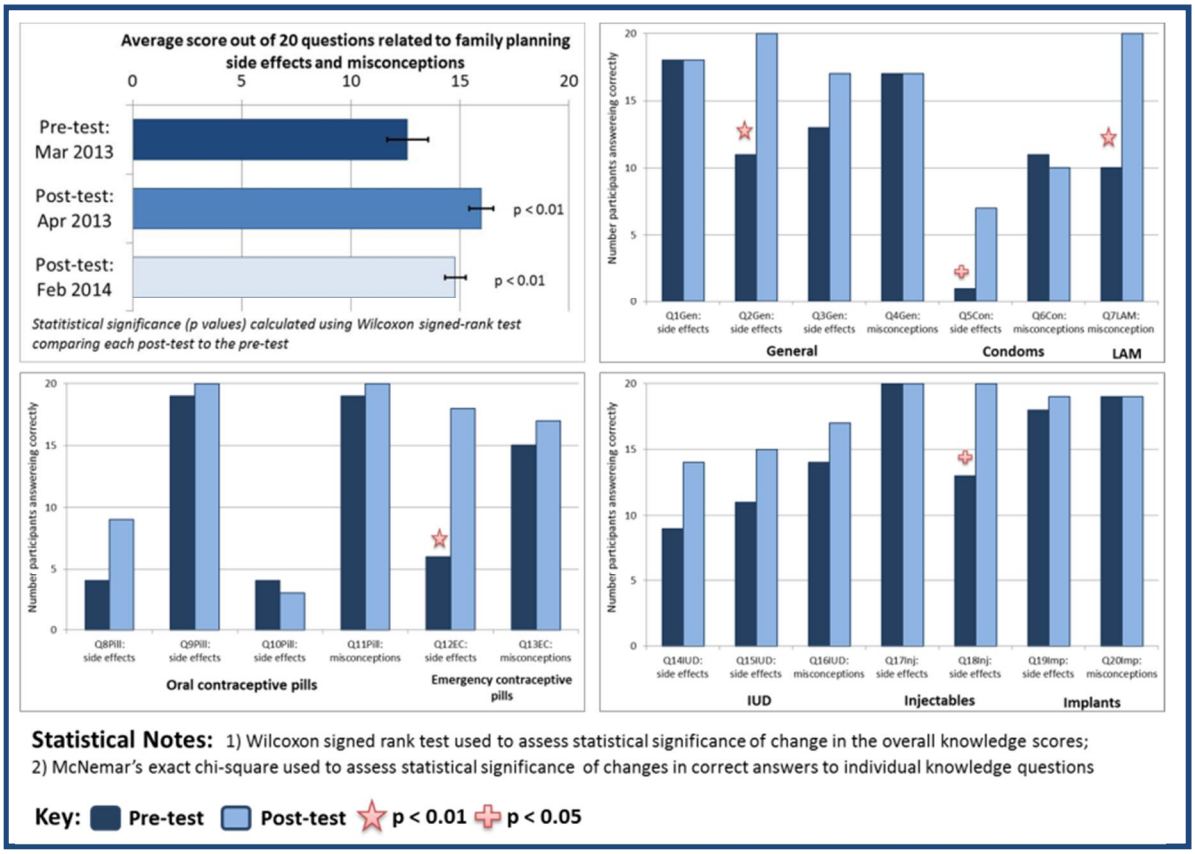
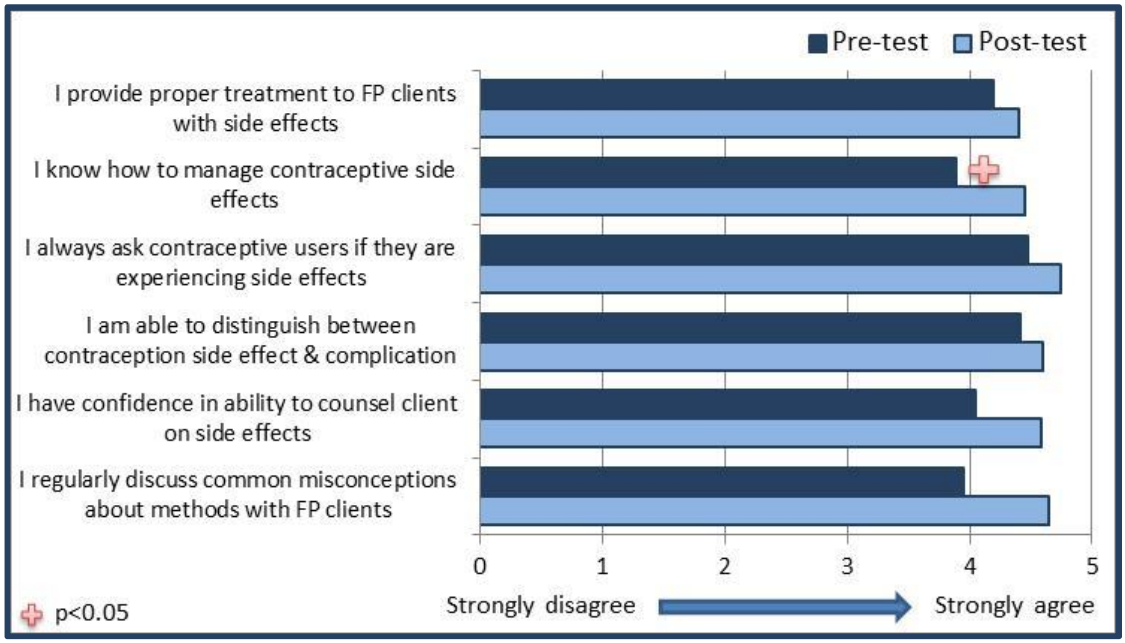


Figure 9: Participants' Perceptions of Knowledge and Ability to Manage Side Effects and Misconceptions Before (Pre-Test) and After (Post-Test) mLearning Course



