mHealth for Safer Deliveries: A mixed methods evaluation of the effect of an integrated mobile health intervention on maternal care utilization

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Introduction

In Tanzania, despite high rates of antenatal care and relatively good access to health facilities, maternal and neonatal mortality remain high—at 310/100,000 live birthsⁱ and 23/1000 live births, respectively, and almost half of all deliveries are performed at home, without a skilled attendant.ⁱⁱ With mobile phone penetration growing so rapidly in Africa, mobile technology is being increasingly utilized and recognized as a tool to improve access to and utilization of health services.

In 2011-2012, [REMOVED FOR BLINDING] began a pilot project with funding from the Bill & Melinda Gates Foundation which successfully reached almost 1,000 women and achieved a facility delivery rate of 75%ⁱⁱⁱ. Based on the success of the pilot and strong evidence that skilled attendance at delivery helps reduce maternal mortality,^{iv} the mHealth for Safer Deliveries program was developed to scale up this intervention in Zanzibar. Implemented from January 2013 to December 2014, the program was designed to address each of the “three delays” to receiving skilled care at delivery: (1) the decision to seek care; (2) reaching skilled care; and (3) the provision of adequate care once at the health facility.^v A secondary aim was increasing levels of postnatal care, which have also been historically low in Zanzibar.^{vi} The program supported community health workers (CHWs) who were trained to use a phone with a user-friendly decision-support application so that through a single device, the CHW could:

- Register women and develop personalized birth plans for them based on medical and obstetrical history;
- Counsel the mother and family on healthy behaviors and recognizing danger signs;
- Record permissions from husband and family members agreeing to a facility-based delivery;
- Screen women (and their babies) for complications from pregnancy up to a week after delivery and refer them as needed to the health facility;
- Use mobile banking to pay for transportation to the health facility when the woman is referred, paying for transport without ever touching cash; and
- Use text or voice communication to notify a health facility that a woman is in transit.

As part of the program, a community referral system was established whereby at least two drivers per ward were identified and program staff pre-negotiated fair rates between villages and all health facilities – including primary, secondary, and tertiary levels. The purpose of this assessment is to determine the effectiveness of the program in increasing facility delivery and postnatal care attendance rates, as well as examine the successes and obstacles of the program from the viewpoint of the health workers, CHWs and beneficiaries.

Material and methods

Setting and procedures

The program supported 223 CHWs from 112 wards in six (of ten) districts in Zanzibar, Tanzania. At the request of the government, we started with those districts with the highest rates of home delivery according to the Demographic and Health Survey (DHS) 2010, rolling out to all districts in the Pemba zone and two in the Unguja zone. Within each district, the program targeted only those wards with particularly low facility delivery according to the Demographic and Health Survey (DHS) 2010 and reaching all districts in the Pemba Zone and two in the Unguja Zone. Within each district,

the program targeted only those wards with particularly low facility delivery rates and significant transport challenges according to District Health Management Teams (Zanzibar Ministry of Health). Hence, coverage within each district ranged from 50-80% and in all, the program reached 48% of the rural population of Zanzibar. Since there was no formal existing CHW cadre, the program created a cadre made up of community volunteers referred by the health facility, traditional birth attendants (TBAs), and helpers or nominees of TBAs. All needed to pass a literacy test, commit to the importance of facility delivery, and perform successfully in a four-day training focusing on maternal and newborn health and use of the phone and mobile application. Most—though not all—had phones of their own, but had only used them for voice and SMS previously. CHWs were supervised by Public Health Nurses at their local primary health care units and designated “champions” supported fellow CHWs with phone troubleshooting. Remotely, program staff were available by phone and would monitor performance regularly by viewing the real-time data on a dashboard. Spot checks were conducted periodically to ensure visits were being made as reported and birth outcomes were being reported accurately.

