Introduction

In Kenya, 362 women die in every 100,000 live births and 22 newborn babies in every 1,000 live births die within the first month (28 days) of life. It is estimated that haemorrhage, hypertensive disorders, and sepsis are responsible for more than half of maternal deaths worldwide, while the main causes of neonatal deaths are birth asphyxia and birth trauma (31.6%), prematurity (24.6%), and sepsis (15.8%). These causes can be prevented in the community with appropriate interventions.

Research has shown that community health volunteers (CHVs), previously referred to as community health workers in Kenya, can contribute to improvements in essential maternal and newborn care practices, including improved ANC attendance, skilled deliveries and exclusive breastfeeding. Although the Kenya Health Policy (2014-2030) and the Community Health Strategy recognise CHVs as a crucial link in improving healthcare services and supplementing the work of facility-based staff, CHVs face challenges in performing their role, some of which have to do with inadequate technical knowledge and competence as they receive only a few days of training before they assume their roles. In addition, due to an excessive workload on the Community Health Extension Workers (CHEWs) whom they report to, CHVs receive insufficient, irregular and poorly structured supervision. Collectively, these challenges affect CHV’s ability to recognise danger signs in pregnant women, new mothers and the newborns, and to make timely referrals for care.

The growth of information and communication technology has brought new opportunities for addressing the challenges facing community health work. Mobile technology and applications (m-Health tools) can be used to deliver essential information and support in decision-making to enhance knowledge and improved task performance of the CHVs. This study sought to assess the value addition of using an m-Health innovation to enable CHVs identify and track mothers and children with danger signs, to reduce pregnancy and post-natal-related complications and newborn deaths in a Nairobi urban slum. The specific objectives were:

a) To assess feasibility of using an electronic decision-support tool (DST) included in a mobile-based health reporting system for CHVs in urban slums;

b) To assess acceptability of using the mobile-based decision-support tool by CHVs and health facility staff;

c) To determine effects of adding the decision-support tool on overall use of maternal and newborn health (MNH) services, reduction of MNH complications and deaths in urban slums.

This brief discusses the findings of the study conducted by the African Population and Health Research Center (APHRC) over a period of 20 months from 2016 to 2018.
Research setting and participants

The intervention project was implemented in Kamukunji Sub-County, with Embakasi Sub-County serving as a comparison site. Both sub-counties are located in Nairobi County - and are comparable - in that they have large urban informal settlements (slums), characterized by poverty, poor coverage of social services, and poor health outcomes. The project worked with 50 CHVs drawn from five community units (CUs) linked to five health facilities in the intervention site, and 30 CHVs in the comparison site, drawn from three CUs that are linked to three health facilities. The CUs and health facilities in the comparison site are geographically distant from the intervention site to limit contamination.

Conceptual framework and theory of change

The study was based on the theoretical assumption that providing a decision support tool would enhance the CHVs’ skills and ability to identify high-risk pregnant women, new mothers and newborns with complications, and make timely and correct decisions on referral for cases that needed intervention. As a result, there would be increased use of maternal and neonatal health services and reduced maternal and neonatal complications and deaths, as illustrated in Figure 1.

Intervention activities and operations

The project developed and tested an innovative m-Health application, referred to as mobile Partnership for Maternal, Newborn and Child Health (m-PAMANECH), which digitized the existing national CHV reporting forms (MOH 100, MOH 513 and MOH 514), and included a decision-support function. This function enabled CHVs to identify high-risk pregnant women, new mothers and newborns with complications, and to make timely and correct decisions to refer cases that needed intervention. The application operated as an interconnected network between CHVs, CHEWs and health facilities. It allowed the CHVs to fill in the digitized reporting forms, and prompted them to screen clients for any danger signs or complications. In the event that at least one danger sign was found, the CHV was required by the system to refer the client.

