

Evaluation of the Implementation Process of the Mobile Health Platform ‘WelTel’ in Six Sites in East Africa and Canada Using the Modified Consolidated Framework for Implementation Research (mCFIR)

Samia El Joueidi (✉ samia.joueidi@ubc.ca)

UBC: The University of British Columbia <https://orcid.org/0000-0001-5749-111X>

Kevin Bardosh

University of Washington Seattle Campus: University of Washington

Richard Musoke

UBC: The University of British Columbia

Binyam Tilahun

University of Gondar

Maryam Abo Moslim

UBC: The University of British Columbia

Katie Gourlay

University of Alberta

Alissa MacMullin

UBC: The University of British Columbia

Victoria J. Cook

BCCDC: BC Centre for Disease Control

Melanie Murray

UBC: The University of British Columbia

Gilbert Mbaraga

WE ACTx for Hope

Sabin Nsanzimana

Rwanda Biomedical Center

Richard Lester

UBC: The University of British Columbia

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Abstract

Background: Health systems globally are investing in integrating secure messaging platforms for virtual care in clinical practice. Implementation science is essential for adoption, scale-up, spread and maintenance of complex evidence-based solutions in clinics with evolving priorities. In response, the mHealth Research Group modified the existing Consolidated Framework for Implementation Research (mCFIR) to evaluate implementation of virtual health tools in clinical settings. WelTel® is an evidence-based digital health platform widely deployed in various geographical and health contexts.

Objectives: To identify the facilitators and barriers for implementing WelTel and to assess the application of the mCFIR tool in facilitating focus groups in different geographical and health settings.

Methodology: Both qualitative and semi-quantitative approaches were employed. Six mCFIR sessions were held in three countries with 51 key stakeholders surveyed. The mCFIR tool consists of 5 Domains and 25 Constructs and was built and distributed through Qualtrics XM. “Performance” and “Importance” scores were valued on a scale of 0 to 10 (Mean \pm SD). Descriptive analysis was conducted using R computing software. NVivo 12 Pro software was used to analyze mCFIR responses and to generate themes from the participants’ input. Semi-structured interviews were conducted with the focus group facilitators to understand their experience using the mCFIR tool.

Results: We observed a parallel trend in the scores for Importance and Performance. Of the five Domains, Domain 4 (End-user Characteristics) and Domain 3 (Inner Settings) scored highest in Importance (8.9 ± 0.5 and 8.6 ± 0.6 , respectively) and Performance (7.6 ± 0.7 and 7.2 ± 1.3 , respectively) for all sites. Domain 2 (Outer Setting) scored the lowest in both Importance and Performance for all sites (7.6 ± 0.4 and 5.6 ± 1.8). Areas of strengths included timely diagnosis, immediate response, cost-effectiveness, user-friendliness, and simplicity. Areas for improvement included training, phone accessibility, health authority’s engagement, and literacy.

Conclusion: The mCFIR tool allowed for a comprehensive understanding of the barriers and facilitators to the implementation, reach, and scale-up of digital health tools. Participants emphasized the importance of creating partnerships with external organizations and health authorities in order to achieve sustainability and scalability.

Trial Registration:

NCT02603536 – November 11, 2015

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Contribution To The Literature

This research addresses a gap in the field of implementation science with relation to digital health tools. In the current climate, adoption of virtual care tools has significantly increased with little research

focused on its implementation efficacy. We provide a guide for mHealth researchers and implementers on how to use our previously published mCFIR tool for digital health implementations. Implementation Science is the ideal journal for us to submit our findings to, as our paper aligns with the paper's scope and readership regarding incorporating novel interventions into routine healthcare contexts.

Background

Mobile Health (mHealth) is the provision of health services and healthcare support via mobile devices (1)]. The substantial increase in the global mobile phone penetration rate, reaching 90% in 2017 (2)], as well as the advancement of mobile technologies, led to the emergence of the mHealth field in 2006 (3)]. The incorporation of mHealth into healthcare delivery in the past decade is revolutionary with numerous stakeholders invested in mobile technology for health purposes (4)]. Although a number of these interventions have shown efficacy and success in global health settings, a select few have reached scalability (5)]. Understanding diverse stakeholders is a key factor to drive effective scale-up and spread (SUS) of mHealth interventions [4, 5]. Implementation science is an emerging field of research that focuses on describing each step of the implementation process of a health intervention with emphasis on the barriers and facilitators of the innovation aiming to increase in scale in targeted communities [6–9].

The Consolidated Framework for Implementation Research (CFIR) is a framework developed to assess the effectiveness and efficacy of the implementation process of health interventions across different stages of implementation (6)]. In 2015, a mobile health specific version of the CFIR, the modified CFIR (mCFIR), was developed by the Mobile Health Research Group at the University of British Columbia (UBC) to facilitate formative and summative evaluation of mobile health interventions and guide future practices and scale up of interventions (7)]. The mCFIR reframed the Constructs from the perspective of mHealth. A scoring system was added for each Construct to rate the Importance and Performance of the various aspects of the implementation process.

WelTel was the world's first digital health platform to utilize text messaging between patients and providers and first to demonstrate improvement in health outcomes(8). For the past 15 years, WelTel has been implemented in various health contexts in East Africa, the United States, and in Canada, within both urban and rural communities [11, 13]. In Northern Kenya, WelTel has been used to address suboptimal access to health services including vaccination access and antenatal care (9). In Rwanda, WelTel has been implemented in Human Immunodeficiency Virus (HIV) clinics to improve adherence to antiretroviral therapy and enhance patient engagement with care (9). In Canada, WelTel has been implemented for HIV, asthma, and tuberculosis care, and in rural areas to support primary care clinics.

This paper examines the implementation of WelTel across six sites, three being in East Africa and three in Canada. The objectives are: 1) To identify the facilitators and barriers to the implementation of WelTel in relation to scale up, and 2) to assess the experiences of using the mCFIR to collect and analyze data of focus group discussions, and to provide a guide for mHealth researchers and implementers on how to use the mCFIR tool for digital health implementations.

Methods

Overview of intervention

WelTel is a digital health communication tool that allows patients to communicate with healthcare providers (physician, nurses, public health officers, etc.) via short message service (SMS), voice and video call. The WelTel tool is based on an open-ended ‘check-in’ model, based on an “Ask, Don’t Tell” approach, in which patients receive a SMS asking them “How are you?”(10). Patients can respond at any time and reach a health care provider (HCP). In turn, responses are automatically sorted into categories for the HCP to review and triage. HCPs can respond via the dashboard using SMS, phone or video. HCPs can utilize other patient support and data collection features present within WelTel.

Overview of intervention sites

A total of six sites were selected for the implementation research study. Two of the sites are in Samburu County in rural Kenya, one in Kigali, Rwanda, two in Vancouver, Canada, and one in Haida Gwaii, a remote island on the Northwest coast of British Columbia (BC), Canada. The following is the description of each of the sites to understand the context of the implementations. Table 1 captures the timeline of each of the implementation sites.

Maralal Referral Hospital, Kenya – It is one of the largest hospitals in Samburu County, located in Kenya’s vast Northern Arid Lands. The hospital offers a range of services to thousands and caters to the rural population of Samburu Country where patients, including many traditional pastoralists, travel long distances for the procurement of healthcare services. According to the 2014 Kenya Demographic and Health Survey, 52.7% of deliveries in Samburu were attended by a friend or relative, whereas only 29.1% deliveries were attended by skilled practitioners (11)]. In July 2016, WelTel was introduced to Maralal Referral Hospital and integrated into the antenatal care clinics (ANC), immunization clinics (IMMC), and comprehensive care clinics (CCC). WelTel was implemented with the goal of improving patient engagement and adherence to treatment (9). Since 2016, around 2000 patients have been enrolled to the platform and followed up for adherence.

