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Knowledge and Skill Retention of a Mobile Phone Data Collection Protocol in Rural Liberia

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Abstract

Introduction—With a large number of births occurring outside the formal health system it is difficult to determine the number of pregnant women in rural regions of Liberia. The exponential growth of mobile phone use in developing countries provides a potential avenue for data collection on maternal and child health in such rural, remote regions.

Methods—A pre-, post-, and one-year post-test design was used to collect data on knowledge and skill retention for seven essential items required for mobile phone use among traditional birth attendants (TBAs) trained in a short message service (SMS) texting data collection protocol (n=99) in rural Liberia.

Results—Sixty-three participants (63.6% retention) completed the one-year post-test and displayed evidence of statistically significant knowledge and skill retention in six of the seven tasks ($p<.005$) including the ability to: (a) turn on the phone; (b) use the mobile phone to make a call; (c) recognize they have coverage; (d) recognize the mobile phone is charged; (e) create a SMS text message without help; and (f) send a SMS text message without help. The TBAs continued to have difficulty with more complex tasks such as adding minutes to a phone.

Discussion—The mobile phone data collection protocol proved feasible with TBAs demonstrating knowledge retention in a one-year post-test, however clinical significance needs further investigation. The protocol increased communication and collaboration among TBAs, certified midwives, and clinic staff.

Keywords

mobile phone; SMS texting; Liberia; knowledge retention

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Introduction

Although much of the world's population lacks access to formal health care and even safe water, over 90% of the world's population and 80% of those living in rural areas now have access to mobile phone networks.¹ Mobile phones are thriving in low-income settings,² with Africa being the fastest growing market.³⁻⁴ There were over two trillion text messages sent in 2009.⁵⁻⁶ Projects using text messages and other mHealth interventions utilizing mobile phone technology to improve maternal and child health are starting to be seen in developed and developing countries.^{2, 7-8}

A wide range of applications including education and awareness, remote data collection and monitoring, community training for healthcare workers, disease and epidemic outbreak tracking, and diagnosis and treatment support are being tested using mHealth.⁹ Projects focused on maternal health in developing countries have supported the use of mobile phone technology specifically as a mode: (a) for data collection;^{9,10} (b) to improve communication among health care providers and provide decisional support;¹¹ and (c) to improve access to prenatal care, skilled delivery, and emergency services.^{12,13} The findings by Andreatta et al.¹⁰ established the feasibility of mobile technology data collection among professional midwives and traditional birth attendants in the villages of rural African communities. Despite these descriptions of data collection in the mHealth literature there has been very little literature reporting on data collection protocols and knowledge retention among non- and low-literate populations.

One of the major challenges faced by health care systems in low resource settings is the lack of accurate data from rural and remote locations.¹⁴ Liberia is no exception. Liberia, located in West Africa is a country trying to rebuild in the aftermath of civil and rebel wars that ravaged the country for 14 years. The turmoil in Liberia has left it with a shattered infrastructure and some of the poorest health statistics on the continent. The World Health Organization estimates that since 2000, the maternal mortality rate in Liberia has almost doubled to 994/100,000 live births in 2007.¹⁵ The staggering increase is attributed to a shortage of skilled birth attendants and an inadequate referral system.

Women in the world's least developed countries are 300 times more likely to die in childbirth or from pregnancy-related complications than women in developed countries.¹⁶ It is estimated that approximately 99 percent of global deaths arising from pregnancy related complications that occur in the developing world where there is a prevalence of high fertility rates, a shortage of skilled birth attendants, and weak health systems. Ten countries in Africa have the highest lifetime risk of maternal death, including Liberia.¹⁶ However, statistics are incomplete due to the large number of births that occur outside of the health system. Significant portions of health care in Liberia are delivered outside the formal health care system. In fact, more than two-thirds of households are located outside of health facility catchment areas.¹⁷ According to the most recent Liberian Demographic Health Survey in 2008, only 47% of all births are attended by a health professional.¹⁸ Due to the lack of communication infrastructure in post-conflict Liberia, mobile phones are a necessary mode of communication. Utilization of mobile phones has steadily increased from approximately 15% in 2008³ to 45% in 2011.¹⁹ Current estimates put the rate at 69%.²⁰ The integration of mobile technology to improve maternal and child health care in rural Liberia is therefore a feasible pathway based on past work in developing countries and climbing mobile phone utilization.

