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High-risk Pregnancy Referral Cards Project

Assessing effectiveness of using high-risk pregnancy referral cards in identification and referral of at-risk pregnancies to primary health care facilities

Bomet County HRP Study Report

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THIS STUDY IS PART OF THE PHILIPS FOUNDATION PROJECT "HIGH RISK PREGNANCY REFERRAL CARDS", IN PARTNERSHIP WITH THE KENYA RED CROSS SOCIETY.

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Project implementation and research work

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Research Reports

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ABBREVIATIONS

AMREF	Africa Medical and Research Foundation
ANC	Antenatal Care
BCS	Birth Companions
CHA	Community Health Assistant
CHS	Community Health Strategy
CU	Community Unit
CHA	Community Health Assistant
CHMT	County Health Management Teams
CHVS	Community Health Volunteer
CHW	Community Health Worker
CHEWS	Community Health Extension Worker
ESRC	Ethics and Scientific Review Committee
FGD	Focus Group Discussion
HRP	High Risk Pregnancy
ICBE	Internal Committee for Biomedical Ethics
ICC	Intra Cluster Correlation Coefficient
ICCM	Integrated Community Case Management
IDI	In Depth Interview
IEC	Information Education and Communication
KRCS	Kenya Red Cross Society
MCH	Maternal and Child Health
MNCH	Maternal Neonatal and Child Health
MMR	Maternal Mortality Ratio
MOH	Ministry of Health
MDG	Millennial Development Goal
MTM	Mother to Mother Support Group
NACOSTI	National Commission for Science, Technology and Innovation
PHC	Primary Health Care
SCHMT	Sub County Health Management Team
SDG	Sustainable Development Goal
TB	Tuberculosis
UNFPA	United Nations Population Fund
WHO	World Health Organization

EXECUTIVE SUMMARY

Background

The Maternal mortality ratio in sub Saharan Africa still remains high at 542 maternal deaths per 100 000 live births. Kenya is among the countries with high maternal mortality ratio in sub Saharan Africa (1). Despite the national decline in maternal mortality, the numbers are still high, and Kenya falls short of achieving the Sustainable Development goal of 70 maternal deaths per 100,000 live births. More efforts are required to address existing gaps in strategies aimed at tackling maternal mortality.

Early detection and timely referral of at risk pregnancies enables proper management and is key in reducing maternal mortality. Lack of awareness on the risk factors and early signs of at risk pregnancies among women of reproductive age is a risk in itself and possess a challenge to achieving this. Equipping the community with knowledge on identifying at risk pregnancies can be achieved by strengthening the first level of contact of individuals, the family, and community.

To this end, the International Committee of the Red Cross (ICRC), Philips Design and the Philips Foundation joined forces to help both lay and professional healthcare workers in providing better services to pregnant mothers with complications in fragile environments which often have limited to no access to electricity and connectivity. One of the results of this cooperation was the High Risk Pregnancy (HRP) Referral Cards: a portable set of tear-resistant cards, which is part of a more comprehensive toolkit aiming to support early detection of high risk pregnancies, and to encourage referral to health facilities for safe delivery. Though initially developed for fragile environments, we hypothesized that it would be of great benefit even in underserved communities in more stable environments where maternal and neonatal mortality is still high.

Study Objectives

The primary objective was to assess the effectiveness of the use of HRP cards in identifying and referring at-risk pregnancies at community and primary health care level. Specifically, we aimed to:

- To determine the proportion of pregnancies correctly identified to be at-risk pregnancies using the high-risk pregnancy referral cards at community level.
- To determine the effect of the use of high-risk pregnancy referral cards on awareness of healthy pregnancy among community health volunteers and women of reproductive age.
- To determine the association between the use of high-risk pregnancy referral cards and utilization of ante natal care services at primary health care level

Methods

We adopted a pre and post-test clustered quasi-experimental design. A mixed methods approach was used in which qualitative and quantitative methods were combined in the design, data

collection and data analysis methods. Study sites comprised of two intervention and two control sub counties selected from two counties, Bomet and Siaya. To determine the number of at risk pregnancies identified using HRP cards, baseline and end line data was abstracted from registers at the health facilities in the study sites and analyzed. To assess the effect of HRP cards on community awareness of healthy pregnancy habits and risks and danger signs in pregnancy, quantitative surveys among women of reproductive age and qualitative interviews including in depth interviews and focus group discussions were conducted among community health volunteers, health workers and health management teams. Multilevel mixed effects ordered logistic regression models, were used to determine the association between knowledge of healthy habits in pregnancy among community members and use of HRP cards. Difference in difference estimation analysis was used to analyze the association between use of HRP cards and utilization of ANC services.

Research Scope

This research study focused on the outcomes of the use of HRP cards is not considered a research impact evaluation but an initial assessment of the effect of the HRP cards. Comprehensive monitoring and measurement of the research impact is a complex undertaking requiring the involvement of many actors evaluating changes brought about by the intervention over a period of time. As such, impact was not assessed. Mention of impact by study participants interviews loosely refers to the immediate effect observed. The study focused on assessing the immediate effect of the use of the HRP cards by community health volunteers, guided by the specific study objectives.

The use of the HRP cards was embedded within activities of the community health volunteers as defined in the community health strategy. Use of the cards was linked to other interventions within the health system such as promotion of NHIF and Linda Mama insurance and mother to mother support groups. As a result, other non-specific secondary effects not defined in the study objectives but observed during implementation are also reported.

This specific report details the findings of the study conducted in Bomet county. The report consist of eight chapters:

Summary of high level key learnings

The overall project touched more than 250 thousand lives across all 4 counties. We explored four themes during the research implementation. Learnings from these are summarized below:

Knowledge Transfer

- We detected a marked increase in knowledge on healthy habits, danger signs and risks in pregnancy among CHVs, Birth ambassadors, pregnant women and community members in general.

- However, we detected positive association between increase in knowledge of healthy habits and risks in pregnancy and use of HRP cards in the intervention site.
- Although not initially planned, utilization of the cards in Mother-to-mother support group and during male involvement fora contributed towards raising awareness on HRP cards.

Behavior Change

- The reorientation and equipping of traditional birth attendants with HRP cards facilitated change of roles and adoption of new practices. As a result, we realised a reduction of home deliveries conducted by or assisted by traditional birth attendants during the study period.

Increased ANC utilization

- We detected a notable increase in the number of referrals of at-risk pregnancies to the health facilities in the intervention site; from zero referrals of at-risk pregnancies at baseline to a total of 197 new referrals from the community to the four link health facilities during the study period. This was 4.6% of 1st ANC pregnancies recorded.
- Health workers reported observing a reduction in the number of high-risk complications in pregnancy which they attributed to the timely referrals linked to use of the HRP cards.

Enhanced link between CHVs and primary health facilities

- Both health workers and community health volunteers reported an improved way of working with better feedback loop between health facilities and CHVs resulting in better follow up and completed referrals.

Chapter 1 INTRODUCTION:

This chapter provides the broader context of this research study and presents an overview of the main themes addressed therein. It includes the statement of the problem focusing on the specific issues and research questions to be addressed by the research.

Background

The World Health organization (WHO) classifies any death of a woman while pregnant or within 42 days of termination of pregnancy irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management as a maternal death (2). Global statistics on maternal mortality, approximated that 295,000 women died from preventable causes related to pregnancy and childbirth in 2017 (2). In the same year about 66% of all global maternal deaths occurred in Sub Saharan Africa (3) in where maternal mortality is higher in settings with women living in rural areas and poor communities. The global maternal mortality ratio (MMR) is estimated at 211 maternal deaths per 100 000 live births which represents a 38% reduction since 2000. The MMR in sub Saharan Africa still remains high at 542 maternal deaths per 100 000 live births.

At the time of adoption of the Sustainable Development Goals (SDGs,), the maternal mortality ratio in developing countries was 239 per 100 000 live births versus 12 per 100 000 live births in developed countries. As of 2017, the lifetime risk of maternal death in high-income countries such as Europe and North America is 1 in 4,800, compared to 1 in 56 in least developed countries, an indication that a substantial proportion of maternal deaths are preventable. Maternal mortality ranked highly among the top causes of death among women of reproductive age in Africa, see figure 1 below.

Kenya is among the countries with high maternal mortality ratio in Africa (1). Recent statistics indicate that maternal mortality ratio in Kenya has fallen from 315·7 deaths per 100 000 in 1990 to 257·6 deaths per 100 000 in 2016 (4). Despite the national decline in maternal mortality, the numbers are still high compared to other neighboring countries. More regional disparities exist within country. Reports by UNFPA showed that about 15 counties accounted for 98% of the country's maternal mortalities (UNFPA, 2016).

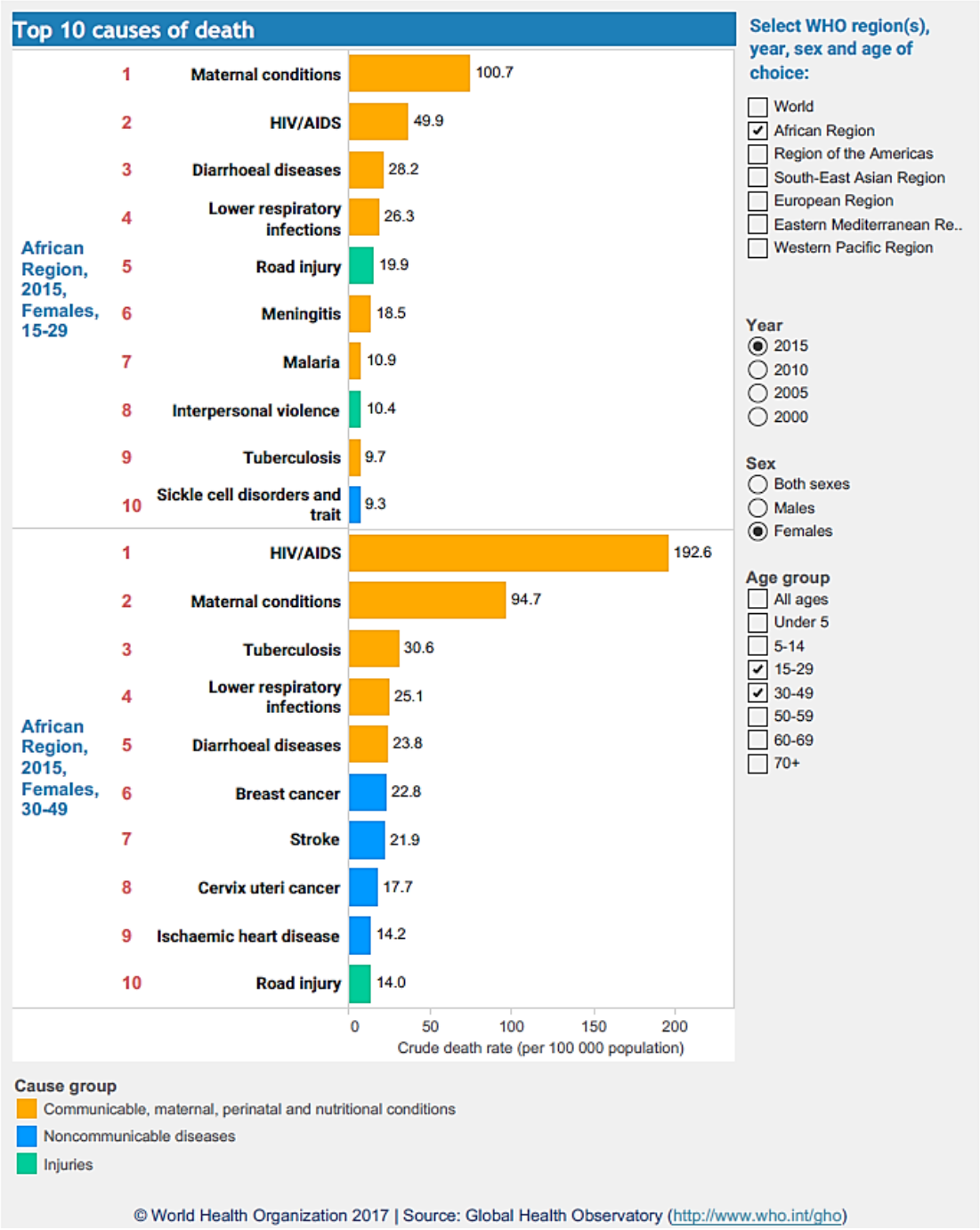


***Figure 1**: Summary of top ten causes of death among women of reproductive age in Africa in 2015*

More efforts are required to address existing gaps in strategies aimed at tackling maternal mortality. Through the use of simple, clear and concise job aids and visual aids, at the community level by community health volunteers (CHVs) and increasing the knowledge amongst both the community members and birth assistants, better health seeking behavior can be embedded at the lowest levels for better maternal health outcomes.

Problem statement:

Deaths from medical complications that arise during pregnancy and after delivery are preventable and manageable if detected in time and attended to by skilled health workers . A gross proportion of these cases are found in Sub-Saharan Africa to which Kenya contributes. As a build-up on the momentum generated by the fifth Millennium Development Goal (MDG 5), a transformative new agenda for maternal health was laid out as part of the Sustainable Development Goals (SDGs) to reduce the global MMR to less than 70 per 100,000 live births by 2030 (5).

Advocacy campaigns and other health system improvement measures aimed at mitigating the rate of maternal deaths have been established. However, despite the existing political support and an enabling policy environment for maternal health, inadequate access to quality maternal health services, including ante-natal, delivery, and post-natal services continues to be a challenge. Many women still live long distances from health facilities and face other barriers to accessing quality care. Deaths of women from pregnancy related causes in Kenya remains unacceptably high and at the current rate, Kenya falls short of achieving its mortality reduction target.

Early detection and timely referral of at-risk pregnancies enables proper management and is key in reducing maternal mortality. Lack of awareness on the risk factors and early signs of at-risk pregnancies among women of reproductive age is a risk in itself and poses a challenge to achieving this. Equipping the community with knowledge on identifying at-risk pregnancies can be achieved by strengthening the first level of contact of individuals, the family, and community with the national health system and leveraging on already existing platforms such as community health strategy in Kenya.