Trends in Utilization of Family Planning Services

Although the intervention did not include any activities on the actual provision of services, we undertook data collection on family planning statistics, in order to explore trends in the utilization of family planning services offered in the facilities of the 20 IVR participants. Figure 10 presents trends in utilization (as measured by proxies of contraceptives distributed and couple years protection) of family planning services before, during, and after the IVR mLearning training in the 20 health facilities where the IVR participants deliver services. Utilization of contraceptives increased overall during this period, with month-to-month fluctuations. In particular, there was a 45% increase in the provision of all methods and a 31% in couple years protection between the nine months before and nine months after the IVR training (i.e., between July 2012–March 2013 and April–December 2013). However, it is difficult to interpret these trends in relation to the IVR mLearning course because the data also represent efforts of health workers who did not participate in the IVR course and the region experienced other efforts to improve family planning around the same time as the IVR training. All but one of the IVR mLearning participants (19 participants) noted that other health workers also provided services and completed the registers and reports at their facility. Additionally, there were two concurrent large initiatives to improve family planning that started in Thiès Region in mid-2013. First, the informed push model initiative (Sutton 2013) to improve the contraceptive supply chain and minimize stockouts at facilities started in the two districts in June 2013, just after participants completed the IVR course. Second, the government of Senegal made commitments to increase contraceptive use and improve family planning programs through the National Action Plan (Ministry of Health, Senegal n.d.) and related district- and local-level activities in Thiès Region commenced in June and July 2013. On the negative side, relatively large drops in contraceptive stocks distributed at these 20 facilities occurred in September and October of 2012 and 2013, perhaps related to seasonal factors.

Figure 11 shows the quarterly trends in new family planning clients by type of contraceptive at the 20 facilities of IVR training participants. To allow for examination of trends, we present only data for new users of each method where those data were available and complete for all quarters. For example, all facilities had data for new users of pill and injections (n=20), while only 14 facilities had complete data for IUDs for all six quarters. The number of new clients reported increased between July 2012 and December 2013, with the majority of new clients opting for oral contraceptives or injections. Similarly to trends in contraceptives distributed (see September 2013 in Figure 10), there was a decrease (11%) in new users in the third quarter of 2013, compared to the previous quarter.

Figure 10: Trends in Quantity of Contraceptive Stock Distributed and Couple Years Protection at 20 IVR mLearning Participants' Health Facilities

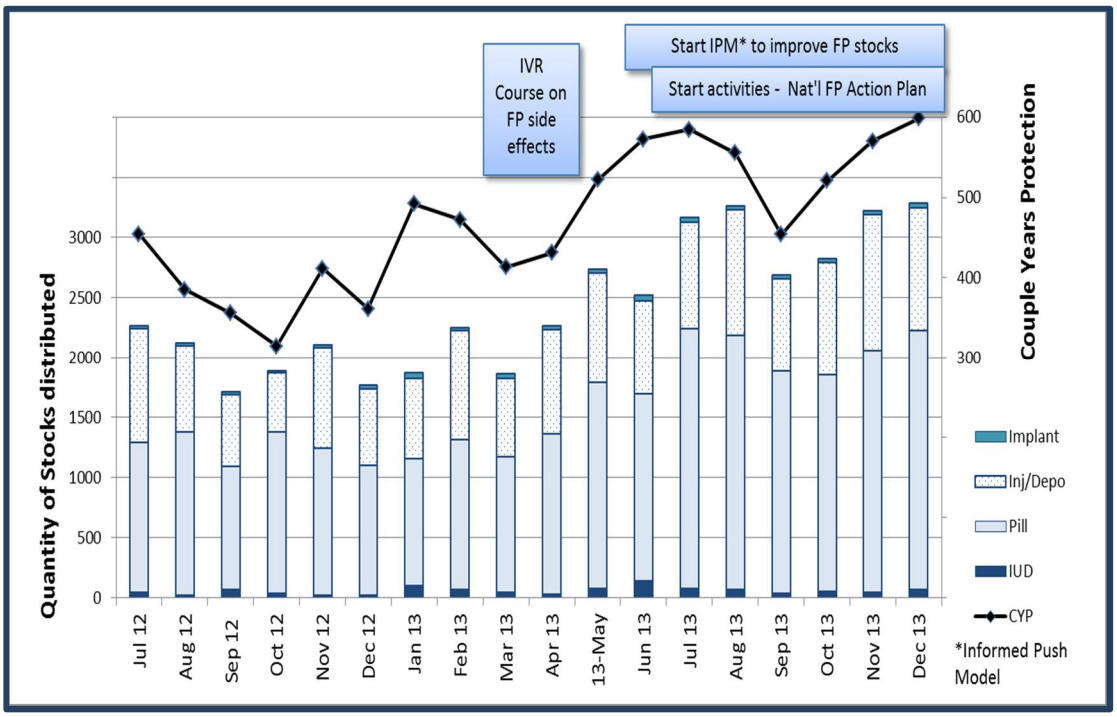
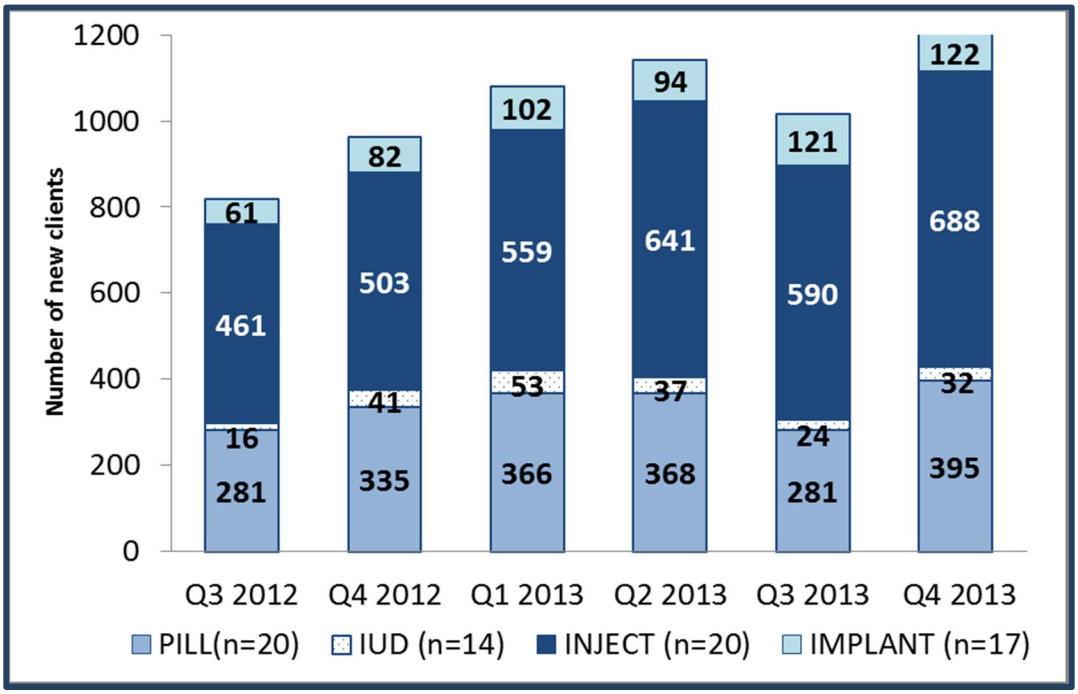


