Assessing the functionality and utilization of the mHealth, Yendanafe electronic mobile reporting system in community health and clinical programming in Neno district, Malawi.

By

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Date: July 2021

DECLARATION

We, Dorothy Mkwezalamba and Elissa Dushime, hereby declare that the practicum capstone thesis has been written by us without any external unauthorized help, that it has been neither presented to any institution for evaluation nor previously published in its entirety or in parts. Any parts, words or ideas, of the thesis, however limited, which are quoted from or based on other sources, have been acknowledged as such without exception.

Signature: Dorothy Mkwezalamba  Date: July 2021

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DEDICATION

This project is dedicated to:

Our late fathers Mr. JD Mkwezalamba and Mr. Darius Ndayambaje.

Our mothers, Mrs. Mercy Mkwezalamba and Mrs. Olive Mukayuhi for the love, moral, and spiritual support.

Dorothy's husband and daughter, Dr. Noel and Agatha Kayange for the support and being the source of strength and inspiration throughout this program.

Dorothy & Elissa

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ABSTRACT

Background

In Malawi, mHealth has been used to improve health in areas like antenatal care, maternal health services, nutrition, and health information system. In 2018, Partners In Health (PIH)-Malawi in collaboration with Medic Mobile designed an mHealth digital tool called Yendanafe to improve the HouseHold model used in the community health program and address some of the challenges caused by using physical/paper-based data collection tools. In 2019, mHealth, Yendanafe system was piloted in 2 out of 14 catchment areas, yet its scale up has been slow, and no evaluation of the system has been done.

Objective:

To assess the effect of the mHealth, Yendanafe system on report completion, program indicators tracking, and program performance assessment in Neno district, Malawi.

Methods:

The first part of the study was a pre and post study that analyzed secondary data to assess the effect of mHealth, Yendanafe system on monthly report completion and program indicators. The second part was a cross-sectional study that analyzed primary data to assess how often the implementation team utilized the system to assess the performance of CHWs and programs indicators. The study was approved by UGHE Institutional Review Board (IRB) in Rwanda and the Neno District Health Research Committee in Malawi. All data collected was aggregated in excel sheets. Descriptive statistics summarized all four key measures, and Mann Whitney test was performed to assess the pre and post implementation report completion rate. All analysis was conducted using SPSS version 27 with a P value set at 0.05.

Results:

In total, 44 monthly reports were included to assess pre and post program report completion rates. No statistical significance was found between paper based and Yendanafe report completion rates (P=0.149). The Yendanafe system could capture 88.4% of the required program indicators compared to 48.2% by the previous paper-based system. 23 out of 24 CHWs performance indicators were always/sometimes used by the majority of the implementers, while only 15 of the 29 program performance indicators were always/sometimes used by the majority of the implementers. Some challenges of using the system were reported.

Conclusion:

The findings showed that the system did not change the monthly report completion rate but increased the percentage of program indicators captured. The system was used to assess CHWs performance but not so much for program indicators performance. Some implementers had some challenges using the system and did not like some of the features. Follow-up studies need to be done to evaluate the system before scaling it up.

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CHAPTER ONE: INTRODUCTION

Background

The use of mHealth in the healthcare industry is increasing. Since its inception, mHealth has been used worldwide in health education and awareness, diagnostics and treatments support, remote data collection, monitoring and evaluation, and other sectors in the health field (Early et al., 2019). In Malawi, mHealth has been used to improve health in areas like antenatal care, maternal health services, nutrition, and health information system (Malanga, 2017). In 2018, Partners in Health Malawi in collaboration with Medic Mobile designed an mHealth digital tool called Yendanafe to improve the HouseHold model used in the community health program and address some of the challenges caused by using physical/paper-based data collection tools.

Problem statement

Since 2019, mHealth Yendanafe system has only been piloted in 2 out of 14 sites in Neno district, Malawi, but its scale up has been slow, and the evaluation of the system has not been conducted. To our knowledge, this study was the first to assess the functionality and utilization of mHealth, Yendanafe system in community and clinical programming in Neno district, Malawi.

General objective:

To assess the effect of the mHealth, Yendanafe system on report completion, program indicators tracking, and program performance assessment in Neno district, Malawi.

Specific objectives:

- To assess the pre and post Yendanafe implementation programs report completion rate by July 2021.
- To assess the effect of mHealth, Yendanafe system on program indicators captured before and after the implementation by July 2021.
- To assess the utilization of mHealth, Yendanafe system by the implementation team in CHWs performance assessment by July 2021.
- To assess the utilization of mHealth, Yendanafe system by the implementation team in program indicators performance assessment by July 2021.

Organization of the report

Chapter one: Introduction: this chapter provides a brief overview of the study, the problem statement, objectives, and why the study needs to be done.

Chapter two: Literature review: this chapter provides a description of the available scholar sources related to mHealth and the existing gaps.

Chapter three: Methods**:** this chapter describes the study setting, study design, sample, data collection procedures, data collection tools, data collectors, measures, data management, and data analysis.

Chapter four: Results: this chapter provides the results of the study on each indicator in table format and highlights the significant findings.

Chapter five: Discussion: this chapter discusses the study findings related to the study objectives and compares them with findings from other studies, the limitations of the study, and the challenges faced.

Chapter six: Conclusion and recommendation**:** this chapter summarizes the findings of the study and provides recommendations for future work.

CHAPTER TWO: LITERATURE REVIEW

Background

Technology and health

Telecommunication has advanced over the years with the invention of the internet, airwaves, mobile technologies, and applications. Globally, the use of mobile technology has increased in recent years and in 2019, it was estimated that 5 billion people had access to mobile devices (Silver, 2019). About 94% of adults in countries with advanced economies and 83% in countries with emerging economies own mobile devices (Pew Research Center, 2020). These advancements have provided platforms for different sectors, including health, to manage information. For example, in Bangladesh, about 55 million mobile telephone users received health related messages in 2007 (WHO Global Observatory for eHealth, 2011). The use of telecommunication and mobile technology in the health sector are often referred to as eHealth, mHealth, telemedicine and telehealth (Talking Medicines, 2020). Although these terms are often used interchangeably within healthcare to describe the wide concept of using mobile and desktop technologies for patient management, they do represent the use of different technologies in healthcare.

