Technology for Maternal and Child Health: mHealth in Ghana

Cori Thompson[a], Eric Yandanbon[b], Colin Rankin[b]

[a] *School of Social Sciences, University of New South Wales, Sydney, Australia*
[b] *Savana Signatures, Tamale, Ghana*
[c] *SALASAN Consulting, Victoria, Canada*

Abstract

The Technology for Child and Maternal Health project involves 33 health facilities in northern regions of Ghana, Africa, and is funded by Global Affairs Canada. The project includes voice and short message service (SMS) messaging for expectant and new mothers, and their partners. Voice messages have been translated into eleven local languages and registration is conducted by health staff during clinics and community "knowledge sharing sessions." Messages are tailored to week of pregnancy or post delivery. Over a thirteen month period, a total of 94,169 messages were delivered to 8,323 unique beneficiaries. 83% of registrants registered for ANC messages with most registering during their second trimester of pregnancy. Interviews with 300 recipients showed that all would recommend the service to others, and identified most useful topics, as well as changes in behaviour as a result of the messaging service.

Keywords:

mHealth, maternal health, Ghana

Introduction

Ghana is committed to achieving the Millennium Development Goals 4 and 5 (MDGs 4, 5) that focus on reducing maternal and infant morbidity and mortality. The Technology for Maternal and Child Health (T4MCH) project has implemented mHealth as a tool towards achieving these goals and the subsequent Sustainable Development Goals (SDGs). Formerly known as the "Golden Coast," Ghana is an African sub-Saharan lower middle income country located on the Bay of Guinea and eastern neighbour to the Ivory Coast. The World Bank defines maternal mortality as the "ratio… of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births"[1]. Through various interventions, Ghana has reduced its maternal mortality by over 50 percent from 1995 to 2015; however, it still experiences 4.5 times the World Health Organization [WHO] target for maternal mortality [1-2]. mHealth is an effective intervention to achieve MDGs 4, 5 by disseminating health information [3-4]. The WHO defines mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices... [including] mobile phone's core utility of voice and short messaging service (SMS)"[3]. mHealth use that is based on behavioural change and uses motivational language is effective[5] and a viable intervention due to rapid development, decreasing costs, increased networks, increased cell phone use[6] and its sustainability[7]. Pregnant women are turning to mHealth for health information during and after pregnancy [8]. The literature shows evidence from studies in Ghana, sub-Saharan, and comparable jurisdictions justifying the Technology for Maternal and Child Health (4MCH) project. Sumankuuro, Crockett, & Wang[9] identified common causes of maternal and neonatal morbidity and mortality in Upper West Ghana, identifying health information needs. mHealth as a maternal health intervention is fairly recent [8] and here is a paucity of research on mHealth in areas such as Ghana [10]. More robust studies are being conducted and reported [11]. mHealth was found to improve accessing antenatal and postnatal care [12]. Further, locally-tailored mHealth used during antenatal care (ANC) may increase the likelihood of facility delivery and subsequent postnatal care (PNC) [13]. Overall, the use of mHealth has shown positive outcomes for prenatal and newborn health services, such as increasing timely referrals and improving prenatal behaviours in Ghana [14]. Chib et al. [15] reported two initiatives in rural Ghana from a review of the literature. In Andreatta et al.'s 2011 study they reported on an SMS-based intervention that enabled traditional birth attendants to report on maternal, newborn, and child health including postpartum haemorrhage. Also in 2011, the second initiative, MOTECH, reported on the use of a cell phone application for nurses to provide information to mothers on maternal, newborn and child health. The 2012 Mobile Alliance for Maternal Action (MAMA) project in Bangladesh also provided evidence in favour of the T4MCH to use voice and SMS messaging to address MDGs 4, 5 [16]. In their review, Chib et al. [15] listed the advantages and disadvantages to mHealth projects. Advantages relevant to the T4MCH project included the ability to increase knowledge through messages of health information, reminders to attend clinic visits, and reminders for immunizations. Benefits of mHealth included real time data transmission, "light weight and lack of printing costs… crucial in remote areas with poor infrastructure" [17]. Challenges of mHealth include potential high costs and "poor existing infrastructure, frequent power outages and network failure" [18].