To better understand maternal and child health care in developing countries, it is imperative we have accurate estimates of the number of pregnancies that occur within these regions. Novel models for data collection are necessary. In an attempt to capture the number of

pregnant women in regions of rural, remote Liberia, this study utilized traditional birth attendants (TBAs) - an integrated and trusted resource within the rural community settings,²¹ and capitalized on the ever expanding use of mobile phones and growing mobile network in Liberia. This article describes the results from a one-year post-test with 63 TBAs for knowledge and skill retention in the use of a short message service (SMS) texting protocol for transmitting real-time pregnancy case finding data from rural, remote locations in Liberia. Specifically, we sought to answer the question: “Can non- and low-literate TBAs in Liberia use SMS messaging effectively to transmit a numeric pregnancy reporting protocol? And what skills are retained one year later?”

METHODS

The mobile phone data collection and training described here was conducted as a component of a larger project entitled Interventions, Research, Operations, and Planned Evaluation (I-ROPE). The I-ROPE project is a four-year project currently underway and funded by the United States Agency for International Development (USAID) to improve maternal and child health in Liberia. The goal of the I-ROPE project is to improve maternal, neonatal, and child health outcomes through the following strategic objectives: (a) overcome critical barriers to women accessing antenatal care and safe delivery services at health facilities; (b) strengthen a high-quality, integrated package of maternal, neonatal, and child health care; and (c) establish an evidence base for scaling up high-impact maternal, neonatal, and child health care interventions.²² As part of the I-ROPE project, maternity waiting homes were constructed as a tool to overcome the barrier of distance that impacts women's ability to access safe delivery services.²³ Maternity waiting homes in this project provide a temporary shelter located near a hospital or rural primary health center that is available for all pregnant women for use prior to or after delivery.

In addition to utilizing maternity waiting homes to improve maternal and child health, an innovative data collection system was integrated into the study in order to capture the number of pregnant women within each community participating in the study. This denominator (i.e., total number of pregnant women in the communities) was necessary in order to compare maternal and neonatal outcomes (i.e., maternal and neonatal mortality) among study sites. This data collection system trained non- and low-literate TBAs to send SMS text messages for real-time data collection on the number of women who became pregnant within each catchment area, or geographical region serviced by a rural primary health facility included in the larger study. Since TBAs serve as trusted maternal health providers at the community level,²¹ they have an opportunity to interface with nearly all pregnant women within their communities. This relationship between the TBAs and community members of childbearing age therefore provided the ability to capture the number of pregnant women within each catchment area giving us a denominator for the larger study and providing accurate data for the Ministry of Health on rural pregnancies within the study area.

Approval for this study was received from the Liberian Ministry of Health and Social Welfare and institutional review board approval was garnered from the University of Michigan, Health Sciences and Behavioral Sciences. Prior to data collection, the study and procedures were explained and verbal informed consent was obtained from all participating TBAs.

Participating TBAs received all supplies necessary to send an SMS text message including a mobile phone, call credit, and a solar charger. In addition, the mobile phone serves as a means for the TBA to communicate with the certified midwife at the rural primary health facility. For the protocol, pregnant women are identified by the TBA, given a pink armband

(to avoid double counting), and encouraged to seek antenatal care at the closest rural primary health facility. The TBA then sends a SMS text to a local server identifying her personal identification code, the health facility identification code under which she lives, the age of the pregnant woman identified, and whether she referred the woman to antenatal care using a standard reporting protocol described elsewhere.²⁴

Guiding Framework

Many TBAs in the study are marginally literate and accustomed to learning through traditional methods such as storytelling, song, and participatory instruction that serves the specific development of skills. Two primary theoretical constructs are conducive with this learning environment and were utilized to frame this study. The first theoretical construct utilized was Situated Learning,²⁵ which refers to instruction that occurs in a context similar to that in which the expected performance will occur. The premise of Situated Learning theory centers on learning as a social process in which knowledge is co-constructed within the context of the social and physical aspects of the environment. Situated learning encourages learners to participate in activities that support socialization, visualization, and imitation towards solving contextually relevant problems. We used a broad social approach that incorporated real-life experiences to motivate the TBAs to learn how to use a mobile phone within their environments. We designed activities and implemented instructional methods to help learners' process information by visualizing, listening, reasoning, and reflecting. We encouraged them to create their own relevant scenarios from which they and their peers could further problem solve and develop critical thinking within a community of practice.