Figure 11: Trends in Number of New Family Planning Clients by Method at 20 IVR mLearning Participants' Health Facilities



Quality of Family Planning Counseling

In February 2014, ten months after the mLearning course, supervision teams directly observed course participants counseling nine new contraceptive clients and seven returning clients, with particular attention to side effects counseling and management. Ideally, observations of provider-client interactions would have been conducted among all 20 IVR mLearning trainees at purposely-arranged visits; however, teams were only able to observe interactions with any family planning clients presenting during supervisory visit day with 11 participants due to resource constraints. Figure 12 presents selected findings on the observed conditions and general content of these 16 counseling sessions, representing a total of 460 item-clients observed. Fourteen of 16 sessions were conducted in a private and discreet location; however, only 19% of clients (three new clients) were reassured of the confidential nature of the visit. In over half the encounters, the provider encouraged the client to ask questions and used visual aids to facilitate comprehension. Clients were asked about their other reproductive health needs and/or if they understood the issues discussed in few encounters (31% and 44% respectively). In all but one counseling session, the provider told the client the date of the follow-up visit, and in the majority of visits, the provider explained that the client can return to the facility whenever she needs. Appendix C presents details on all the counseling conditions, communication aspects, and content for new and returning clients, respectively.

Figure 12: Observed Conditions and Generic Content of Family Planning Counseling among 11 IVR mLearning Participants Counseling 16 Clients (Nine New and Seven Returning)

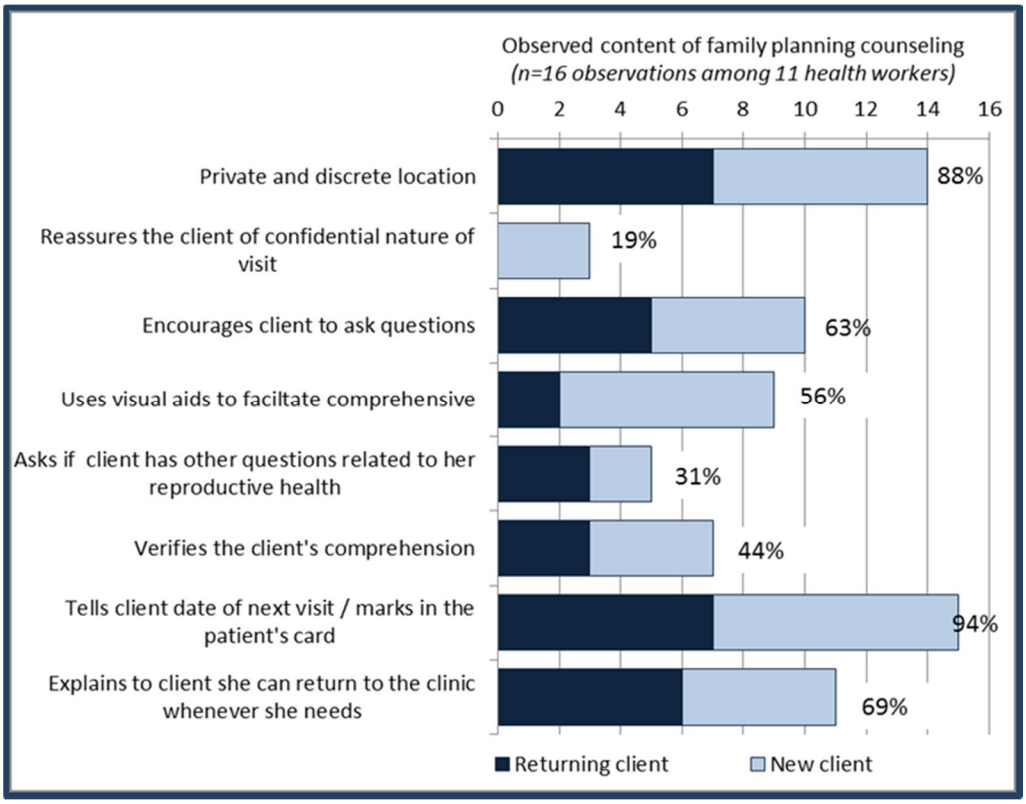
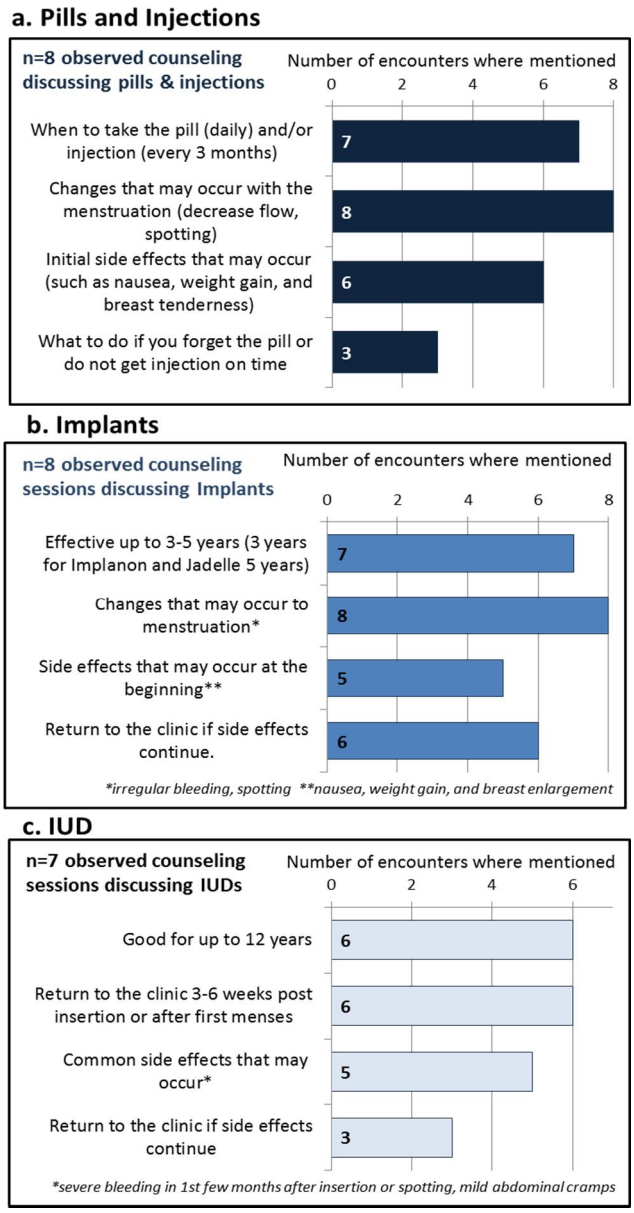


