Original Article

Embracing Modern Technology in Providing Maternal Child Health: A Case of Malaica Pregnancy Program in Kenya

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ABSTRACT

Background: Modern technology has been embraced across sectors such as education, business, agriculture, and health to improve service delivery. In Kenya, the maternal mortality ratio (MMR) remains high at 355 per 100,000 live births, compared to the global average of 223 per 100,000. Gaps and delays in accessing quality maternal health care are major contributors to this. Mobile health (mHealth), which uses mobile applications and social media to deliver health services, has emerged as a strategy to bridge these gaps and improve maternal outcomes. **Intervention:** The Malaica Pregnancy Program is one of Kenya's mHealth initiatives aimed at providing comprehensive, personalized care for pregnant and postnatal mothers. It supports Kenya's goal of reducing maternal and neonatal mortality and contributes to Sustainable Development Goal 3 (SDG 3): ensuring good health and well-being for all. The program operates through WhatsApp, where each mother is assigned a nurse-midwife who provides evidence-based care according to World Health Organization (WHO) guidelines. Mothers are added to WhatsApp support groups moderated by trained "Supamoms," connecting them with peers who share similar due dates. Participants receive daily updates about pregnancy progress, appointment reminders, and health tips. Malaica also hosts Flash Chats—short expert-led Q&A sessions on pregnancy and parenting topics. **Outcome:** Malaica has improved maternal and child health outcomes by increasing awareness and promoting early detection of complications. Mothers receive continuous support, enabling timely interventions when necessary. The program empowers mothers to create birth plans and prepare for emergencies in collaboration with their assigned nurse-midwives. Overall, it has made the pregnancy and postpartum experience more convenient, informed, and safe, showcasing the significant potential of mHealth in transforming maternal care in Kenya.

INTRODUCTION

Modern technology has been embraced by most sectors to improve their service delivery (Giri, 2020). The education sector is using modern technology, for example, in administering examinations, conducting classes, and even marking the exams. Most businesses are either online or hybrid. This includes businesses like Jumia in Kenya and Amazon, among others. Agriculture too has embraced technological advancements to deal with climate change. The health sector is slowly utilizing technology in providing services like patient monitoring, imaging, laboratory testing and treatment (Yeung et. al, 2023). One such technology is the use of mobile phone applications in providing health care (Yeung et. al, 2023).

Worldwide, modern technology has been embraced in maternal-child health. In India, the use of mobile application services has helped to improve coverage of maternal and child health services (Modi et. al., 2019). A meta-analysis and systematic review found that mHealth improved indicators of MCH like clinic attendance, skilled birth attendance and vaccination coverage (Lee et. al, 2015).

In sub–Saharan Africa (SSA), m-health has also been used in providing neonatal child health services. Big Sis chatbot on Girl Effect's Springster mobile platform helps young women to discuss contraceptives without shame or fear of stigma (Mlambo, Sibanda, Ntshangase, and Mvuyana, 2022). 'Mum & Baby', a simple SMS-based health information service in South Africa where mothers are given information on breastfeeding and vaccination, has 95% and above of the mums acting for the well-being of their children. A program in Rwanda called Rapid SMS has enabled health workers to more efficiently track pregnancies, spot danger signs, and ensure that women can access emergency obstetric care if complications occur. Mobile health has also reduced delays in maternal childcare (Pagalday-Olivares et al., 2017).

In Kenya, maternal mortality stands at 355 deaths per 100,000 live births. The use of technology has been adopted as one of the interventions in helping reduce the MMR. For example, mHealth has helped reduce mother-to-child transmission of HIV with SMS (Odeny et al., 2012). Other mHealth services that have been implemented have been providing behaviour change communication, client education, provider training and education, data collection and reporting (Njoroge et al., 2017).