The intervention was evaluated using both qualitative and quantitative data. Quantitative data were collected as part of the intervention between January 2013 and December 2014. The mobile electronic decision-support protocols were separated into forms which not only helped guide CHWs through critical observations, but also produced the relevant data that, once entered into GPRS-enabled Nokia phones, were sent to a central server. Pregnant women were first visited at home for registration, which included gathering demographic information, medical and obstetrical history, and details about the current pregnancy. Other forms included permission forms whereby decision makers could provide permission ahead of time for referral of the woman as needed (filled once); screening forms for pregnancy, labor, and post-delivery periods (filled at each visit); referral forms filled in case any danger sign was identified; and postpartum forms to collect birth and postnatal outcomes (filled at postnatal visits). Women were visited at least two times during pregnancy, once during labor for referral, and twice after giving birth at days 2-3 and 8-9 post-delivery. The electronic protocols guiding the forms were previously validated through the pilot study with 23 CHWs. They were then further refined based on feedback from MOH counterparts, maternal and newborn health experts, and the users themselves. To enhance effectiveness, the intervention included counseling of women and families at home during visits on recognition of danger signs, healthy behaviors, and the importance of birth planning and facility attendance for ANC, delivery, and postnatal care. The CHW would also coordinate transport, pay for transport using mobile money based on pre-negotiated rates, call the health facility on the way to ensure preparedness, and escort the woman to the facility when she was ready to go.

For the qualitative component, purposive sampling was utilized and interviews were conducted by [REMOVED FOR BLINDING] program staff during September-October 2014 in all districts using semi-structured interviews.^{vi} Prior to the interviews each participant gave verbal informed consent based on the scripts included in the interview guides. Interviews were conducted privately, in Swahili, by teams of two female bilingual program staff. Detailed notes were taken by team members in English and synthesized through debriefing after the interviews.

Sample and variables

Quantitative data came from all 13,231 women who were enrolled and gave birth in the project. Pregnant women were located by the CHWs through visits to local clinics and referrals by clinic staff. The first questions on the registration form included consent for the CHW (1) to use the phone to enter personal data; and (2) return to visit the women. All enrolled women were Muslim

and from poor, rural areas of Zanzibar. Participants were an average of 27 years of age and at 5 months gravida at registration.

A total of 13,690 women were registered into the program; 373 of these had miscarriages and 86 were lost to follow-up because they moved out of the project area or were otherwise unable to be found. For facility delivery and skilled attendance rates, the postpartum form filled on the first visit after delivery was used. For the purposes of this evaluation, skilled workers were defined as a lower level health worker or nurse-midwife/doctor. At 8-9 days after delivery mothers were asked whether they attended postnatal care.

The qualitative component included 27 mothers, 25 CHWs, and 12 health facility workers. Interview guides for each participant group were field-tested and revised before data collection. Subgroups of mothers included 9 mothers who delivered at facilities, 11 mothers who delivered at home and 7 mothers who had delivered “on-the-way” to the facility. All three informant groups were asked open-ended questions to describe their experiences, with a focus on how the program affected their deliveries. Participants were probed on barriers to facility delivery.

Analysis

Quantitative data from the dashboard were exported in CSV format and analyzed using SAS 9.2 and rates of facility delivery, skilled attendance at delivery, and postnatal attendance at the clinic were calculated. These rates were compared to all available data sources by zone, region, and district including DHS 2010 and Health Management Information System (HMIS) data.^{iii,vii} Thematic analysis was conducted on the qualitative data.^{viii} The notes taken during the interviews were read in detail to identify inductive themes before coding began. A codebook was created including predetermined deductive themes and those inductive themes that emerged from the data. Notes were coded accordingly using Microsoft Word functions, including highlights and comments. Coded data were summarized across participant groups and sub-groups.

Results and Discussion

[FIGURE 1]

Facility delivery rates

Of the 13,231 women who delivered in the program, 75% did so at a facility and 78% under skilled care compared to a baseline of 35% according to the most recent DHS.ⁱⁱ Figure 1 compares regional delivery rates of the program compared DHS, illustrating a very large increase in facility delivery rates in all regions. Figure 2 illustrates a significant increase in facility delivery rates during the intervention period.^{vii} Though this cannot entirely be attributed to the program, it is suggestive of a positive impact of the program on rates of facility delivery in both zones of Zanzibar— and particularly in Pemba, the program’s primary area of focus. Although there were other efforts to increase facility delivery, such as the addition of two delivery facilities at the primary care level by the MOH and other supply-side efforts such as pre- and in-service trainings, there were no other known demand-creation initiatives ongoing at the time.