Wamba Health Center (WHC), Kenya – WHC is located in Wamba, a rural town in Samburu County. WHC provides inpatient and outpatient health services to the population (~10, 000) living in and surrounding Wamba (12). Based on positive outcomes observed in Maralal, in September 2018, WelTel was scaled up to two other clinics in WHC. Since then, around 500 patients have been enrolled on the platform. WelTel has been implemented in maternal, neonatal, and child health programs.

We ACTx for Hope, Rwanda – WE-ACTx is a local community-based HIV/AIDS initiative in the capital city of Rwanda, Kigali (13). The project was launched in 2004 in response to an urgent global appeal from Rwandan genocide survivors to access HIV/AIDS medications. Today, a dedicated team of Rwandan HCPs operate their own Non-Governmental Organization (NGO) – the WE-ACTx for Hope clinic. WE-ACTx provides HIV care and treatment services to more than 2000 patients in Kigali, including women (67%)

and adolescents (20%). In 2017, WelTel was successfully introduced into the clinic with the support of the Rwanda Biomedical Centre (RBC). Over 1000 patients, including youth and key populations, have been enrolled since (14).

Tuberculosis (TB) Clinic, Vancouver – A scale-up project was launched following a randomized clinical trial of the use of WelTel for Latent TB Infection (LTBI) at the BC Center for Disease Control (15)(16). A total of 132 patients were enrolled on the platform between 2017 and 2019.

Oak Tree HIV Clinic, BC Women's Hospital (BCWH), Vancouver – Oak Tree Clinic is a provincial tertiary care center located at the BCWH in Vancouver. The clinic provides multidisciplinary care for women, children and families living with HIV. Between 2012 and 2020, a pilot program was conducted at the Oak Tree Clinic to explore the use of WelTel as a digital health tool where a repeated measures study found the intervention achieving improved viral suppression among vulnerable populations (17)(18)(19). A total of 106 patients have been enrolled on the platform since inception.

Xaayda Gwaay NgaaysdII Naay – Haida Gwaii Hospital & Health Centre, Dajing Giids – Queen Charlotte, Haida Gwaii – Haida Gwaii is an island located off the Northwest Coast of BC, the traditional territory of the Haida Nation. In April 2017, a pilot of WelTel was conducted at Xaayda Gwaay NgaaysdII Naay, Haida Gwaii Hospital and Health Centre in Dajing Giids, Queen Charlotte. This hospital is one of two on the island and serves nearly 3000 patients from 5 communities, including the neighboring Haida community of HIGaagilda – Skidegate. There are four practices (A – D) and a total of 7 Family Physicians. At 17-months, 138 patients were enrolled in WelTel, utilizing the service for chronic disease management through symptoms management & assessment, data sharing, prescription refills, and appointment scheduling and reminders. WelTel is still being implemented in Haida Gwaii and the number of patients and practices using the platform continues to increase. This is the first application of a bidirectional texting service in BC's primary care system.

mCFIR framework

The original CFIR unified 19 published implementation theories to provide researchers with a range of Constructs (n=39) within five domains to promote effective implementation: *inner setting*, *outer setting*, *intervention characteristics*, *implementation characteristics* and *characteristics of people involved* (6). The mCFIR tool, developed by the UBC mHealth Research Group, digitalized key Constructs within the domains, introducing a scoring system for Importance and Performance of each Construct for the implementation goal that can be re-evaluated over time. The tool consists of five key Domains and two subdomains adapted in its Constructs to include a scoring element for relative comparisons (7). The Domains are 1) Intervention Characteristics, 2) Outer Settings, 3) Inner Settings, 4a) End-User Characteristics – Health Care Providers, 4b) End-User Characteristics – Patients, and 5) Implementation Process. The subdomains are 1) Goal Attainment Scale, and 2) Impact Assessment. Each Domain consists of a number of topics formulated as questions and each question is followed by the Performance and Importance scale to rate from 0 to 10. For additional information, please refer to appendix A-1.

mCFIR session protocol

The mCFIR tool was imported into Qualtrics Survey Software with electronic and paper copies created for the convenience of the participants with sessions taking between 2 to 3 hours. First, participants are asked to collectively identify the health issue being addressed through the implementation of WelTel, the mHealth platform used, and the implementation goals the site would like to achieve to reach their desired outcomes. The facilitator presents one Construct at a time as a question and invites discussion amongst the stakeholder attendees. A note taker is present to take detailed observational notes and the mCFIR session is also audio-recorded if consent is unanimous. After each Construct, the participants are asked to include their anonymous comments via Qualtrics. Participants are then asked to rate, on scale from 0 to 10, the Performance and the Importance of the Construct discussed. This process is repeated for every Construct for all Domains of the mCFIR tool. Scores of the Performance and Importance of each Construct are captured through the Qualtrics Survey tool.

Data analysis

Both qualitative and quantitative data analyses were conducted. For quantitative analysis, survey data were exported from Qualtrics in csv and imported into Microsoft Excel (2019), and then analyzed by R computing software using the ggplot2 package. For data cleaning, qualtrics, tidyverse, and dplyr packages were used. For data visualization, ggplot2 and ggpubr were used. Quantitative data including Performance and Importance scores are reported as Mean \pm Standard Deviation (SD). For qualitative analysis, survey comments were exported from Qualtrics and then imported into NVivo 12 Pro software where thematic analysis was conducted following an inductive or exploratory approach. mCFIR session notes were also imported into NVivo. Audio recordings were transcribed manually and then analyzed in NVivo. The responses were coded, grouped into themes, and divided into two major categories: 1) Strengths & Benefits, 2) Barriers & Suggestions. The mCFIR tool, protocol, and analysis frameworks are made available for site leaders and researchers upon request.

Ethical approval

The study was approved by the University of British Columbia's Clinical Research Ethics Board (H17-03414, H12-03002, H17-00074& H16-00189), Rwanda Biomedical Center Review Committee, and AMREF in Kenya Ethics & Scientific Review Committee (ESRC).

Results

Six mCFIR sessions were held between August 2019 and January 2020 with four facilitators moderating them. There were 51 participants attending the mCFIR session, where 49 responses were recorded through Qualtrics and two surveys were either missing or not recorded. mCFIR surveys originally captured on paper surveys were manually inputted into Qualtrics post-session.

Participants were selected from a diverse group of stakeholders with the help of site leaders in order to have a comprehensive representation of the community (Table 2). A policy maker role was assigned to a participant if they were affiliated with health authorities or held a leadership position with relations to policies and/or finance. An external stakeholder role is assigned to a participant who works within the health or mHealth sector pertinent to the health issues the clinic addresses but is not a member of the HCP/clinic. The Implementation Manager is the individual in the clinic who coordinates or manages the WelTel implementation on site. Healthcare provider (HCP) can be either physicians, nurses, or medical social workers who are using WelTel to communicate and follow-up with patients. Patients are the end user of WelTel, the one receiving the messages and calls to their devices.

More participants attended the mCFIR session in East Africa than in Canada. The majority of participants fell under the end user categories, HCPs and patients. More interest was requested from external stakeholders in Rwanda to attend the mCFIR session to better understand and assess WelTel's intended health setting for scale up purposes. The variability in the type of participants attending each mCFIR session site is reflected in the results. The TB Clinic and Haida Gwaii Hospital had no patient attendance. The patient Constructs in the Haida Gwaii session were answered by the attending participants from the perspective of the patient. The Haida Gwaii hospital site sited next steps as redoing the mCFIR focus group with patient participants.

Each site was asked to identify health issues and implementation goals at the beginning of the mCFIR sessions. Most of the goals identified revolved around access to HCPs outside of regular visits and treatment follow-up (Appendix A-2).