In a bid to contribute to addressing this gap, The International Committee of the Red Cross (ICRC), Philips Design and the Philips Foundation joined forces to help both lay and professional healthcare workers in providing better services to pregnant mothers with complications in fragile

environments which often have no or limited access to electricity and connectivity. One of the results of this cooperation was the High Risk Pregnancy (HRP) Referral Cards: a portable set of tear-resistant cards, which is part of a more comprehensive toolkit aiming to support early detection of high risk pregnancies, and to encourage referral to health facilities for safe delivery. The cards also aim to raise awareness on healthy pregnancy habits and importance of regular antenatal check-ups and safe delivery at healthcare care facilities. **We hypothesized that use of the cards in Kenya, a less fragile environment but with relatively high maternal mortality will also improve the identification of at-risk pregnancies, promote timely referrals and increase utilization of ANC services at primary health care facilities, resulting in better maternal outcomes and in turn contributing to reducing maternal mortality. To test this hypothesis, an evaluation of the effectiveness of the cards was required**.

Chapter 2 REVIEW OF LITERATURE:

This chapter discusses in detail the literature and previous research conducted in relation to identification and referral of at risk pregnancies to the health system. We detail a review of current evidence and gaps present which provide a justification leading up to the current study.

- **High-risk pregnancies**

Maternal deaths are caused by complications during pregnancy or after childbirth most of which are, if detected in time, preventable or treatable. Other complications may exist before pregnancy but are worsened during pregnancy, especially if not managed as part of the woman's care. Determining the specific medical causes of maternal deaths is a challenge given that some of the births take place at home and go undocumented. A pregnancy is considered at-risk if there are medical conditions that may affect maternal or fetal health or life of the mother, fetus or both. High-risk pregnancies account for nearly 75% of maternal deaths due to risk factors such as pre-existing health conditions (hypertension, diabetes), overweight and obesity, multiple births, young maternal death, pre-eclampsia and infectious diseases (6).

- **Management of High-risk pregnancies**

It is particularly important that skilled health professionals attend all births, as timely detection and management of at-risk pregnancies can make the difference between life and death for both the mother and the baby. Other factors that prevent women from receiving or seeking care during pregnancy and childbirth include poverty, distance, lack of information, inadequate services and cultural practices. To improve maternal health, barriers that limit access to quality maternal health services must be identified and addressed at all levels of the health system.

- **Barriers to proper referrals**

Geographical and financial accessibility are well-documented reasons for abstaining or delaying obstetric referral at the community level. The decision for or against referrals often depends on the balance between effort, resources needed and subsequent treatment and the perceived benefit of the treatment in hospital (7). Other reasons that hospital care is avoided include poor interpersonal skills and attitudes and incompetence of health workers, stigmatization and discrimination and

especially to rural women who are afraid of unfamiliar environment and deeply rooted in tradition and mostly use traditional birth attendants (8).

Efforts to strengthen the health referral system through utilization of community health volunteers (CHVs) have been made through various interventions in majority of the low-income regions. In Kenya, the community health strategy remains a key component to the attainment of Universal Health Coverage that will lead to reduction of maternal mortality in an effort to attaining SDG 3. Currently the community health strategy stipulates that high-risk pregnancies identified at the community level be referred to the nearest immediate primary health care facility (9). Community health volunteers work closely with the primary health care facilities however most referrals are made based on severity. The CHVs often miss out on detecting early signs of high-risk pregnancies, a gap that we hope to address by equipping the CHVs with the necessary knowledge to detect high-risk pregnancies at an early stage and make referrals in good time to allow for timely interventions.

- **Use of information, education, and communication (IEC) materials and job aids**

Job aids are cost effective instruments used on the job, in several fields including health, to improve human performance by enhancing the knowledge and/or skills of performers (10). There are three main types of job aids in healthcare namely: reminders including process flowcharts; picture aids; and pocket manuals most of which have been digitized recently (11). They enhance performance by reducing errors caused by poor recall and faulty decision making, promoting compliance with standards, and reducing costs of training and retraining (12). Studies have also shown improvement in client performance after use of job aids. Although job aids have been introduced to community health workers in a large number of international health projects, the literature available on the actual use by such workers is very limited. We envision that use of visual teaching/job aids will enable CHVs to easily share their health messages and for the women to remember the content by the use of graphics.

The high-risk pregnancy referral card is a basic teaching/job aid concept designed to identify at-risk pregnancies at the earliest possible and facilitate timely referrals from the community level to the health facility. The cards are also designed to raise awareness among the community as regards healthy and unhealthy habits in pregnancy.

The High-Risk Pregnancy referral cards comprise of a portable and durable set of cards which double up as a teaching aid, showing a range of high-risk symptoms during pregnancy. The pictures represented on each card have been tested in health centers in Africa, and local-language versions of the cards specifically designed for communities in the selected study sites.

The cards (Figure 2 below) are intended to aid in to identifying high-risk pregnancies for earlier referral to healthcare facilities and to educate & raise awareness on practices for healthy pregnancies. The cards were initially designed to help both lay and professional healthcare workers in providing better services to pregnant mothers with complications in fragile environments which often have no or limited access to electricity and connectivity. However, we hypothesize that it will be of great benefit even in underserved communities in more stable environments where maternal and neonatal mortality is still high.

Figure 2: *High Risk Pregnancy (HRP) referral cards*

Chapter 3 RESEARCH OBJECTIVES:

This chapter provides a detailed overview of the research objectives and the conceptual framework. The main research questions and study hypotheses are also expounded

Primary objective:

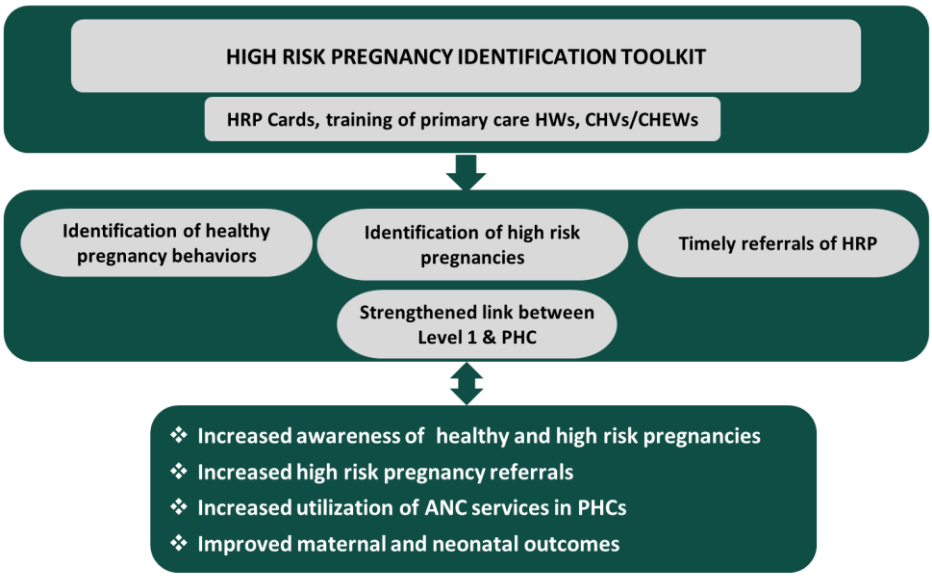
The primary objective of the study is to assess the effectiveness of the use of HRP cards in identifying and referring at-risk pregnancies at community and primary health care level.

Secondary objective(s):

The secondary objectives of this study are:

- To determine the number of at-risk pregnancies correctly identified using the high-risk pregnancy referral cards at community level.
- To determine the effect of the use of high-risk pregnancy referral cards on awareness of healthy pregnancy among community health volunteers and women of reproductive age.
- To determine the association between the use of high-risk pregnancy referral cards and utilization of ante natal care services at primary health care level

Conceptual Framework



Research Questions and Hypotheses

Research Questions:

The primary research question was : **are HRP cards effective in identification and referral of high risk pregnancies from the community to primary health care facilities?**

This question was further broken down into five sub-questions, as follows:

1. what is the effect of the high risk pregnancy cards on awareness of healthy and at risk pregnancies among CHVs and women of reproductive age?
2. What proportion of at risk at risk pregnancies can be identified and referred using the HRP cards information?
3. Is there an association between use of HRP cards and utilization of ANC services at primary health care facilities?

Study Hypotheses:

The sub-questions resulted in five study hypotheses outlined below:

- The HRP cards will increase awareness of healthy and at risk pregnancies among CHVs and women of reproductive age.
- Knowledge from the HRP cards will enable CHVs to identify at risk pregnancies
- Knowledge from the HRP cards will enable CHVs to refer at risk pregnancies to primary health care facilities.
- There is an association between use of HRP cards and utilization of ANC services at primary health care facilities
- Use of the HRP cards will increase the referrals of at risk pregnancies to PHC facilities.

Chapter 4 METHODS:

This chapter describes the design of the research study and the methods that were used in implementing the research. We provide details of the study setting, study participants, inclusion and exclusion criteria and a sample size justification.

Study Design

This study is not considered a research impact evaluation but an initial assessment of the effect of the HRP cards. The study adopted a pre and post-test clustered quasi-experimental design with a mixed methods approach utilizing both quantitative and qualitative data collection methods.

Study site

The study is part of a broader project implementing the use HRP cards in the community. The research was conducted in Bomet and Siaya counties in Kenya. This report details finding from the study in Bomet County.

Bomet county was selected due to the interplay of socio-cultural and environmental factors in the communities, a high presence of pastoral communities, birth assistants, few health facilities, high illiteracy and poverty levels. At the time, the county also registered poor maternal and child health indicators. Two sub counties were selected from the county, Sotik and Bomet Central. Selection of the sub counties was conducted by the County Health Management Team (CHMT) in collaboration with the research team and was based on the sub-county maternal mortality indicators, presence of functional community units, absence of similar parallel donor activities in the research sub-counties and the physical distance between the sub counties.

Study population

The study participants were broadly categorized into three:

1. Community health assistants and community health volunteers (CHAs & CHVs) from the community unit attached to the health facilities in the Bomet Central county.
2. Primary health care workers working at the selected facilities in Bomet Central sub county.
3. Women of reproductive age in the community units in Bomet Central and Sotik sub counties

The characteristics of the study participants, inclusion and exclusion criteria are described below.

- **Community Health Volunteers**

  Inclusion Criteria

  1) Living and offering service in the study catchment areas
  2) Aged between 18- 65 years.
  3) Provision of written informed consent.
  4) Willingness to use HRP cards and submit usage data

  Exclusion criteria

  1) Inconsistency in offering services to the community
  2) Refusal to provide consent to participate

- **Primary health care providers**

  Inclusion Criteria

  1) Working in the selected health facilities
  2) Provision of written informed consent.
  3) Willing to use the HRP cards.

  Exclusion criteria

  1) Refusal to give informed consent.
  2) Unavailability during the study period

1. **Women of reproductive age**

   Inclusion Criteria

   1) Women aged 18-49 years
   2) Visited by the community health volunteers
   3) Provision of written consent

   Exclusion criteria

   1) Inability to communicate in English or Swahili or local language.
   2) Residing outside the health facility catchment area.
   3) Refusal to consent to participate.

Sample Size and Justification

The study was based on a multistage sampling design. The first stage was purposive sampling of the study counties. Counties were selected based on their maternal mortality rates and the national community health strategy implementation status.

Selected counties were in the process of implementing the national community health strategy. The second stage of sampling was the selection of sub-counties in the research counties. This was done based on guidelines from the county health management teams.

The third stage of sampling was selection of clusters represented by CHVs in the study. Estimates for the calculation of the final sample size for the surveys were derived from a previous quasi experimental study aimed at assessing effectiveness of CHVs in promotion of health services in a rural community in Kenya. The intra-cluster correlation coefficient (ICC) was obtained from the 2005 WHO global survey on maternal and perinatal health. Using the previous ANC utilization estimates, an estimated cluster size of 100 in both the intervention and comparison arms, an ICC of 0.161 and a 95% confidence level to obtain power of 0.90, a minimum sample size of 900 participants in each arm was required. Considering the attrition rate of 40% and a non-response rate of 25%, the sample size was optimized to 1500 participants per study arm.

Ethical Considerations

Ethical approval was provided by the Internal Committee Biomedical Experiments (ICBE) of Philips Company (ICBE-2-32190, August 23, 2019) the AMREF Ethics and Scientific Review Committee (ESRC) in Kenya (ESRC P701/2019, September 27, 2019) and the National Commission for Science, Technology & Innovation (License No: NACOSTI/P/19/1996, October 23,2019). The study was conducted following the ethical considerations of the protocol.

Informed consent was asked of all respondents and participants of the study who were informed that they could refuse to answer questions and could stop the participation at any time without any repercussions. Data collection was done in safe and comfortable environments. Only the research team had access to the data and identifiers were removed from the transcripts. The research team included male and female research assistants who spoke the language of the study area where necessary. Prior to data collection, the research team was trained on ethical issues to ensure that guidance on ethical conduct was clearly understood and implemented.

Research study procedures

This chapter provides a detailed account of procedures and processes followed during the running of the research study. The study comprised of three main phases, a baseline survey phase, an implementation phase and an end line survey phase. Details of activities conducted in each of the phases are elaborated below.

Project preparations

Prior to commencement of the project, National engagement meetings were held with the division of community health and division of reproductive health at the Ministry of health to get a buy in. The project objectives were presented and approval to proceed obtained.

Figure 3: *Bomet CHMT engagement meeting and*

County level engagement meetings were held with the county health management teams. Identification of specific sub counties and community units to involve in the study were decided by the CHMT.

Baseline data collection

Baseline data collection was conducted before the implementation of the interventions. After selection of the community units, community health assistants and community health volunteers from both the intervention and comparison sub counties, a listing of all households visited by the CHVs was developed. The women of reproductive age in these households were visited by field staff and asked for consent to participate in the survey. A questionnaire to collect demographic details, details of their knowledge on healthy and at-risk pregnancies, contact with CHVs among other relevant questions was administered.

We also conducted a baseline data abstraction exercise from the facilities for the year prior to the study. The data was abstracted from records from the public health facilities to which the area CHVs are linked. We abstracted the data from the Ministry of Health tools; MOH 100, MOH 514, MOH 513. The main indicators collected included data on number of pregnant women referred for ANC and ANC defaulters referred and data on referrals of high-risk pregnancies from MOH 100 referral forms.

Implementation phase

Implementation phase began after completion of baseline surveys. The CHAs, CHVs and the primary health care workers from Bomet the intervention sub-county, were trained on the use the high-risk pregnancy cards. All participants were given a refresher training on in addition to the usual iCCM training, identifying healthy pregnancies and high-risk pregnancies using the cards as a guide as well as a module on Hybrid Maternal Infant and Young Child Nutrition (MIYCN). Reorientation sessions for the traditional birth attendants (TBAs) to birth companions within their area of jurisdiction were conducted with about 20 TBAs.