The T4MCH project included collection of baseline information prior to initiation of activities, followed by monitoring of quantitative and qualitative performance indicators every six months throughout the four year life of the project. The monitoring was aimed at determining whether the project interventions (including regular voice/text messaging, and mobile equipment and technical training for health talks in health facilities and in communities) had an impact on maternal and infant morbidity and mortality. This paper reports on results documented between July 2017 and August

2018, midway through the project. The project's scheduled completion is March 2020.

Methods

The T4MCH project, and its precursor, Technology for Maternal Health (T4MH) project, used voice and SMS interventions as tools towards achieving MDGs 4, 5 in Ghana. To supplement the messaging, enhanced health talks or "knowledge sharing sessions" (KSS) were also implemented. The project addresses both health information "users" (expectant and new mothers and their partners and families) and providers (Ghana Health Services (GHS) health staff). The multi-pronged and integrated approach included: (1) communication and registration of expectant and new mothers and their partners to receive voice messages in one of eleven local languages of their choice; and (2) support to health workers with technical capacity: presentation tools (laptops, projectors, and remote wireless microphones), technical training (computer use, PowerPoint presentations), and content (health information messages and resources). By increasing the capacity of health service providers to generate and communicate knowledge, and improving access of expectant women and new mothers to health information, the project is intended to contribute to the reduction of maternal and child mortality in nine Districts of northern Ghana.

At a country level, GHS has adopted the District Health Information Management System (DHIMS 2) built to WHO and international standards. Each facility in a health district reports monthly on a common set of indicators, with the data aggregated for regional and national reporting. The T4MCH project conducted a comprehensive baseline survey that drew on the DHIMS reporting and additional data, and included all 33 participating health facilities in nine districts across three regions of northern Ghana. Subsequent T4MCH project monitoring, conducted semi-annually, includes additional qualitative surveys among health staff and clients. The voice messaging platform includes a survey function that broadens the reach of monitoring to include the thousands of registrants who receive health messages through the system. In addition to this consistent periodic monitoring and assessment of results, the project supports targeted "mini-studies" that involve supplemental data collection and analysis. These studies include: reach and effectiveness reviews of knowledge sharing sessions (KSS) and voice messaging; quality of care assessment; adoption and use of information communications technology among health care workers; and a longitudinal study involving semi-annual interviews of twenty young mothers over four years.

Figure 1– T4MCH Project Facilities

The health information is disseminated through a mix of sessions delivered through scheduled or ad hoc KSS or KSS delivered in the community. Examples of topics for the KSS include anemia and healthy eating during pregnancy, exclusive breastfeeding for the first six months, with complementary feeding ages 7 to 24 months, and appropriate exercise. Mothers and others are recruited into the voice messaging at local clinic visits or at community KSS conducted by health staff.

Message registration prerequisites are (1) pregnant or new mother or male partner or family member, (2) residing in one of the subject communities, and (3) owning or having access to a basic mobile phone, including a neighbour's phone.

Figure 2– Registering for the messaging system at clinic visit

Figure 3– Registering for the messaging system during KSS

The messaging platform enables repeat attempts if initial delivery is not successful, up to four attempts daily at differing times (e.g., during day, evening), with an automatic update to the following week's message if not delivered within a one week timeframe tied to stage of pregnancy. The messages follow a structured format with content developed by a team that included clinical, communications and ICT expertise. The Week 3 message, for example, addressed health seeking behaviour: opening tag 1 – hello, this is Anna your mid-wife bringing you a message from the T4MCH project; tag 2 – this week's message is about how your health facility can assist you during your pregnancy; message content (tailored to message time available in local language); tag 3 – don't forget to take your medication as directed by your midwife, and eat good food so that you and your baby stay healthy; closing tag 4 – next week's message is about how your partners, relatives and friends can assist you during your pregnancy. I look forward to talking to you again soon!