The second theoretical foundation used in this study is the Experiential Learning model.²⁶ While situated learning is contextually relevant, experiential learning is learner relevant. That is, experiential learning occurs through individual interaction with an instructional environment, including observations that occur during the individual's interaction, and reflection on how those experiences relate to the individual's current knowledge. With experiential learning, learners create meaning through firsthand real-time engagement with relevant activities (concrete experience) that provide the basis for observation and reflection (reflective observation). Learners may then assess their own abilities relative to what is expected and make modifications to improve their performance (abstract conceptualization). Finally, these modifications become part of their existing knowledge and lead to a continuous cycle of learning (active experimentation) that benefits a deep understanding of the learning construct.

By combining both Situated Learning theory and the Experiential Learning model, we were able to engage the TBAs through a process of reflection and real-life experiences. These theoretical constructs provided the basis to allow for engagement of the TBAs to learn complex tasks that could be adapted based on their personal knowledge and environmental situations.

Setting and Participants

As previously reported by Lori et al.,²⁴ initial training was conducted using a training of trainers model where training sessions were taught by three researchers from the United States. All participants were recruited from Bong County in north-central Liberia. The study team has a long history of working within Bong County and has established trusting relationships with the Bong County Health Team and rural communities. It is one of the most populous counties and represents the largest indigenous group, the Kpelle tribe, within Liberia.

The study enrolled ten rural primary health facilities and their respective catchment areas and one hospital based clinic in the region for a total of eleven sites. Each rural primary health facility provides care for a large geographic region. Rural clinics are typically staffed by at least one trained certified midwife and one registered nurse, providing care for up to 20,000 residents within their catchment area. The TBAs serve as maternal health care providers and birth supporters at the community level for residents living in smaller villages within each catchment area. Original participants included a Liberian research nurse and 11 two-person master trainer teams consisting of a certified midwife and TBA. These master trainer teams were then responsible for conducting a training session in the use of mobile phones for data collection among the non- and low-literate TBAs within their community with the assistance of the research nurse.

All participating TBAs were recruited via word of mouth from the certified midwives working within the rural primary health centers. The TBAs were informed that a study was being conducted to improve maternal and newborn health by building maternity waiting homes near the rural health centers and by collecting data on the number of pregnant women in the surrounding communities. TBAs were recruited with a specific focus on enrolling TBAs to represent all portions of the catchment area. Inclusion criteria for the TBA data collectors included: (a) fluent in Kpelle or English; (b) currently serving as an active TBA within their communities; (c) willing to work with clinic staff to identify pregnant women in their respective communities; and (d) willing to participate in a three-day training session.

Study Design and Data Collection

The master trainer teams followed a standardized protocol for teaching the mobile phone skills to be employed by all participants that included pictorial cards displaying designs of the mobile phones (see Figure 1).

During the initial training of trainers each participant received a mobile phone allowing her to create and send SMS texts, a solar panel for charging, reading glasses if needed, a paper ledger, and a laminated pictorial depiction of the mobile phone protocol. All participants were taught to record the data in their ledger and then send a ten digit code that provided the study team with data on the number of pregnancies, age of the pregnant women (if known), and the community of the pregnant women. The ten digit code included the following components entered in sequential order: (a) a code of 9 for pregnancy; (b) a three digit unique identification code; (c) a three digit unique location code; (d) a two digit code for age in which '99' was utilized if the age was unknown; and (e) a referral code where '1' indicated a yes for referral to antenatal care and '0' indicated a no for referral. Thus, the first seven digits were repetitious for each TBA collecting data. When the TBA identified a pregnant woman within her community, she was instructed to record the woman's age and whether or not she was referred to antenatal care in her ledger and then send the ten digit SMS text code described above to a pre-programmed number on her phone. The participants only sent the ten-digit numeric SMS text code described above and were not required to enter any letters or words. All data are sent to a secure, remote server located within the country. During the one-year data collection period the TBAs sent nearly 6,500 messages. Twice a year the research team traveled to each rural primary health facility to meet with the TBAs using the mobile phones to examine the data for reliability and validity. This was accomplished by triangulating the data received to the paper ledgers kept by the TBA and the stored sent messages in the mobile phones. We also ensured the phones were functioning properly but did not engage in any formal refresher training of mobile phone skills.