Upon successful completion of the trainings, CHAs, CHVs and TBAs were issued each with a set of the HRP cards to carry alongside their usual tools in the field during their household visits as stipulated in the community strategy. CHVs were instructed to note down any referrals of at-risk pregnancies that occur as a result of the knowledge gained from the HRP cards on their normal CHV referral forms (MOH 100) which are used to refer women to the health facility.

The CHAs, CHVs and the primary health care workers from sub counties selected for the comparison arm received only the standard iCCM training that is provided to lay and professional health workers according to the community health strategy. After the refresher training, CHAs and CHVs in the comparison/control arm sub counties continued with their usual. Study implementation lasted for a period of 13 months with periodic interruptions in study activities due to COVID-19 mitigation measures.

End line data collection

At end line, a quantitative survey similar to that conducted at baseline was carried out. Qualitative interviews were also held. In depth interviews were conducted with health workers and county

health management teams. Focus group discussions were held with CHVs, TBAs, mothers from mother to mother support groups and men from the male sensitization fora. In each FGD, study participants were seated in a semi-circle with the PI and notetaker. Before the discussion, each participant was given an identification number to be used throughout the discussion. All FGDs were recorded using digital voice recorders. Before recording, participants written consent was requested. The FGDs were conducted in either Swahili, English, Luo or Kipsigis language as per the participant's preferences. FGS were moderated by the PI a notetaker and the Kenya Red Cross Project Officer . each FGD lasted between 45 and 60 minutes. The study PI conducted all in depth interviews following similar procedure by first requesting written consent then recording the interview on a digital recorder.

Data analyses

All quantitative data was analyzed and summarized in tables and/or graphs to support the interpretation of the overall results. To test for baseline differences between intervention and control sites, chi-square tests for categorical variables was used. Multilevel ordinal logistic regression models were estimated on the likelihood of increased knowledge associated with use of the HRP cards as a function of sociodemographic and ANC utilization variables. While were primarily interested in the effects of the interventions, sociodemographic characteristics and prenatal care utilization can confound the relationship between the interventions and awareness of healthy habits and dangers signs in pregnancy. Therefore, we controlled for their effects and the effect of clustering by community unit in the analysis. In all analyses, $P<0.05$ was taken to indicate statistical significance. Variables which exhibited a high degree of multicollinearity were examine and one excluded from the analysis.

Digitally recorded FGDs were transcribed verbatim and later translated to English to facilitate analysis. Data were analyzed manually using qualitative thematic analysis approach. The analysis started by getting familiar with the data through reading the transcriptions several times to obtain a sense of the whole discussion. The PI and other researchers familiar with the context of the topic manually did independent coding. Thereafter, a preliminary coding structure was agreed upon and a codebook was created. The additional codes which emerged during coding process were added concurrently. Saturation was achieved after reviewing and coding emerging themes from all interviews when there was no more new information obtained.

Chapter 5 RESULTS

This chapter presents the results of the research study, we describe how the scientific questions were tested and detail the findings. The chapter is divided into three sections. The first section expounds on the results from the operational aspects of the implementation. The second section details the findings from the surveys conducted among women of reproductive age. The third section presents results from the analysis of ANC utilization data abstracted from health facility registers.

Section 1: HRP cards implementation operational results

Summary

This section describes the operational results obtained from the qualitative data (in depth interviews and focus group discussions with CHVs and health workers). We detail how the HRP cards intervention was fit within the existing community health strategy and health system, the enablers of the use and uptake of the interventions by the different study participants. An overview of the highlights below

Key Highlights

- A total of 200 CHVs were trained and equipped with HRP cards for use in raising awareness, identifying and referring at risk pregnancies to the health system.
- Use of the HRP cards was incorporated into the CHV roles as directed in the community health strategy. The cards enhanced CHVs roles by adding the task of educating the community members on healthy habits in pregnancy, risks and danger signs in pregnancy, identifying at risk mothers and referring them to health facilities for management.
- Use of the HRP cards was further optimized by incorporating 35 TBAs who were reoriented from the traditional role of conducting home deliveries to the role of raising awareness using the HRP cards, identifying and referring at risk pregnancies to the health facilities for delivery.
- All participants were impressed by the HRP cards content, color, size, material and weight. The use of pictorial illustrations and local language in the cards was a key highlight of the design.
- A total of 276 mothers were enrolled in mother to mother support groups formed in the intervention sub county. The mother to mother support groups focused using the HRP cards with the expectant women in the community.

- Male sensitization meetings were organized by the CHAs and the CHVs where men of mixed ages were invited to discuss reproductive health matters particularly around high risk pregnancies.

CHV Roles in maternal health

CHVs and TBAs were the main groups targeted to use the HRP cards in the community. As such we endeavoured to evaluate the roles of these individuals in the community before and after the introduction of HRP cards. We held six FGDs, four with CHVs and two with TBAs.

Prior the introduction of the HRP cards, CHVs perceived themselves as a link between the community and the formal health system/ health facilities. One of the CHVs gave the remarks below about CHV roles during an interview:

> *"…if there is something from the facility that should be taken to the community the CHV takes it there and if there is something in the community that should be communicated to the head of the facility, he takes it too"* ***CHV Kapkoros CU, Bomet***

Additionally, CHVs were in charge of health promotion, tracing defaulters in ANC, TB treatment and immunization, promotion of community sanitation and hygiene, household visits to educate the community on prevention of communicable diseases, creating awareness of disease outbreaks, updating household registers, referring ill community members to health facilities, conducting iCCM and communicating ministry of health directives on community health to the community. This was reiterated in interviews with the health workers and members of the CHMT. Following the introduction of HRP cards, CHVs roles were expanded with the addition of the task of educating the community on healthy habits, risks and danger signs in pregnancy, identifying at risk mothers and referring them to health facilities for management.

TBA roles in maternal health

The role of TBAs at baseline was majorly to conduct home deliveries. To optimize the use of the HRP cards, we sought to reach all traditional birth attendants in the project sites and reorient them from their traditional role of home deliveries to the role of to raising awareness using the HRP cards and referring (and sometimes accompanying) pregnant women to the health facilities for delivery.

A total of 35 TBAs from Bomet central were reoriented and re-branded "Birth Companions" (BCs). The new BCs in the project embraced their new roles and one of them expressed herself as below:

> *"we feel that we gained knowledge because previously we were TBAs and we could conduct deliveries at home without protective equipment like gloves, we used to handle the expectant mothers with bare hands. After sensitization we understood that every mother should deliver at the hospital and when the mothers call us, we usually accompany them to the facility instead …"* ***TBA Bomet central CU***

The health workers recognized their efforts and applauded them. A community health assistant reported in one of the interviews:

> *"…about the TBAs again, there was a day we were having a community outreach. One of the TBAs stood and I felt so good because she stood in a 'baraza' … we were very many… She stood, she told the community, "It is me who used to deliver you and from today it is me who will ask you why are you delivering at home? And she told the mothers, "I have said from today, if I find you delivering at home… mmh? If I find you going to so and so, delivering at home, then it is you and me who will talk…""* ***CHA Singorwet CU, Bomet.***

HRP cards Training

A total of 200 CHVs and 35 traditional birth attendants from twenty community units in Bomet Central were trained on the use of HRP cards. A one day raining was conducted in each of the community units by the reproductive health coordinators working together with the community health focal persons who had been sensitized as the trainer of trainers. CHVs reported that the training was comprehensive. Majority felt that the training should have been conducted over two days and include a refresher as explained by some of the CHVs in the focus group discussions

> *"It was not enough and if it would have been for about two days people would have understood completely."* ***CHV Kamogoso Bomet***

***Figure 4**:CHV training session on HRP cards in Bomet Central*

Ad hock refresher trainings were conducted by the CHAs for specific community units in the course of the implementation period.

HRP card content and quality

We sought to understand the initial reactions of both the CHVs and health workers towards the HRP cards and observed a mixed sentiment. Majority of the health workers were happy with how well summarized the cards were. The County Chief medical officer in Bomet had this to say:

> *"…This provides a very tailored kind of messaging that the CHVs can actually easily pass and communicate in the community. it was so good when I saw it that, you mean the whole information that we've been having can be simplified given out so easily in a method that is easily understood by the clients with the pictures…"* ***County CMO Bomet***

This was resounded by most of the health workers and county health team members. One of the CHAs initially thought the HRP cards were meant for medical professionals due to the detailed presentation of the risks in pregnancy but later reported that the cards were beneficial to the CHVs:

> *"I thought the book initially was for medics. Was specifically for medics... But I am telling you through this book… these CHVs have really been empowered"* ***CHA Kapkoros CU Bomet.***

Likewise, CHVs from Bomet Central sub county expressed excitement when they first received the cards. Majority were impressed by the pictures and color of the cards. The quality of the

cards was commended by all respondents. The material of the card was applauded for being tear proof and waterproof. They explained that the cards did not get dirty easily and if they got dirt, they were easy to clean.

> *"…It is durable. In fact when I saw it, I wanted to know 'what is this material?' and I was happy. It cannot tear off. And remember even for me I've been having a copy of the card; I have been walking with it in my bag all the time and unlike the other books it has never gotten torn. It has never lost some pages. It has remained as new as it was in the beginning. So I think this is the best material ever."* ***County Reproductive Health Coordinator Bomet***

The color design was well understood with most associating the red color with danger and green with safety as mentioned by one of the CHVs in an FGD:

> *"And the way it is colored even if there is a big gathering and you show them like this (lifting up HRP cards) they will all see. when you are teaching when you show this, the green parts they know that it is healthy. So when you go to the red part– they see it is danger."* ***CHV Kapkoros CU Bomet***

In another interview the respondent remarked as below:

> *"And then whoever designed this book I think they thought so well. You know when you see red it is danger. … then the green, the green is showing that's a good indicator. I think these two the way they are combined it is very nice. I like it. Whoever thought of these colors did so well."* ***County nutritionist Bomet***

CHVs seemed pleased with the size of the card explaining that it was portable and not bulky with some describing it as *"pocket friendly"*. The use of pictorial illustrations resonated as a key highlight in the design of the cards in all CHV focus group discussions.

***Figure 5**: CHVs and TBAs in Comet using the HRP cards*

We also examined the participant's views on the content of the HRP cards. At the national and county management level, the teams approved the content and messaging in the HRP cards and granted approval to use the card in the communities. During informal conversations, CHMT members pointed out that in addition to the risks and danger signs present in the mother to and child booklet which has seven risks, the HRP cards offered more information which was previously only privy to the health workers. They termed the card a very educative tool. The sentiments were echoed by both the CHVs and even the community as expressed by one of the men during a focus group discussion below:

> *"This book covered nearly everything because in the high risk part when you are an expectant mother with risk, we have to take you to the facility. You cannot assume anything. So this book teach us very many things…. This book covers everything. It is quite comprehensive…"* ***Male sensitization forum FGD***

The use of pictures was mentioned as a big advantage for communicating the message in the cards.

> *"…we are talking to people in the community. Some are not literate and when they see the pictures, they really internalize, they see it, like for the HRP guide, that is a very smart tool that we used, which really the mothers are able to see in the picture, the person maybe carrying the heavy weight and they really remember. It's not like when they've not seen the picture…****County RH Coordinator, Bomet****".*

Mother to Mother support groups

To ensure maximum impact of the HRP cards in reducing complications in pregnancy and averting maternal deaths, with the guidance of the community health assistants and Kenya Red Cross project officers, CHVs went a step further and targeted the actual pregnant women within their communities. This was done by seeking out expectant women and mothers who had just delivered within the community units in small groups and providing them with a platform to discuss health problems, pass on important health information as well as sensitize them on healthy habits, risks and danger signs in pregnancy using the HRP cards. These forums of women were referred to as mother to mother support groups (MTM). A total of 276 women from four community units in Bomet central were enrolled in mother to mother support groups. Mothers exited the support group when they stopped lactating. In addition to lessons on the HRP cards, mothers were taught how to develop a birth plan, register to "Linda Mama", a pregnancy cover, and to the national insurance scheme NHIF.

Figure 6: *Pregnant women attending a mother to mother support session*

Through these platforms, the mothers were also able to start "merry go round" saving schemes and partner up to start kitchen gardens within their villages. One of the community health assistants who was expectant during the study period benefited from the mother to mother support groups and had this to say:

> *"I was pregnant in March, when we were implementing HRP project… So I was in the support group. Myself, I am a CHA but am in the support group. Now I am an ambassador after giving birth. There were the good things that I saw during the support group and it changed me... So it has really changed women."* ***CHA Bomet Central***

The effect of the mother to mother support groups was felt by mothers, CHVs and even health workers. One of the nurses had this to say about the MTM support groups:

> *"I tell you, mothers whom we had placed in support group, they are quite different from the mothers who are not involved in the support group. If you compare the two, the ones who were in support group and the ones who are not support group you will realize that this one is more knowledgeable than the one who is not in support group."* ***Nurse, Bomet***

Male involvement in pregnancy

Majority of the communities in Bomet Central ascribe to the patriarchal social system where the husband or father in a home has absolute authority over the family group and by extension, one or more men exert absolute authority over the community as a whole. For this reason, it was deemed necessary to involve the men in the HRP project since some of the decisions affecting the women's pregnancy were decided by the men. The County Acting Director of Public Health shared similar opinion during an interview:

"...you see our men are the financial keepers everything is in their pocket. You go to Kapkoros where we have the tea plantation, when the tea payments come it is the man who takes everything. It is registered under the man. So, if they don't understand what you are talking about in HRP, then they will not finance it. So it is very good for them to understand for the purposes of financing and supporting the project." ***Bomet County Ac. Director of Public Health***

To ensure the men in the community were on board, male sensitization fora were held. Male sensitization fora were meetings that were organized by the community CHAs and the CHVs where men of mixed ages were invited to discuss health matters particularly on the HRP cards. Male forums were held once a month in each community unit with a meeting having as many as sixty men in attendance.