Importance & Performance Scoring

During the mCFIR sessions, each participant was asked to rate the Performance and Importance of each Construct on a scale of 0 to 10 (Figures 1-5). The heat map in Figure 1 presents the scores of Performance and Importance reported per site for each of the five Domains. Scores are displayed following a turquoise spectrum (from pale to dark turquoise). The pale turquoise represents the Domains that scored lowest in terms of Importance and/or Performance, and the dark turquoise represents the Domains that scored highest for Importance and/or Performance.

Nearly all sites rated all Domains high for Importance (Figure 1). Notably, a darker gradient is observed across Domain 4A "End users - HCP" for all sites (mean=8.9; STD=0.5). Comparatively, we observe a lighter gradient across Domain 2 "outer settings" for all sites as well (mean=7.6; STD=0.2). Oak Tree gave the highest ratings for most Domains (mean=9; STD=0.7). As for the overall Performance, we observe the darkest color gradient for Domain 4A "end users HCP", (mean=7.6; STD=0.7). We also observe a lighter gradient across Domain 2 (outer settings), (mean=5.6; STD=1.8), and Domain 5 "implementation process", (mean=6.4; STD=1.4). The Rwanda and Wamba sites rated Performance highest for most Domains. Given no patients attended the mCFIR sessions in the TB Clinic, the team chose not to fill out Domain 4B "end users patients", represented in the graph as a white 'X' box.

Performance and Importance scores per site

Figure 2 represents the rating of the various Constructs of each site to better understand which areas act as either facilitators or barriers when implementing WelTel's platform in each of the intended settings.

For the Maralal site in Kenya, a total of 6 out of the 23 Constructs were rated on the higher end of the scale. These 6 Constructs include: Domain 1 "Comparative Advantage", Domain 3 "Acceptance", Domain 4 "Benefit Perception" and "Privacy", Domain 4B "Benefit Perception" and "Language". As for the Wamba site, 19 out of the 23 sites were rated high in Performance. The Constructs that rated on the lower end of the Performance scale were Domain 2 "Stakeholder Engagement", Domain 4A "Training", Domain 4B "Accessibility" and "Language". As for Rwanda, 22 out of 23 Constructs were rated high in Performance. Domain 2 "Stakeholder Engagement" was the Construct with the lowest rating.

As for the Canadian sites, Oak tree rated 11 out of 23 Constructs on the lower end of the Performance scoring scale. The Constructs were Domain 1 "Affordability", Domain 2 (all three Constructs), Domain 3 "Organizational Support", Domain 4A "Privacy", Domain 4B "Accessibility", Domain 5 (all 4 Constructs). TB Clinic rated 10 out of 23 Constructs on the lower spectrum of the Performance scoring scale. The Constructs were with regards to Domain 1 "Affordability", Domain 2 "Stakeholder Engagement" and "External Support", Domain 3 "Acceptance", Domain 4 (all three Constructs), Domain 5 (all Constructs except "Execution". For the Haida Gwaii site, most Constructs were rated on the lower spectrum of Performance except for Domain 1 "Comparative Advantage", and Domain 4A "Privacy".

Performance and Importance scores by participant type

Figure 3 presents the reported scores of Importance and Performance per participant type for all three East African sites. The highest Importance ratings were provided by healthcare providers (HCPs) and policy makers, followed by external stakeholders.

In terms of Domains, Domain 4A "End users HCP", Domain 1 "Intervention Characteristics", and Domain 3 "Inner Settings" received the highest scoring. The highest Performance scores were provided by policy makers followed by patients and HCP. External stakeholders scored lowest in terms of Performance. Similarly, WelTel implementation managers scored most Domains lowest except for Domain 1 "Intervention Characteristics". Domain 2 "Outer Settings" was ranked lowest by WelTel managers and ranked highest by policy makers. Whereas, Domain 4B "Patients" was ranked lowest by external stakeholders and highest by patients.

High and low Constructs for the three East African sites

Figure 4 represents the Constructs rated high or low in terms of Performance and Importance per participant type for all three East African sites. The heat map presents the Constructs that are perceived as either facilitators or barriers from the perspective of all participant types. External stakeholders rated 9 out of 23 Constructs high in Performance. These Constructs pertained to Domain 1 "adaptability", Domain 2 "External Support", Domain 3 "Acceptance", Domain 4 "Benefit Perception" and "Privacy",

Domain 4B “Benefit Perception”, and “Language”, Domain 5 “Execution”. As for HCP, they rated 6 out of 23 Constructs low in Performance . These Constructs were in relation to Domain 1 “Affordability”, Domain 2 “Stakeholder Engagement” and “Scale-up Support”, Domain 3 “Organizational Support”, Domain 4B “Accessibility”, and Domain 5 “Evaluation”. Patients rated 7 out of 23 Constructs low in Performance . Constructs were the following, Domain 1 “Adaptability”, Domain 2 “Stakeholder Engagement”, Domain 3 “Organizational Support”, Domain 4A “Benefit Perception”, Domain 4B “Language”, Domain 5 “Intervention Planning”, “Evaluation”. Policy makers rated 4 out of 23 Constructs low in Performance . The Constructs were in relation to Domain 2 “External Support”, Domain 4A “Training”, Domain 4B “Privacy”, Domain 5 “Evaluation”. WelTel implementation managers rated 7 out of 23 Constructs low in Performance . The Constructs were with regards to Domain 2 “Stakeholder Engagement” and “Scale-up Support”, Domain 4A “Training”, Domain 4B “Accessibility”, Domain 5 “Intervention Planning” and “Execution”.

Performance of Domain 1 “Affordability” was rated highest by WelTel implementation managers. Domain 4B “Training” and “Privacy” were rated highest by patients and lowest by external stakeholders.

Overall Performance rated against implementation goals

Figure 5 presents the reported Performance scores for “Goal Attainment” and “Impact Assessment” per site. At the end of the mCFIR sessions, the team revisits the implementation goals identified at the beginning of the session and are asked to rate their overall Performance in achieving their desired goals and outcomes. A total of 5 of the 6 sites filled out these two Constructs due to time constraints; with 28 entries recorded for the goal attainment scale and 26 recorded for the impact assessment. Only half of the participants were able to complete the survey and fill out the last two Constructs. The highest score given for Performance for goal attainment and impact assessment was from Rwanda. The lowest Performance rated was from TB Clinic.

Qualitative Analysis

Participant inputs during the mCFIR session, summarized in the tree map in Figure 6, were first divided into two major categories, 1) Strengths & Benefits, 2) Barriers & Suggestions. Subsequently, sub-themes were Constructed for each category. The Participant responses included a combination of evaluation of the intervention (WelTel) and evaluation of the implementation process itself. The larger the area size on the tree map, the greater the proportion. Table 3 and Table 4 highlight some of the statements made by the participants during the mCFIR session.

Strengths & Benefits

The main sub-themes discussed by participants regarding the first major category, Strengths & Benefits of WelTel's implementation were the following:

1. Timely Diagnosis & Response – Participants shared the convenience of communicating and addressing health issues in a timely matter from home. A mother from Maralal, Kenya said that the

platform “is real-time”, and that she was able to communicate with her HCP whenever she faced a health issue. Policymakers mentioned how the WelTel's platform has assisted them with “timely identification of opportunistic infections”.

2. Cost-Effectiveness – Policymakers highlighted the advantage of not requiring additional human resources for the implementation of the digital health platform WelTel. Communicating with patients through the platform has been incorporated into their care process. Patients did not incur any costs when texting their HCPs which has been considered a motivation for enrollment.
3. User-Friendliness – The implementation team managers and other end-users including clinicians reported the ease of using the platform. Patients did not require training as they only needed to reply via SMS to the check-in messages.
4. Security & Safety – Patients are the only ones who understand the intention of the “How are You?” message received. They have highlighted how their privacy is respected since the language of the message does not reflect their health status.
5. Appointment Attendance – The use of WelTel texting service to remind patients of their appointments has been highlighted as a benefit by external stakeholders as patients tend to lose their health cards that hold their appointment dates.