Skills were assessed prior to training, immediately post-training, and again at one-year follow-up using a skills checklist. Initial performance and one-year follow-up were conducted on the following skills: (a) able to turn on mobile phone without help; (b) able to

use mobile phone to make a call; (c) able to recognize they are in a mobile phone coverage area (identify bars); (d) able to recognize the mobile phone is charged (identify battery icon); (e) able to create a SMS text message without help; (f) able to send a SMS text message without help; and (g) able to use a scratch card to add minute credit to the phone. Participants were given a scripted scenario to develop the SMS text message and instructed to demonstrate the steps to create and send a message. Each of the seven actions on the skills checklist was worth one point. If the participant performed the skill correctly, she was awarded the entire point. For the one-year post-test a Liberian research nurse and a United States research assistant traveled to each rural health facility to repeat the mobile phone knowledge and skills assessment with TBAs enrolled in the study.

Data Analysis

All data were analyzed using IBM Statistical Package for the Social Sciences 20.0 (SPSS, Inc., Chicago, IL, USA). To evaluate knowledge retention across the three time points, a repeat measures analyses of variance (RM-ANOVA) was conducted to determine if overall mean scores (or number of items completed correctly) varied significantly across the three time points. The Mauchly test indicated the assumption of sphericity had not been violated and was used for interpretation of the RM-ANOVA results. Post-hoc tests to compare individual means were performed to assess for individual skill and knowledge retention for each of the seven steps involved in the SMS training and texting protocol. Due to the dichotomous nature of the data, the nonparametric McNemar test was used to determine if individual skills were maintained over time. All *P* values were two-tailed and set at .05.

Results

Ninety-nine TBAs participated in the original training by the master trainer teams of one certified midwife and one TBA at 11 sites in north-central Liberia. At the one-year follow-up we were able to conduct the post-test with 63 of the original participants (63.6% retention rate); analyses were conducted using only the 63 participants with complete data. Throughout the course of the first year, one TBA died and eight TBAs were replaced based on decisions made at the community level by the certified midwife. Additionally, many participants were unable to walk the two to four hours to the rural primary health facility for the post-test due to daily tasks of farming and child-rearing.

The characteristics of the TBAs are displayed in Table 1. All participants were female and ranged in age from 38-60 years (*M* = 51 years); however 39.7% of respondents did not know their age. Respondents were also questioned about their current mobile phone use. At the time of the original training 73.7% of participants reported someone in their family owned a mobile phone. However, at the one-year post-test this number increased to 87.3% of participants. These results demonstrate that within a one-year time period there was a rapid increase in mobile phone ownership within our sample setting. In general, participants had a better grasp of numeric literacy due to their daily interactions buying, trading, and selling goods in the market.

Statistical analysis using RM-ANOVA demonstrated that participants knowledge retention changed over time [$F(2, 124)=182.23$, $p<.001$, partial eta squared = .747]. Additional analyses, which took into consideration the multiple comparisons between time points (with Bonferonni corrections), revealed that there were significant differences in the TBAs ability to perform the seven mobile phone skills ($P<.001$) between the following time points: (a) pre-test and immediate post-test; (b) pre-test and one-year post-test; and (c) immediate post-test and one-year post-test. Participants demonstrated an increase in the mean number of skills they were able to perform between pre-test (*M*=1.13, *SD*=1.63) and both the immediate post-test (*M*=4.86, *SD*=1.31) and the one-year post-test (*M*=3.86, *SD*=1.80).

However, the mean number of skills participants were able to complete did decrease slightly between the immediate post-test and one-year post-test.

Analysis of individual skills verified a significant retention of knowledge, between the pre-test and one-year post-test, in six of the seven mobile phone skills as demonstrated in Table 2.

Despite the statistically significant differences in the ability to perform skills between pre-test and one-year post-test, after examining the percentage of participants able to perform each individual skill, we found many TBAs continued to have trouble demonstrating the more complex skills of adding credit to a mobile phone using a scratch card, sending a text, and creating a text. The more complex task of adds credit by scratch card was the greatest challenge for participants at both time points with only 11.1% of participants able to complete the task at one-year post-test and none of the participants able to complete the task at pre-test, $p=.016$. This is a more complicated skill, requiring an individual to enter a series of codes into the mobile phone from a purchased card to add mobile phone usage time and proved to be very difficult due to low literacy rates and poor cell phone reception.