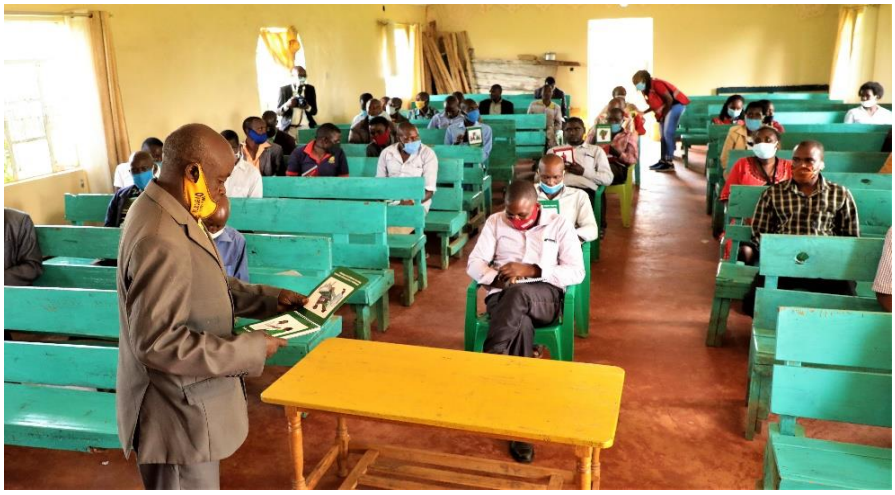


Figure 7: *CHV facilitating a male sensitization forum on high risk pregnancies*

The sessions were very informative to the men and majority reported that they had gained much knowledge and understood the sensitivity of pregnancy. Health workers reported an increase in the number of men who accompanied their wives to the ANC clinic. One of the Chas reported in an interview:

"You know you could go for a session with the men, and they could ask you questions that they were never open to asking, they could not open up to someone else about pregnancy. But when we were there with the sub-county team, together with the project coordinators, they could ask questions that you would feel that this project is really working for them" ***CHA Singorwet CU, Bomet****.*

Section 2: HRP CARDS KNOWLEDGE SURVEY

Summary

This section addresses the objective which seeks to determine whether the use of the HRP cards increases the awareness and knowledge about healthy habits and risks /danger signs in pregnancy among women of reproductive age. To determine the effect of the use of high-risk pregnancy referral cards on awareness of healthy habits and risks in pregnancy among women of reproductive age in the community, we conducted surveys before and after the intervention in both intervention and control sub counties and compared the results. The section is divided into three parts: a description of survey participant sociodemographic characteristic, the results of analysis of knowledge of healthy habits in pregnancy and results of analysis of knowledge on risks and danger signs in pregnancy.

Study timelines

The baseline survey was conducted in October 2019 followed by an implementation period of thirteen months from November to December 2020 when CHVs moved in the community raising awareness using the cards. End line surveys were conducted in December 2020. The survey targeted CHVs, health workers and women of reproductive age in the two sub counties.

Part 1: Survey Participant Demographic characteristics

Rationale: To determine the actual association of the HRP cards and women's knowledge in intervention sites, we sought to account for the effect of variables most likely to contribute towards differences in knowledge level among participants in both intervention and control sites. These factors include socio-demographic characteristics such as age, education level, marital status, number of children, income and employment status to understand the population dynamics and control for these variables in the analysis. In addition, we collected data on factors which affect access to healthcare and knowledge on community health services. These factors are likely confounders in our study. In this section we provide a detailed overview of the participant characteristics which are later included in the downstream analysis.

Key highlights:

- A total of 6,863 women of reproductive age consented to the survey and were interviewed: about 3,104 women at baseline and 3,759 women at end line.
- We detected differences in the selected survey participants' age, education level, marital status and employment status at baseline compared to end line. These variables were factored during in the analysis

Survey participants were selected from nine community units drawn from two sub-counties, Sotik and Bomet Central as the control and intervention sub-counties respectively. A total of 6,863 women of reproductive age consented to the survey and were interviewed: about 3,104 women at baseline and 3,759 women at end line.

Age: Participants' overall median age was 30 years. Majority of the participants in both control and intervention sites at baseline and end line were aged between 25 and 35 years. We detected differences in the age of participants at end line compared to baseline with more women below 25 years participating in the survey at end line in the control site. The reverse was observed in the intervention site with less women below 25 years and more women aged 25-35 years participating at end line. (see table 1 below). Less than 10% of the participants were above 45 years.

Education : Overall, almost all the participants at baseline and end line (99%) had received some form of schooling. We detected a difference in level of education at end line. Overall, about 8% more women had attended secondary school at end line across all study sites. Of the women who had no formal schooling, 30% were below 35 years. Figure 8 shows the comparison of level of education at baseline and end line in intervention and control sub counties.

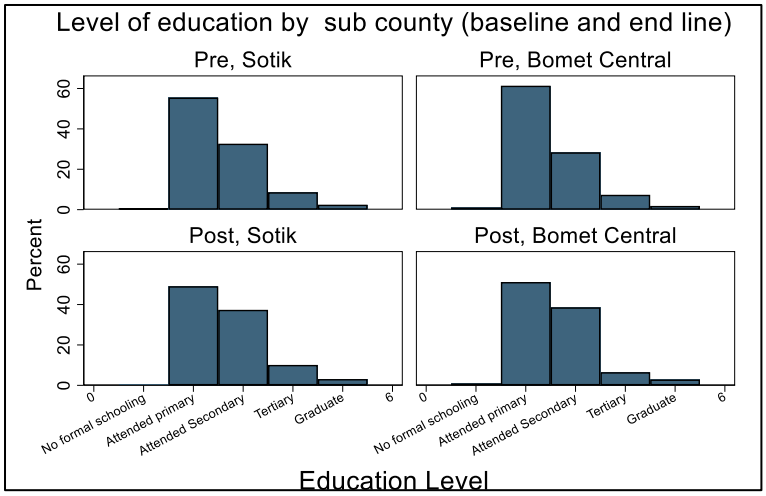


Figure 8: *Survey participants' education level*

Marital status and family composition: More than two thirds of the women were married and living with their husbands across all study sites with about 80% living in nuclear families. There were fewer women living alone in Bomet central, the intervention sub county compared to Sotik. A very small proportion of the participants, 1% and 2% were either divorced or widowed respectively.

Single women made up only 22% of all participants with majority living alone. There was a slight difference in the proportion of participants without children in the control site at end line. No difference in family composition was detected in the intervention site. See table 1 below for more details.

Four out of every five participants had children, ranging from 1 child to 14 children. Half of the study participants had between one and three children with only 1% of the participants having more than ten children. The proportion of participants without children was higher in the control site at end line compared to baseline. There was no difference in the number of children per participant between study sites on the whole.

***Table 1**:Survey participants' demographic characteristics*

Characteristic	Intervention (Bomet Central)			Control (Sotik)		
	Pre	**Post**	**P value***	**Pre**	**Post**	**P value***
Age						
<25 years	509 (33)	564 (28)		361 (23)	509 (29)	
25-35 years	610 (39)	881 (44)		668 (43)	714 (41)	
35 - 44 years	310 (20)	464 (23)		385 (25)	389 (22)	
>45 years	132 (8)	109 (5)	<0.001	129 (8)	129 (7)	0.002
Highest Education						
No formal schooling	16 (1)	18 (1)		12 (1)	6 (0)	
Attended Primary	958 (61)	1032 (51)		856 (55)	854 (49)	
Attended Secondary	443 (28)	779 (39)		504 (33)	651 (37)	
Tertiary	115 (7)	131 (6)		133 (9)	176 (10)	
Graduate	29 (2)	58 (3)	<0.001	38 (2)	54 (3)	0.001
Family composition						
Alone	105 (7)	75 (4)		114 (7)	103 (6)	
Nuclear	1240 (79)	1718 (85)		1221 (79)	1383 (79)	
Extended	216 (14)	225 (11)	<0.001	208 (13)	255 (15)	0.175
Occupation						
Student	42 (3)	37 (2)		11 (1)	25 (1)	
Employed	70 (4)	128 (6)		91 (5)	173 (10)	
Casual	2 (0)	4 (0)		46 (3)	12 (1)	
Self employed	821 (53)	971 (48)		534 (35)	778 (45)	
Unemployed	626 (40)	878 (44)	0.006	861 (56)	753 (43)	<0.001
Marital status						
Single	400 (26)	439 (22)		316 (20)	393 (23)	
Married-living with husband	1074 (69)	1437 (71)		1098 (71)	1210 (70)	
Married not living with husband	38 (2)	89 (4)		90 (6)	81 (5)	
Divorced	21 (1)	13 (1)		9 (1)	27 (2)	
Widowed	28 (2)	40 (2)	<0.001	30 (2)	30 (2)	0.023

*Chi square test was conducted

Employment and income Overall, about 70% of all participants reported a family monthly income of less than ten thousand shillings. There was a significant difference in participant monthly earnings at baseline compared to end line in both intervention and control sites. A higher portion of women reported not knowing their monthly family income at baseline.

Table 2: *Participant demographic characteristics (cont…)*

Characteristic	Intervention (Bomet Central)			Control (Sotik)		
	Pre	**Post**	**P value***	**Pre**	**Post**	**P value***
Number of children						
No children	160 (10)	246 (12)		135 (9)	225 (13)	
1-3 children	777 (50)	997 (49)		784 (51)	884 (51)	
4-9 children	607 (39)	753 (37)		612 (40)	619 (36)	
>10 children	17 (1)	22 (1)	0.318	12 (1)	13 (1)	0.001
Family income						
0–10,000	1040 (73)	1422 (70)		1096 (78)	1191 (68)	
10,001–20,000	334 (23)	463 (23)		271 (19)	402 (23)	
20,001–30,000	49 (3)	84 (4)		40 (3)	94 (5)	
30,001–50,000	7 (0)	18(1)		6 (0)	23 (1)	
>50,000	1 (0)	6 (0)		0 (0)	5 (0)	
Don't know	130 (8)	25 (1)	<0.001	130 (8)	26 (1)	<0.001
Disability (yes))						
Hearing disability	1 (0)	3 (0)		0 (0)	2 (0)	
Visual disability	6 (0)	2 (0)		3 (0)	6 (0)	
Physical disability	12 (1)	14 (1)		4 (0)	4 (0)	
Mental disability	1 (0)	3 (0)		0 (0)	1 (0)	
Speech disability	0(0)	0 (0)		0 (0)	1 (0)	
No disability	1541 (99)	1995(99)		1536 (100)	1726 (99)	

*Chi square test was conducted

Access to health care indicators

Nearest health facility: A total of 5,771 (84%) participants from Bomet, identified government dispensaries as the nearest health facility. A further 10% could access a government health centre as the nearest point of care. Level five government facility and private hospitals were only easily accessible to 1% of the participants majority from the control site. A significantly higher proportion of women from the intervention site reported living near either a level 1 or two health facility.

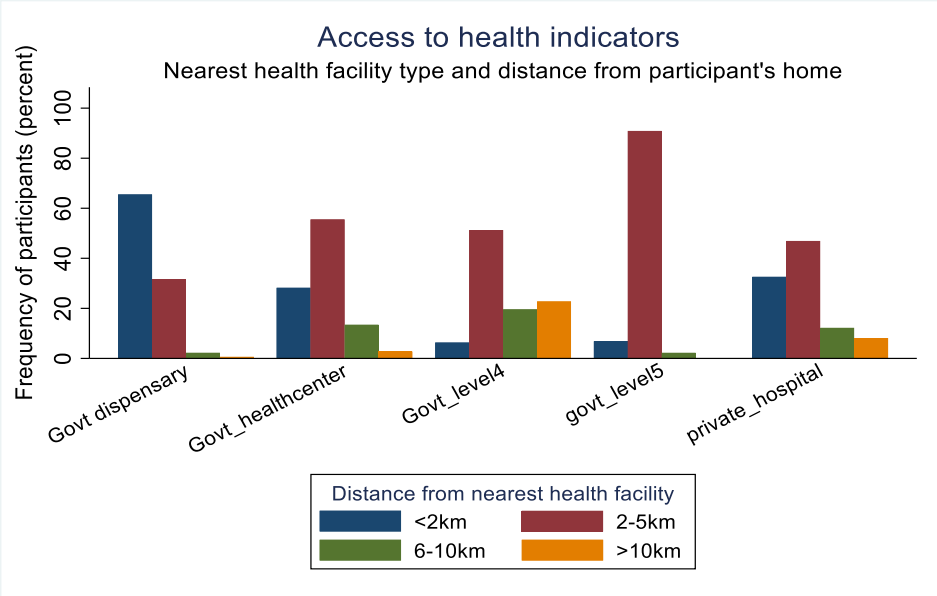


Figure 9: *Graph showing distance from participant's home to nearest health facility*

Distance to health facility: In addition to the type of facility, participants also reported the distances covered to the nearest health facility. Out of the 5,771 participants who resided near a government dispensary, 3,781 (65%) reported living less than 2 kilometers from the health facility, 1822 (32%) lived 2-5 kilometers away and only 1% had to cover more than 10 kilometers to get to the dispensary. Women in Sotik, the control site had to cover more distances to access health facilities in comparison to those in the intervention site. Details of the distance and type of nearest health facility and used are shown in figure 9 above.

About nine in every ten women who lived 2 kilometers from the nearest health facility walked to the facility with the remaining 10% using motorbikes. Motorbikes were the most popular means of transport for those who lived more than 2 kilometers from the nearest health facility. Figure 10 below shows the preferred means of transport by distance from the health facility.