Barriers & Suggestions

As for the second major category, Barriers & Suggestions, several sub-themes emerged. Issues regarding phone accessibility, literacy, partnerships with stakeholders, staff training, and scale-up of the program were discussed as major barriers to the implementation of WelTel:

1. Phone Accessibility – Some patients share phones with a family member. This has been highlighted as a potential barrier as these patients might not be reached at all times.
2. Literacy – Literacy is a challenge amongst certain patient groups. It creates a barrier by hindering patients' ability to text back to the platform and share their issues and concerns.
3. HCP Training – Further training has been requested by HCPs to independently train new staff members on the digital health intervention being implemented.
4. Scale-up – Participants expressed the desire to scale up the project to other health departments and regions.

I. mCFIR Tool Experience & Effectiveness

This section reports on the use of the mCFIR as an implementation science tool in a focus group like setting. A total of four trained facilitators were present to moderate the focus group discussions. Semi-structured informal interviews were held over videoconference to understand the experience of applying mCFIR as a tool to facilitate the discussion on implementation assessment. In this section of the paper, the process followed by facilitators and the research team to collect, analyze, and share data with the implementing clinics will be described.

Pre-mCFIR session

A set of slides were prepared to provide a background on the digital health platform being discussed, the field of implementation science, and the mCFIR tool. A note taker was assigned to assist the facilitators by taking observational notes of the session and discussion. Multiple rounds of mock mCFIR sessions were held with the UBC mHealth Research Group to pilot the tool, the Domain questions, and estimate session length. The team concluded that the mCFIR tool would require approximately 2 hours to be completed with 8 stakeholders. The mCFIR surveys were built into Qualtrics survey software. Sites were identified if they were currently implementing the digital health tool of interest. Participant recruitment was conducted through the clinic staff with the medical director of the clinics identifying patients and HCPs who might be interested and available to participate. External stakeholders and policy makers were either identified by the clinic staff or by the research team staff. In the 3 Canadian sites, only patients participating were given honorariums for their attendance. All participant types in East Africa were given honorarium to compensate for expenses incurred or time spent to attend. The sessions were audio recorded if all participants provided consent. Tablets were made available by the research team for the sessions conducted in Canada. The session facilitators shared the consent form and survey links with the participants prior to the session for convenience.

mCFIR session

At the beginning of the session, the facilitator collects consent from participants, including consent to record the discussion. Afterwards, the participants are asked to introduce themselves, their profession and experience with the digital health platform being discussed or any other digital health platforms. The facilitator goes through the set of slides to provide background to the purpose of the session. Afterwards, the participants are asked to collectively identify implementation goals the team would like to work on in the upcoming 4 to 6 months. After identifying the goals, the facilitator guides the discussion using the mCFIR tool. One Construct at a time was presented in the form of a question. During the group discussion, participants are encouraged to put the survey aside, and share their thoughts with the group. After discussing a certain Construct, the facilitators ask the participants to score the Importance and Performance of the Construct being discussed anonymously on the Qualtrics survey. This process was repeated for each Construct, by order of Domain. At the end of the session, the participants are asked to rate the goal attainment and impact assessments of their goals and outcomes. The sessions' duration varied from 2 to 3.5 hours. The note taker's role during the session was to support the facilitator, keep track of time, and take notes of the discussion being held as well as any observations.

Post mCFIR Session

After the session, the facilitator and note taker met to reflect on the session, share notes and develop a summary report of the discussion. The report was intended to be shared with the research team, clinic directors, and participants. Additionally, the report includes a snapshot of the session and major points brought up by the participants. Implementation goals identified by participants are highlighted in the

report with the aim to guide implementation activities until the next mCFIR session. The mCFIR session is encouraged to be held every six months to 1 year to reassess the goals identified and identify new goals.

Discussion

This paper focused on identifying the facilitators and barriers to the implementation of WelTel in six sites in Kenya, Rwanda, and Canada, and in assessing the application of a Modified Consolidated Framework for Implementation Research (mCFIR) tool in facilitating focus groups for mHealth, digital clinical messaging, and virtual care. The CFIR framework was modified to meet the needs of the digital health field to inform stakeholders on ways to enhance and scale up the implementation of the digital health tool under investigation. We tested the modified framework (mCFIR) with the WelTel platform projects across diverse geographic and health settings. For the purpose of this paper, a general quantitative and qualitative analyses were conducted.

We observed that the Domains & Constructs that ranked lowest on the gradient of Performance are perceived as barriers to the implementation of WelTel. On the other hand, Domains & Constructs that received the highest ranking in terms of Performance are perceived as facilitators to the implementation of WelTel. By this categorization, Domain 4A (end-users- HCP) represented a facilitator for all sites, whereas, Domain 2 (outer settings) represented a challenge reported by most sites. Outer setting corresponds to the environment of stakeholder in which the implementation is occurring; challenges within this domain reflects the ability to scale-up the intervention. Furthermore, the major priority areas of action reported by all sites involved expansion of WelTel across various sites and services, as well as improving health indicators identified by each site. In fact, the utility of these findings is supported in the real-world implementation progress across these sites; the WelTel tool expanded in Rwanda (where overall scores were highest), paused then restarted in Kenya, during the COVID-19 (coronavirus disease) pandemic (where scores were in the middle), and stopped in the TB program in Vancouver (where overall scores were lowest).

The mCFIR approach further provided the ability to identify, quantify and visualize areas of strengths and opportunities for improvement. The scoring component of Importance and Performance was added so that stakeholders can rank the Domains and Constructs. Moreover, bringing together a diverse group of stakeholders provides an opportunity for feedback with different points of view that can more accurately guide the scaling of digital health platforms. For instance, in Rwanda, the facilitator observed interactions between external stakeholders and patients during the mCFIR session, where the stakeholder wanted to understand and hear feedback from the patient regarding their experience with the platform. In the Canadian Oak Tree Clinic, HCPs thought that security is a patient perturbation, and were surprised to hear from the patient during the mCFIR session that they have no security concerns related to partaking in the mHealth implementation. Moreover, choosing heat maps to visualize Performance and Importance scores allows easier comparison among Domains and Constructs across sites and time.

We observed a parallel trend in the scoring of Performance and Importance of Domains. Domains that scored highest in Importance scored highest in Performance too. Accordingly, we speculate whether including only the Performance scale would be enough for future mCFIR sessions as dichotomizing these scales was not significant to participants.

Partnership with health authorities and stakeholder engagement were repeatedly mentioned during the discussions. On the other hand, the outer setting Domain was rated the lowest for both Importance and Performance for all sites. We deduce that this could be a potential factor that hindered the scale-up of the WelTel platform. For an intervention to achieve scalability, we suggest investing efforts in the outer setting Domain.

The UBC mHealth Research Group is completing development of a publicly available data visualization tool to facilitate the analysis of the mCFIR inputs in order to provide immediate feedback at the end of the mCFIR session. This will allow participants to better identify the Domains and Constructs that are performing well, and the ones that need focus, as well as provide further opportunity for discussion based on the visualized group responses. The mCFIR brings together diverse stakeholders to discuss all aspects of implementation from each of their diverse perspectives.