The project also introduced the intervention health facilities to a web-based platform on desktop computers, which linked to the mobile application. These served to share the information sent in by CHVs to the server for clinicians to access the patient’s profile, record the action taken, and give feedback to the CHV. An alert to follow-up was then sent to CHVs for any referral patient who had not been seen within 24 hours at any of the networked facilities. The CHVs played a vital role in improving the mobile application platform during its development, to better suit their needs during household visits.

Study design and sampling strategy

The research study used a quasi-experimental design with baseline and end line surveys in both control and intervention sites, to determine the impact of the decision-support system, if any, on the MNH services and selected health indicators. The CUs in the intervention and comparison groups were purposely selected to pick the ones with the worst health indicators, including those serving informal settlements. The end line survey used a mixed methods approach combining both quantitative and qualitative data collection methods involving 73 participants in the intervention sites and 62 in the comparison sites. The quantitative survey covered women of reproductive age, CHVs...
and health facility staff. It collected information on the background characteristics of the women participants and health-seeking behaviours including utilisation of family planning, antenatal, skilled attendance at birth and immunisation services. For CHVs, the survey collected information on the households allocated to them, community services they offer, and data documentation. Qualitative data included focussed group discussions with mothers, and key informant interviews with CHVs and health facility staff interviews with CHVs and health facility staff.

**Limitations of the study**

This study focused on application of the decision support module in Nairobi’s low-income informal settlements, and the results may therefore not necessarily be applicable to other contexts. In addition, the intervention was for a short period, which was also affected by disruptions due to a nationwide nurses strike and the national election period. The following findings should therefore be interpreted in this perspective.

**Results**

**Usability of the decision-support tool**

The results show that majority of the CHVs (87%) and half (50%) of the formal healthcare workers found the application easy to use and to learn. The healthcare workers particularly appreciated that the platform made it easy to track referrals and CHV performance:

“...Okay, it is easier to use... to receive referrals, making referrals, giving feedback to the community and like I said to give reports, generating reports because normally it’s easier to tell how many antenatal mothers were referred within a particular time. It’s very easy you just click but for these other reports, you have to wait until the CHV send us their entire report to be able to get this report. So this one we normally have them like anytime you want it you just get with a click of a button.”

(Healthcare Worker, Kamukunji)

Some of the barriers to effective use of m-PAMANECH include erratic electricity supply and insecurity in one facility, which meant that the desktop computer was locked away in a safe room, rendering the application unemployed. Some CHVs also found that usability of the phone with the application was affected by instability of internet connectivity, which would cause the application to freeze.

“Sometimes you get to a house and the phone hangs... you wonder what to do. You remove the battery and when you start the phone the information is lost and you have to start again”

(FGD, CHV, Kamukunji)

Graph 1 below summarises the views of health care workers and CHVs on the usability of the decision support tool.

<table>
<thead>
<tr>
<th>Function</th>
<th>HCWs</th>
<th>CHVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would imagine that most people would learn to use this mobile/web app very quickly</td>
<td>50%</td>
<td>76.90%</td>
</tr>
<tr>
<td>I found the various functions in this mobile/web app were well integrate</td>
<td>87.50%</td>
<td>82.10%</td>
</tr>
<tr>
<td>I thought this mobile/web app was easy to use</td>
<td>50%</td>
<td>87.20%</td>
</tr>
<tr>
<td>I think that I would like to use this mobile/web app frequently</td>
<td>80%</td>
<td>92.30%</td>
</tr>
</tbody>
</table>

Figure 2: Perceptions of health care workers and CHVs on usability of the mPAMANECH tool
Acceptability of the mobile-based decision-support module by CHVs and healthcare workers

The study findings show that the use of the device by the CHVs in Kamukunji Sub-County was nearly universal, with 80% of the CHVs interviewed reporting that their most common method of data collection was electronic. In addition, majority of the CHVs (87%) here were satisfied with their method of data collection, compared to only 33% in the control site, who said they were satisfied with the current method. More than 90% of CHVs in Kamukunji Sub-County reported that an electronic/mobile data capture system made their work easier and reduced the time taken in households.