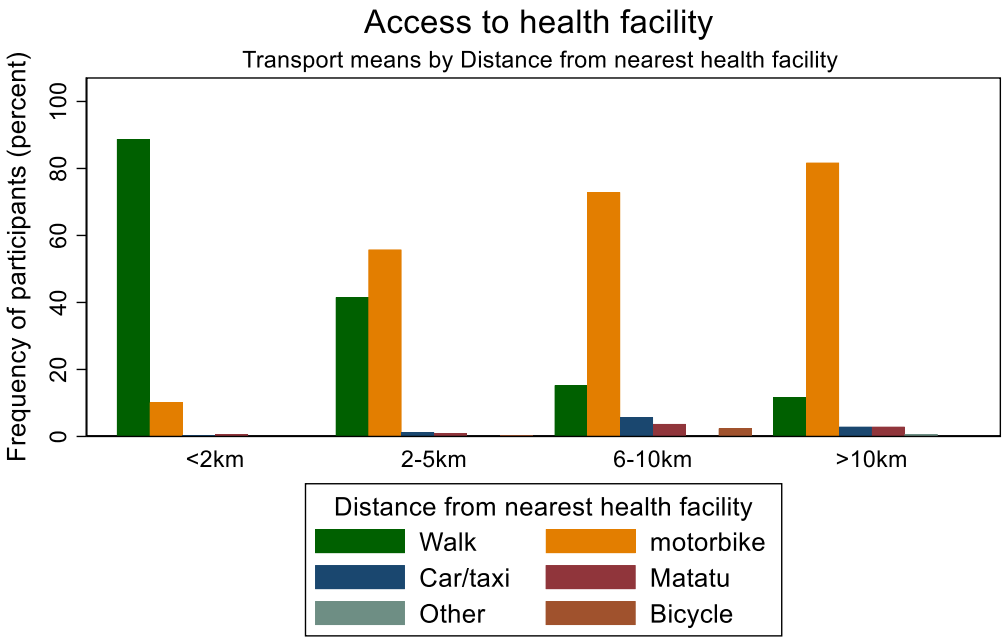


***Figure 10**: Graph showing transport means used for each distance category*

***Table 3:** Comparison of participants access to health facility indicators between intervention and control sites*

Characteristic	Intervention (Bomet Central)			Control (Sotik)		
	Pre	Post	P value*	Pre	Post	P value*
Nearest health facility						
Gov't Dispensary	1532 (98)	1683 (83)		1292 (84)	1265 (73)	
Gov't health center	25 (1)	315 (16)		100 (6)	212 (12)	
Gov't level 4	2 (0)	3 (0)		116 (8)	226 (13)	
Gov't level 5	1 (0)	0 (0)		29 (2)	14 (1)	
Private hospital	1 (0)	18 (1)	<0.001	6 (0)	24 (1)	<0.001
Registered for NHIF						
No	-	925 (46)		-	698 (40)	
Yes	-	1093 (54)		-	1043 (60)	0.869
Distance to nearest HF						
<2km	1242 (80)	1080 (54)		798 (52)	886 (51)	
2-5km	302 (19)	810 (40)		649 (42)	664 (38)	
6-10km	7 (0)	108 (5)		76 (5)	104 (6)	
>10km	10 (1)	10 (1)	<0.001	20 (1)	87 (5)	<0.001

*Chi square test was conducted

Community awareness of CHV work and maternal health services.

Rationale: Since the information in the HRP cards reached the community though community health volunteers, knowledge of one's area community health volunteer and interaction with them is a key factor in determining whether the women will see or interact with the HRP card. We collected data on this indicator and included it in the downstream analysis. This data helps to explain why some of the women did not see or interact with the HRP cards.

Key highlights:

- Knowledge of the existence and work of community health volunteers increased over the study period in intervention site from 54% to 94% participants sensitized on CHV work in the community.
- The main reasons reported for attending ANC during their current pregnancy was for checkup (63%), for a follow up visit (49%) or due to illness(16%). Similar reasons were reported at baseline and end line.
- Despite living near health facilities 504 (15%) women who had previously been pregnant delivered at home. However, there was a 10% decrease in proportion of women who delivered at home end line.
- After adjusting for study site differences, the likelihood of having received advice on complications in pregnancy in the intervention site was 140% higher at end line compared to baseline. (OR 2.41, 95%CI-2.18-2.65, P=0.001).

Knowledge of area CHVs: We set out to establish the participants' level of knowledge concerning CHVs work in the community. At baseline, three in every five participants (61%) interviewed had heard about community health volunteers in general. Knowledge of the existence and work of community health volunteers increased over the study period in both intervention and control sites to an average of four in every five participants sensitized on CHV work in the community. However the change was significantly higher in the intervention site with 94% of the participants reporting knowing the CHVs working in their community unit. The odds of knowing one's area CHV were 0.6 times higher in the control group at baseline. The reverse was true at end line with the odds of knowing and interacting with the CHVs at 1.6 times greater in the intervention sites compared to the control site.

At baseline, 80% of the participants in control site had received a visit within the last quarter from their area CHV. The proportion was 20% lower in the intervention site. About half of the participants from both the intervention and control site had been visited by their area CHV within

the last quarter prior to the end line survey. proportion of participants who had never been visited by their area CHV significantly reduced at end line in all sites.

Previous pregnancy and ANC attendance: The proportion of participants who were pregnant during the survey was higher at end line with majority in the second trimester. There was no significant difference in the proportion of women who had attended ANC during their current pregnancy in both sites at baseline and end line. Majority of the participants at end line (70%) reported accessing ANC services at a government health center. The main reasons reported for attending ANC during their current pregnancy was for checkup (63%), for a follow up visit (49%) or due to illness(16%). Similar reasons were reported at baseline but none of the participants reported attending ANC due to advice received from a CHV, a TBA or a family member. At end line 5% of the participants from the intervention site reported attending ANC specifically due to advice received from the CHV. About half of the women who had not attended ANC during their current pregnancy reported being healthy as the main reason. About 10% thought it was unnecessary, 3% reported the health facility as being too far and 3% were scared to go for ANC.

Table 4: *Knowledge of CHVs and maternal healthcare utilization*

Characteristic	Intervention (Bomet Central)			Control (Sotik)		
	Pre	Post	P value	Pre	Post	P value
Heard of CHVs						
No	717 (46)	88 (4)		487 (31)	216 (12)	
Yes	844 (54)	1930 (95)	<0.001	1056 (68)	1525 (88)	<0.001
Know area CHV						
No	365 (43)	120 (6)		335 (32)	148 (10)	
Yes	479 (57)	1810 (94)	<0.001	721 (68)	1377 (90)	<0.001
Pregnancy status						
Not pregnant	1484 (95)	1835 (91)		1447 (94)	1604 (92)	
Currently Pregnant	77 (5)	183 (9)	<0.001	96 (6)	137 (8)	
Attended ANC (current pregnancy)						
No	29 (38)	51 (28)		27 (28)	55 (32)	
Yes	48 (62)	132 (72)	0.118	69 (72)	93 (68)	0.515
Previous pregnancy						
No	179 (11)	316 (16)		151 (10)	278 (16)	
Yes	1382 (89)	1702 (84)	<0.001	1392 (90)	1463 (84)	<0.001
Attended ANC (Previous pregnancy)						
No	44 (3)	24 (1)		11 (1)	29 (2)	
Yes	1338 (97)	1678 (99)	0.001	1381 (99)	1434 (98)	0.007
Place of last delivery						
Home	337 (24)	242 (14)		242 (17)	262 (18)	
Health Centre	422 (31)	645 (38)		216 (16)	238 (16)	

Sub County Hospital	147 (11)	346 (20)		435 (31)	471 (32)	
Private/Mission	337 (24)	396 (23)		380 (27)	364 (25)	
County Referral	135 (10)	67 (4)		117 (8)	120 (8)	
Miscarriage	4 (0)	6 (0)	<0.001	2 (0)	8 (1)	0.357
Previous complications						
Yes	204 (15)	268 (15)		219 (16)	238 (16)	
No	1194 (85)	1475 (85)	0.541	1188 (84)	1265 (84)	0.841

A total of 5,939 (87%) participants had previously been pregnant with 98% of them having attended ANC at least once during their pregnancy. The proportion of women who had attended ANC during their previous pregnancy was higher in the intervention site. More than two thirds of the participants reported having completed at least four ANC visits during their pregnancy.

Overall, despite living near health facilities 1,083 (18%)women who had previously been pregnant delivered at home. The proportion of women who delivered their previous pregnancies at home was higher in the intervention site at baseline but significantly lower at end line. No difference was detected in the control site. The pie chart below (figure 8) shows a comparison of the nearest health facilities and the facilities the women had delivered during their last pregnancy.

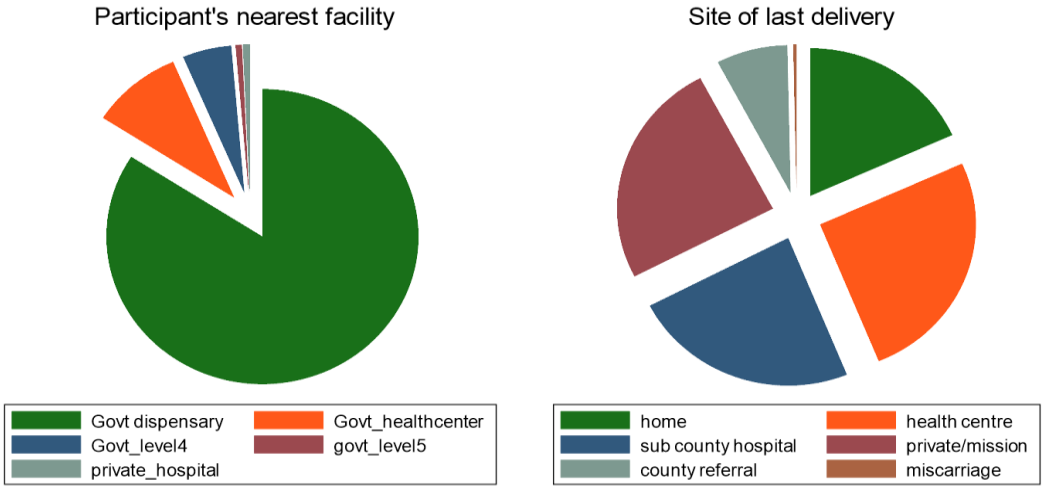


***Figure 11**: Comparison of nearest health facility and facility of last delivery*

Majority of the women who delivered at home were assisted by a relative or friend. 33% of those who delivered at home in the intervention site were assisted by TBA. Table 5 below details other sources of assistance for women who delivered at home.

Table 5: *Assistance during home delivery*

Characteristic	Intervention (Bomet Central)			Control (Sotik)		
	Pre	Post	P value	Pre	Post	P value
Home Delivery Assistance						
Relative/Friend	158 (47)	107 (44)		130 (54)	116 (44)	
TBA	78 (23)	81 (33)		52 (2)	101 (39)	
Health worker	22 (7)	14 (6)		15 (6)	6 (2)	
Self-delivery	79 (23)	40 (17)	0.028	45 (19)	39 (15)	<0.001
Received advice on complications						
No	928 (59)	516 (26)		777 (50)	744 (43)	
Yes	633 (41)	1502 (74)	<0.001	766 (50)	997(57)	<0.001
Advice on pregnancy complications						
Nurse	569 (90)	1173 (78)	<0.001	639 (83)	846 (85)	0.413
Advised by CHV	4 (0)	595 (39)	<0.001	5 (1)	53 (5)	<0.001
Advised by family	9 (1)	60 (4)	0.002	135 (18)	77 (8)	<0.001
Advised by TBA	75 (12)	93 (6)	<0.001	13 (2)	32 (3)	<0.046
Heard from media	31 (50	47 (3)	0.047	31 (4)	41 (4)	0.945
Read about it	46 (7)	113 (8)	0.837	46 (6)	65 (7)	0.659

Out of all the participants who had ever been pregnant, 929 (15%) had experienced complications during their pregnancy. There was no difference in proportion of women who had experienced complications in both study sites. High blood pressure was the most common complication experienced by study participants. Other complications reported include diabetes, infections preterm birth, miscarriages, and still birth. We detected a difference in the proportion of women who experienced pre-eclampsia and infections at end line in comparison to baseline.

The proportion of participants who reported visiting the health facility as a first reaction to pregnancy complications was higher in the intervention site at end line.

After adjusting for the study sites odds of having received advice on complications and risks in pregnancy was 2.4 times greater at end line in the intervention site (OR 2.41, 95%CI-2.18-2.65), in comparison to the control site.

Two thirds (66%) of the participants from both sites reported receiving advice on complications in pregnancy at end line. The odds of receiving advice from a CHV in the intervention site was 11.68 times the odds in the control site at end line (OR: 11.68 CI: 8.70-15.70). More details on proportion of women who received advice on complications in pregnancy are shown in table 5 above.

Part 2: Effect of High-Risk Pregnancy Cards on knowledge

Summary

This section describes results from the analysis conducted to determine the effect of the use of HRP cards on the knowledge on healthy habits, in pregnancy among women of reproductive age in the study sites. We include insights from both in depth interviews with CHVs and interviews with women of reproductive age in the community.

Key highlights

- The odds of having received advice on healthy habits in pregnancy were 4.2 times higher among women who had seen the HRP cards compared to those who had not seen the cards (OR: 4.21 95% CI: 3.47-5.10 P<0.000) in the intervention site.
- Overall, the adjusted odds of increased knowledge in healthy habits in pregnancy after the implementation of HRP cards was 8.76 times the odds before the implementation of HRP cards.
- At end line, the odds of receiving advice from a CHV in the intervention site was 11.68 times the odds in the control site (OR: 11.68, 95%CI: 8.70-15.70, P<0.001).
- At end line, the five most commonly mentioned healthy habits in both intervention and control sites were healthy eating, avoiding carrying heavy weights, attending ANC, good hygiene and drinking clean water.
- The average number of healthy habits mentioned by participants who has seen the HRP cards was significantly higher compared to those who had not seen or interacted with the HRP cards (t = -36.2080 df=6861, p = <0.001, 95%CI = -2.20 -1.97).

Use of the HRP cards enhanced CHV's and TBAs' ability to identify multiple risks and danger signs in pregnancy. During training, majority of the CHVs could only identify the seven risk and danger signs present in the MOH mother and child booklet. At end line, CHVs across all FGDs reported gaining new knowledge and that the HRP cards enabled them to differentiate between a normal pregnancy and a high risk pregnancy as expressed by a respondent:

> *"These CHVs have really been empowered. their capacity has been elevated to another level, I am telling you, even if you are to interview them, to ask them, "can you give me five danger signs on the spot" They will do it off head. So this book… to me initially I was of the idea, this will be the doctor's book, but the CHVs here have it is wonderful…It seems they are our community doctors now…"* ***CHA Kapkoros Bomet***

The increase in knowledge was also detected among the community members during the

community surveys.

In the survey, we examined and compared the participants' knowledge on healthy habits in pregnancy before and after the introduction of the HRP cards.

The odds of having received advice on healthy habits in pregnancy were significantly higher in the control site at baseline **(OR: 0.83 CI:0.71-0.96 *P*=0.015). The opposite was true at end line with the odds of having received advice on healthy habits in pregnancy at 2.2 times higher in the intervention site (OR: 2.20 CI:1.85-2.62 *P*<0.001).**

Majority of the participants got advice on healthy habits in pregnancy from a health worker specifically a nurse. However, we detected a significant increase in proportion of participants who received advice on healthy habits in pregnancy from CHVs in the intervention site, see table 5 above.

High risk pregnancy cards were deployed in the intervention site. **About 4 out of every 5 participants from intervention site reported having seen and interacted with the HRP cards. More than two thirds (72%) received information on the HRP card from a CHV**. A further 44% received the information from a nurse at the health facility, and 2% from a TBA, a friend or from posters.