E-health is the general term that refers to the use of telecommunications and information technology in the field of health (Mea, 2001). Typically, eHealth initiatives are being implemented through computer-based systems to promote access to health-related information. With the increasingly widespread use of mobile phones, mHealth emerged as a subset of e-Health. It uses mobile and wireless technologies and its applications to generate, accumulate and exchange medical information with the aim to improve healthcare outcomes, services, and research (Gruessner, 2015). mHealth has become the more popular and preferred technology over the computer-based eHealth initiatives because of the portability of mobile devices: they can be used outside the fixed locations of offices, which improves continuous data flow (Deloitte, 2014).

Use and benefits of mHealth

mHealth technologies are increasingly being used in the healthcare industry for myriad purposes. Health education and awareness, diagnostic and treatment support, disease, and epidemic outbreaks tracking, healthcare supply chain management, remote data collection, monitoring and evaluation, healthcare worker telecommunication and training are some areas that commonly utilize mHealth applications (Early et al., 2019). In Brazil, for example, about 86% of mHealth was used for disease surveillance, health surveys, patients records and monitoring (Iwaya et al., 2013).

One of the most common applications of mHealth technologies is in facilitating treatment adherence**.** In a systematic review of 107 studies, 40.2% used SMS for chronic disease management (Hamine et al., 2015). The second global survey on eHealth by WHO in 2011 showed that mHealth technologies were very helpful in appointment reminders; more than 70% of participating member states in high-income groups use mHealth for that purpose, specifically the use of SMS (WHO Global Observatory for eHealth, 2011).

Apart from enhancing treatment adherence, mHealth technology has been very useful in disease case identification. A pilot study conducted in South Africa in 2018 reported the use of mHealth to identify tuberculosis resulted in reduced time to TB treatment initiation (Maraba et al., 2018). Recently in Kenya, a smartphone app was developed to detect different antibodies to Ebola on a Rapid Diagnostic Test tool (Wood et al., 2019).

mHealth technologies were also found to be useful in improving sexual, maternal, and reproductive health outcomes (Braun et al., 2013). In many low- and middle-income countries (LMIC), the burden of pregnancy and neonatal deaths were high due to fewer available physicians. A systematic review on the effectiveness of mHealth interventions targeting health care workers to track pregnant women, the results showed improved antenatal and delivery care and facilitated referrals and contributed to the improved maternal and neonatal outcomes in LMIC (NIH, 2016).

The WHO global survey on eHealth also showed that mHealth technologies are very useful for community mobilization and health promotion. Many countries use text messaging for health promotion as well as alerting targeted people on health campaigns. In a randomized clinical trial conducted in southern India, people at risk of type 2 diabetes were divided into two groups. Over a period of three years, the study group was sent a variety of text messages with education and healthy lifestyle advice, and the control group was only given standard advice at the start of the trial. The results showed that 18% in the intervention group versus 27% in the control group developed type 2 diabetes within the study period (Hall et al., 2014).

mHealth technologies were proven to be cost effective because it reduced cost of transportation for both patients and healthcare workers, decreased in time to diagnosis, and reduced hospital visits for patients (Iribarren et al., 2017). mHealth allows patients faster access to providers and care: with the use of mHealth, patients can send secure text messages to schedule appointments and connect to health care providers at any time (Ross, 2019). mHealth can also improve communication and coordination among providers. Due to tight schedules of doctors, it is often very challenging for them to connect with coworkers and patients. mHealth technology improves their ability to connect through secure messaging and texting (Ross, 2019). For example, in Ghana, only two thousand physicians were available to serve a population of nearly 24 million, using reliable communication systems to conduct consultations as well as to refer patients helped improve medical practice (WHO Global Observatory for eHealth, 2011).

Challenges and limitations of mHealth

Although the use of mHealth provides numerous benefits, its applications also are met with various challenges and limitations. Some of the infrastructure and technology issues included low coverage of mobile network, poor internet accessibility and stability, electricity outage, as well as expensive mobile device maintenance (NIH, 2016). In addition, text messages have limited text characters, so it is difficult to ensure text messages content are properly interpreted (Aranda-Jan et al., 2014). The lack of effective training to help Community Health Workers adopt mHealth tools, the lack of consistent methodology to assess mHealth outcomes, and lack of cultural relevance to the communities were among some of the challenges (Early et al., 2019). Studies have also suggested that the use of mHealth is minimal in supporting decision making, treatment compliance and awareness programs. Most targeted mHealth users were physicians

and community health workers; only 5% of health managers were involved in using mHealth (Iwaya et al., 2013).

mHealth's expansion in Africa

Over the years, access to telecommunication services has improved in many African countries. A study conducted in 24 African countries showed that mobile phone subscribers have increased from 10 million to more than 110 million in six years' period (Minges et al., 2008). With the increase in mobile and internet coverage, the use of mHealth in sub-Saharan African countries also increased. Between 2006 and 2016, over 400 mHealth programs were implemented in sub-Saharan Africa, with Kenya, Tanzania, and Uganda implementing the most mHealth programs compared to other countries (Lee et al., 2017). Malawi was not an exception to this. The mobile cellular subscribers increased from 0.44% in 2000 to 47.78% in 2019, and internet users have increased from less than 2% to 13.78% during the same period (WorldData, 2021). And many mHealth programs were implemented.