[FIGURE 2]

Looking at those who had given birth at home for their last delivery—those individuals considered the most “at-risk” of home delivery—63% delivered in a health facility and 2.3% delivered “on-the-

way.” As reflected in the qualitative interviews the high on-the-way figure (despite relatively close distances to the facilities) was likely caused by delay in reporting labor and short labor periods since all these women had previous deliveries. Thus, among those women whose previous delivery was at home, more than 65% intended to deliver at a health facility.

Postnatal care attendance

A secondary objective of the program after increasing facility delivery was increasing postnatal care attendance, another priority of the MOH.^{ix} Overall, rates of postnatal attendance were as high as 88% among women in the program. This is a significant increase compared to 10.9% within one week^x and 36% within 41 days.ⁱⁱ Consistent with facility delivery, postnatal care attendance varied somewhat by district, with the lowest rate in Chake Chake, South Pemba (75%) and the highest in Central, South Unguja (95%).

Perceptions of program effectiveness

The qualitative interviews identified perceptions of the program, including both reasons for its success and pervasive barriers to facility delivery.

Quality of care and linkages: One of the themes that emerged from many of the CHW participants was the positive effect of the phone in increasing their confidence in referring women to the health facility. CHWs felt a greater sense of self-efficacy due to a broadening of their knowledge.

I used to be unsure when to send a women to a facility before I had the phone, but now I can confidently identify when a women needs to seek help, thanks to the screening form on the phone guiding me to make the referral (CHW21).

CHWs and mothers cited the portability of the phone (with client record) and the ability to send and receive calls and SMS messages critical for their communication with clients, health facilities, and drivers at all times of the day. For mothers, the ability to easily reach their designated CHW also created a sense of security and trust between them.

She was always there for me, I didn't need to worry and I trusted that she would always respond. The one-to-one support made me feel less alone (MO18).

Overall the sense of feeling safe, supported, and secure was a strong theme that emerged from the data collected and a primary reason for women getting to the facilities.

The ease of arranging and paying for transport in case of a complication or for labor was cited as critical in all three informant groups. One mother reported:

She came to the house and screened me, and then the next moment there was a car outside waiting to take me to Mkoani Hospital (MO19).

Transport was cited by most health worker informants from delivery facilities as a reason for the increase in facility delivery:

The transport service has made a real impact on women, especially for those living remotely who have no reliable forms of transport functioning in their village. I think this is having an effect on the reduction of home deliveries in these areas as women can finally have a reliable means of getting to the facility 24 hours a day (HW1).

Counselling and escorting: The actual decision to seek care was often attributed to CHWs' counselling messages and the general support they provided during the mother's pregnancy, delivery,

and the postnatal period, even over the availability of free transport. One CHW tells a pertinent story:

One day, I got a call from the neighbor of one of my mothers to tell me to go to her house. When I got there, I could see this mother was bleeding, but the family refused for her to go to hospital.... All I could do was to counsel the family and stress the importance of their daughter/wife to get to hospital or she could die. Finally after about 15 minutes of informing them of the consequences, they let me call for a driver to come. I escorted her to Micheweni hospital and she delivered, requiring a blood transfusion (CHW17).

Another important factor was the reassurance mothers got from being escorted to the facility. The CHW escort facilitated a handover to health worker staff on arrival with the mother and influenced some mothers' decisions to be referred to hospital for their complication or delivery.

I had never delivered at hospital before so I was not sure what to expect. I felt much safer knowing that the CHW was with me. She brought me into the hospital ward and spoke with the nurse. She then left and I felt OK. She only left knowing I was in safe hands (MO6).

Many health workers stated that a CHW present at the point of referral was a positive impact on the health worker preparedness:

It's harder when a mother comes alone with just relatives as they cannot really tell us much information and so we have to spend more time with them to find out their obstetric history and problems and start assessments. [REMOVED FOR BLINDING] mothers can be assisted more quickly as we have information from the CHW who is with her (HW12).

Health workers from delivery centers almost universally attributed the increase in deliveries at their facilities to the program:

We used to have around 10 deliveries a month 2 years ago, then the [REMOVED FOR BLINDING] project launched here and we had 130 deliveries last month (HW4).

Health workers were directly asked about rates of facility delivery, but an important inductive finding from the majority of health workers was that it was not only delivery attendance that was increased by the project, but also attendance for antenatal and postnatal care:

Antenatal and postnatal numbers have also risen over the past 24 months and I am sure it's a direct result of the safer deliveries program which counsels women to attend these clinics (HW2).