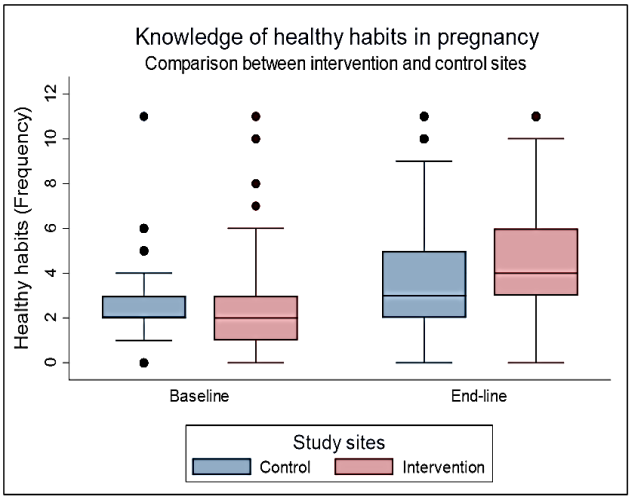
We sought to find out the awareness of healthy habits in pregnancy before and after the introduction of the HRP cards. At baseline, **the four most commonly mentioned healthy habits in both intervention and control sites were healthy eating, maintaining good hygiene, avoiding carrying heavy weights and attending ANC**. The least mentioned habits were, using proper latrines, attending health education group talks, taking all prescribed medicine and giving birth at a health facility.

The proportion of women who identified healthy habits in pregnancy was significantly higher at end line. This was true in both intervention and control sites. However, the crude proportions were higher in the intervention site. Details of other mentioned healthy habits are presented in table 6 below.

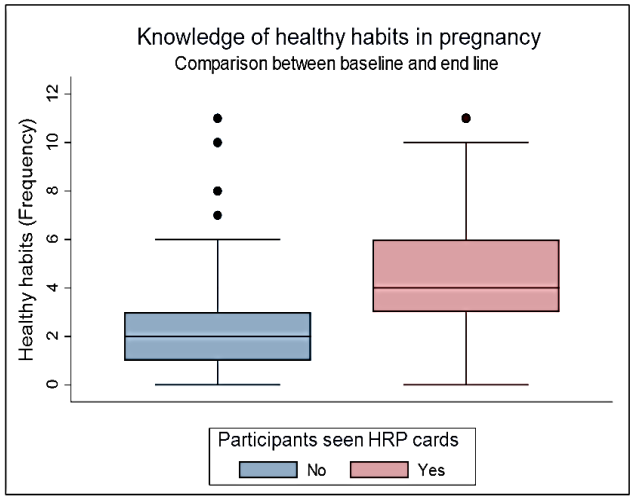
***Table 6**: Known healthy habits in pregnancy*

Characteristic	Intervention (Bomet central)			Control (Sotik)		
	Baseline	**End line**	**P value**	**Pre**	**Post**	**P value**
Healthy eating	1204 (77)	1819 (90)	<0.001	1143(74)	1471 (84)	<0.001
Sleep under a mosquito net	235 (15)	860 (43)	<0.001	317 (21	611 (35)	<0.001
Drink clean water	103 (7)	923 (46)	<0.001	226 (15)	681 (39)	<0.001
Do not carry heavy weights	682 (44)	1067 (53)	<0.001	918 (59	780 (45)	<0.001
Attend ANC	345 (22)	947 (47)	<0.001	511 (33)	665 (38)	0.002
Good hygiene	238 (15)	1043 (52)	<0.001	454 (29)	732 (42)	<0.001
Wash hands	41 (3)	626 (31)	<0.001	61 (4)	384 (22)	<0.001
Use a proper latrine	32 (2)	506 (25)	<0.001	18 (1)	294 (17)	<0.001
Give birth at a HC with a midwife	93 (6)	475 (24)	<0.001	51 (3)	249 (14)	<0.001
Take all prescribed medicine	33 (2)	459 (23)	<0.001	48 (3)	252 (14)	<0.001
Attend health education group talks	36 (2)	381 (19)	<0.001	15 (1)	136 (8)	<0.001
Other Habits	26 (2)	72 (4)	0.001	232 (15)	101 (6)	<0.001

Participant's awareness and knowledge on healthy habits in pregnancy was scored by summing the number of correct responses given when asked to list any healthy habits in pregnancy they knew. There was an overall increase in participant knowledge of healthy habits at end line in comparison to baseline. However, the change was significantly higher in the site with HRP cards. Figure 12 below shows the proportions of participant for each level of knowledge.



Graph A: showing a higher median number of healthy habits mentioned by study participants at baseline and end line. The median is higher in the intervention site compared to the control site.



Graph B: showing a higher median number of healthy habits mentioned by study participants who had seen the HRP cards compared to those who had not seen the HRP cards in the intervention site

***Figure 12**:Comparison of number of healthy habits in pregnancy mentioned by study participants across both sites before and after implementation of HRP cards*

Part 3: Effect of High-Risk Pregnancy Cards on knowledge of risks and danger signs in pregnancy

Summary:

This section describes results from the analysis conducted to determine the effect of the use of HRP cards on the knowledge on risks and danger signs in pregnancy among women of reproductive age.

Key highlights

- About seven in every ten participants across all sites were aware of at least one risk or danger sign in pregnancy at end line.
- The mean number of risks/danger signs identified after implementation of HRP cards was significantly higher in the intervention site compared to the control site.
- After controlling for confounders, the odds of increased knowledge in healthy habits in pregnancy was higher in the intervention site (OR =2.74, 95%CI 2.02-.72 P<0.001) compared to the control site (OR=1.38, 95% CI: -1.16 – 1.66, P<0.001)
- The odds of having increased knowledge in risks and danger signs in pregnancy among participants who had received advice and counselling on risks and complications in pregnancy using the HRP cards were four times the odds at baseline (OR=3.98 95% CI: 3.07-5.18, P<0.001).

We also queried participants' knowledge on signs of risks or complications in pregnancy. About 2,935 (78%) participants across all sites were aware of at least one risk or danger sign in pregnancy at end line. This was 17% higher than reported at baseline. To test if there was a significant difference in the mean number of risks identified at baseline and end line in control and intervention sites, we applied a difference in difference model. The mean number of risks/danger signs identified after implementation of HRP cards was significantly higher in the intervention site compared to the control site.

***Table 7**:Difference in difference model for average number of risks identified in intervention and control sites*

	Baseline			End line			
Outcome	**Control (Sotik)**	**Intervention (Bomet Central)**	**Diff**	**Control (Sotik)**	**Intervention (Bomet Central)**	**Diff**	**Diff-In-Diff**
Mean number of risks identified	2.562	1.899	-0.663 (*P*<0.01)	3.631	5.556	1.925 (*P*<0.01)	2.588 (*P<0.01**)
*inference p<0.01							

Out of the twenty-three risks/danger signs found in the HRP card, excessive vomiting, fever, vaginal bleeding in pregnancy and anemia in respective order were the most mentioned risks at both baseline and end line.

***Table 8:** Identified risks and danger signs in pregnancy*

Characteristic	**Intervention (Bomet Central)**			**Control (Sotik)**		
	Pre	**Post**	**P value**	**Pre**	**Post**	**P value**
Shortness (<160cm)	37 (4)	273 (16)	<0.001	37 (4)	42 (3)	0.619
Pelvic malformation	19 (2)	280 (17)	<0.001	44 (4)	65 (5)	0.353
Chronic diseases	55 (6)	459 (27)	<0.001	206 (21)	2626 (21)	0.744
Malnourishment	49 (5)	470 (28)	<0.001	63 (6)	239 (19)	<0.001
Short interval between pregnancies	26 (3)	329 (19)	<0.001	40 (4)	62 (5)	0.255
High multigravida	11 (1)	337 (20)	<0.001	27 (3)	75 (6)	<0.001
Previous uterine scar	29 (3)	276 (16)	<0.001	6 (1)	109 (9)	<0.001
Previous labor complication	51 (6)	262 (15)	<0.001	40 (4)	77 (6)	<0.019
Fever	229 (25)	910 (53)	<0.001	313 (31)	599 (49)	<0.001
Vomiting	301 (33)	965 (57)	<0.001	384 (39)	656 (53)	<0.001
Diarrhea	29 (3)	550 (32)	<0.001	52 (5)	300 (24)	<0.001
Anemia	122 (13)	695 (41)	<0.001	297 (30)	4242 (34)	0.022
Edema/Pre-eclampsia	36 (4)	391 (23)	<0.001	81 (8)	182 (15)	<0.001

Eclampsia	16 (1)	182 (11)	<0.001	69 (7)	42 (3)	<0.001
Premature onset of labor	65 (7)	305 (18)	<0.001	57 (6)	110 (9)	0.004
Premature rupture of membranes	66 (7)	308 (18)	<0.001	90 (9)	113 (9)	0.917
Vaginal bleeding	257 (28)	716 (42)	<0.001	447 (45)	427 (35)	<0.001
No fetal movement	113 (12)	434 (26)	<0.001	83 (8)	201 (16)	<0.001
Twins	13 (1)	183 (11)	<0.001	6 (1)	70 (6)	<0.001
Fetal mal presentation	86 (10)	327 (19)	<0.001	55 (6)	115 (9)	0.001
Prolonged labor	76 (8)	319 (19)	<0.001	99 (10)	114 (9)	0.579
Harmful habits during pregnancy	21 (2)	353 (21)	<0.001	51 (5)	149 (12)	<0.001
Young age	12 (1)	133 (8)	<0.001	5 (1)	45 (4)	<0.001

Knowledge on risks and danger signs in pregnancy was scored by summing the number of correct responses given when asked to list risks and dander signs in pregnancy they knew. This was then was rated on a scale where respondents who mentioned less than seven risks in pregnancy (derived from number of risks present in the ANC booklet) were considered to have little knowledge whereas respondents who could mention between 7 to 14 risk/signs were considered to have average knowledge. Participants who could state more than 15 risk signs in pregnancy were considered to have high/adequate knowledge. We reported no significant difference in the level of knowledge of risks in pregnancy between the intervention and control sites at baseline. At end line however, we detected a strong association (χ 2=119.39, P<0.001) between the level of knowledge of risks in pregnancy and the study site. There was a significant increase in knowledge of risks and dangers in pregnancy among participants in the intervention site. Figure 13 below shows a comparison of the level of knowledge of risks in pregnancy between the study sites at baseline and end line.

Table 9: *Detail of the scoring of knowledge of risks and danger signs among study participants*

Characteristic	**Intervention (Bomet C)**			**Control (Sotik)**		
	Pre	**Post**	**P value**	**Pre**	**Post**	**P value**
Knowledge in risks and danger signs in pregnancy						
No Knowledge	**656 (42)**	**316 (16)**		547 (35)	508 (29)	
Little knowledge	877 (56)	1107 (55)		968 (63)	1006 (58)	
Average knowledge	**26 (20**	**509 (25)**	<0.001	27 (2)	223 (13)	<0.001
Adequate/high knowledge	2(0)	86 (4)		1 (0)	4 (0)	

Level of knowledge of risks in pregnancy between the study sites at baseline and end line

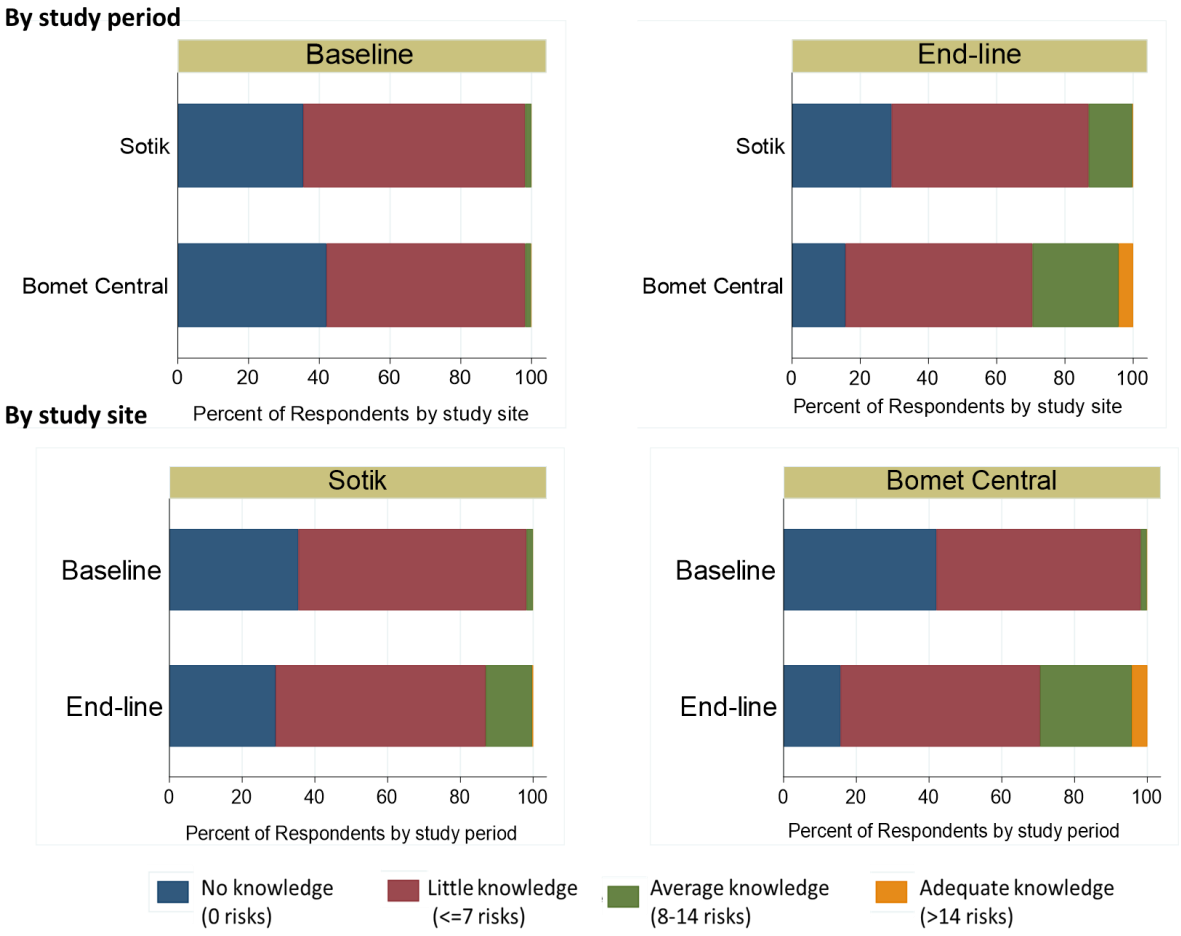


Figure 13: *Graph showing a comparison of level of knowledge of risks in pregnancy between control and intervention sites and between study periods (baseline and end line).*

Overall, 97% of the respondents indicated that they would go to a health facility for assistance upon experiencing any of the risks or danger signs in pregnancy.