Figure 13a-c presents the counseling with the small number of new clients on the day of the supervision visit, specifically on side effects of pills/injections (Figure 13a), implants (Figure 13b) and IUDs (Figure 13c) provided by eight IVR mLearning participants. Health workers discussed important side effects for all methods in the majority of encounters. Across these 92 item-client observations, IVR-trained providers positively scored in 70 of them, for an average of 76% performance to standard. Despite this overall positive performance, there were a couple of items where most providers failed to fulfill required tasks. Thus, in fewer than half of the encounters did the health workers mention what to do if a pill or injection was not taken on time, nor did they appropriately counsel clients that IUD users needed to return to the clinic if side effects continued.

Figure 13a-c: Observed Technical Content of Counseling of New Clients on Contraceptive Side Effects Provided by Eight IVR mLearning Participants



Discussion

Summary of Findings

Our findings show that an innovative mLearning system to deliver refresher training via simple mobile phones using IVR and SMS text is feasible to implement, greatly appreciated by health workers, and associated with gains in knowledge in the short term and close to a year after training. Notably, the participants' most common recommendations were to expand the system to deliver training to other health workers and to extend it to cover different refresher training topics. These results have been disseminated and discussed in Senegal (see Box 5).

Box 5: Local and National Findings in Senegal

The IVR mLearning participants and district and regional authorities came together in July 2013 to learn about the preliminary findings from the pilot test and receive certificates of participation for the training. In March 2014, a national dissemination event in Dakar brought together participants; district, regional, and national-level Ministry of Health officials; development and research partners (nongovernmental organizations); and donors to learn about the IVR mLearning system and the results from the pilot test. There was great interest in the mLearning system and pilot experiences. Participants at the meeting discussed: 1) using the IVR mLearning system for policy updates and other refresher training; 2) including photos, vignettes, or videos to expand the system to more clinical training; 3) estimating the potential cost of scaling up and lowing network provider costs; 4) resolving issues with the cellular network; 5) incorporating scripts/systems for reminders to participants; and 6) considering the system's requirement to respond to a large number of texts/calls at the same time for implementation at larger scale.

Participants expressed great appreciation for the learning and knowledge generated by the IVR mLearning pilot implementation and assessment. High-level participants from the Ministry of Health, USAID Senegal, and nongovernmental organizations noted that the Ministry recently created an mHealth Task Force to ensure coordination of mHealth activities and to define a strategic vision for the use of mHealth in improving health services. The Senegal mHealth Task Force is currently carrying out a census of all mHealth/eHealth activities to identify promising initiatives. The IVR mLearning experience has been included within this census.

We are not aware of other research on the use of IVR to improve health workers' knowledge and practices. The IVR mLearning system, using the spaced-education approach, holds great promise to reach health workers with simple mobile phones in areas that do not have good Internet connectivity. It could easily be adapted and adopted to reach illiterate or semiliterate community health workers, since it relies only on voice and simple numeric interactions rather than written materials. The IVR mLearning system also has the potential to overcome language barriers, as training messages can be recorded in any language or dialect. As with other mHealth initiatives, the reliability of cellular networks in remote areas remains a challenge.

IVR mLearning participants have increased knowledge of contraceptive side effects and misconceptions almost a year after the training. Our findings are consistent with previous studies of the spaced-education approach showing improved knowledge retention (Kerfoot, Baker, et al. 2007; Kerfoot, DeWolf, et al. 2007; Kerfoot 2009; Kerfoot, Fu, et al. 2010; Kerfoot, Lawler, et al. 2010). This pilot intervention on an innovative learning system was not designed to measure effects on service delivery. However, upon exploring contraceptive service statistics at participants' facilities we found—despite inconsistent data quality and unexplained fluctuations—positive trends over the periods before, during, and after the intervention. This is a welcome finding, although we are not able to attribute it to the intervention.

This innovation appears to be well suited to deliver refresher training in the context of the Senegalese health system. Participating nurses and midwives were already using their mobile phones for many work-related activities. All participants rated the overall experience of using the phone for training as good or very good and the large majority (90%) noted that using the phone for the course was easy. All 20 trainees that started the course completed it within nine weeks and the majority of participants rated the course content highly and felt that the refresher training was pertinent to their jobs.

We found that participants prompted the majority of IVR calls during nonregular working hours and that the average call time was about 13 minutes, suggesting that the IVR mLearning system training did not disrupt the health workers' service delivery. The aspect participants appreciated most was the convenience of the system—the ability to determine when and where to access the training, as well as the ability to determine the pace of completing the course. The IVR mLearning system included some interaction and repetition of the questions, both aspects previous studies have found to be effective in self-directed learning, where learners can go at their own pace and access the information when convenient (Bluestone et al. 2013). The half-day orientation did require participants to leave their site of service; however, participants noted that the orientation prepared them well for the course, and previous experiences in mHealth initiatives have highlighted the importance of good orientation for participants (Riley and BonTempo 2011). The orientation to the IVR mLearning system is only required once, so any additional IVR training among the same participants would not require them to leave their work sites.

Although our results are encouraging, refresher training through mobile phones should complement—not replace—different approaches within an in-service training strategy and the broader health systems support for health workers. Training delivered on basic mobile phones does not permit trainees to interact with the instructor and other participants, perform clinical practice/simulation, or view didactic images such as diagrams, photos, and graphs. These approaches are essential for teaching and learning certain material (Bluestone et al. 2013) and thus simple mobile technology may not be appropriate for certain pedagogic objectives. However, hands-on training and use of images are not necessary for all topics. For example, updates on regulations and guidelines for family planning or other health services could be communicated to health workers via a mobile phone, thereby ensuring standardization and quality assurance in communication on the topic.