Challenges:

We identified several important challenges to our methodology. First, participant recruitment was a challenge within certain sites, and among different participant types. It was challenging to recruit patients, external stakeholders and policy makers for the mCFIR session. We observed greater interest from health authorities and external organizations in East Africa to attend the mCFIR session with Rwanda having the highest external stakeholder participants. This is reflected by their success in scaling up their intervention to two additional sites (14). There was a lack of patient representation in most of the Canadian sites. For instance in Haida Gwaii, HCPs preferred to conduct the first mCFIR sessions without involving patients in order to test the mCFIR tool and ensure that questions would be relevant and appropriate for patients. Given the diversity of the participants, there is a possibility of power dynamics skewing the scoring and feedback shared by participants resulting in a social desirability bias (20). Further limitations, including uneven distribution of participant types across sites, could have impacted the overall scoring. Selection bias may exist as participant recruitment was not random; participants were identified with the help of the clinics' medical directors. With regards to the mCFIR tool, there are some limitations assumed to affect the overall scoring. This includes the possibility of participants misidentifying their roles in the survey, participants mis-ranking the Domains, and/or inaccurately distinguishing between the Importance and Performance scoring. There have been a number of missing entries where participants either left some answers blank or did not complete the survey due to time constraints. Language was also a barrier for some participants among the East Africa sites. Facilitators have offered translations to preferred languages upon request. There could also be a potential cross-cultural referencing, where certain Constructs are perceived differently due to the diversity in cultures and needs of the different geographical and health contexts. Lastly, the approach required a significant

amount of time for analysis. This significantly hindered the rapid process of feedback of results to the participants, which is an intended feature of the original CFIR tool, in order to adapt and inform implementation itself.

Conclusion

This paper reports the first large-scale application of the mCFIR tool. The mCFIR tool was used to evaluate the implementation of an mHealth intervention across multiple global settings. This approach allowed for an improved understanding of the barriers and facilitators to the implementation and scale-up of the mHealth tool under investigation. We learned that HCPs are the most likely champions to the implementation of a digital health platform and that efforts are necessary to involve outer settings, which in turn facilitates scale up of mHealth interventions. Further site-specific analysis is currently underway. Results are being disseminated to the healthcare teams implementing the WelTel services in order to address the challenges mentioned. There have been suggestions around translating the mCFIR tool to accommodate for other languages. The tool will be reexamined to further revise the questions and potentially shorten the Domains to be more streamlined and operational. The mCFIR tool is currently in the planning phase for a second round at some of the sites presented in this paper for a time series analysis in order to assess progress in Performance across time, especially since some sites are implementing WelTel for the current COVID-19 pandemic(21). In parallel, the mHealth Research Group is completing the development of a publicly accessible data visualization tool to facilitate analysis so that facilitators can immediately share results with participants at the end of the mCFIR session; results are intended to be available to other implementation researchers.

Declarations

Ethics Approval: The study was approved by the University of British Columbia's Clinical Research Ethics Board (H17-03414-A001 & H16-00189), Rwanda Biomedical Center Review Committee, and AMREF in Kenya Ethics & Scientific Review Committee (ESRC).

Consent for Publication: Not applicable.

Availability of Data and Materials: All data generated and/or analyzed during this study are available from the corresponding author on reasonable request.

Competing Interests: Principal Investigator Dr. Richard Lester has a financial and professional interest in WelTel Incorporated, a company for which he is Chief Scientific Officer. WelTel Incorporated is subcontracted to provide the SMS software platform and maintenance for the project. WelTel Incorporated is a company founded by Dr. Lester's wife, Dr. Gabrielle Serafini. The company develops software and related technologies to support mobile health (mHealth) through SMS-based, patient engagement platforms. WelTel Inc. has been contracted by this research project to provide the software and the implementation service.

As Chief Scientific Officer of WelTel Inc., Dr. Lester advises on the research and development aspects of WelTel Inc. and communicates with the scientific and customer communities concerning the evidence-base and utility of the software.

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Author's Contributions:

Samia El Joueidi*: First author, carried out and managed the implementation of the study, wrote the manuscript, conducted qualitative data analysis.

Kevin Bardosh: Assisted in designing the modified version of the Consolidated Framework of Implementation Research, provided revisions.

Richard Musoke: Assisted in designing the modified version of the Consolidated Framework of Implementation Research and provided revisions.

Binyam Tilahun: Assisted in designing the modified version of the Consolidated Framework of Implementation Research and provided revisions.

Maryam Abo Moslim: carried out data collection for 2 sites in Canada and provided paper revisions.

Katie Gourlay: Facilitated data collection at the TB clinic in Vancouver and provided paper revisions.

Alissa MacMullin: research coordinator at the implementation site in Haida Gwaii. Facilitated data collection in Haida Gwaii, Canada; and provided paper revisions.

Victoria J Cook: implementation research partner and clinical director at the TB implementation site and provided paper revisions.

Melanie Murray: implementation research partner and clinical director at the TB implementation site and provided paper revisions.

Gilbert Mbaraga: Medical director at the implementation site in Rwanda and provided paper revisions.

Dr Sabin Nsanzimana: Research partner in Rwanda.

Dr. Richard Lester: Principal investigator of the research study, is in charge of overall direction and planning of the study.

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Appendix

Appendix A-1: mCFIR Constructs

Domain Title	Construct Descriptive	Construct Title
Domain 1 - Intervention Characteristics	Construct 1 How well does the intervention perform in its intended setting?	Performance Fidelity
Domain 1 - Intervention Characteristics	Construct 2 How adaptable is this intervention to meeting local needs ?	Adaptability
Domain 1 - Intervention Characteristics	Construct 3 How user-friendly is the service of this intervention?	User-friendliness
Domain 1 - Intervention Characteristics	Construct 4 How advantageous is this intervention over alternative solutions that are already in place?	Comparative advantage
Domain 1 - Intervention Characteristics	Construct 5 How acceptable are the costs of the intervention to the implementer and users?	Affordability
Domain 2 - Outer Setting	Construct 6 How well connected is the project implementer team with outer setting stakeholders?	Stakeholder Engagement
Domain 2 - Outer Setting	Construct 7 Do external stakeholders or competing organizations support the implementation of the intervention?	External support
Domain 2 - Outer Setting	Construct 8 How do external strategies contribute to spread this intervention?	Scale-up support
Domain 3 - Inner Setting	Construct 9 How strong is the networking and communication within the target organization?	Internal communication
Domain 3 - Inner Setting	Construct 10 Is use of the intervention welcomed, encouraged, and supported within the inner setting?	Acceptance
Domain 3 - Inner Setting	Construct 11 How well is the infrastructure and logistic support provided to the intervention by your organization?	Organizational Support
Domain 4A - End-User Characteristics, HCP	Construct 12 The health care providers believe that the intervention improves health outcomes.	Benefit Perception

Domain 4A - End-User Characteristics, HCP	Construct 13 The health care providers feel well-trained and confident while using the intervention.	[HCP] Training
Domain 4A - End-User Characteristics, HCP	Construct 14 The health care providers feel secure with the level of privacy offered by the intervention.	[HCP] Privacy
Domain 4B - End-User Characteristics, Patients	Construct 15 Patients believe the intervention improves their health outcomes compared to the current practice.	Benefit Perception
Domain 4B - End-User Characteristics, Patients	Construct 16 Patients feel confident in their own ability to use the intervention.	[Pt.] Training
Domain 4B - End-User Characteristics, Patients	Construct 17 Patients have adequate access to the service the intervention provides.	Accessibility
Domain 4B - End-User Characteristics, Patients	Construct 18 Patients feel secure with the level of privacy offered by the intervention.	[Pt.] Privacy
Domain 4B - End-User Characteristics, Patients	Construct 19 Patients understand the language used in the intervention.	Language
Domain 5 - Implementation Process	Construct 20 How adequate has attention been given to planning the implementation towards the set goal?	Intervention planning
Domain 5 - Implementation Process	Construct 21 How well are the stakeholders engaged during the implementation?	Stakeholder engagement
Domain 5 - Implementation Process	Construct 22 How well has the intervention been carried out according to plan?	Execution
Domain 5 - Implementation Process	Construct 23 Is time dedicated for reflection or debriefing about the implementation before, during and after the implementation process?	Evaluation
Goal Attainment Scale	Construct 24 How well are you achieving your implementation goals?	Goal attainment

Impact Assessment

Construct 25

**Outcome
Assessment**

How well are you achieving your key outcomes?