"Complications in pregnancy" was identified by respondents from both sites as the main cause of maternal deaths. The proportion of deaths caused by complications in pregnancy was significantly lower in the intervention site at end line in comparison to the control site. About 7% on of all respondents felt that some of the maternal deaths occurred as a result of negligence by health workers at the facility. One in every five women could not identify the specific cause of the maternal deaths.

Multilevel ordered logistic regression models

Analysis of effect of the use of the HRP cards on the knowledge of healthy habits and risks/danger signs in pregnancy.

We sought to determine the overall effect of the use of the HRP cards on the knowledge of healthy habits and risks in pregnancy after accounting for the effect of other independent variables and clustering at the community health unit level in the study. Using multilevel mixed effects ordered logistic regression, we model awareness of healthy habits and danger signs in pregnancy as a function of sociodemographic characteristics, antenatal care utilization, and HRP cards interventions results are presented in table 11 below.

We detected crude associations between knowledge of healthy habits in pregnancy and most of the demographic and other variables (see table 11 below). We report an association between the use of HRP cards and knowledge of healthy habits in pregnancy after adjusting for other variable in the study. A few associations such as associations between healthy habits and participant income, occupation and having received advice on complications in pregnancy remained significant in the final model.

Table 10: *Factors associated with knowledge of healthy habits in pregnancy(Multilevel ordered logistic regression model)*

Exposure		Crude odds ratio	P value	Adjusted odds ratio	P value
Study Period	**Before HRP cards**	1		1	
	After HRP cards	5.21	<0.001	8.76	<0.001
Occupation*	**Occupation type**	0.60	<0.001	0.64	<0.001
Income	**0–10,000**	1			
	10,001–20,000	1.80	0.094	1.64	<0.001
	20,001–30,000	2.15	0.035	1.90	0.004
	30,001–50,000	4.45	0.011	1.60	0.042
	>50,000	18.59	<0.001	7.52	0.007
Seen HRP card	**No**	1	0.04	1	
	Yes	2.10		1.77	<0.001
Advice on complications	**No**	1		1	
	Yes	4.72	<0.001	2.46	<0.001

**variables preventing model from converging. Used as continuous variables instead.*

We fit a similar model for the control site. The odds of high knowledge on healthy habits in pregnancy in the control site were 3.78 times the odds at end line. We also fit an overall model

adjusting for all study sites. The odds of high knowledge in risks at end line was 1.85 times the odds at baseline (95% CI:-1.59 – 2.15, *P*<0.001).

We conducted a similar analysis for the associations between independent variables and knowledge on risks and danger signs in pregnancy. Crude associations were obtained and variables with significant associations included in the final model. Results from this model are presented below.

***Table 11**: Factors associated with knowledge of risks and danger signs in pregnancy(Multilevel ordered logistic regression model)*

Exposure		Crude odds ratio	P value	Adjusted odds ratio	P value
Study Period	**Before HRP cards**	1		1	
	After HRP cards	5.21	0.002	2.74	<0.001
Education*	**No schooling**	1		1	
	Primary	2.62	0.047	2.87	0.053
	Secondary	3.34	0.058	4.03	0.011
	Tertiary	4.35	0.012	5.34	0.003
	Graduate	5.63	0.004	5.09	0.008
Occupation*	**Occupation type**	0.582	<0.001	0.72	<0.001
Income	**0–10,000**	1		1	
	10,001–20,000	2.11	0.014	1.73	<0.001
	20,001–30,000	3.11	<0.001	1.84	0.004
	30,001–50,000	3.72	0.023	1.70	0.234
	>50,000	11.54	0.015	3.43	0.164
				0.85	0.625
Attended ANC previously	**No**			1	
	Yes	3.18	<0.001	2.08	0.03
Seen HRP card	**No**	1		1	
	Yes	5.28	0.001	1.83	<0.001
Advice on complications	**No**	1		1	
	Yes	6.51	<0.001	2.81	<0.001
Community unit clustering	**Var (_cons)**	0.26		0.20	

Crude associations between knowledge of risks and dangers in pregnancy and a range of variables were detected (see table 12 above). After adjusting for confounders and other variables using multilevel mixed effects ordered logistic regression, association between knowledge of risks and dangers in pregnancy and use of HRP cards remained significant. At end line, the odds of high knowledge in risks and danger signs in pregnancy was 2.74 (95%CI 2.02-.72 P<0.001) times the odds at baseline. similar model was fit for the control site. The odds of high knowledge on risks in pregnancy in the control site were 1.84 times the odds at baseline. Overall, the odds in the control

site were significantly lower in the control site compared to the intervention site (OR 2.74 vs OR 1.84).

After adjusting for confounders in the final model, predictor variables such as education level, occupation status, knowledge of CHV work and having received advice on complications in pregnancy remained significant showing association with knowledge of risks in pregnancy.

Section 3: Effect of HRP cards on ANC attendance and referrals

Summary

This section addresses the objective which seeks to determine whether the use of the HRP cards promotes referral of at-risk pregnancies to the health facilities and increases the utilization of maternal health services. To estimate the effect of the use of the HRP cards on ANC attendance, we compared the mean number of first and fourth ANC visits before and after the intervention in link health facilities in both the intervention and control groups.

Key findings

- There was a statistically significant increase in mean number of fourth ANC visits in intervention sites compared to the control site.
- 288 new referrals of at-risk pregnancies to the health facilities from the birth companions and community health volunteers were recorded in the intervention site after introduction of HRP cards.

We abstracted data from ANC registers in all facilities one year before the intervention and compared it to the data obtained during the implementation period of the HRP cards project. For this analysis, we applied a difference in difference model which relies on the difference in difference estimator defined as the difference in average outcome in the treatment group before and after treatment minus the difference in average outcome in the control group before and after treatment. Table 13 below shows the result of the models.

Table 12: *Difference in difference model for analysis of ANC data*

	Baseline			End line			
Outcome	Control	Intervention	Diff	Control	Intervention	Diff	Diff-In- Diff
Mean 1st ANC	31.229	65.104	33.875 (*P*<0.001)	36.162	75.500	39.338 (*P*<0.001)	5.463 (*P*=0.455)
Mean 4th ANC	6.977	10.019	3.042 (*P*<0.001)	7.235	15.733	8.498 (*P*<0.001)	3.274 (*P*<0.001)

*inference p<0.1

The number of 1st ANC visits was higher in the intervention site overall. The difference in difference estimator shows an increase in the mean number of first ANC visits in both sites, however, this was not statistically at 10%. A visual inspection confirms the data meets the parallel trend assumption for both models (see figure 17 below). However the increase in fourth ANC visits was higher in the intervention site statistically insignificant at 5% significance level.

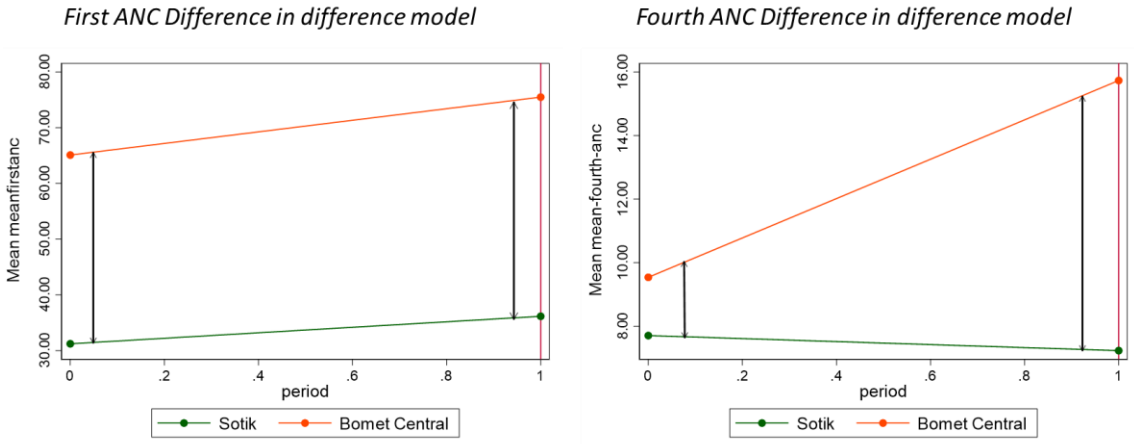


Figure 14*: comparison of ANC visits at baseline and end line in both sites.*

To track the number of women identified in the community by both CHVs and birth companions as having at risk pregnancies as a result of new information in the HRP cards, participants were each provided with a referral from to present at the health facility. Health workers from each of the link facilities had been sensitized on the project procedures and provided with a HRP project specific files where they stored the referral forms. Each correct referral of at risk pregnancy was specially marked with a code to avoid mixing with other referrals. **We tallied 288 referrals from both the community health volunteers to the 4 link facilities in the study intervention**

site. Figure 18 below shows the number of referrals of at risk pregnancies identified during the project period in addition to the usual referrals by CHVs.

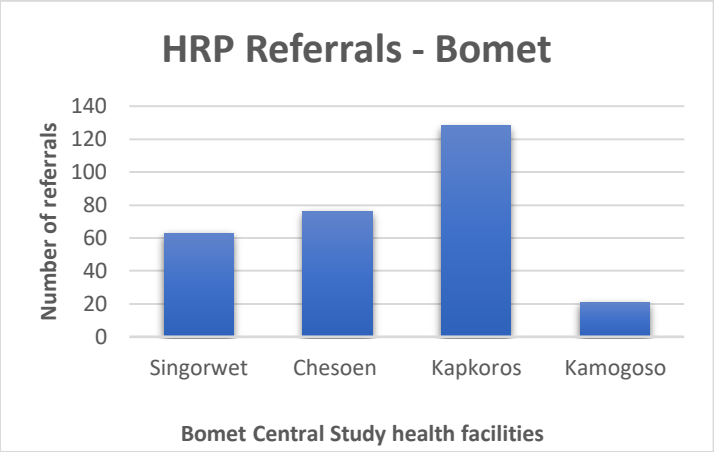


Figure 15: *New referrals of at risk pregnancies identified by CHVs in Bomet central during the study period. No new referrals identified in control site at they did not have the intervention*

Chapter 6 DISCUSSION

This chapter reviews the main findings of the research and provides an interpretation within the broader context of the literature of similar work previously published. In this section we reflect on the three study objectives and examine whether all study questions were answered. Through the discussion, the experimental results have been summarized and reasonable conclusions drawn from the scientific data. We also discuss factors which contributed to the success of the research and limitations that could have influenced the results, such as sources of error or bias in interpretation. The significance of the results is addressed and remaining scientific questions and/or potential future experiments examined.

Lack of adequate knowledge about healthy pregnancy habits, risks and danger signs in pregnancy has been identified as a key contributing factor to delays in seeking obstetric care and in turn to maternal morbidity and mortality especially in low and middle income countries (3,13,14). With improved awareness, women, CHVs and community members at large are more likely to identify risks in pregnancy early enough for timely action. Majority of the women in LMICs receive information related to danger signs in pregnancy through health workers during ANC visits (15). In comparison to those who do not attend ANC, these women relatively were more aware of risks in pregnancy (16). However, studies have shown that despite attending antenatal care, women generally had low awareness of danger signs and obstetric complications (13,15,17,18). This was also related to the women's perception of risks where most perceive a 'normal pregnancy' without severe complications as a normal state not needing specific medical care. (13,19–21). In settings with limited number of health workers limited time is allocated to proper counseling on ante natal care, good habits, risks and dangers associated with pregnancy (22).

Particularly in facilities where health personnel are either understaffed, such as one clinician responsible for all services at a health centre or where they have multiple clinical responsibilities, an alternative may be to explore the feasibility and effectiveness of task shifting and expanding the role of community health volunteers to fill this gap . In this backdrop, we conducted the current study to assess the effectiveness of using the HRP cards, an intervention aimed at facilitating the sharing of information on healthy pregnancy habits and risks and danger signs, by

community health volunteers to ensure identification of risks at the earliest possible and timely referral to the health facilities for management. HRP cards were initially designed as paper-based booklet to serve in fragile environments with poor (digital) infrastructure, we aimed to demonstrate its value even in more stable and varied settings such as rural Kenya where maternal morbidity and mortality was still a concern. Our study addressed all the study objectives.

Knowledge on healthy habits, risks and danger signs in pregnancy

An initial assessment of the awareness and knowledge on pregnancy risks and dangers signs before implementing the intervention revealed poor knowledge of risks in pregnancy. Initial results were homogenous across study sites representing most rural communities in Kenya. Only three out of every five (61%) women of reproductive age interview could correctly identify at least one risk in pregnancy. Majority of these women could identify a maximum of only three risks or danger signs in pregnancy at baseline. This is a common picture across sub Saharan Africa and South Asia with several studies reporting poor, unevenly distributed and inconsistent knowledge on risks in pregnancy among women (14,16,23–27). In line with the findings from other studies across Africa, vaginal bleeding was one of the most commonly identified risk in pregnancy explained by the fact that it was one of the most noticeable odd signs (17). Women did not perform better in knowledge of healthy habits in pregnancy with at most 50% overall identifying at least one healthy habit in pregnancy. There is a paucity of evidence on the knowledge on healthy habits in pregnancy. At baseline we also estimated level of knowledge on healthy habits in our study. About a fifth of the 3,104 women of reproductive age interviewed at baseline knew at least three healthy habits. After implementation of the high risk pregnancy referral cards, results from our study show significant increase in women's knowledge of both healthy habits and risks in pregnancy in the intervention site. Statistically significant improvements in knowledge of risks and danger signs in pregnancy were observed. Overall we had a crude 5% increase in the proportion of women with average knowledge and a 26% decrease in women with no knowledge in risks and dangers signs in the intervention site. This was in tandem with the estimates on women who received advice on risk and possible complications in pregnancy which was significantly higher at end line. These results were in line with a study on women's awareness of obstetric complications and danger signs in Tanzania (28). Evidence studies on factors associated with awareness of risks in pregnancy in Ethiopia,

Egypt and Tanzania indicated a positive association between maternal age (25,27) obstetric history, higher education levels, previous pregnancy and attendance of ANC (13,17,21,23,24). We present similar results; however, we still have positive associations between the use of the HRP cards and women's awareness of risks in pregnancy after adjusting for these predictor variables. Unlike the control site where most women received brief advice from health workers, women in the intervention site reported increased engagement with the CHVs who took time to educate them on the risks and danger signs in detail.