One of the ongoing challenges in our pilot study and other similar mHealth initiatives is the variability of the cellular network. A third of participants reported their phone calls were dropped and one quarter cited poor cellular reception as the reason they were not always able to receive and complete the training questions, and a similar proportion cited poor network reception where they live as the thing they liked least about the course. In a wider application, these concerns may discourage potential users from completing required courses and limit the impact of such intervention. Although improving all cellular network reception issues is not within the purview of the mLearning system, future implementation should consider working with the network providers in private-public partnerships to ensure reliable cellular reception.

Suggested Modifications to the IVR mLearning System and Delivery of Refresher Training

One of the inherent purposes in our pilot deployment of the IVR mLearning system was to identify issues and challenges requiring improvements before implementation on a larger scale. Below we outline potential modifications that should be considered before larger-scale implementation.

Include a preliminary period for setup of contract

We experienced challenges in the first week related to the contract with the telephone network and loading of credit for airtime, issues similar to those found in other pilot studies of mHealth applications (Riley and BonTempo 2011). We were able to resolve the issues relatively quickly, and a full-time, local coordinator for the activity facilitated the resolution of issues with the network carrier and participants over the duration of the course. For larger-scale implementation, we recommend that sufficient time and financial resources be budgeted to allow a preliminary period (before the start of the official training) for the testing of the airtime and contract mechanisms.

Consider using Internet telephony

Using the Internet to place phone calls may be less expensive for larger-scale implementation than setting up local phone lines. A local phone line for texting may still be required to keep costs down for participants SMS texting the mLearning system. Other options, such as using local landlines to place the IVR calls or using bulk Internet SMS text services, could also be considered in Senegal and other contexts depending on comparative costs. We experienced some issues with FreeSWITCH accessing multiple voice lines at the same time, and this issue may be resolved through incorporation of a less expensive server/modem combination to handle individual calls, with one system managing all the interfaces to determine the timing of calls. This setup would also facilitate the expansion of the system with new phone lines.

Consider modifications to the mLearning technologies

Depending on the implementation needs—such as an increased number of participants—future applications of the mLearning system may consider modifying the types and configuration of the open source technologies. For example, Gammu could be replaced by similar technologies that process SMS texts and interface with FreeSWITCH. The use of Moodle to manage course content is also optional, although the middleware would also need to be modified to account

for a new configuration. Additionally, we experienced some issues with FreeSWITCH accessing multiple voice lines at the same time. This issue may be resolved through incorporation of a server/modem combination to handle individual calls, with one system managing all the interfaces to determine the timing of calls. This setup would also facilitate the expansion of the system with new telephone lines. In this pilot application, participants found using a text to prompt an IVR call feasible and convenient. However, future adaptations of the system for less literate learners might allow participants to prompt an IVR call with a simple call to the system, similar to the Mobile Academy system in Bihar, India (Ananya 2013).

Incorporate participant tracking mechanisms

During the pilot, one participant was not aware he had not completed the course. We recommend the incorporation of a progress report feature that would text participants their daily or weekly progress, as well as planned supervision through phone calls to participants.

Enhance courses with more interactive exercises and/or written reference materials

A few participants disliked the lack of exercises or demonstrations, and the inability to ask questions and interact with other participants. Some participants also suggested more contact with the system and course coordinator, as well as the inclusion of written reference materials. We recommend that future implementation of the refresher-training course on contraceptive side effects and misconceptions and other training courses delivered via the IVR mLearning system provide participants with written reference materials and consider incorporation of exercises, teleconferences with coordinators and participants, or other interactive mechanisms. The inclusion of supplementary materials and/or interactive methods could potentially increase learners' satisfaction and retention of course competencies, although their inclusion will increase the costs of delivering the training.

Consider course duration and frequency and number of questions

We found that it was feasible to deliver the course within about eight weeks. More than half of participants noted that the course duration was too long, although other participants took the full eight weeks to complete the course of 20 questions. The spaced-education approach relies on delivering material over time to increase learning and retention of the content, so substantially shortening the course may not result in the same improvements in knowledge. An important number of participants would also prefer to have more questions included in the course, especially if the course duration remains at eight weeks. Although the contraceptive side effects and misconceptions course may not require changes to the duration, the IVR mLearning system can and should be adapted for different content and audiences, with shorter or longer course duration and more or fewer questions included, depending on the training content and target learners. Future implementation of the IVR mLearning system could compare learning outcomes when the same course is given over different periods of time.

Consider mechanisms to reduce costs

Many of the larger costs associated with this pilot application—such as development of the system and course material—could be reduced in future, larger-scale applications. However, the cost of telephone airtime must be reduced in larger-scale applications. Similar to Mobile

Academy in India (Ananya 2013), a toll-free number could be established, rather than contracts for all participants. Also, some countries are moving toward cellular networks that allow health professionals to communicate with each for free (Switchboard n.d.), and the IVR mLearning system could be incorporated into these networks.

Study Limitations

We deployed and assessed the IVR mLearning training system among a very limited number of purposively selected participants (20 nurses and midwives). Working with a small sample allowed us to pilot test in a controlled way the IVR mLearning system and to make changes based on participant feedback before attempting to deliver training with the system at a much larger scale. Though the nature of the intervention justified it, the selective sample and its small size, lack of any control group, and no measurement of changes in health worker practices before and after the intervention preclude conclusions about the overall effectiveness of the training system. We were able to explore trends in utilization of family planning services in an 18-month period covering before, during, and after implementation of the course. However, inconsistencies in data quality, limited sample sizes, and lack of a comparison group to control for secular trends and other interventions existing in such areas limit the inferences drawn in relation to the effects of the IVR mLearning training on service delivery. Any larger-scale implementation will need to be accompanied by a more rigorous evaluation that includes a comparison group and examination of health worker behaviors and the quality and quantity of service delivery over time.

We purposively selected providers to receive the IVR training and paid for all costs associated with the training, potentially limiting the external validity of our findings, even within the Senegalese context. Participants worked in both urban and rural settings, and health workers in rural areas did report more issues with cellular reception than their urban counterparts during the IVR mLearning system pilot (data not shown). However, the health workers that participated in the IVR mLearning pilot were similar in demographic characteristics to other nurses and midwives in Senegal.