Looking at mHealth services currently being used mostly, SMS is the most common way of communication in reaching out to mothers. Malaica an online pregnancy program is an innovation that is upcoming utilizing WhatsApp in offering mHealth services to their mothers. WhatsApp had an estimated 750 million users by 2015 with an estimated addition of twenty million users every month worldwide (Deshmukh, 2015). The app is

simple to use, secure with end-to-end encryption and its ability to send media files made it the preferred app for use for this program. In addition, the app allowed bulk automated messages to be sent. The app allowed two-way conversations such as video or voice calls and messages making virtual consultations easy. Malaica was established to address a gap in delays in maternal mortality via telemedicine, remote antenatal contacts and having a support group for the mothers. This article describes the implementation of the mHealth program and how it addresses the gaps in maternal-child health.

LITERATURE REVIEW

Overview of Maternal Health

The World Health Organization describes maternal health as the health of a woman during pregnancy, childbirth, and 6 weeks after delivery (WHO, 2023). Globally, in 2020 maternal mortality ratio (MMR) was approximately 223 deaths per 100,000 live births. This represents a 34% decline from 339 deaths per 100,000 live births in 2000 (UN (United Nations) Interagency, 2023). This is an improvement and a good move towards achieving the goal of reducing the global maternal mortality ratio to less than 70 per 100,000 live births by 2030.

Despite global progress in maternal-child health, the African region still records high maternal and child mortality and morbidity rates. In the African region, the MMR in 2020 was at 531 deaths per 100,000 live births. This represents 69% of the maternal deaths occurring globally (UN Interagency, 2023). Robust steps need to be adopted to improve this including the use of modern technology.

The most common causes of maternal mortality include excessive blood loss, infection, high blood pressure, unsafe abortion and obstructed labour (WHO, 2024). Most of these causes can be avoided if some preventive measures are taken early. This makes maternal deaths preventable. In addition, poor healthcare access, socio-economic inequalities, poor infrastructure, and gender disparities contribute to poor maternal health (Kruk et al., 2018).

In Kenya, the MMR was 355 per 100,000 live births (KNBS (Kenya National Bureau of Statistics) and ICF (International Coaching Federation), 2023). Factors that have been documented to contribute to maternal deaths include poor quality of care, inadequate supply of important supplies like blood and drugs, communication gaps between referring and receiving facilities, inadequate staff and poor documentation, among others (Masaba et al., 2022).

Kenya has made progress due to some initiatives taken by the government to improve maternal health. One such initiative is the Linda Mama program. The Linda Mama package pays for antenatal care, delivery, care of infants and post-partum family planning. This has improved indicators of maternal-neonatal health. According to (KNBS and ICF, 2023), 88% of the deliveries were conducted in a health facility, and 98% of the mothers attended antenatal care clinics from a skilled provider with two-thirds of them having at least four visits. 90% of the pregnant mothers have been on iron and folic supplements, 28% dewormed and 75% have been given tetanus vaccines. For the newborns, 83% have been able to receive a check-up within 2 days of birth, while 80% of the babies have been vaccinated (KNBS and ICF, 2023). This is similar to the findings of (Lang'at, Mwaniri and Temmerman, 2019) which showed an increase in skilled care before and during delivery. According to (Oyugi, Kendall, Peckham, Orangi and Barasa, 2023), the cost-benefit ratio for the program was 21:22. This means the benefit is 21 times higher than the cost. Other innovations targeting the identified gaps will help to achieve a reduction in maternal and child mortalities and morbidities.