Impact of mHealth in Malawi

mHealth programs in Malawi have improved in the areas of antenatal care, maternal health services, quality of nutritional data, information flow, and feedback loops (Malanga, 2017). Chipatala Chapa Foni (CCPF) Mnch, which means Health Centre by Phone, was a collaboration between VillageReach, the Ministry of Health in Malawi, Baobab Health, and Grameen Foundation's Mobile Technology for Community Health (MoTeCH), to improve health seeking behavior and the uptake of home and facility-based care (Jezman et al., 2015). The impact evaluation of the project showed the use of antenatal care, bednets, and knowledge on maternal health services were improved (Jezman et al., 2015). In another pilot project, RapidSMS and UNICEF Malawi worked together with UNICEF Headquarters, Columbia University School of International and Public Affairs, Airtel Malawi, Telecom Net-works Malawi, Bunda College of Agriculture, Ministry of Health, and the Department of Nutrition, HIV and AIDS surveillance of nutritional data. The project reduced time for data collection, improved timely feedback and enhanced the quality of data (Malanga, 2017).

Challenges and limitations of mHealth in Malawi

Despite the benefits and positive impact, mHealth implementation in Malawi was not without challenges. While the mobile phone and internet accessibility are increasing, ICT infrastructure remains inadequate, especially in rural areas in Malawi (VillageReach, 2014). Most rural areas in Malawi, electricity supply can be unstable and insufficient, which poses significant challenges to the mHealth implementation (Jezman et al., 2015). Poor mobile network access also caused higher costs of sending SMS, which limited the success of mHealth projects. High costs often reduced the number of sent messages, while network interruption often led to health workers sending duplicates of messages to clients (Friderichs et al., 2019). The durability of the devices posed another challenge to the mHealth implementation. In one mHealth program, 60% of phones had broken down (Watkins et al., 2013).

The local culture must be considered in the implementation of mHealth. In Malawi, women disclosing the due date of their pregnancies to strangers is not culturally acceptable. This posed a

challenge during the data collection of mHealth project on maternal care (Watkins et al., 2013). The lack of financial incentives for community health workers to participate in various mHealth training was found to reduce their engagement and commitment in mHealth projects.

mHealth, Yendanafe system

In 2018, Partners in Health (PIH)-Malawi in collaboration with Medic Mobile designed an mHealth digital tool called Yendanafe to support the program operations. PIH is a nonprofit organization that works in Neno, Malawi to provide comprehensive health care. Medic mobile is a nonprofit organization that designs, develops, and supports world-class software for health workers who provide care in hard-to-reach areas.

mHealth, Yendanafe system was designed to improve the HouseHold model and address some of the challenges caused by using physical/paper-based data collection tools. The tool has been piloted in 2 out of 14 sites in Neno district, Malawi, since 2019. CHWs can use the tool to report routine household data, case screening, client follow up management, loss to follow up tracing, referrals, managing performance targets tracking, household survey and sputum collection. The Community Health Management and Leadership team can use the tool for monitoring program-based indicators, decision making, performance management, program management, and reporting to the Ministry of Health (Partners in Health Malawi, 2018a). Since the pilot in 2019, the scale up of mHealth, Yendanafe has been slow, and the evaluation of the system has not been conducted. The study assesses the functionality and utilization of mHealth, Yendanafe system in community and clinical programming in Neno district, Malawi. The results will inform the strategy in scaling up mHealth, Yendanafe in the entire Neno district.

CHAPTER THREE: METHODS

Setting

HIV is among the top 10 burdens of diseases in Malawi (GBD, 2019). Malawi's malnutrition rates in children under five is at 4 % (UNICEF, 2018). Malawi's maternal mortality is one of the highest in the world at 497 per 100,000 live births (National Statistical Office, 2017) and non-communicable diseases (NCDs) related deaths are estimated at 28% of all deaths in Malawi (Gowshall & Taylor-Robinson, 2017). The southern region also has the highest HIV prevalence in Malawi (12.8%). Neno is a rural district in the southern region of Malawi, with a population of 138,291 (National Statistical Office, 2018). It is a remote, hilly, and hard to reach district that borders Mozambique, and the road to Neno District Hospital is not paved. Only 57% of married women in Neno are using modern contraceptives (Dunbar et al., 2018). Only 49% of the population use treated safe water and 3.7% have access to electricity (National Statistical Office, 2017).

In 2006, PIH partnered with the Malawi Ministry of Health to provide primary and secondary health care delivery in 14 catchment areas (12 health centers and 2 hospitals) for about 165,000 people in rural hard to reach Neno district, Malawi (Neiman, 2017). Primary health care extends to community health. In Neno, community health workers (CHWs) were assigned to specific households - the HouseHold (HH) model, to conduct community-based screening programs for various conditions at household level (Partners in Health, 2018b). Each CHW visits about 20 to 40 households each month to provide health education and conduct disease screening for conditions like sexually transmitted infections (STI), TB, HIV, pediatric malnutrition, hypertension, and diabetes (Dunbar et al., 2018). Through the screening, they could identify new cases and refer them to care. They also provide psychosocial support and ensure treatment and appointment adherence (Dunbar et al., 2018).

In 2019, two of the 14 catchment areas have been selected as pilot sites to implement the mHealth, Yendanafe system for collection and reporting of data.

Study design

The study had two parts. In part one, a secondary data analysis was conducted to assess the effect of mHealth, Yendanafe system on the pre and post monthly report completion and program indicators. In part two, a cross-sectional study design was used to investigate the frequency of the implementation team utilized mHealth, Yendanafe system to assess the performance of CHWs and programs indicators.

Sample

Part 1. For assessing the effect of mHealth, Yendanafe system on report completion and program indicators tracking:

Sample: Monthly reports of the community health programs were audited.

Inclusion criteria: All community health program paper based monthly reports between August 2017 and August 2019 from the pilot sites were included in the pre-intervention sample and all

between September 2019 and April 2021 were included in the post-intervention sample.

Part 2. For assessing utilization of mHealth, Yendanafe system in CHWs and program indicators performance assessment:

Sample: the mHealth, Yendanafe system implementation team members.