Appendix A-2: Health Issues and Implementation Goals by Site

Site	Health Issue Addressed Through Implementation of WelTel	Implementation Goals
Maralal, Kenya	<p>1) Continuity of care and access to healthcare provider support outside of regularly scheduled appointments/visits for pregnant women and children < 1.</p> <p>2) Treatment support (i.e. medication, appointments, clinical instructions, immunization etc.) for pregnant women and children < 1</p>	<p>1) Reduce dropouts by 25% for antenatal care. 2) Include messages to increase Skilled Birth Attendance (SBA) at 36 weeks. 3) Include reminders for postnatal care. 4) Address transport and finance issues for clients who reply "Shida".</p>
Wamba, Kenya	<p>1) Continuity of care and access to healthcare provider support outside of regularly scheduled appointments/visits for pregnant women and children < 1.</p> <p>2) Treatment support (i.e. medication, appointments, clinical instructions, immunization etc.) for pregnant women and children < 1.</p>	<p>Improving the following health indicators: 1) Improve antenatal Care. 2) Increase the rate of Skilled Birth Attendant at deliveries. 3) Improve adherence to child immunization.</p>
Rwanda	<p>1) Side effects of treatment.</p> <p>2) Follow up of treatment.</p> <p>3) Inquire about clinic services.</p> <p>4) Early detection of diseases.</p> <p>5) Appointment reminders (for adolescents).</p> <p>6) Psychosocial support.</p> <p>7) Early management of treatment failure</p> <p>8) Follow up on Prevention Mother to Child Transmission (PMTCT)</p>	<p>1. Increase the percentage of viral suppression for adolescents from 86% to 97.8%.</p> <p>2. Expand the WelTel platform to other health centers in Rwanda.</p> <p>3. Sensitize patients to respond to the weekly check-in message.</p>
Oak Tree, Vancouver	<p>1) Access to health care providers outside of regularly scheduled appointments.</p> <p>2) Access to support surrounding Social Structural Factors / Social Determinants of Health</p> <p>3) Adherence to treatment (i.e. medication, appointments, clinical instructions, etc.) for individuals living with HIV.</p>	<p>1) Offer WelTel to all incoming patients; Enroll 100 new patients (receiving HIV treatment) in the OakTree Clinic in 1 year.</p> <p>2) Obtain project funding to research the use of WelTel at OakTree, and its transferability to other patients/treatments in BC Women's Hospital.</p>
TB Clinic Vancouver	<p>1) Access to health care provider support outside of regularly scheduled appointments.</p> <p>2) Treatment support (i.e. medication, appointments, clinical instructions, etc.) for TB patients.</p>	<p>1) Offer WelTel to all incoming TB patients; enroll 100 new patients (receiving HIV treatment)</p> <p>2) Obtain project funding to research the use of WelTel and its</p>

		transferability to other patients/treatments.
Haida Gwaii, British Columbia	<p>1) Access to health care providers outside of regularly scheduled appointments</p> <p>2) Initially targeting patients with one or more chronic disease, including: congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), cancer, diabetes mellitus, & hypertension.</p> <p>3) Symptom assessment & management, data sharing, appointment reminders, appointment scheduling, prescription refills and adjustments, other (e.g. requisition forms, clinic hours).</p>	<p>1) Work to integrate WelTel as an effective and sustainable primary care service in the clinic. Includes quality assurance of data in WelTel, training staff, and promote use among all practices to increase capacity and improve processes.</p> <p>2) Change wording of “How Are You?” messaging to guide patients to use the service for principally medical needs.</p> <p>3) Expand reach to patients with greatest need, but only once well-established and in consult with key implementers (i.e. Primary Care Assistants).</p> <p>4) Continued training & support from WelTel for providers and implementation team.</p> <p>5) Include other allied health on platform (i.e. physiotherapists, midwives).</p>
<p>Reach – proportion enrolled within your target population</p> <p>Adoption – by Health Authority, by site, or by clinical practices (different levels)</p> <p>Scale-Up – building infrastructure to support the full-scale implementation</p> <p>Spread – replicating an intervention across populations or to different sites</p> <p>Sustain/maintain – efforts to sustain the intervention in practice</p>		

Tables

Due to technical limitations, table 1,2,3,4 is only available as a download in the Supplemental Files section.

Figures

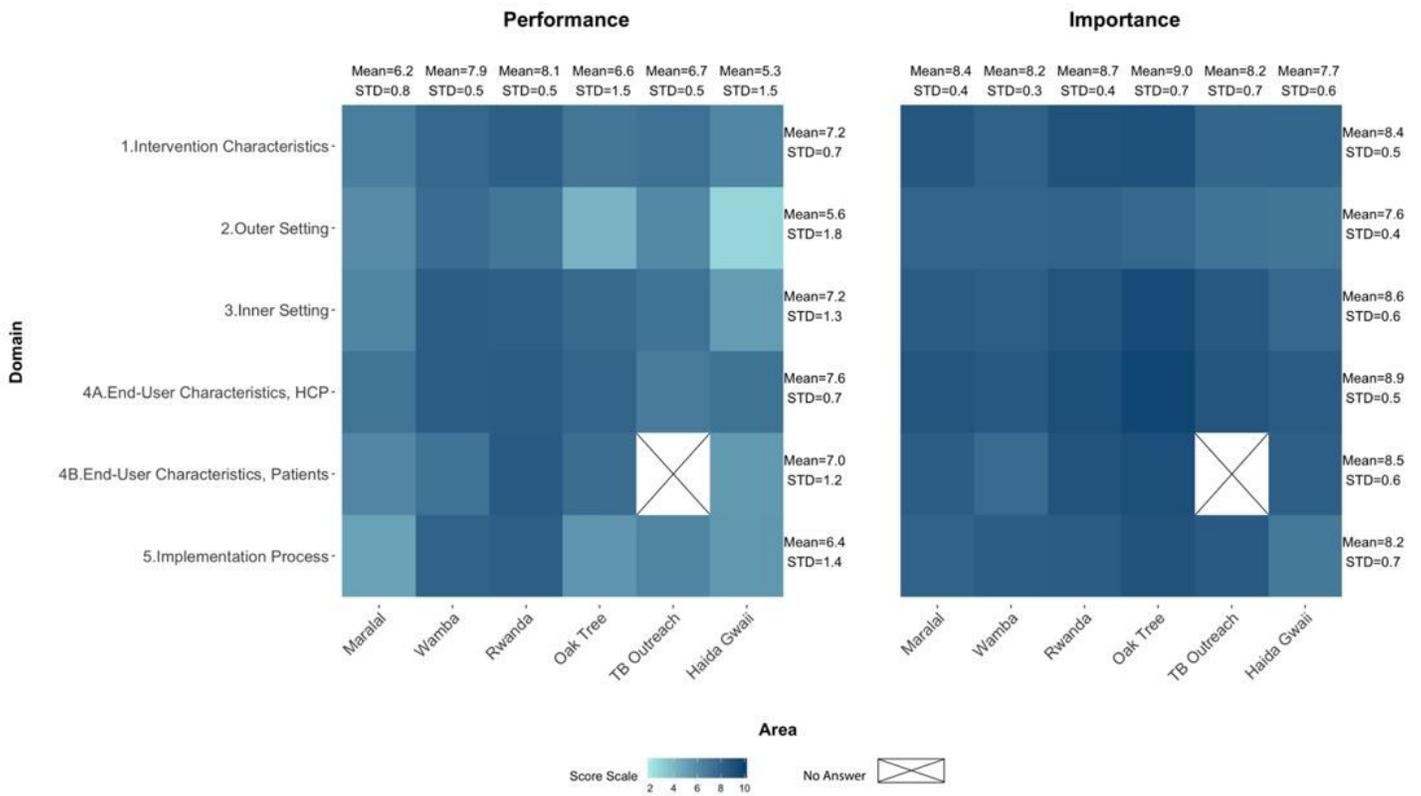


Figure 1

Heat map of the reported scores Performance & Importance per Domain and per site.