Mobile Health

The COVID-19 pandemic led to an increase in the utilization of digital health innovations. Some of the digital health technologies include the use of mobile applications, use of text messages, web-based

applications, use of social media and wearable or sensor-based devices (Leung et al., 2023 and Sim, 2019). Mobile health has been defined as the 'use of mobile and wireless technologies to support the achievement of health objectives' (Levine et al., 2015). Increased availability of mobile phones also makes it easier to implement mHealth in lower-middle-income countries (LMIC) (Majeed-Ariss, Hall, McDonagh, Fallon and Swallow, 2015)

Mobile health has been shown to positively impact maternal and child health (WHO, 2019; Bossman, Johansen and Zanaboni, 2022). Mobile health overcomes barriers like transport problems, like long distances, poor road networks or being able to afford transport charges (Peprah et al., 2020). In addition, mHealth improves outcomes and access to care, reduces clinical resource hours, improves patient experience, and increases workplace efficiency through reduced travel time (Bhavnani, Narula and Sengupta, 2016).

Mobile Health and Antenatal and Postnatal Care Coverage

Antenatal and postnatal clinic (PNC) visits have immense benefits for pregnant and postnatal mothers. During antenatal clinic (ANC) visits, mothers receive social and emotional support. In addition, they are screened for any warning signs and given early treatment for any illness. Mothers are also able to receive micronutrient supplements and immunization against tetanus (United Nations Children's Fund (UNICEF), 2024). The World Health Organization (WHO) recommends at least four visits in the first 6 weeks after delivery. During the PNC visits they get health education, screening and treatment for any danger signs and treatment for both the mother and child. Partner involvement in newborn care is also encouraged as a form of support to the mother (WHO, 2022).

In Ethiopia, a non-randomized control trial to find out the effects of mHealth intervention on delivery and PNC utilization was implemented. In the trial, a reminder message system was adopted among postnatal and antenatal mothers to remind them of their clinic visits. Mothers who received the reminder messages went for more antenatal and postnatal care visits and delivered in a health facility (Shiferaw, 2016). Similarly, a meta-analysis study revealed that the odds of women who received education messages and PNC clinic reminders were four times more likely to attend PNC visits compared to women who did not receive (Gayesa, Ngai and Xie, 2023).

Telemedicine, as a form of mHealth allows pregnant and postnatal mothers to have consultations remotely. They can also have remote antenatal visits which increase the ANC and PNC coverage.

Behaviour Change Communication

Pregnant and postnatal mothers seek information on the care of the baby, complications they are likely to face during delivery, the baby's growth and development and nutrition (Kamali et al., 2018). Various sources of information include the internet, healthcare professionals, family and friends (Vogels-Broeke et al., 2022). This information at times, is conflicting leading to anxiety (Bjelke, Martinsson, Lendahls and Oscarsson, 2016). Mobile health is a tool that can be used to effectively implement behaviour change communication (Gurman, Rubin and Roess, 2012). There is an increase in access to information through the internet. This is good since there is easy access to information. However, this comes with the danger of misinformation. Vogels et al. (2022) found that information from digital sources was perceived as less trustworthy by pregnant mothers. Yet it was the commonest source of information. With the same resources as access to internet and mobile phones, a mother can get credible and evidence-based information from licensed HCPs.

Mobile health has been shown to educate antenatal and postnatal mothers on topics related to pregnancy and lactation. Implementation research among mothers in informal settlements in Kenya reported an increase in knowledge level among

participants. In the study, pregnant and postnatal mothers were sent messages based on their stage. The messages included reminders about their upcoming visits, information on danger signs to watch out for, breastfeeding and infant care. The participants could also ask questions via SMS which were responded to by an AI-enabled helpdesk. This brought about a decrease in the number of complications that were dealt with in the partnering hospitals (Ochieng et al., 2023). However, AI typically operates within the limits of its programming and may struggle with atypical or ambiguous cases. Experienced HCPs can make nuanced clinical decisions that consider complex patient histories, social contexts, and non-verbal cues.