HRP cards as a Visual aid

Job aids have been used in many settings to enhance the performance of health workers(15). visual aids offer an even simplified form of a job aid. Research has shown that the effectiveness of health communications can be significantly increased by including pictures in the design of health education materials (29,30) these studies show that appropriately designed visual aids are often highly effective, transparent, and ethically desirable tools for improving decision making, changing attitudes, and reducing risky behavior. When we present information on risks visually is considered easier to understand and recall and requires less viewing time overall (31,32). The HRP cards is one such visual aid (33). The cards were designed through a complimentary design process between teams from ICRC and Philips design sponsored by Philips Foundation (34,35). An inclusive design approach was taken where all stakeholders were engaged in collaborative workshops to gather insights and shape the prototype. The card was tested in Somalia, Nigeria, South Sudan and DRC with ICRC's healthcare professionals and beneficiaries. It was deployed in six other African countries. Our study provides scientific evidence if the effectiveness of the use of simple visual aids in communicating on risks to communities. The simple text and graphics used on each card are easily adapted to different languages and audiences. It is interesting to note that some health workers indicated that the images actually reduced the time needed for explanation, allowing them to increase the number of messages and utilize their time efficiently.

HRP cards enhancing link between CHVs and health workers

In addition to improving the knowledge and awareness in the community, the use of the HRP cards also impacted the work of the CHVs. The trainings conducted contributed towards capacity

building by equipping the CHVs with skills to identify women who were at risk very early in their pregnancies. We observed a general acceptance of the intervention by both health workers and community member. Uptake in the use of the visual aids was high among health care providers and the county health management teams. The master training on the use of the cards involved the health facility in-charges (head nurse-midwife) regardless of the extent of their involvement in usual antenatal communication. The community health assistants were involved as actual trainers of the community health volunteers. This was done to facilitate the link between the CHVs, and the health facility needed to improve communication, particularly for referrals of women to the facility and back to the community and ensuring adequate feedback mechanisms. Evidence shows that involving the leadership in the health system enhances the implementation of new practices which is consistent with the programmatic experience of this study. Excerpts from the focus group discussions show the enthusiasm of the CHVs and BCs. Recognition is key in motivating CHVs in the community.

Utilization of ANC services.

Adherence to antenatal-care schedules and facility based delivery is generally poor across sub Saharan Africa and Kenya is not an exception (36). In our study we analyzed data on ANC visits. In line with estimates in other countries, first ANC visits were significantly higher than the 4th ANC visits in both intervention and control sites. Figure 19 and 20 above shows the upward trends in the numbers of women accessing ANC services in the study sites. Despite the Covid situation in the country, we realized an increase in especially the 4th ANC visits across all link facilities in the intervention sites. With more awareness, among women in the community, health workers reported an increase in both self-referrals and CHV initiated referrals. The study was also enriched by the involvement all women in the community. The cards targeted all women of reproductive age while pregnant women were specifically engaged in the mother to mother support groups an initiative with the potential of addressing issues around knowledge, attitude, behaviors and norms around pregnancy on its own.

Male involvement in matters maternal health

There is a little of evidence on men's awareness of risks and danger signs in pregnancy across Africa. Results from a study conducted in Ethiopia in 2014 assessing factors associated with men's awareness of danger signs in pregnancy showed low levels of awareness of obstetric

danger signs among men. As key decision makers in the home in most African contexts, their decisions can affect access to health services by pregnant women. We aimed to raise awareness among men in the community as well. Special meetings where men were sensitized on the beneficial habits and risks in pregnancy using the HRP cards contributed to the overall success of the project. Health workers reported an observable increase in the proportion of women who were accompanied by their husbands to ANC.

Research Implications

- A range of policy and programmatic implications emerge from the study findings. Our study demonstrates the positive effect of using the simple yet comprehensive HRP cards in raising awareness about healthy habits, risks and danger signs in pregnancy. It also strengthens existing literature on use of visual aids to promote health literacy among community members. Hinging on the already existing structures to engage community health volunteers in the extra task of educating women as they visit households in their usual routine has proved a practical strategy in reaching majority of the community members and impacting them with the information necessary for early identification of risks and timely action. The thousands of recently trained CHVs across the Kenya by the Kenya Red Cross Society provide an opportunity and platform for scale up of the intervention for maximum impact.
- The research demonstrates the intervention's direct effects on maternal knowledge, which provides important insight on programmatic strategies to improve health outcomes. The visual aids have great value in their design as a practical tool in communication to the community, which plausibly is crucial in empowering the women to safeguard their pregnancies.
- Another factor relates to implementation of the intervention. Acceptance and utilization of the visual aids was high among both the health workers and health management. Engagement of the county health leadership and the cascaded training formula ensured all actors within the maternal health space were on board. This was done to facilitate the link between the CHVs and the health facility which was greatly enhanced.

Study strengths and limitations

A key strength of our study was the use of both quantitative and qualitative methods. We had a large sample size used in the surveys and the very close monitoring of the study activities by the Kenya Red Cross project officers. The intervention was also implemented in four counties across the country representing different cultural contexts, varied socioeconomic and economic modalities improving the generalizability of our study.

Our study may have suffered some limitations. Firstly, the study was conducted during the Covid-19 pandemic which heavily affected the CHV activities and interfered with the study timelines. Restrictions in movement both within the community and fear of spreading the disease may have reduced the ability of CHVs to reach more women with the cards.

Efforts to only implement cards in intervention sites were executed. However, it is possible that cross contamination may have occurred in the study sites owing to the fact that CHVs across the county may have had some common meeting especially during training on infection prevention and control of Covid -19 and shared information on the cards. Slight contamination was detected in the survey results where some of the participants in control sites mentioned having seen the HRP cards. This could have led to an underestimation of the relative effect of the HRP cards in intervention site.

In addition, effect of the cards may have been underestimated due to the confounding effect of a county intervention where CHVs were equipped with pregnancy test kits to screening women and refer those found pregnant to the health facilities. This could explain the low differences in ANC attendance between the study sites.

Due to the nature of the intervention , it was not operationally possible to blind the data collection team regarding the intervention or control status of participating sites. Some reporting bias may have occurred. However, the questionnaires were designed robustly to allow the participants to self-report the knowledge on the risks in pregnancy with little no assistance from interviewers.

Chapter 7 CONCLUSIONS

Findings from our study show that use of a visual aid focused intervention is a practical and relatively efficient approach to improve the awareness of healthy habits, risks and danger signs among women of reproductive age in the community. Appropriately designed visual aids are highly effective, transparent, and ethically desirable tools for improving decision making, changing attitudes, prompting good habits and reducing risky behavior. the inclusive design of the HRP cards aided in adoption by the CHVs and acceptability by health workers and community members. Use of the cards was positively associated with an increase in healthy habits, risks and danger signs knowledge among women or reproductive age and men in the community. Appropriate and sustainable mechanisms for scale-up of this intervention are required. Further studies are needed to assess the retention of the knowledge among the women.

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Chapter 9 SUPPLEMENTARY MATERIAL

Study participants opinions and suggestions on the HRP cards

The HRP cards were received and appreciated in Bomet Central, however, respondents had some opinions and suggestions on the content of the HRP cards for their settings. The most mentioned suggestions are discussed below.

Inclusion of domestic violence as a risk and transfer of the card titled *" Do not carry heavy weight"* from the green side with healthy habits to the red side with risks and danger signs. One of the community members commented as below:

> *"I can see in green that woman who is carrying a bay on the back and she is also pregnant and carrying a lot of luggage. It is not supposed to be in that green because it is overloaded. She is overloaded and it is very risky… It should be written " carrying heavy weight " in the red side"* ***Male forum FDG, Bomet***

Inclusion of pictures of men in both the green and red cards to support male involvement and engagement. The inclusion of pictures of men in the cards was suggested by all groups of respondents. The respondents explained that men were responsible for making decisions in the household including those affecting the woman's pregnancy Specifically in the risk "*high multigravida*" and healthy habits "*healthy mother and child*", "*visit health centre for antenatal care*", and "*health education group talk" cards* . a TBA had the below opinion:

> *"I feel that a male picture should be included in the picture where a mother is visiting the health centre for ANC because we are advocating for male involvement during pregnancy. As far as we are talking about male involvement there are no pictures of the males in the card…"****TBA Bomet central***

CHVs had received requests to include men in the cards from the community during their household visits and dialogue day and one of them reported as below:

> *"Now there was an issue because we have been to communities where they are saying "now that you are talking about male involvement, why should we not be included in the pictures? Why are we only seeing mothers in these pictures…?"****CHA Kapkoros CU , Bomet.***

Knowledge on causes of maternal mortality

We inquired if the participants had ever heard of any maternal deaths in their community units. About one third of the participants reported knowing at least one woman who had died during pregnancy or delivery. Table 9 below lists some of the causes of death listed by the women.

Table 13: *Causes of maternal deaths by verbal autopsy*

Characteristic	Intervention (Bomet Central)			Control (Sotik)		
	Pre	Post	P value	Pre	Post	P value
Pregnancy complications	402 (66)	311 (61)		351 (57)	317 (67)	
Illness	23 (4)	45 (9)		51 (8)	59 (12)	
Negligence at health facility	52 (9)	39 (8)	<0.001	24 (4)	22 (5)	<0.001
Long distance to health facility	35 (6)	13 (3)		16 (3)	14 (3)	
Accidents	7 (1)	19 (4)		13 (2)	11 (2)	
Other Cause	88 (15)	87 (17)		157 (26)	50 (11)	

Trends in ANC attendance pre and post HRP cards

As part of the project monitoring and evaluation, we monitored the monthly trend of ANC attendance during the implementation of the HRP project and compared these two trends from the previous year. The monthly trends of ANC visits in link health facilities is shown below.

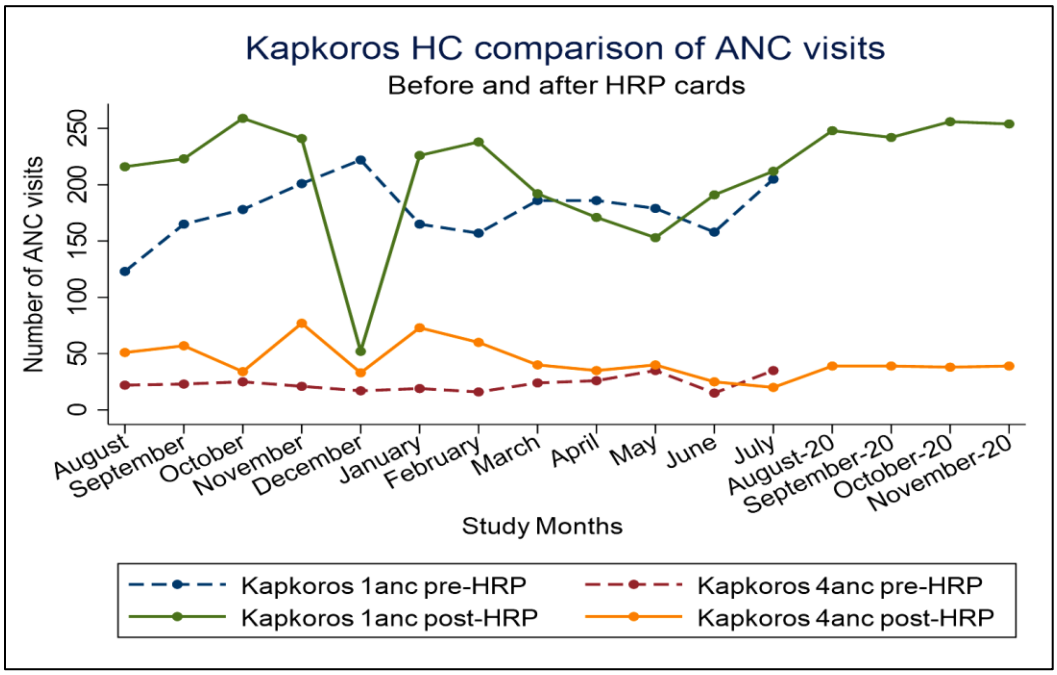

Figure 16*: 1st and 4th ANC visit trends before and during study period in Kapkoros health centre*

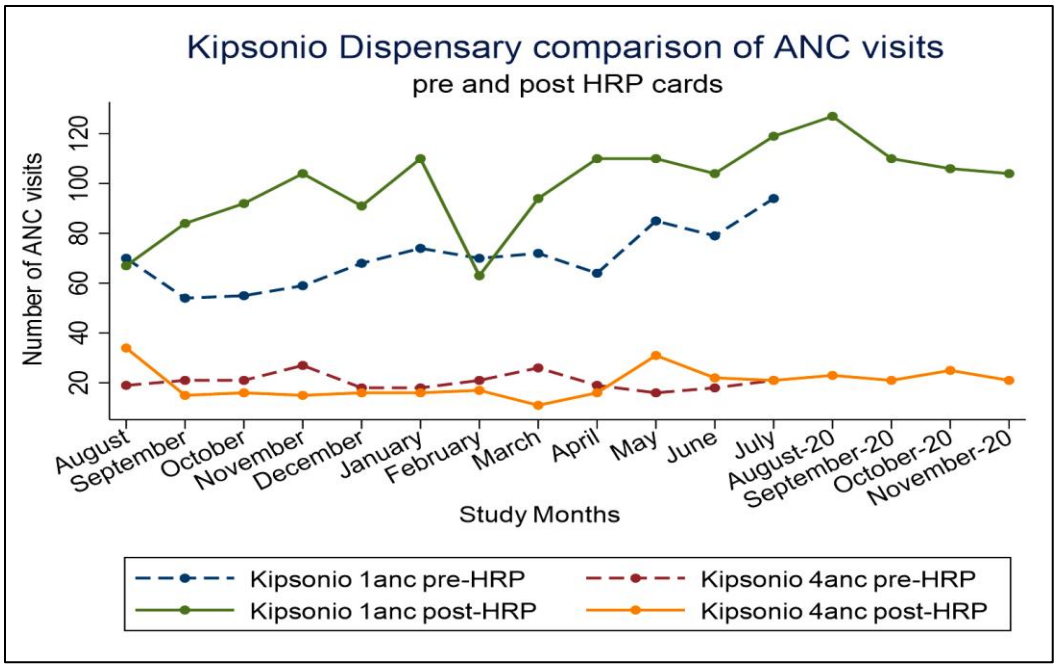

Figure 17: *1st and 4th ANC visit trends before and during study period in Kipsonoi dispensary*