Recommendations

Modify the IVR mLearning system based on findings from this pilot

We conducted this pilot to identify necessary changes to the system. We suggest that any future implementation include the following modifications described in more detail above:

- Include a preliminary period for setup of contract
- Consider the use of Internet telephony or other technologies to lower the cost of phone calls and SMS texts
- Consider alternative technologies to meet the scale and needs of the training
- Incorporate participant tracking mechanisms
- Enhance courses with more interactive exercises and/or written reference materials
- Consider course duration and frequency and number of questions.

Extend the IVR mLearning system to other participants in Senegal and expand to other health topics

Based on our positive findings, we strongly recommend that the refresher training on contraceptive side effects and misconceptions be offered to other nurses and midwives in Senegal. Programs can develop additional spaced-education courses on appropriate topics and offer them to health workers using the IVR mLearning system. We constructed the system using open source software so that it can be adapted to other training content and even other uses, such as performance improvement and behavior change communications, depending on the needs.

Ideally, the Ministry of Health would house and administer the IVR mLearning system to deliver refresher training. Private-public partnerships, such as with Sonatel, should be explored to defray costs and reinforce technical capacity to modify and administer the system. During any scale-up, implementers must also give sufficient attention and financial resources to the system architecture, organizational and administrative systems, and training and supervision for staff to manage the system (Piette, Lun, et al. 2012).

Evaluate the effectiveness and cost-effectiveness of the IVR mLearning system on a larger scale

Most documented experiences with mHealth applications are at a small scale and do not examine the effectiveness of the interventions on provider practices or service delivery (Callan et al. 2011; Piette, Lun, et al. 2012). Evaluations of the impact of in-service training on health worker behaviors and patient outcomes are also scarce (Bluestone et al. 2013). This pilot is no exception, and an evaluation with a strong, controlled design and examination of health workers' quality of service delivery should accompany any larger-scale implementation. Rigorous evaluation will require adequate financial and human resources. Future effectiveness evaluations could use a step-wedge design (Hussey and Hughes 2007), in which the training is rolled out to groups of health workers over time. Any evaluation should adapt a comprehensive framework to document and assess the IVR mLearning approach to in-service training (O'Malley, Perdue, and Petracca 2013).

Conclusion

This study demonstrated that the application of an mLearning system using IVR, SMS text messages, and simple mobile phones to provide refresher training is feasible, well-liked by participants, and associated with sustained increases in content knowledge. The IVR mLearning platform has the potential to be an effective and efficient approach to providing refresher training and/or updates to national guidelines, policies, and protocols in family planning and other health service areas. The IVR mLearning system is especially well suited to reach rural and low-literacy health workers with refresher training content. We can hypothesize that improved knowledge and skills of providers should eventually lead to better quality of care and increased use of services; however, such a conclusion is not possible under this small-scale pilot intervention. The system should be scaled up to other geographic areas and training topics in Senegal. Close monitoring and rigorous evaluation of larger-scale implementation can provide robust evidence that the IVR mLearning system is feasible and effective at scale.

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Appendix A: Definitions of mHealth, mLearning, and mHealth Education

mHealth
Medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices. mHealth is a component of eHealth*.

mLearning
Use of mobile devices to enhance knowledge and performance**. Ability to access educational resources, tools and materials at anytime from anywhere using a mobile device.

mHealth education
Applications of mobile devices to the training, testing, support, and supervision of health workers, as well as to the provision of health information to individuals. It forms a subset of mHealth and of mLearning***.

**Definition from World Health Organization. 2011. mHealth: New horizons for health through mobile technologies: Based on the findings of the second global survey on eHealth. Global Observatory for eHealth series, volume 3. Geneva, Switzerland: World Health Organization. http://www.who.int/goe/publications/goe_mhealth_web.pdf*

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Appendix B: Management of Contraceptive Side Effects and Misconceptions Training Questions

General	When counseling a client for the first time on a contraceptive method, what should you tell him or her about the potential side effects? **Explain the most common side effects**
	True or False. Side effects due to contraception are warning signs of a complication. **False**
	Many rumors and misconceptions exist about contraception. What is the best way to counteract a rumor about a family planning method? **Politely explain that the rumor is not true and why it is not true.**
Condoms	A man visits your facility and tells you that he is very concerned because after he used condoms for the first time he had itching and redness on his genitals. How can you help this man? **Suggest that he try another brand of condoms.**
	Which of the following statements about condoms is FALSE? **Condoms very frequently break or slip off during sex.**
Pills	If a woman experiences ordinary headaches after initiating use of combined oral contraceptive pills, what can you do to help her? **Advise the woman to take standard doses of pain relievers to relieve the headache symptoms.**
	A woman who started taking combined oral contraceptive pills several months ago returns to your facility and explains to you that she is concerned because every month her breasts become tender. What can you say or do to help this woman? **Perform or refer for a breast exam. If the results are normal, recommend that she wear a supportive bra and take a pain reliever.**
	Which of the following is NOT a side effect of combined oral contraceptive pills? **Breast cancer**
	Irregular monthly bleeding such as spotting is common among women who use progestin-only pills. What can you recommend to a woman to help decrease the amount of spotting she experiences in between monthly bleedings? **Ensure that the woman is taking the pill at the same time every day.**
	A woman who has given birth eight weeks ago and is breastfeeding would like to use progestin-only pills as contraception. What should you tell the woman before giving her the pills? **Progestin-only pills can be used by women who are breastfeeding.**
Emergency contraceptive pills	You provide emergency contraceptive pills to a young woman and inform her that potential side effects include nausea and vomiting. What should you tell her to do if she vomits within 2 hours after taking the pills? **Advise her to return to the facility or pharmacy to procure another dose to take as soon as possible.**
	True or False. Emergency contraceptive pills work by disrupting an existing pregnancy. **False**
Injections	A woman has returned to your facility for her third shot of progestin-only injectable contraception. She tells you that she is worried because she has stopped having menstrual bleeding. What can you do to help this woman? **Reassure her that this is common and is not harmful.**
	A young woman who has no children would like to use injectable contraception to delay