Another positive factor that impacted facility preparedness was the CHWs' calling the facility ahead to inform staff of the referral, as it enabled more timely, effective care. In one case, a CHW called the facility in advance of a referral and was informed that the hospital would not be able to manage the mother's problem, bleeding, due to a lack of staff and they suggested the CHW take her to an alternative hospital. Other times CHWs found that doctors were away or electricity was out, and could make alternative plans. The majority of CHWs discussed the positive relationships that emerged between themselves and the facility worker due to their frequent communication.

Perceptions of barriers to facility delivery

Though largely effective in increasing access and utilization of care at the facility, some barriers emerged and are detailed below.

Concerns about facility care and costs: Several women expressed concerns about going to the facility based on stories of bad birth experiences from other mothers and some women said that they themselves had not been treated well.

I hear that the staff can so rough with you and even beat you if you are screaming too loudly (MO5).

Several women and CHWs said they were sent home because their labor was not far enough along, resulting in deliveries at home. One CHW said:

I referred the mother to the hospital in town, but when we got there the nurse examined her and said she hadn't progressed enough and the mother should go home to wait until the labor progressed. So I transferred the mother back home, which took about an hour. But by the time we got home, she started to deliver in her house, so I couldn't get her back to the facility (CHW8).

Some mothers also mentioned the cost associated facility deliveries being a deterrent to themselves or their husbands/families, despite national policy declaring services to be free. Occasionally money was demanded and most women had to bring a plastic sheet, cloth material, porridge, and sometimes gloves, syringes, and/or medicines if stocks were low—all of which contribute to the economic burden on families for a facility delivery.

After I delivered, I was talking with the nurse who told me that I needed to give her 10,000Tsh [6 USD] towards the delivery so the ward could buy cleaning materials. So I gave it to her (MO9).

Negative Advice: Older female relatives and husbands would sometimes discourage mothers from calling the CHW too soon, with the idea that if the labor seemed normal, the mother could deliver safely and avoid the cost and inconvenience. Some TBAs who were not part of the program discouraged women from attending facilities, as they saw it as taking away their income:

The old woman was telling mothers if they went to the hospital they would die. She said it was a cursed place and so many of my mothers never called me. (CHW15).

Conclusions

This mixed methods evaluation shows that the mHealth for Safer Deliveries program is by any measure a “success,” having reached over 13,000 pregnant women in Zanzibar with unprecedented rates of both facility delivery and postnatal care attendance. The program empowered CHWs to more effectively reach women in the most remote communities with accurate information and education and link them to facilities.

The assessment faced a number of limitations, the most significant being the lack of a control group for the quantitative findings. Hence, while the increase in facility deliveries and postnatal attendance was evident when compared to DHS 2010 as well as HMIS data before and during the intervention period, the lack of a randomized design does limit the conclusiveness of the results. Nonetheless, the dramatic difference from DHS data and the increase evident in HMIS data do support the claim that this program made a difference. The qualitative data must be given significant weight as well, as what emerged was very rich data from mothers, CHWs, and health workers that pointed to the success of the program. Importantly, it also brought forward certain barriers that contributed to the 25% of deliveries that did occur at home or on the way to the health facility, and these should not be underestimated. Moving forward, such cultural and institutional barriers should be recognized and addressed through proven behavior change interventions which can be integrated with community mHealth components of any program. For example, the CHWs themselves took the initiative to hold community meetings to raise awareness about facility attendance, but this could be a more systematic component of the intervention. Radio has been proven to be an effective means of

education and sensitization, particularly in reaching men, who are often the decision makers in this and many other settings.^{xi}

Though each aspect of the program was important on its own, the success of the Safer Deliveries program came from integrating novel mHealth approaches—including decision support, data storage, mobile banking, and communications—into a broader community-based intervention that effectively linked institutional and community level to overcome barriers to hospital deliveries in Zanzibar. It was this combination that has spurred the beginning of a “culture shift” in delivery practices in Zanzibar and shows a great potential of improving maternal health outcomes and reaching MDG-5 within Zanzibar, across Africa, and around the world.

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Figure Legend

Figure 1: Facility delivery by region compared to DHS 2010

Figure 2: Facility deliveries over time according to HMIS data

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Figure 1. Facility delivery by region compared to DHS 2010

Figure 2. Percentage facility delivery by year (HMIS)