“The phone makes my work easier. I see the work is good because right now I would be carrying around that big book of MOH 514 and that MOH 514 is now on my phone so I think it is easy. I would be carrying the MOH 100 for a referral. Now I see it in my phone... so that one makes my work easier because carrying three books... they can’t fit in this bag. For the phone, I will put it in my bag and walk with it you see now that makes my work easier”

(IDI, CHV).

The tool also appears to be acceptable to CHEWs interviewed, who reported that the linked platform (on the facility-based desktop computer) made it easy to follow the performance of the CHVs:

“...immediately they visit a household you can actually get the information right where you are. Personally, I can use my phone to actually check on what they are doing, by the fact that you can put in the GPRS coding, you can know that this person actually was doing this at a particular area at this particular time and not in their own household. So, when it comes to report transmission it is very prompt and you can actually make a decision concerning that particular household in good time,”

(KII, community health assistant).

On the other hand, a system usability score analysis found slightly lower acceptance of the application among facility-based healthcare workers - the web application was accepted by 64% of the facility-based healthcare workers, compared to 70% of CHVs who found the mobile-based application acceptable.

Healthcare workers reported that they found the web-based application cumbersome and that it gave them extra work. During project implementation, it was observed that some of the healthcare workers had no ICT skills, which may have affected their ability to use the application effectively. Moreover, the nurses industrial strike started two months after the implementation commenced and the facilities were understaffed, which might have made having to use the platform seem like extra work:

“I said the challenges we have between us and the CHV are, one, we are very few who were trained [on the application use], secondly because of the nurses strike we have not been able to do a close follow up on the referral from the community to us, at times we even forget to [launch the application] because of the workload. Because right now we are very few indeed. So by the time we remember to open it, you find that the time is already gone because of the workload”

(KII, healthcare worker, Kamukunji Sub-County).

Effect of the DST on recognition of danger signs and referrals

The results show improvement in knowledge scores of the CHVs in recognising danger signs in both mothers and newborns, in some instances in both intervention and comparison sites, making it difficult to isolate the effect of the application. For instance, while increase was noted in CHVs’ knowledge of danger signs in the mothers and newborns in the intervention site from about 88% at baseline to 92% at end line, there was higher increase observed in the comparison site, from 70% to 90%. In addition, at both baseline and end line, nearly all the CHVs in both sites could identify at least two danger signs in pregnancy. Moreover, there were only slight increases in the proportion of those that could identify at least two danger signs in the postpartum period, from about 93% to 100% in the intervention site, and 90% to about 93% in the comparison site.

Notably, there were marked differences in the proportion of CHVs who could identify specific danger signs at end line, with much CHVs in the intervention site able to identify jaundice in newborns (67%, compared to only 33% in comparison site) and breathing difficulties, identified by 56% and 38% of the CHVs in the intervention and comparison sites respectively. Further, only 21% of CHVs in the comparison site could identify abnormal discharge as a danger sign in postpartum mothers in the comparison site, compared to 47% in the intervention site. Slightly more CHVs in the intervention site could identify headache and severe abdominal pain as danger signs in pregnant women, compared to the comparison site.

Effect of the DST on the use of MNH services

An analysis of the findings suggests that the use of the DST by CHVs did not influence the use of maternal services by pregnant women. In both sites, there was a noted decline in the proportion of women making the first ANC visit within the first trimester, and those making the recommended four visits. Also, the proportion of women who made it to the first ANC visit in the first trimester dropped from 24% at baseline to only 20% at end line. At the comparison site, the decline was similar: from 28% to 18%. The proportion that made the fourth ANC visit also dropped from 56% at baseline to only 26% in the intervention site, compared to 70% in the comparison site. Across both sites, there was a decrease in the proportion of women who delivered at a health facility, which may be attributed to the prolonged strike by nurses and political disruptions due to general elections during this period.