Results are drawn primarily from data collected in August and September 2018 from the messaging platform (SGS Collect) and 300 interviews with beneficiaries (recipients of voice or SMS messaging).

The mERA checklist [19] was consulted to increase rigour of reporting the study.

Results

In a thirteen month period (July 2017-September 2018) a total of 8,323 individuals registered to receive weekly voice messages in one of eleven local Ghanaian languages or SMS text messages in English. The majority of registrants received voice messages, with only 710 receiving SMS texts in English. Ninety-five percent (7,906) of the registrants were women. Eigthy-three percent (6,926) registered for ante-natal care (ANC) messages, including 3,398 registering in their second trimester (13-28 weeks), 1,906 in their first (before 13 weeks), and 1,622 in their third trimester (29-42 weeks).

A total of 94,169 messages were successfully delivered to the 8,323 registrants, with an average of 13 messages per registrant. There were a maximum of 48 ANC and post natal care (PNC) messages possible over the study period.

The review team conducted 300 interviews with message recipients (291 females, 9 males) at 31 health facilities. Of this total, 236 (79%) indicated that they had received messages on personal phones, 60 (20%) on their partner's phone, and four (1%) on another relative's phone.

When asked whether the information received in messages had influenced or led to changes in their behaviour, 97% of those interviewed (290/300) responded positively. Examples of changes in behaviour cited during interviews included:

"I discuss details of messages received with my midwife;"

"My husband and I prepared our birth oack with all items needed for the delivery of our baby… transport was pre-arranged and we arrived at the facility on time;'

"After discussions with my husband, we both visited the health facility to get family planning;" and,

"I live alone with my husband in a new community and don't have anyone beside the health staff advising me on my pregnancy – the weekly SMS I receive serves as my source of information on best ways to care for myself and I have delivered my baby without complications."

The messages are categorized into four main topics: (1) fetal devleopment, (2) maternal health, (3) health-seeking behaviour, and (4) partner/family support. Recipients commented that maternal health and health-seeking behaviour were the most useful topics (205 and 189 positive responses repectively), while fetal development was viewed as the least useful (22 positive responses).

Seventy-six percent of female recipients (222 of 291 females) felt that the messages have encouraged their partners and family to support them through their pregnancy, delivery and child care. Examples of this support provided in the interviews included: assisting in household chores (washing, cooking, fetching of water, bathing of children), provision of food stuffs for the family, and providing financial assistance. Those who cited lack of support from family members mentioned in particular their husbands, citing partner travelling outside to work, staying with the man's family, and the role of traditional beliefs which inhibit men from supporting women.

All 300 of the recipients interviewed said that they do or would recommend the weekly messaging service to their friends and family. Recipients provided the following statements as reasons for their recommendation: "it will empower [their friends] in making healthy decisions for the pregnancy, delivery and caring for their baby", "it will help expand their [friends'] knowledge and understanding of MCH issues and how they can get their partner to support them in prgnancy and child care", "it will help [their friends] stay healthy and reduce maternal and child deaths", and "male partners will learn to understand and appreciate MCH issues, hence they will support their partners/wives".

Discussion

Emerging findings from project monitoring and reporting point to the importance of multi-pronged and coordinated activities aimed at reducing maternal and child mortality in remote and rural settings. Voice messages received in a local language, tailored to stage of pregnancy, and encouraging regular visits to local health clinics are valued by women and their partners. Preliminary quantitative and qualitative findings show increased numbers of clinic visits and satisfaction with services among expectant and new mothers. Health staff also report increased confidence in sharing information through KSS at clinics and in communities, as well as satisfaction with effectiveness of their efforts. Effectiveness of mHealth initiatives is predicated on sufficient numbers of qualified and well trained health staff, adequate facilities, and availability of affordable or free supplies such as vitamin supplements and vaccines. At the midway point of the four year project, it is inappropriate to correlate changes in maternal or child mortalities with specific initiatives such as voice messaging. However, preliminary results point to positive results in terms of increased knowledge among providers and clients, readiness to access skilled delivery services, and satisfaction with services provided through the Ghana Health Service community health system.