Inclusion criteria: implementation team members who have been in the current job for at least six months were included.

Exclusion criteria: implementation team members who have been on leave for a month or more during the past six months were excluded.

Sample size: all team members fulfilled the selection criteria were sampled since the numbers were few.

Data collection procedures

Part 1. For assessing the effect of the mHealth, Yendanafe system on report completion and program indicators tracking:

Data from the community health program reports was extracted. The number of fields and the number of completed fields in each monthly report were entered into a data collection form (appendix 1). The number of program indicators captured by the monthly reports were also recorded in the data collection form (appendix 2).

Part 2. For assessing utilization of mHealth, Yendanafe system in CHWs and program indicators performance assessment:

Written consent (appendix 4) was obtained from participants after detailed information and explanation of the study were provided to them. A paper-based survey (appendix 3) was given to the participants in their offices at work, they were given one day to complete the survey. The research team returned and collected the completed questionnaires in the next after. The survey approximately took 25 to 30 minutes to complete.

This study was approved by the University of Global Health Equity (UGHE) Institutional Review Board, the Neno District Health Research Committee, and the PIH management

Data collection tools

Part 1. For assessing the effect of the mHealth, Yendanafe system on report completion and program indicators tracking

A data collection form (appendix 1) was developed to collect data on the number of fields in the report and the number of fields completed. The second data collection form (appendix 2) was developed to collect data on the number of program indicators captured before and after the implementation of mHealth, Yendanafe system.

Part 2. For assessing utilization of mHealth, Yendanafe system in CHWs and program indicators performance assessment:

A survey (appendix 3) was developed to collect data on the frequency the implementation team used the mHealth, Yendanafe system to assess the performance of CHWs and programs' indicators.

The survey had four parts. Part 1 contained some basic demographic information. Part 2 had 24 4-point Likert scale questions related to assessing community health workers performance, part 3 had 29 4-point Likert scale questions related to assessing the program indicators. The Likert scale in part 2 and 3 had the options of selecting "always", "sometimes", "rarely" and "never". Part 4, had two open ended questions asking about the challenges faced, liked features, and disliked features.

Data collectors

All data collection was performed by the research team: Dorothy Mkwezalamba and Elissa Dushime. No external data collectors were hired.

Measures

In this study, we had four key measures.

- Pre and post implementation programs report completion rate.

  Completion rate was calculated by dividing the number of fields completed by the total number of required fields in each monthly report.

- Pre- and post-implementation program indicators capture rate.

  The capture rate was calculated by dividing the number indicators captured by the total number of program indicators required.

- The frequency of utilization of the mHealth, Yendanafe system to assess CHWs performance.

  "Always" and "sometimes" were combined and "rarely" and "never" were combined into two categories. The percentages of these categories were used to measure the utilization frequency.

- The frequency of utilization of the mHealth, Yendanafe system to assess program indicators.

  "Always" and "sometimes" were combined and "rarely" and "never" were combined into two categories. The percentages of these categories were used to measure the utilization frequency.

Data management

All collected data was aggregated in an excel sheet. Data was cleaned and coded before analysis. All digital files were stored on a password protected laptop to ensure data confidentiality, and only the research team had access to it. All paper files were stored in a locked cabinet at UGHE. The data will be deleted after 10 years upon completion of the study.

Data analysis

Descriptive statistics were used to summarize all four key measures. Mann Whitney test was used to assess the pre and post implementation report completion rate. All analyses were conducted using SPSS version 27 with a P value set at 0.05.

CHAPTER FOUR: RESULTS

For report completion rate

In total, 44 monthly reports were audited to assess the report completion rates, with 24 paper based monthly reports for the pre-intervention period and 20 mHealth, Yendanfe system monthly reports for the post-intervention. The median completion rate was 100% (ranged from 57.7% to 100.00%, interquartile range=21.15) pre-intervention; and 85.1% (range from 82.7% to 94.2%, interquartile range=7.45%) post-intervention. There was no statistical significance difference between the pre- and post-intervention report completion rates (P=0.149) (Table 1).

Program indicators captured

Out of 112 program required indicators, 54 (48.2%) indicators were available in paper-based, and 99 (88.4%) indicators were available in mHealth, Yendanafe system (table 1).

Table 1: Pre and post implementation changes in report completion rates and program indicators captured

Variables			Pre-intervention	Post-intervention	P-value
Monthly reports	Sample		24	20	NA
	Fields	Required	52	104	
		Completed	47.33	90.45	
	Completion rate	Median (IQR)	100% (21.15%)	85.1% (7.45%)	0.149
		Range	57.7% - 100%	82.7% - 94.2%	NA
Program indicators	Indicators required		112	112	NA
	Indicators captured		54 (48.2%)	99 (88.4%)	

Utilization of mHealth, Yendanafe system in CHWs performance:

A total of 12 implementation team members participated in the survey. The majority (>50%) of the respondents always/sometimes used 23 out of 24 indicators related to assessing CHWs performance, and 1 indicator was always/sometimes used by 50% of the respondents. The three most always/sometimes used indicators were total CHWs (n=12, 100%), proportion of household visits (n=12, 100%), and number of total households (n=12, 100%). The three least used indicators were proportion of traced Patients successfully found (n=6, 50% always/sometimes used), number of suspected TB found positive (n=7, 58.33%) and proportion of SCHWs meeting their coughers sample targets (n=7, 58.33%) (Table 2).

Utilization of mHealth, Yendanafe system in program indicators performance

15 of the 29 indicators related to assessing program performance were always/sometimes used by more than 50% of respondents. 11 indicators were always/sometimes used by less than 50% of the respondents, and 3 indicators were always/sometimes used by 50% the respondents. The three most used indicators were total households visited (n=12, 100% always/sometimes used), total home deliveries (n=12, 100%), and total households registered (n=11, 91.67%). The three

least used indicators were partners in catchment area (n= 1, 8.33% always/sometimes used), top halves referral & accompaniment - signed and unsigned (n=2, 16.67%), and SCHWs present during SS- SCHW Monthly Meeting (n=4, 33.33%) (Table 2).