The majority of participants (69.8%; $n=44$) relied primarily on others with higher educational levels to assist them with mobile functions such as creating and sending SMS messages and adding credit (Figure 2). Participants also used their mobile phone to communicate with the certified midwife on cases from the community. Approximately one quarter of the participants completing the one-year post-test were able to utilize the mobile phone for this purpose (23.8%, $n=15$) while a number of participants (14.3%, $n=9$) reported they wanted to communicate with the certified midwife using their mobile phone but they were hampered by poor reception in their communities.

DISCUSSION

One-year post-test evaluations allow researchers to determine sustainability of knowledge and skills over time.²⁷ Guided by Situated Learning theory and the Experiential Learning model we sought to teach TBAs how to use mobile phones in order to transmit data. Since TBAs are accustomed to learning through participatory instruction we tailored our training to increase opportunities for co-constructed knowledge, thereby increasing the use of mobile phones to solve problems of concern to the TBAs (e.g., maternal health). Further, we used a learning model that emphasized the creation of meaning through firsthand real-time engagement; this allowed TBAs to assess their own abilities and make modifications to improve their performance. These modifications led to a more sustained learning cycle, a cycle that helped keep TBAs engaged in the process.

mHealth is burgeoning across the globe and great strides are being made in developing regions where you would least expect it, but where it is critical to introduce innovative solutions for improved health.²⁸ There is a need to broaden the use of mobile technology to acquire data that can be used to identify the needs of the population. Accurate health care data is important for policy makers and health care providers to design effective policies, procedures, and treatment options that will most appropriately meet the needs of all individuals. Mobile technology data collection provides the advantages of: (a) improving data collection accessibility; (b) addressing numerous health care and public health problems; (c) avoidance of the errors, data entry, and storage costs associated with paper surveys; and (d) faster data assembly and analysis.^{29,30} There has been a call to explore mHealth as a modality to improve maternal and child health via partnerships between industry, the government, local communities, and those involved in technology development.^{2,31} However, potential maternal and child health interventions require an

accurate understanding of the number of women who are pregnant and number of women who give birth in rural, under resourced areas. This mode of data collection therefore has the potential to provide expedient access to information needed to improve maternal and child health in developing countries.^{2, 32}

Employing TBAs as data collectors using mobile phones provides a pathway for a more integrated care system that will enable TBAs to expedite emergency referrals and communicate with skilled providers, such as certified midwives.² As Speciale and Freytsis³² note, midwives have an important role in making sure mHealth is implemented with a focus on women and their needs. By incorporating TBAs into data collection, the traditional care providers that rural Liberian women trust and interact with daily were included in the study framework.

Our findings demonstrate TBAs in this study were able to learn and retain a statistically significant number of mobile phone skills over a one-year time period. However, in its current format this training did not result in knowledge and skill retention that was adequate to clinically impact maternal health. This study was aimed at evaluating knowledge and skill retention without refresher training and therefore did not provide regular feedback to the TBAs participating as data collectors on their messages sent. Following our biannual visits to Liberia, where we interacted with the TBAs for monitoring and evaluation of data collection, we noted an improvement in the number of correct messages sent. With the addition of regular refreshers, we believe the TBA's knowledge and skill retention of the SMS protocol could have been vastly improved.

Additionally, this method of data collection increased the TBAs communication and interaction with skilled professionals at the rural primary health facility. This improved communication was noted at our regular visits as we observed the TBAs interacting with clinic staff to review pregnancy cases encountered in the community and sent via SMS text messages. This interaction was also noted as TBAs sought help in sending data and adding credit to their phone from the certified midwife and other clinic staff members. Although the purpose of this study was to evaluate the feasibility of data collection using a SMS texting protocol with non- and low-literate TBAs, this finding of improved interaction and communication between the TBA and clinic staff, including the certified midwife, is worth noting. It has previously been noted that mHealth communication interventions are more likely to succeed when integrated within existing health systems by improving human contact.³³