In Ethiopia, healthcare providers (HCPs) could track assigned clients for follow-up home visits using the mHealth app. The application reminded the HCP of the follow-up home visit. In addition, the application had automated information, education and communication materials for HCP to strengthen the health message being taught. This strengthened the health message and made it easier for the concept to be explained by the HCP (Nigussie et al., 2021). According to (Lee et al., 2015), mHealth improved the number of mothers exclusively breastfeeding. This infers mHealth platform can significantly enhance service delivery by improving the continuity and timeliness of care, ensuring that healthcare providers can efficiently track and follow up with clients. The integration of standardized Information, Education, and Communication (IEC) materials within the app provided HCPs with consistent, evidence-based resources that strengthened their communication with clients, allowing them to explain complex health concepts more effectively. This method of delivering health education is central to behaviour change communication, as it not only conveys information but also actively encourages individuals to adopt healthier behaviours and make informed health decisions.

Maternal Mental Health

Maternal health has been shown to have a significant influence on a baby's development (Naaz and Muneshwar, 2022). Maternal mental health issues like stress, depression and anxiety lead to cognitive, behavioural and emotional difficulties for the baby. Mothers' stress can influence how the mother and baby bond and their attachment (Naaz and Muneshwar, 2022).

Mobile health has been shown to help in diagnosing maternal mental health issues (Osma, Barvera and Ramphos, 2016). The acceptance of the use of mHealth for improving perinatal mental health is also high (Varma et al, 2023). A scoping review to evaluate the use of m health apps for perinatal mental health found that health apps could screen and manage perinatal depression. The apps contain screening tools, connection to therapists, psychoeducation interaction and a free writing feature. (Funnell et al., 2022). While maternal health apps offer quick and convenient screening, close follow-up is essential to ensure adherence to recommended interventions. Therefore, relying on apps alone may be insufficient. In addition is limited evidence regarding the long-term engagement of users with mHealth applications for perinatal mental health. While initial uptake and short-term usability appear promising, few studies have assessed sustained user interaction over extended periods.

Summary of Literature

Several studies have looked at ways mHealth can be used to improve maternal-child health. This includes improving antenatal and postnatal utilization. Mobile health has helped in the diagnosis and management of maternal mental health issues and in behaviour change communication. Implementation studies reviewed rely solely on mHealth without human follow-up may limit the success of interventions. Few studies have been done in Kenya to evaluate mHealth programs in place too. This paper looks at the

implementation of an mHealth program integrated with human support with a focus on improving maternal health in Kenya.

MALAICA PROGRAMME

Malaica is a hybrid pregnancy program based in Kenya. The name is derived from 'malaika' a Swahili word meaning angel. An angel is someone who takes care of you during a vulnerable phase. The online program is based on the WhatsApp mobile application. The program was founded to provide comprehensive and personalized care for expectant and lactating mothers in 2022.

Process of the Program

Mothers join the program as referrals from friends or staff, from websites, Instagram or Facebook. When the client wants to join the program, they contact customer service, who take a brief history and then they are allocated to a nurse midwife (NM).

The NM begins the onboarding of the clients by getting a material health profile and reviewing her previous clinic and her progress. Mothers who have not begun clinics are educated on the importance of clinics and help to choose a facility with good reviews from the database.

During onboarding, once the client's details are filled in the database, they start getting daily messages. Daily messages are automated messages that give her information about every stage of pregnancy, like how the baby is developing, gestation and any intervention expected during gestation. When the clients are still in the program and have babies for over 8 weeks, they start getting weekly messages. The messages are about newborn care, breastfeeding, milestones expected at each stage, immunization, nutrition, danger signs for newborns and postnatal mothers and management of common postnatal conditions.

The client also joins a WhatsApp group with other mums who share the same expected delivery month. This is a support group where mums can share their experiences. The groups are regulated by a supamom. A supamom is a mother who is tech-savvy with motherhood experience. Nurse midwives are also allocated to each group. They offer medical guidance to any medical issues raised in the group, like management of pregnancy symptoms or dispelling any myths. The NM also offers health education on various topics.

The client can chat with the paired NM daily. Sometimes calls are scheduled to discuss the mother's progress. In case the mother has a medical emergency, she is given directions on the best action to take. If the case is complicated, it can be referred to a gynaecologist or paediatrician.