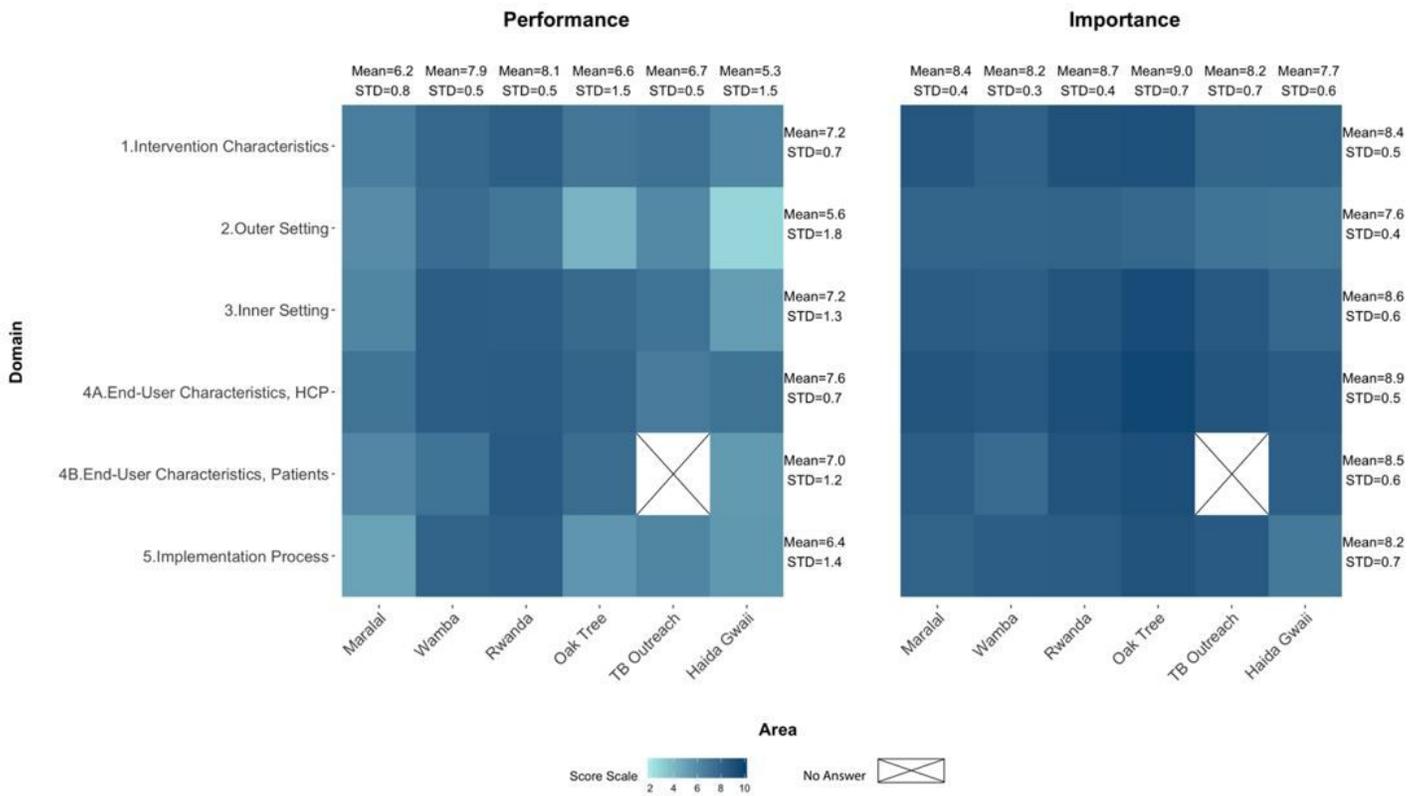


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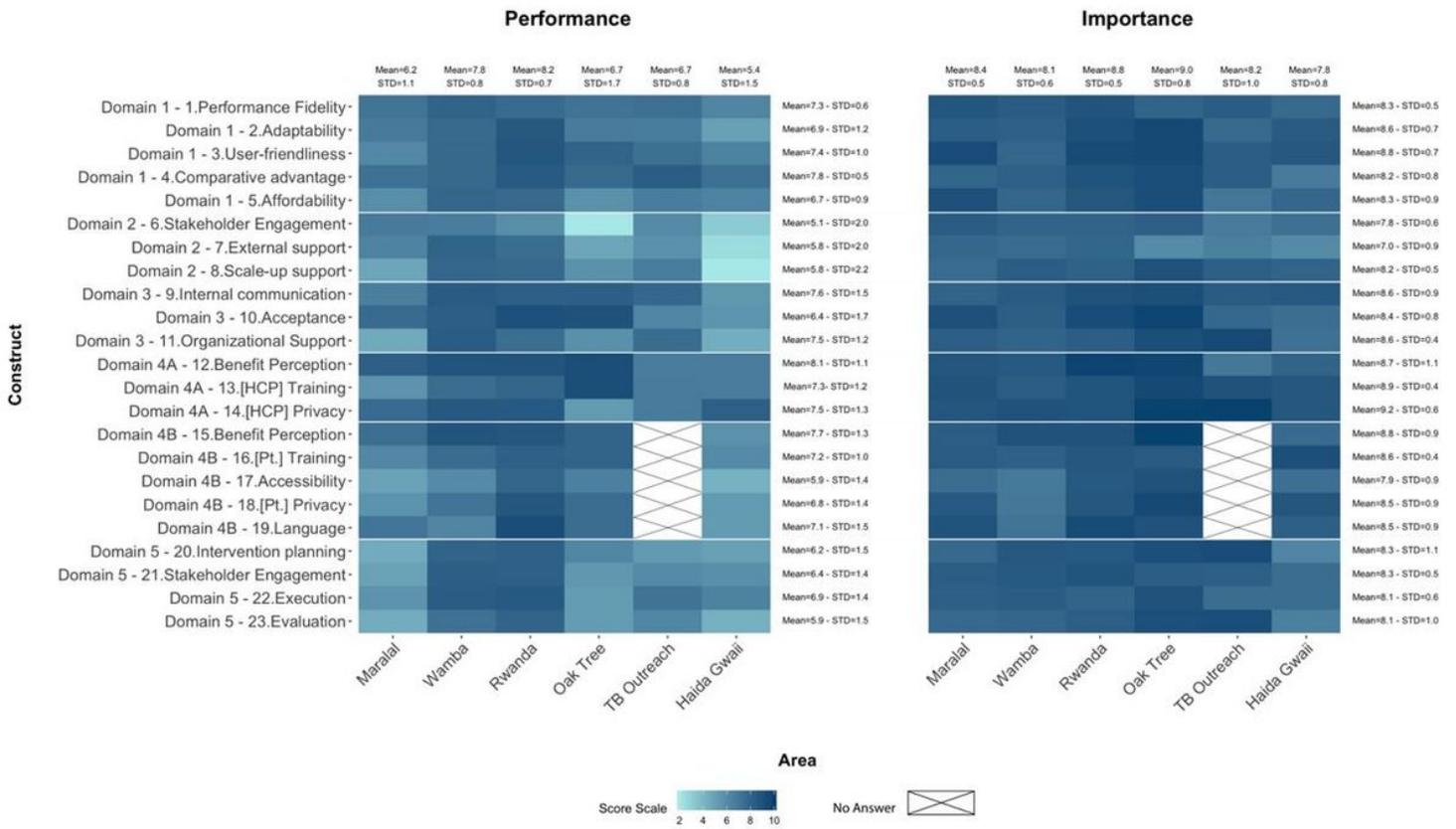