There were several limitations to this study including: (a) a focus on TBAs in one geographic location; (b) a modest retention rate (63.6%); (c) technological problems including poor reception, lost and damaged phones, and difficulty with certain mobile phone models; and (d) poor to modest skill retention for some skills. The ability of this study to retain participants was limited by difficulty recruiting and gathering participants for the one-year post-test. The certified midwives in the study were thoroughly invested in the study protocol and were entrusted with monitoring the mobile phones and the distribution of scratch cards for adding credit to send messages. Future work should therefore take into consideration these limitations. For instance, future data collection protocols (whether with TBAs or certified midwives) should include regular refresher training. Additionally, study staff should research mobile phone models to ensure they can accurately store and send the messages required by the study and that participants have adequate mobile phone reception to complete all study procedures. Additional work is also warranted to evaluate the impact of mobile phone use on communication and interactions between TBAs and clinic staff, including certified midwives. Due to the location of the rural primary health clinics and the literacy level of the certified midwives, future data collection protocols may incorporate the

TBAs and certified midwives as teams as opposed to individual data collectors. Finally, future work may also include an expanded study to evaluate the capacity of non- and low-literate community health workers such as TBAs to conduct data collection and SMS texting for more complex, multivariate data sets. Despite these limitations, this study succeeded in engaging and training a non- and low-literate population for a mHealth data collection protocol.

CONCLUSION

As midwives continue to work to meet the reproductive health needs of the world's women, it is imperative we remain abreast of novel methods for data collection, communication, and treatment. The rapidly expanding field of mHealth, in particular the use of mobile phones in resource poor regions, provides an exciting avenue for reaching marginalized women with some of the worst health outcomes in the world. This study demonstrates the potential feasibility of using mobile phones for data collection in a rural, underdeveloped region of Liberia. It also provides important lessons learned regarding TBAs ability to retain the knowledge and skills necessary to use mobile phones for data collection and communication about maternal and child health. Using innovative solutions and teamwork it may be possible that traditional health care providers, such as TBAs, have the ability to be involved in this shift to incorporate mobile technology into health care.

This study lays the groundwork for midwifery-led mobile technology implementation within low-resource regions. It also addresses the call for midwives to find technological modalities that will connect health care providers in low-resource regions.³² The overwhelming growth of mobile phones within developing regions means our ability to share information and provide improved communication is infinite. However, mHealth objectives must continue to focus on regional and national health objectives as opposed to the priorities of researchers or corporations.³⁴ As women's health care providers, midwives are in the unique position to establish partnerships with patients and policy makers to implement mHealth tools to truly meet the needs of women.³⁵

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References

1. International Telecommunication Union (ITU). [May 21, 2013] The world in 2010. <http://www.itu.int/ITU-D/ict/material/FactsFigures2010.pdf>. Published 2010.
2. Tamrat T, Kachnowski S. Special delivery: An analysis of mHealth in maternal and newborn health programs and their outcomes around the world. *Matern Child Health J*. 2012; 16(5):1092–1101. doi: 10.1007/s10995-011-0836-3. [PubMed: 21688111]
3. International Telecommunication Union (ITU). [May 21, 2013] Information society statistical profiles 2009: Africa. http://www.itu.int/ITU-D/ict/material/ISSP09-AFR_final-en.pdf. Published 2009.
4. [May 21, 2013] Vodafone. Africa: The impact of mobile phones.. Vodafone Paper Policy Series, No. 2. http://www.sarpn.org/documents/d0001181/P1309-Vodafone_March2005.pdf. Published March, 2005.
5. CITA-The Wireless Association. [May 21, 2013] Background on CTIA's semi-annual wireless industry survey. http://files.ctia.org/pdf/CTIA_Survey_YE_2012_Graphics-FINAL.pdf. Published 2010.
6. International Telecommunication Union (ITU). [May 21, 2013] Measuring the information society. http://www.itu.int/ITU-D/ict/publications/idi/2011/Material/MIS_2011_without_annex_5.pdf. Published 2011.
7. Lund S, Hemed M, Nielsen BB, et al. Mobile phones as a health communication tool to improve skilled attendance at delivery in Zanzibar: A cluster-randomised controlled trial. *BJOG*. 2012; 119(10):1256–1264. doi:10.1111/j.1471-0528.2012.03413.x. [PubMed: 22805598]
8. Parker RM, Dmitrieva E, Frolov S, Gazmararian JA. Text4baby in the United States and Russia: An opportunity for understanding how mHealth affects maternal and child health. *J Health Commun*. 2012; 17(S1):30–36. doi:10.1080/10810730.2011.649162. [PubMed: 22548596]
9. Vital Wave Consulting. mHealth for development: The opportunity of mobile technology for healthcare in the developing world. UN Foundation-Vodafone Foundation Partnership; Washington, D.C.: 2009. <http://unpan1.un.org/intradoc/groups/public/documents/unpan/unpan037268.pdf>. [August 20, 2013]
10. Andreatta P, Debpuur D, Danquah A, Perosky J. Using cell phones to collect postpartum hemorrhage outcome data in rural Ghana. *Int J Gynecol Obstet*. 2011; 113(2):148–151. doi: 10.1016/j.ijgo.2010.11.020.
11. Karoshi M, Keith L. Challenges in managing postpartum hemorrhage in resource-poor countries. *Clin Obstet Gynecol*. 2009; 52(2):285–298. doi:10.1097/GRF.0b013e3181a4f737. [PubMed: 19407535]
12. Lund, S.; Hemed, M. Wired mothers: Use of mobile phones to improve maternal and neonatal health in Zanzibar. University of Copenhagen; Copenhagen: 2010. http://www.oresund.org/logistics/content/download/74534/429853/file/Ida%20Marie%20Boas_Wired%20Mothers.pdf. [August 20, 2013]
13. Mechael, P.; Dodowa Health Resarch Center. MoTech: mHealth ethnography report. Grameen Foundation; New York: 2010. http://www.healthunbound.org/sites/default/files/Grameen_Foundation_FinalReport_3_.pdf. [August 20, 2013]
14. Gisore P, Shipala E, Otieno K, et al. Community based weighing of newborns and use of mobile phones by village elders in rural settings in Kenya: a decentralized approach to health care provision. *BMC Pregnancy Childbirth*. 2012; 12:15. <http://www.biomedcentral.com/1471-2393/12/15>. [PubMed: 22429731]
15. World Health Organization. Global Observatory for eHealth Series: Volume 3. WHO Press; Geneva, Switzerland: mHealth new horizons for health through mobile technologies.. http://www.who.int/goe/publications/goe_mhealth_web.pdf. Published 2011. [May 21, 2013]