	having children until she is older. What information is important to give to the woman before she begins using injectables? **Sometimes there is a delay of 6-12 months after the last injection before a woman regains her fertility.**
IUD	A woman who has had a copper-bearing IUD inserted at your facility two months ago has returned with complaints of heavy menstrual bleeding. What should you do? **Reassure the client that heavy menstrual bleeding is not unusual and should diminish after a few months.**
	Which of the following statements on side effects is important to tell a woman who has decided to have an IUD inserted? **She can expect some cramping and mild pain, especially in the first few days after insertion, and ibuprofen can be taken to alleviate the discomfort.**
	A woman who had an IUD inserted two weeks ago returned to the health center concerned because when she checked to see if her IUD was still in place she did not feel the strings of the IUD. What may have happened? **The IUD has fallen out without the woman knowing.**
Implants	A woman who recently had implants inserted has returned to your facility and reports having irregular menstrual bleeding. What medication can you offer to the woman to help alleviate the irregular bleeding? **Both combined oral contraceptives and ibuprofen**
	Which of the following statements about implants is FALSE? **Implants can move from the arm to other parts of the body.**
LAM	True or False. All women who have just given birth, including women living with HIV or AIDS, can use Lactational Amenorrhea Method to prevent pregnancy. **True**
SE = Side effects; RM = Rumors and misconceptions	

Resources from Senegal:

IntraHealth International. Manuel du facilitateur sur l'AAP : Plans de sessions sur les competences techniques du paquet planification familiale.

Ministry of Health, Senegal. Protocoles de services de santé de la reproduction.

Diatta, S., H. Talla, F.T. Thiam, M Pina, M. Mbaye, and A. Niang. La planification familiale : Rumeurs, faits et réalités. Dakar, Senegal: IntraHealth International.

Global resources:

USAID, WHO, and UNFPA. The training resource package for family planning. http://www.fptraining.org/

World Health Organization Department of Reproductive Health and Research (WHO/RHR) and Johns Hopkins Bloomberg School of Public Health/Center for Communication Programs (CCP), Knowledge for Health Project. 2011. Family planning: A global handbook for providers: 2011 update. Baltimore, MD, and Geneva, Switzerland: CCP and WHO.

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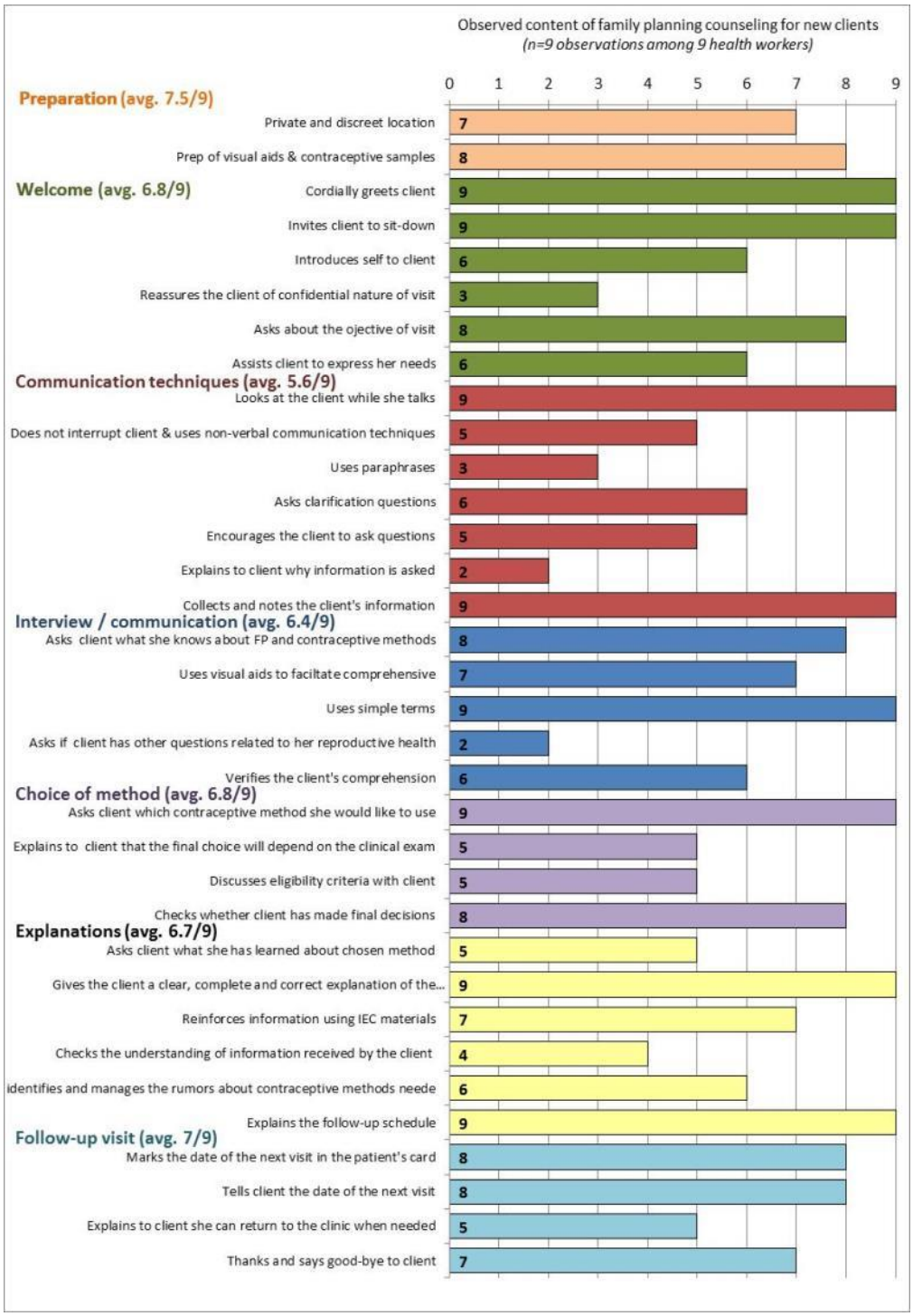
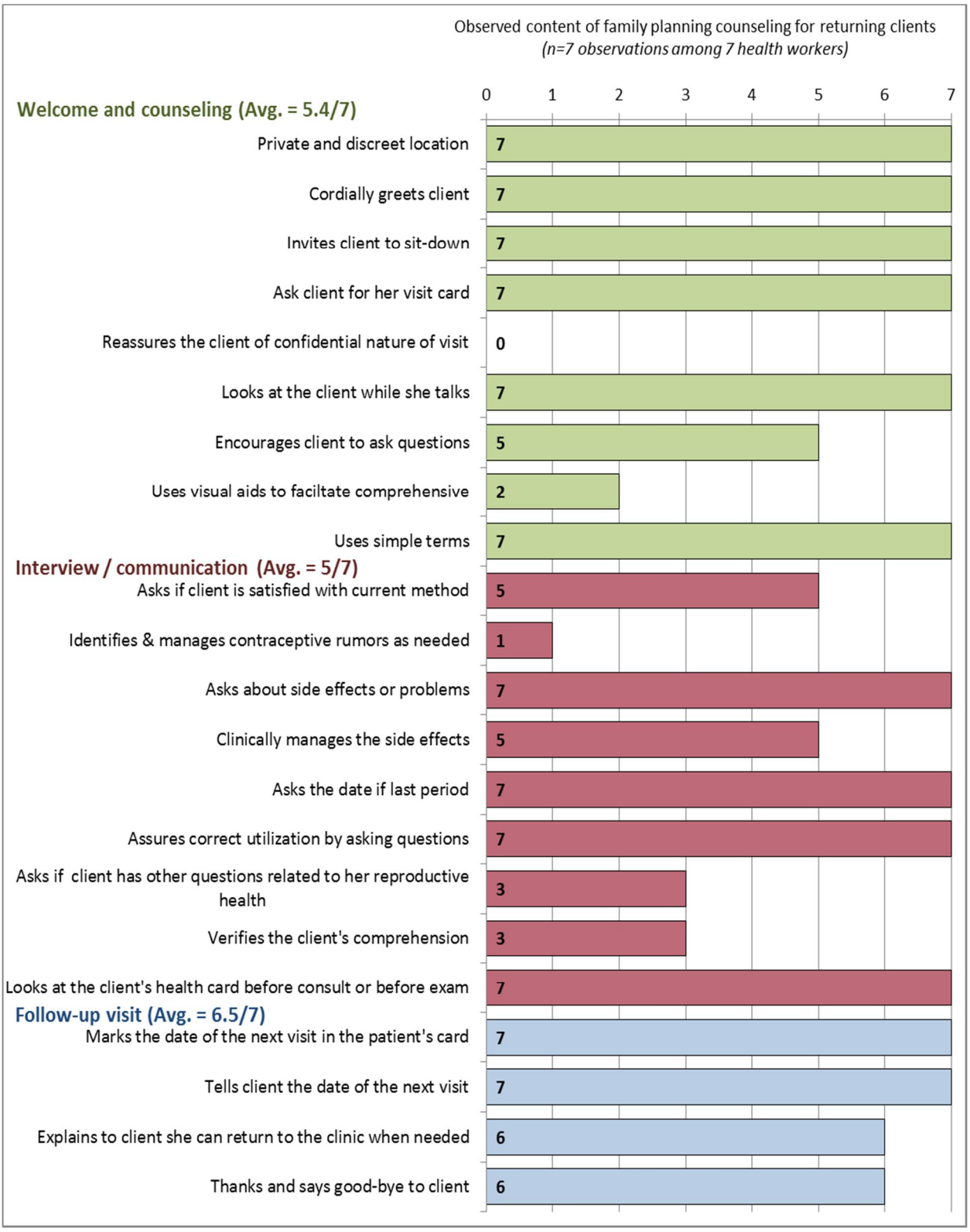
APPENDIX C: ADDITIONAL RESULTS FOR CONTENT AND QUALITY OF FAMILY PLANNING COUNSELING IN FEBRUARY 2014