Table 2. Utilization of Yendanafe in CHWs and program indicators performance assessmen

Using Yendanafe to assess CHWs performance indicators?	Always/Sometimes	Rarely/ Never
# Total CHWs	12 (100%)	0 (0%)
# of CHWs active during the period	10 (83.33%)	2 (16.67%)
% of CHWs active on app during the period	10 (83.33%)	2 (16.67%
)% of pregnant women visited	11 (91.67%)	1 (8.33%)
% of births happened at home	11 (91.67%)	1 (8.33%)
# of children screened for malnutrition	11 (91.67%)	1 (8.33%)
# of children screened for danger signs	11 (91.67%)	1 (8.33%)
# of women of reproductive age screened for FP	11 (91.67%)	1 (8.33%)
# of screenings for NCD conducted	11 (91.67%)	1 (8.33%)
# of people screened for HIV	11 (91.67%)	1 (8.33%)
# of suspected TB found positive	7 (58.33%)	5 (41.67%)
# of new TB cases identified	8 (63.64%)	4 (36.36%)
Proportion of households visited	12 (100%)	0 (0%)
Proportion of SCHWs meeting their coughers sample targets	7 (58.33%)	5 (41.67%)
Proportion of traced Patients successfully found	6 (50.00%)	6 (50.00%)
CHW activity status (Active/Inactive)	8 (66.67%)	4 (33.33%)
# of total households	12 (100.00%)	0 (0%)
# of total registered HH members	11 (90.91%)	1(9.09%)
% of PNC Women Visited	11 (91.67%)	1 (8.33%)
% of under 5 visited	11 (91.67%)	1 (8.33%)
% of TB visited	10 (81.82%)	2 (18.18%)
% of HIV visited	10 (83.33%)	2 (16.67%)
% of referrals followed up by the CHW	10 (83.33%)	2 (16.67%)
% of HH members visited	12 (100.00%)	0 (0%)
Using Yendanafe to assess program performance indicators	Always/Sometimes	Rarely/Never
Total households visited	12 (100%)	0 (0%)
Total households registered	11 (91.67%)	1 (8.33%)
Total facility-based deliveries	10 (83.33%)	2 (16.67%)
Total home deliveries	12 (100%)	0 (0%)
Total accompanied first ANC	10 (83.33%)	2 (16.67%)
Number of under 5 children in CMAM	9 (75.0%)	3 (25%)
Number of TB patients enrolled	7 (58.33%)	5 (41.67%)
Pregnant or postnatal women who died.	8 (66.67%)	4 (33.33%)
CMAM clients under 5 who died	7 (63.64%)	4 (36.36%)

Registered TB clients who died	5 (41.67%)	7 (58.33%)
Total number of referral and accompaniments	7 (58.33%)	5 (41.67%)
Total CHWs received Supervision	7 (58.33%)	5 (41.67%)
Total number of CHW	11 (90.91%)	1 (9.09%)
Total households SCHW visited during CHW SMSc	6 (50%)	6 (50%)
Number of CHW received supervision x3	5 (41.67%)	7 (58.33%)
Total number of coughers	8 (66.67%)	4 (33.33%)
Total number of SCHW x4	6 (50%)	6 (50%)
Total number of NEW TB cases this month	8 (63.64%)	4 (36.36%)
Total SCHWs received supervision	6 (50%)	6 (50%)
Total households SS visited during SCHW SMSc	3 (25.00%)	9 (75%)
Number of SCHW received supervision x3	4 (33.33%)	8 (66.67%)
Total clinical participants in facility review meeting	2 (16.67%)	10 (83.33%)
SCHWs present during SS- SCHW Monthly Meeting	4 (33.33%)	8 (66.67%)
Total number of SCHW	10 (83.33%)	2 (16.67%)
Total SS-HSA check-ins	5 (41.67%)	7 (58.33%)
Total SIGNED top halves - referral and accompaniment	3 (25%)	9 (75%)
Top halves referral & accompaniment - signed and unsigned	2 (16.67%)	10 (83.33%)
Clients referred for POSER support	3 (25%)	9 (75%)
Partners in catchment area	1 (8.33%)	11 (91.67%)

Three (27.3%) respondents faced challenges using mHealth, Yendanafe system. The challenges were: poor communication on the database system that keeps on changing (60%), lack of good documentation of data dictionary (20%), and brokage/misbehaving of gadgets (20%) (Table 3).

Two (14.3%) respondents indicated they liked the CHWs performance and dashboard features of the Yendanafe system, while 7.1% liked the workflows, indicator tracking and aggregation, supervision tool component, the task, accompagnement, offline data, data warehouse, and CHWs spot checking features of the system (Table 3).

Two (33.3%) respondents indicated they disliked the workflow and muted features of the Yendanafe system, while 16.7% disliked the data sync and form length features of the system (Table 3).

Table 3: Challenges, features liked, and features not liked

Variables		n	%
Challenges in using Yendanafe	Yes	3	27.27%
	No	8	72.72%
challenges faced	Poor communication on database system that keeps on changing	3	60.00%
	Lack of good documentation of data dictionary	1	20.00%
	Brokage/misbehaving of gadgets	1	20.00%
Liked Yendanafe features	Workflows	1	7.14%

	Tracking of indicators and aggregation	1	7.14%
	Supervision tool component	1	7.14%
	The task feature	1	7.14%
	Accompagnement features	1	7.14%
	All Yendanafe features	2	14.28%
	Offline data feature	1	7.14%
	Data warehouse	1	7.14%
	CHWs spot checking	1	7.14%
	CHWs performance features	2	14.28%
	Dashboard	2	14.28%
Disliked Yendanafe features	Data sync features	1	16.66%
	Workflow	2	33.33%
	Form length	1	16.66%
	Muted feature	2	33.33%

CHAPTER FIVE: DISCUSSION

Since mHealth, Yendanafe system was piloted in two catchment areas of Neno district in 2019, there had not been any evaluation of the system, hence the scale up has been slow. This study was the first to assess the effect of mHealth, Yendanafe system on report completion, program indicators tracking, and program performance assessment.