16. United Nations Children's Fund (UNICEF). [May 21, 2013] The state of the world's children 2009: Maternal and newborn health. <http://www.unicef.org/protection/SOWC09-FullReport-EN.pdf>. Published 2008.
17. Lee PT, Kruse GR, Chan BT, et al. An analysis of Liberia's 2007 National Health Policy: Lessons for health systems strengthening and chronic disease care in poor, post-conflict countries. *BMC Globalization Health*. 2011; 7:37. <http://www.globalizationandhealth.com/content/pdf/1744-8603-7-37.pdf>.
18. Liberia Institute of Statistics and Geo-Information Services. [April 24, 2013] Liberia Demographic and Health Survey 2007. <http://www.measuredhs.com/pubs/pdf/FR201/FR201.pdf>. Published 2008.
19. Public-Private Infrastructure Advisory Facility. [May 21, 2013] PPIAF supports telecommunications reform and liberalization in Liberia. <http://www.ppiaf.org/ppiaf/sites/ppiaf.org/files/publication/PPIAF-Impact-Stories-Reforming-Liberia-Telecom-Sector.pdf>. Published 2011.
20. Global Health Workforce Alliance. [May 21, 2013] Africa human resources for health scorecard – incorporating skilled health personnel, maternal mortality, reproductive health and female life expectancy at birth. <http://www.who.int/workforcealliance/media/news/2012/2012AfricaHRHScorecard.pdf>. Published 2011.
21. Lori JR, Boyle JS. Cultural childbirth practices, beliefs and traditions in postconflict Liberia. *Health Care Women Int*. 2011; 32(6):454–473. [PubMed: 21547801]
22. Lori JR, Munro ML, Rominski S, et al. Maternity waiting homes and traditional midwives in rural Liberia. *Int J Gynecol Obstet*. In press. doi:10.1016/j.ijgo.2013.05.024.
23. Lori JR, Wadsworth AC, Munro ML, Rominski S. Promoting access: The use of maternity waiting homes to achieve safe motherhood. *Midwifery*. In press. doi:10.1016/j.midw.2013.07.020.
24. Lori JR, Munro ML, Boyd CJ, Andreatta P. Mobile phones to collect pregnancy data from remote areas in Liberia. *J Nurs Scholarsh*. 2012; 44(3):294–30. doi:10.1111/j.1547-5069.2012.01451.x. [PubMed: 22672157]
25. Lave, J.; Wenger, E. *Situated Learning: Legitimate peripheral participation*. Cambridge University Press; Cambridge, UK: 1990.
26. Kolb, DA.; Rubin, IM.; McIntyre, JM. *Organizational Psychology: A Book of Readings*. 2nd ed.. Prentice-Hall; Englewood Cliffs, N.J.: 1974.
27. Lori JR, Majszak CM, Martyn KM. Home-based life saving skills in Liberia: Acquisition and retention of skills and knowledge. *J Midwifery Womens Health*. 2010; 55(4):370–377. [PubMed: 20630364]
28. Rockefeller Foundation.. *From silos to systems: An overview of eHealth's transformative power*. The Rockefeller Foundation; New York: 2010. http://www.rockefellerfoundation.org/uploads/files/e331d255-059f-4fc6-b814-5938f8ee017e-rf.silos_1-13.pdf. [August 20, 2013]
29. Patnaik, S.; Brunskill, E.; Thies, W. Evaluating the accuracy of data collection on mobile phones: A study of forms, SMS, and voice.. *Information and Communication Technologies and Development 2009 International Conference.*; <http://research.microsoft.com/pubs/137974/patnaik-ictd09.pdf>.
30. Tomlinson M, Solomon W, Singh Y, et al. The use of mobile phones as a data collection tool: A report from a household survey in South Africa. *BMC Med Inform Decis Mak*. 2009; 9:51–58. doi:10.1186/1472-6947-9-51. [PubMed: 20030813]
31. Sloninsky, D.; Mechael, P. *Towards the development of an mhealth strategy: A literary review*. World Health Organization and Earth Institute; New York: 2008. http://www.who.int/goe/mobile_health/mHealthReview_Aug09.pdf. [August 20, 2013]
32. Speciale AM, Freytsis M. mHealth for midwives: A call to action. *J Midwifery Womens Health*. 2013; 58(1):76–82. doi:10.1111/j.1542-2011.2012.00243.x. [PubMed: 23317302]
33. Sherry JM, Ratzan SC. Measurement and evaluation outcomes for mHealth communication: Don't we have an app for that? *J Health Commun*. 2012; 17:1–3. doi:10.1080/10810730.2012.670563. [PubMed: 22548591]
34. Mechael PN. The case for mHealth in developing countries. *Innovations*. 2009; 4:103–118.