Limitations to the study include that the study is still relatively new and it is diffcult to attribute reduction in health outcomes solely to the technological interventions. The geographic challenges to travel limit the frequency of study monitoring and data collection. Last, network infrastructure is not consistently robust in all communities. Service interruptions impact successful delivery of all messages to the registrants.

While the registration process and KSS session delivery prohibit anonymity at the point of care, the data relied on in this study report is deidentified.

The T4MCH project is underway until March 31, 2020. While this is a small study at the midpoint of the project, it gathers data from 33 community focused health facilities in northern Ghana. Implications for policy, practice, and future research are still under review. Key feedback is incorporated into the project as part of formative evaluation. It is unknown whether results are generalizable to all of Ghana as the study focuses on rural and rural remote locations and does not include any urban Ghanaian communities. Further, while it is possible that the T4MCH project approach might be successful in similar communities in other countries, implementation has not yet been attempted to our knoweldge.

Conclusions

The T4MCH project has contributed to existing knowledge base by studying the impact of mHealth (voice messaging and

wireless technology) on maternal and infant morbidity and mortality. Results to date appear to suggest postive impact. Further study to 2020 will enable time series comparisons to increase rigour in study results. World Bank Reports trends of maternal and infant morbidity and mortality will suggest overall health outcome impact.

Acknowledgements

Thank you to the health facility staff of Ghana Health Services, Project Officers who collected data and conducted interviews for this study; Rebecca Raworth, Island Medical Program Librarian, University of Victoria, for her assistance; and other partners for their support and collaboration in this project. T4MCH is funded under Global Affairs Canada (GAC) Partnerships for Development Innovation Branch. This 2016 project is funded until 2020. No competing interests are known.

References

[1] World Bank. *Maternal mortality ratio* (modeled estimate, per 100,000 live births). 1990 to 2015 data, Retrieved Nov 18, 2018 from https://data.worldbank.org/indicator/SH.STA.MMRT?locations=GH&name_desc=false

[2] World Health Organization. *Maternal mortality*, (2018, Feb 16), retrieved Nov 18, 2018 from http://www.who.int/news-room/fact-sheets/detail/maternal-mortality

[3] World Health Organization. *mHealth: New horizons for health through mobile technologies: second global survey on eHealth*, (2011). Available from http://apps.who.int/iris/bitstream/handle/10665/44607/9789241564250_eng.pdf?sequence=1&isAllowed=y

[4] S.H. Lee, U.B. Nurmatov, B.I. Nwaru, M. Mukherjee, L. Grant, and C. Pagliari, Effectiveness of mHealth interventions for maternal, newborn and child health in low- and middle-income countries: Systematic review and meta-analysis, *J Glob Health*, 6(1) (2016), 01040. https://doi.org/10.7189/jogh.06.010401

[5] E. Poorman, J. Gazmararian, R.M. Parker, B. Yang, and L. Elon, Use of text messaging for maternal and infant health: A systematic review of the literature, *Matern Child Hlth J*, 19(5) (2015), 969-989. https://doi.org/10.1007/s10995-014-1595-8

[6] J. Brinkel, A. Krämer, R. Krumkamp, J. May, and J. Fobil. Mobile phone-based mHealth approaches for public health surveillance in sub-Saharan Africa: A systematic review, *Int J of Environ Res Public Health*, 11(11) (2014), 11559-11582. https://doi.org/10.3390/ijerph111111559