Based on the study results, the monthly report completion rates did not change since the implementation of the digital mHealth, Yendanafe system. A study conducted in Ethiopia to compare paper-based and mHealth tools for collating and reporting clinical cases of lymphatic filariasis and podoconiosis showed similar findings that there was no difference between paper-based and mHealth number of cases reported. 59 Health Extension Workers who were trained on both systems collected and reported the same number of cases by paper-based (n=2,377) and SMS (n=2,372) systems (Martindale & Mableson, 2018). The reason could be that although the system changed from paper based to Yendanafe, the users (CHWs, Site supervisors) of both systems were the same, and if the information was not collected in the field, the report completion rate could not change.

The percentage of program indicators captured increased from 48.2% by the paper-based system to 88.4% by the mHealth, Yendanafe system. However, the system has a capacity to capture 100% of indicators, but not all activities are currently happening. The reason for the 88.4% increase in the percentage of indicators captured in Yendanafe could be attributed to the capacity of mHealth, Yendanafe system to record and report every activity done by the CHWs, which was not the case for paper-based system. This was shown in the mHealth, Yendanafe system design exploration activities report conducted in Neno district in August 2018 that showed that CHWs were not able to record/report some of the indicator activities during the paper-based system. For example, CHWs lacked screening reporting tools, and there was incomplete referral loop as CHWs could not report if the client attended the referral or not after conducting the referral follow up (Partners in Health Malawi, 2018a). This could reduce the number of indicators being reported.

The majority of the respondents always/sometimes used 23 out of 24 indicators related to assessing CHWs performance, and 1 indicator about the proportion of traced patients successfully found was always/sometimes used by half the respondents and the other half rarely/never used that indicator. Overall, the findings proved that mHealth, Yendanafe system was used to assess CHWs performance. Similarly, according to Benjamin et al. (2019), a digital toolkit that was developed by HealthEnabled with support from Living Goods used mHealth to monitor performance of healthcare providers using routine supervision checklist on performance indicators in Uganda and Kenya.

The majority of respondents always/sometimes used 15 out of 29 indicators related to assessing program performance. 11 indicators were rarely/never used by the majority of respondents, and 3 indicators were always/sometimes used by half the respondents and the other rarely/never used those indicators. The 11 indicators that were rarely/never used by the majority of respondents were registered TB clients who died, number of CHWs received supervision x3, total households SS visited during SCHW SMSc, number of SCHW received supervision x3, total clinical participants in facility review meeting, SCHWs present during SS- SCHW Monthly

Meeting, Total SS-HSA check-ins, total SIGNED top halves - referral and accompaniment, top halves referral & accompaniment - signed and unsigned, clients referred for POSER support, and partners in catchment area. The 3 indicators that were always/sometimes used by half the respondents and the other rarely/never used them were total households SCHW visited during CHW SMS, total number of SCHW x4, and total SCHWs received supervision. For the 4 indicators related to facility/site activities, the reason could be due to having only 2 Site Supervisors out of the 12 participants directly coordinating the operations of the two pilot sites. For the 8 indicators related to CHWs and Site Supervisors work and supervision, the reason could be attributed to having only 4 out of the 12 participants being directly working with and supervising CHWs. For the one indicator related to TB case identification, the reason could be due to the suspension of TB community program activities during the Covid-19 period.

The findings showed that only 27.3% of mHealth, Yendanafe system implementers faced challenges while using the system, and the most common being poor communication by the officers responsible for the system to the users when the database system changes. The example given was where data for the past full month keeps on changing if the user checks it at different time intervals, which shows that users change data in the system at any given time. Other challenges were lack of good documentation of data dictionary, and brokage/misbehaving of gadgets. Regarding the workflow feature, participants complained that some workflows like trace and supervision workflows were not performing as they used to be for paper based, which was challenging. For the form length, participants complained that the form length was restricted to screen size. For the muted feature, which was designed to exclude certain data that the users do not want to consider, participants complained it does not work properly. For example, the muted Households were still being calculated when totaling their (CHWs) performance. The challenges faced and features disliked could be attributed to the system being under development, and participants have not been using it for long, and gadgets being of poor quality. Prior studies showed similar results, where the durability of the devices posed a challenge to the mHealth implementation. In one mHealth program, 60% of phones had broken down (Watkins et al., 2013). Another study showed that users face challenges using mHealth when it is new but eventually gain experience after a certain period of time using the system (Gatara & Cohen, 2014). For mHealth, Yendanafe system, it is recommended that someone in the technical know-how should do regular check-ins with the users to help them with the challenges they are facing.

Conclusively, the research findings showed that the mHealth, Yendanafe system has increased the percentage of program indicators captured and has been helpful to the program implementation for assessing CHWs performance and most program indicators. However, there is a need for improvement in supervision to check if activities and reporting are being done. There is also a need for improvement in using the system to assess program indicators performance and the need to address the challenges of poor communication to the users about any change in the data system and lack of good documentation of data dictionary. The workflow, data sync, form length, and muted features of the Yendanafe system that were disliked need to be improved too. Thus, it is recommended that the software development team should modify the system features to address the challenges.