Content and Quality of Family Planning Counseling for Nine New Clients Performed by IVR mLearning Participants in February 2014



Content and Quality of Family Planning Counseling for Seven Returning Clients Performed by IVR mLearning Participants in February 2014



Appendix D: Assumptions for Estimating Cost of Development and Implementation

Costs for development and implementation of the IVR mLearning system		Assumptions
		Overall: Direct costs only (no overhead included); US and Senegal staff salaries calculated with fringe benefits; Capital costs of building rental & vehicle use (for orientation) not included; no depreciation or rate of inflation taken into consideration
A. Development and installation of IVR mLearning system	**USD**	
Technical assistance for the development and installation of the system *(Salaries, Trips and Orientation)*	$ 38,493	*Salary estimates for senior systems developer for 30 days to develop and scale the system and 15 days in country to implement and one day orientation for information technology officer in Senegal; Travel Cost is derived from 2 trips to Senegal, estimated economy class flight ticket ($1,200) and State Department per diem, factoring in travel time from the States
Software *(Open-source)*	$ -	
Equipment/Hardware *(Server, Mobigator/GSM, Power inverter)*	$ 3,342	Mobigator shipped from Bulgaria (cost of shipping was high); Software updates mean there are smaller/cheaper modem options - recommendation not to use Mobigator in future applications; Power inverter borrowed from other project & used for mLearning - but needed for scale-up due to irregular electricty (power outage resets server) - market price of power inverter
TOTAL	**$ 41,835**	
B. Development & adaptation of training		
Development, review and revision of content *(Salaries of US and Senegal staff)*	$ 10,765	Development and review of course content by US staff (22 days) & Senegal IntraHealth staff (3 days); in-kind review by MOH reproductive health focal person
Audio recordings *(Actress, Studio rental, Audio editing)*	$ 1,482	Senegal IntraHealth staff salary for 1.5 days for audio recording; studio rental was in-kind contribution (cost included at 208$); audio editing required 10 days of Senegal staff time. Future applications could rent studio with all audio editing included for approx. $600 (less expensive than in-kind studio rental with audio editing done by staff)
TOTAL	**$ 12,247**	
C. Implementation		
Orientation *(1/2 day for 20 participants)*	$ 1,164	1/2 day orientation for participants held at regional office.
Telephone contract/systems costs	$ 80	Cost of network contract where it was free to call anyone included in system/contract
Costs of SMS texts & *airtime for participants*	$ 800	Participants given 10,000cfa (~21usd) airtime per month to be enlisted in the contract system and to use for text messaging the system
Coordination and adminstration of the systeme & orientation *(Dakar & regional staff salaries)*	$ 1,993	Senegal IntraHealth staff salaries include: 1) Thies regional coordinator to assist with orientation and local trouble-shooting (3 days); 2) mLearning pilot coordinator and information technology specialist approximately 1 hour of coordination and trouble-shooting/maintenance per day throughout 8 weeks of training (5.5 days each); 3) coordinator to prepare & conduct orientation (2 days)
TOTAL	**$ 4,037**	

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