[7] J.F.M. van den Heuvel, T.K. Groenhof, J.H.W. Veerbeek, W.W. van Solinge, A.T. Lely, A. Franx, and M.N. Bekker, eHealth as the next-generation perinatal care: An overview of the literature, *J Med Internet Res*, 20(6) (2018), e202 1-15. https://doi.org/10.2196/jmir.9262

[8] J.M. Radin, E.J. Topol, and S.R.Steinhubl, A digital toolkit for improved maternal health, *Lancet*, 392(10153) (2018), 1107. https://doi.org/10.1016/s0140-6736(18)32294-3

[9] J. Sumankuuro, J. Crockett, and S. Wang, Maternal health care initiatives: Causes of morbidities and mortali-ties in two rural districts of Upper West Region, Ghana, *PLoS One*, 12(8) (2017), 1-18. https://doi.org/10.1371/journal.pone.0183644

[10] S. Iribarren, K. Cato, L. Falzon, and P.W. Stone, What is the economic evidence for mHealth? A systematic review of economic evaluations of mHealth solutions, *PLoS One*, 12(2) (2017), e0170581. https://doi.org/10.1371/journal.pone.0170581

[11] J. Crawford, J.C. Fotso, A.C. Noordam, and A.L. Robinson, Fostering the use of quasi-experimental designs for evaluating public health interventions: Insights from an mHealth project in Malawi, *African Population Studies*, 29(1) (2015), 1607-1627. https://doi.org/10.11564/29-1-713

[12] A. Feroz, S. Perveen, and W. Aftab, Role of mHealth applications for improving antenatal and postnatal care in low and middle income countries: A systematic review, *BMC Health Serv Res*, 17(1) (2017), 704-711. https://doi.org/10.1186/s12913-017-2664-7

[13] S. Shiferaw, M. Spigt, M. Tekie, M. Abdullah, M. Fantahun, and G. Dinant, The effects of a locally developed mHealth intervention on delivery and postnatal care utilization: A prospective controlled evaluation among health centres in Ethiopia, *PLoS One*, 11(7) (2016), e0158600 1-14. https://doi.org/10.1371/journal.pone.0158600

[14] T. Tamrat, and S. Kachnowski, Special delivery: An analysis of mHealth in maternal and newborn health programs and their outcomes around the world. *Matern Child Hlth J*, 16(5) (2012) 1092-1101. https://doi.org/10.1007/s10995-011-0836-3

[15] A. Chib, M.H. van Velthoven, and J. Car. mHealth adoption in low-resource environments: A review of the use of mobile healthcare in developing countries, *J Health Commun*, 20(1) (2015), 4-34. https://doi.org/10.1080/10810730.2013.864735

[16] MAMA Bangladesh, *Lessons learned on the way to 500,000 subscribers*, (nd). Retrieved Oct 4, 2018 from https://www.mhealthknowledge.org/sites/default/files/BangladeshCaseStudy2014.pdf

[17] J.A. Blaya, H.S.F. Fraser, and B. Holt. E-Health technologies show promise in developing countries, *Health Affair*, 29(2) (2010), 244-251. https://doi.org/10.1377/hlthaff.2009.0894

[18] M.O. Akanbi, A.N. Ocheke, P.A. Agaba, C.A. Daniyam, E.I. Agaba, E.N. Okeke, and C.O. Ukoli. Use of electronic health records in sub-Saharan Africa: Progress and challenges, *J Med Trop*, 14(1) (2012), 1-6.

[19] S. Agarwal, A.E. LeFevre, J. Lee, K. L'Engle, G. Mehl, C. Sinha, A. Labrique, for WHO mHealth Technology Evidence Review Group. Guidelines for reporting of health interventions using mobile phones: Mobile health (mHealth) evidence reporting and assessment (mERA) checklist, *BMJ*, 352 (2016), i1174. http://dx.doi.org/10.1136/bmj.i1174

Address for correspondence

Corresponding author: Eric Yandanbon, c/o Savana Signatures, Plot# 164, Naa Luro Estate, P.O. Box TL 332, Tamale, Ghana. Email: eric@savsign.org .