“... There was a strike before and still it went a bit and the strike continued... that nurses’ strike has brought a problem. You can refer a client and she comes back and tells you where I was taken I was pushed to another place and I didn’t have money. That is where I see a challenge has been because of that strike. It has been there for long... and still up to now the strike is still going on. So you find that you refer a client to a government hospital and you find she has been thrown to these NGOs (papers flipping) or she is just in another hospital. That is what I have seen a challenge has been.

(FGD, CHV, Kamukunji)

Effect on referrals

Evidence suggests that use of the application increased CHVs’ ability to make timely referrals at the community level. Over half (52%) of the mothers in the intervention site reported that they were referred by a CHV to seek care at a health facility during the postpartum period, compared to only 27% in the comparison site.

Across the two sites, about 10 women were referred for care related to pregnancy danger signs by the CHVs in the three months before the end line survey, and 30 were referred
for postpartum family planning – 38% of these were in the intervention site and 20% in the comparison site.

**Effects on CHV’s home visits and care for mothers and newborn**

Home follow-up of newborns after discharge from health facilities is recommended by the World Health Organisation as an effective strategy in improving newborn care. The results from this study suggest that the DST may have had an effect on the CHVs’ performance of newborn home follow-up. At baseline, only 30% of mothers with newborns were visited at home by a CHV in the intervention site, but this had increased to 63% at end line. In contrast, only 37% women in the control were visited by a CHV after discharge at end line, a small increase from 32% at baseline.

More children in the intervention site (62%) than in comparison site (55%) were exclusively breastfeeding at six months of age. Slightly more mothers in the intervention site (28%) than in control (21%) reported that a CHV had visited them at home when their baby was ill. Further, 67% of the mothers in the intervention site said that the CHV had identified danger signs during the home visit, compared to only 38% in the control site. More mothers (91%) whose child had danger signs in the intervention site were referred for care by the CHV than in control site (78%).

**Conclusions and recommendations for policy and practice**

The Kenya Health Policy and the e-Health policy create space in the healthcare system for effective e-Health solutions as one way for the country to deliver equitable, affordable and convenient health services to all Kenyans’. Adoption of solutions such as the CHV DST may have the potential to strengthen the health system’s capability to reach marginalised population groups in low-resource settings. This study provides useful insights into how these technologies can be integrated into the existing system, the effects they can have if well used, and the challenges in operationalizing them.

The results show that a mobile-based decision support tool for CHVs is feasible and largely acceptable by CHVs, and can be a useful addition in the health system if challenges observed in the linked health facility are addressed. The results also show that exposure to the decisions-support system has potential to improve quality of MNH services, as it led to an increase in CHV knowledge of danger signs in pregnant women, new mothers, and new-borns. These findings also suggest that e-Health innovations can be useful in improving knowledge and skill, especially for CHVs. However, the study found insufficient evidence on the impact of such a tool on maternal, newborn and child health outcomes.

Drawing on the findings of this study, the following recommendations can be made:

- The CHV decision-support tool has positive effects in some significant areas of a CHV’s role, including recognition of danger signs and subsequent referrals. The implementation of the community health strategy should take advantage of digital solutions such as m-PAMANECH, which can contribute to improving the performance of the CHVs and can be used to transfer essential knowledge and skills.
- Further implementation research is needed to understand the factors that influence acceptability and use of such tools particularly by facility-based healthcare workers.
- The government should do more to fully exploit the opportunities offered by advances in the ICT sector. For instance, by improving the infrastructure to support quality, high-speed Internet connections at health facilities, generation and use of data for decision making would be made easier.
This project is funded by the UK government under the County Innovation Challenge Fund (CICF). The CICF invests in innovative interventions, products, processes, services, technologies and ideas that will reduce maternal and newborn mortality in Kenya.

www.mnhcicf.org

For more information about this project, please contact:

Pauline Bakibinga,
African Population and Health Research Centre,
Email: pbakibinga@aphrc.org