Challenges and limitations

This study had some challenges and limitations. First, the study did not provide specific reasons

as to why implementers did or did not use the system to assess performance, which could have helped in the evaluation of the system, especially to know if some indicators could not be used to assess performance due to the system or other factors. Second, the study used secondary data, and human error in data entry could not be checked, which could affect the accuracy of the data, hence affecting the results and conclusions. Lastly, the study did not assess if the new system made it easier for the implementers to assess performance than paper-based system. Although the study had these challenges and limitations, it provided a basis for more future studies and evaluation on mHealth, Yendanafe system.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

Conclusion

The study aimed at assessing the effect of mHealth, Yendanafe system on report completion and program indicators, and assessing the utilization of mHealth, Yendanafe system in CHWs and program indicators performance assessment. The findings showed that the system did not change the monthly report completion rate but increased the percentage of program indicators captured compared to paper-based system, which showed that Yendanafe has a capacity to capture more program indicators than paper-based system. The findings also showed the majority of the respondents used the Yendanafe system to assess CHWs performance, but less were using the system to assess program performance. Some implementers had some challenges using the system and did not like some of the features.

Recommendations

According to the research findings, it is recommended that:

- Future studies should be conducted to assess why the implementers did not use mHealth, Yendanafe system to assess specific program indicators performance, and if the system improved the household model and addressed the challenges caused by using paper-based tools.

- Another study should be conducted to see how much time it takes users to complete reports.

- There is a need for improvement in supervision to check if activities and reporting are being done.

- Partners In Health Malawi needs constant feedback from the mHealth, Yendanafe system implementers about how the system is functioning. There is a need for cost assessment to scale up the mHealth, Yendanafe system.

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APPENDICES

Report completion data collection form (Appendix 1) Catchment area……

	Report completion	
Months	**# of fields required**	**# of fields completed**
September 2017		
October 2017		
November 2017		
December 2017		
January 2018		
February 2018		
March 2018		
April 2018		
May 2019		
June 2018		
July 2018		
August 2018		
September 2018		
October 2018		
November 2018		
December 2018		
January 2019		
February 2019		

March 2019		
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March 2020		
April 2020		
May 2020		
June 2020		
July 2020		
August 2020		
September 2020		
October 2020		
November 2020		
December 2020		
January 2021		
February 2021		

March 2021		
April 2021		

Program indicators data collection form (Appendix 2)

Program indicator name	**Paper-based**		**mHealth, Yendanafe**	
	Captured		**Captured**	
	Yes	**No**	**Yes**	**No**
Total households visited				
Total households registered				
Total facility-based deliveries				
Total home deliveries				
Total accompanied first ANC				
Number of under 5 children in CMAM				
Number of TB patients enrolled				
Pregnant or postnatal women who died				
CMAM clients under 5 who died				
Registered TB clients who died				
Total number of referral and accompaniments				
Total CHWs received Supervision				
Total number of CHW				
Total households SCHW visited during CHW SMSc				
Number of CHW received Supervision x3				
Total number of coughers				
Total number of SCHW x4				
Total number of NEW TB cases this month				

Total SCHWs received supervision				
Total households SS visited during SCHW SMSc				
Number of SCHW received supervision x3				
Total clinical participants in facility review meeting				
SCHWs present during SS-SCHW Monthly Meeting				
Total number of SCHW				
Total SS-HSA check-ins				
Total SIGNED top halves - referral and accompaniment				
Top halves referral & accompaniment - signed and unsigned				
Clients referred for POSER support				
Partners in catchment area				

Survey (Appendix 3)

Participant name: ……

Position: …….

In the last three months, how often did you use mHealth, Yendanafe system to assess the following Community Health Workers permanence (CHWs) indicators? (Please rate yourself in the table below by ticking in category that matches your answer).

Name of CHW's indicator	**Always**	**Sometimes**	**Rarely**	**Never**
# Total CHWs				
# of CHWs active during the period				
% of CHWs active on app during the period				
% of pregnant women visited				
% of births happened at home				
# of children screened for malnutrition				
# of children screened for danger signs				
# of women of reproductive screened for FP				
# of screenings for NCDs conducted				
# of people screened for HIV				
# of suspected TB found positive				
# of new TB cases identified				
Proportion of households visited				
Proportion of SCHWs meeting their coughers sample targets				

Proportion of traced Patients successfully found				
CHW activity status (Active/Inactive)				
# of total households				
# of total registered HH members				
% of HH visited				
% of pregnant women visited				
% of PNC Women Visited				
% of under 5 visited				
% of FP screening				
% of malnutrition screening				
% of TB visited				
% of HIV visited				
% of referrals followed up by the CHW				
% of HH members visited				

In the last three months, how often did you use mHealth to assess performance of the following program's indicators? (Please rate yourself in the table below by ticking in category that matches your answer).

Name of program's indicator	Always	Sometimes	Rarely	Never
Total households visited				
Total households registered				
Total facility-based deliveries				
Total home deliveries				
Total accompanied first ANC				
Number of under 5 children in CMAM				
Number of TB patients enrolled				
Pregnant or postnatal women who died				
CMAM clients under 5 who died				
Registered TB clients who died				
Total number of referral and accompaniments				
Total CHWs received Supervision				
Total number of CHW				
Total households SCHW visited during CHW SMSc				
Number of CHW received Supervision x3				
Total number of coughers				
Total number of SCHW x4				
Total number of NEW TB cases this month				
Total SCHWs received supervision				
Total households SS visited				

during SCHW SMSc				
Number of SCHW received supervision x3				
Total clinical participants in facility review meeting				
SCHWs present during SS-SCHW Monthly Meeting				
Total number of SCHW				
Total SS-HSA check-ins				
Total SIGNED top halves - referral and accompaniment				
Top halves referral & accompaniment - signed and unsigned				
Clients referred for POSER support				
Partners in catchment area				

a) Do you have any challenges using mHealth, Yendanafe system? Please tick a box of your choice.

☐ Yes

No ☐

b) If yes, what are the challenges.

Answer:

a) What features do you like about mHealth, Yendanafe system?

Answer:

b) What feature do you not like about mHealth, Yendanafe system?

Answer:

Information and consent form (Appendix 4) Participant ID: __

Project title: Assessing the functionality and utilization of the mHealth, Yendanafe electronic mobile reporting system in community health and clinical programming in Neno district, Malawi.