35. Kallander K, Tibenderana JK, Akpogheneta OJ, et al. Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: A review. *J Med Internet Res*. 2013; 15(1):e17. doi:10.2196/jmir.2130. [PubMed: 23353680]

Precis

This study provides evidence that non- and low-literate traditional birth attendants can learn and retain skills to use mobile phones for data collection.

Quick Points

- Non- and low-literate traditional birth attendants retained the knowledge and skills to perform six of seven essential mobile phone tasks required for mHealth data collection over a one-year time period.
- Real-time, reliable data can potentially be sent using SMS text by non- and low-literate traditional birth attendants from rural and remote locations.
- Mobile phones have the potential to increase teamwork and communication among traditional health care providers, such as traditional birth attendants, and skilled providers related to maternal health.

Figure 1.
Schematic of Mobile Phone Texting Protocol

Figure 2.
Mobile Phone Assisters

Table 1

Select Characteristics of Traditional Birth Attendants

Total Sample (n=63)	
	n (%)
Range (years) ^a	38-60
Mean (years) ^a	51
Marital Status	
Married	34 (54.0)
Divorced	2 (3.4)
Widowed	11 (17.5)
No Answer	16 (25.4)
Years of Formal Schooling	
None	38 (60.3)
2 nd -6 th grade	5 (7.9)
7 th -12 th grade	4 (6.4)
Missing	16 (25.4)
Mobile Phone in Family	55 (87.3)

^a Statistics were computed only on those who knew their age (n=38)

Table 2

Percentage of Correct Responses on Individual Pre- and One-year Post-Test Items

Skill	Pre-test n=63	One-year post-test n=63	P value
	n (%)	n (%)	
Turns on mobile without help	18 (28.6)	59 (93.7)	<.001
Makes call without help	21 (33.3)	34 (54.0)	.004
Identifies mobile coverage	15 (23.8)	53 (84.1)	<.001
Identifies mobile is charged	15 (23.8)	52 (82.5)	<.001
Creates text without help	1 (16)	21 (33.3)	<.001
Sends text without help	1 (16)	17 (27.0)	<.001
Adds credit by scratch card	0 (0.0)	7 (11.1)	.016