Malaica also hosts flash chats weekly on various maternal-child health topics. During flash chat, an expert is invited to share the chosen topic. The topics range from social, financial and medical. The expert gets to talk about a topic that has been shared earlier then the mothers can ask questions.

In addition to helping clients when sick, the NM is also responsible for identifying high-risk mothers and following up to ensure they receive evidence-based care. They also provide health education based on the health needs of the mother.

Methodology

The program was evaluated between January and March 2024. During the period the program had 168 mothers who were the target population. Nurse-midwives (NMs) primarily completed structured scripts during consultations with clients. These data were systematically captured, analysed by the program's system, and monitored via the impact dashboard. The aggregated and analysed data constituted the principal evidence base for this case study. The program has regular quality audit checks of the scripts to ensure accurate and complete data collection.

Impact of the Program on Maternal-child Health

Increased Antenatal Care.

Through daily messages that they get, the mother is reminded of their upcoming visits. The mother is therefore able to book their appointments early enough.

Mothers are also able to have remote antenatal and postnatal contacts with a malaica nurse midwife. This increases the number of contacts a mother has, as recommended by WHO. Between the months of January and April 2024, all the antenatal clients had had at least four antenatal visits in their pregnancy. This is higher compared to ⅔ of the antenatal mothers in Kenya according to KNBS and ICF (2023). If more Malaica clients have more antenatal visits, this will help increase the antenatal coverage in Kenya.

In terms of postnatal coverage in the period of January and March 2024, all Malaica mothers had at least 2 PNC visits which is higher compared to the Kenyan national average of 80%

Behaviour Change Communication

Daily messages sent to the mother containing information on breastfeeding, care of a newborn, vaccinations, management of common symptoms and nutrition helped the mums to change their health behaviours. Of all the mothers in the program, 87% read their daily messages through WhatsApp.

This health information was also shared during flash chats and webinars where different experts on different health topics. The number of mothers who attended the live session was 36%. This information helps mothers to adopt health behaviours like exclusive breastfeeding, hygiene practices, increased uptake of vaccines and adherence to the supplements. From the community polls done on WhatsApp, the knowledge level of the mothers on various health topics increased from 60% to 90%. These findings align with those of Ochieng et al. (2024), who observed a significant increase in participants' knowledge levels in implementation research.

This would have contributed to all the mothers delivering at the health facility and 100% breastfeeding their babies exclusively until they graduated from the program.

Maternal Mental Health

The program screened all the mothers during the antenatal and postnatal period for depression. The incidence of pre and postnatal depression was 6% during the period of January and March 2024. All the clients screened were referred to the psychologist for therapy.

Flash chats on mental well-being were also conducted to raise awareness of mental health issues and to reduce the stigma associated with mental illness.

Emotional support was also offered to mothers who experienced loss, for example, after a miscarriage.

Implications of the Study

Mobile health has immense benefits and can help bridge the gap in maternal-child health caused by limited health infrastructure and misinformation. The program should be expanded to include the marginalised and underserved rural populations that experience. The program should continuously be improved and updated based on feedback from the users. For sustainability, the program should have a financial sustainability plan which could be user fee models or donor support.

Limitations and Future Recommendations

In the study, the accuracy and completeness of the data depended on the consistency with which nurse-midwives filled out structured scripts during client interactions. Additionally, the reliance on structured scripts may have constrained the depth of data collected, missing refined insights into client experiences. Future studies should include qualitative data to capture richer and more information on maternal experiences and feelings.

CONCLUSION

The Malaica pregnancy program has demonstrated a positive impact on maternal and child health. It has increased antenatal and postnatal care coverage, supported behaviour change communication, and contributed to improvements in maternal mental health and wellness. The success of the Malaica program highlights the significant role of mHealth solutions in achieving better maternal and child health outcomes.

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