Study population: paper based and mHealth, Yendanafe system reports and mHealth, Yendanafe system implementation team at PIH-Malawi.

Principal Investigators:

Elissa Dushime, Bachelor of Arts in Healthcare Management

Dorothy Mkwezalamba, Bachelor of Science in Health Management, Diploma in Clinical Medicine.

Master of Science in Global Health Delivery candidates at the University of Global Health Equity.

This research is being conducted as part of our fulfillment for the Master of Science in Global Health Delivery at the University of Global Health Equity (UGHE). The research team has gotten the necessary approval from UGHE IRB in Rwanda and the Neno District Health Research Committee in Malawi and complies with international ethical standards of research.

About this consent form

Dear participant,

You are being invited to take part in this study, which aims at assessing the functionality and utilization of the mHealth, Yendanafe electronic mobile reporting system in community health and clinical programming in Neno District, Malawi. Before joining the project in question, you must understand and take into consideration the contents of this form, since it contains important information to assist you in deciding whether to participate or not. Please take your time in choosing whether to participate in this research or not. Please feel free to ask any question regarding this research or about this form. If you agree to participate, you will sign this form and be given a copy for your records.

Participation is voluntary.

It is your choice whether to participate in this project or not. If you choose to participate, you may change your mind and leave the study at any time. Refusal to participate or stopping your participation will involve no penalty or loss of benefits to which you are otherwise entitled. Note that this survey is solely for the purpose of research and not for performance assessment.

What should you know about this research study?

The aim of this study is to assess the effect of the mHealth, Yendanafe system on report completion, case tracking and program performance assessment in Neno district, Malawi. As you are part of the mHealth, Yendanafe system implementation team, you are being asked to take part in this study to help us assess utilization of the tool in human and program indicators' performance assessment.

What is the purpose of this project?

The purpose of this project is to assess the effect of the mHealth, Yendanafe system on report completion, case tracking and program performance assessment in Neno district, Malawi. Since the mHealth, Yendanafe system has been in its pilot stage from June 2019, its scale up has been slow and the evaluation on the system has not been conducted. The results of this study will determine the possibility of scaling up the tool in the whole of Neno district. The objectives of the study are to assess the effect of mHealth, Yendanafe system on report completion rate, CHWs and indicator performance, and assess case tracking for HIV and malnutrition case enrollment and referrals compared to paper-based system by July 2021.

How many people will take part in this research?

All mHealth, Yendanafe implementation team at PIH-Malawi who have been in the current job for at least six months will be included. However, the Implementation team members who have been on leave for a month or more during the past six months will not be part of this research.

What is the procedure for participation in this project?

If you choose to participate in this study, you will be asked to take part in a survey. The research team will take you through all the questions in the survey where you will provide your answers regarding your usage of mHealth, Yendanafe system in assessing performance of Community Health Workers and programs' indicators. The survey should take you approximately between 25 to 30 minutes.

What are the possible risks or discomforts related to taking part in this project?

The research does not pose any physical foreseeable risks to the participants. However, psychologically, participants may perceive this as a performance assessment. Therefore, we would like to assure everyone that this survey is solely for research purposes. No names or any identifiable information will be collected.

What are the possible benefits of taking part in this project?

If you choose to participate, you will not receive any direct benefits. However, you will be helping to improve the development of mHealth, Yendanafe system which is intended to improve community health and clinical programs in Neno district. This could potentially lead to improved health for your family and community.

What are my alternatives to participating in this study?

Your participation is voluntary; thus, you have the right to choose not to participate.

Will I be compensated for participating in this research?

You will not be compensated for participating in this study.

What will I have to pay for if I participate in this research?

It will not cost you anything to participate in this research.

What happens if I am injured as a result of participating in this research study?

The research study does not pose any risk of physical injury to the participants.

Can my taking part in the research end early?

You may decide not to continue in the research at any time without it being held against you. The person in charge of the research can remove you from the research at any time without your approval for any reason. If you decide to leave the research, contact the research team.

If I take part in this project, how will my privacy be protected? What happens to the information you collect?

The information will not have your name on it. Data collected may be seen by the Neno District Health Research Committee and UGHE Institutional Review Board (IRB), which oversee the research. To ensure protection of privacy and confidentiality, only the research team will have access to raw data from the surveys, and only aggregated results will be shared with any third parties. All paper documents will be locked in the UGHE office, and digital data will be stored in a password protected folder on researchers' computers, and data will be destroyed after 10 years.

The research findings will be shared with UGHE as part of academic fulfilment and with PIH Malawi by 17th August 2021. Results will be shared through reports and presentations.

If I have any questions, concerns, or complaints about this project, who can I talk to?

If you have any questions, concerns, complaints about the project during the research time, or you think the project has harmed you in any way, and wish to withdraw from the study, or you would like to talk to the research team about the study, please feel free to contact us.

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This research has been reviewed by the Neno District Health Research Committee and the University of Global Health Equity Institutional Review Board. If you wish to speak with someone from the IRB regarding any ethical issues, please contact the Neno District Health Research Committee Secretary at mmulwafu@pih.org, telephone: +265 999 291 047.

If your questions, concerns, or complaints are not being answered by the research team. If you cannot reach the research team.

If you want to talk to someone besides the research team.

If you have questions about your rights as a research participant, or. If you want to get information or provide input about this research.

Statement of consent

Your signature or fingerprint below indicates that:

You have understood the content of this form.

You have had the opportunity to ask questions and received answers that were satisfactory.

If needed, you took time to discuss this information with others to help you decide whether to participate.

You will receive a dated and signed copy of the form. You agree to participate in this research project.

Full name and signature of the witness	Date and location
Full name and signature of the person requesting consent	Date and location

I have read the information in this consent form including risks and possible benefits. All my questions about the research have been answered to my satisfaction. I understand that I am free to withdraw at any time without penalty or loss of benefits to which I am otherwise entitled.

I consent to participate in the study.

SIGNATURE