Figure 2

Heat map of the reported scores Performance & Importance per Construct and per site

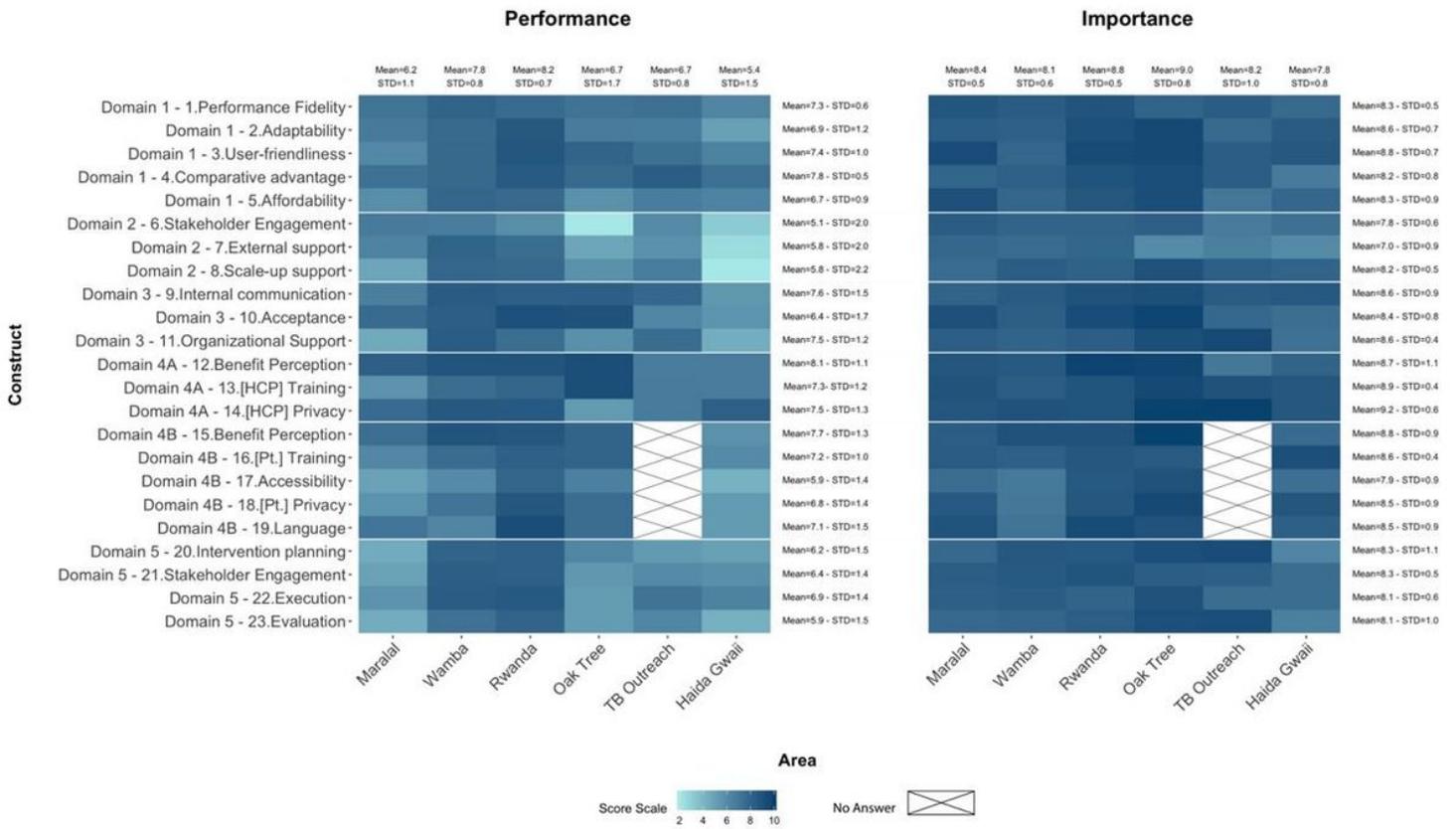


Figure 2

Heat map of the reported scores Performance & Importance per Construct and per site

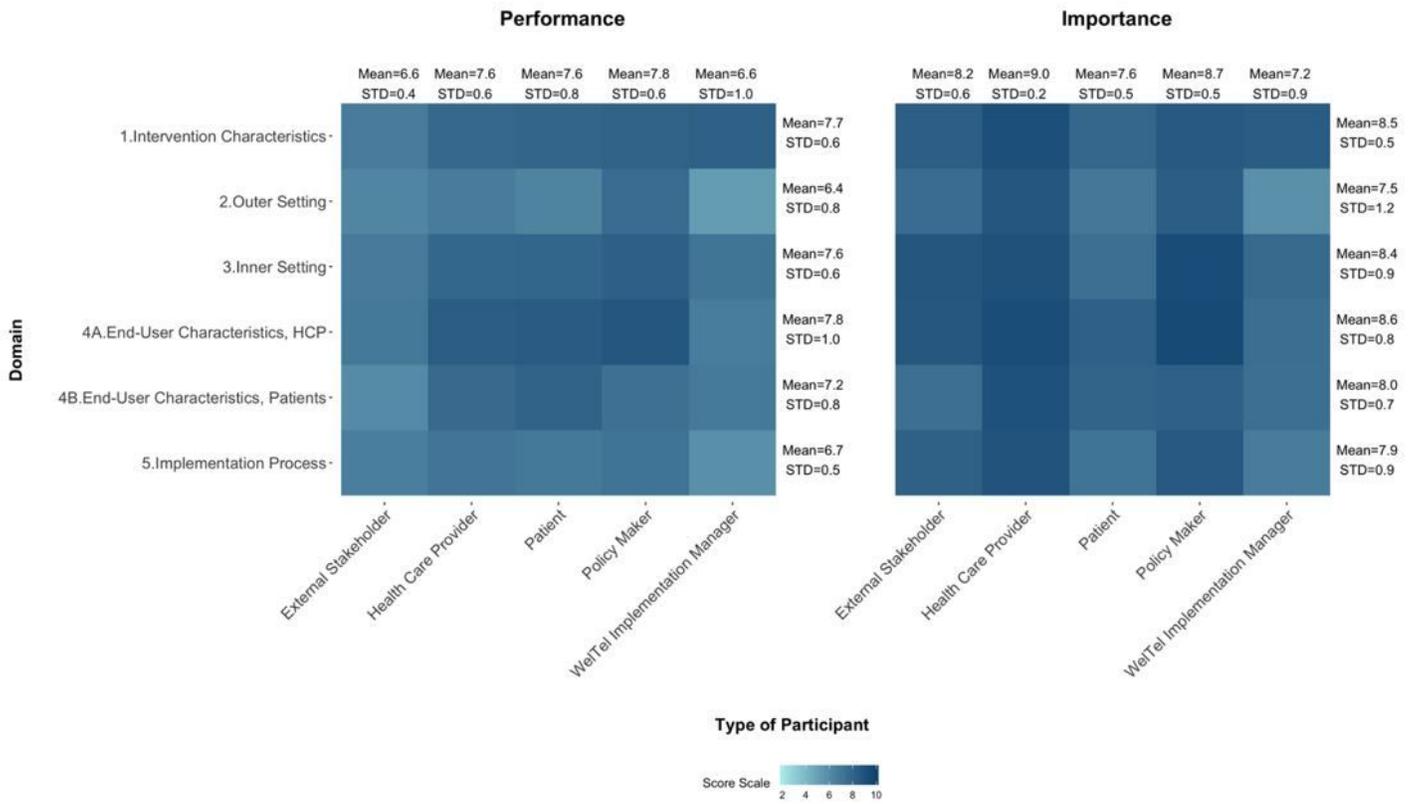


Figure 3

Heat map of the reported scores Performance & Importance per Domain and per participant type

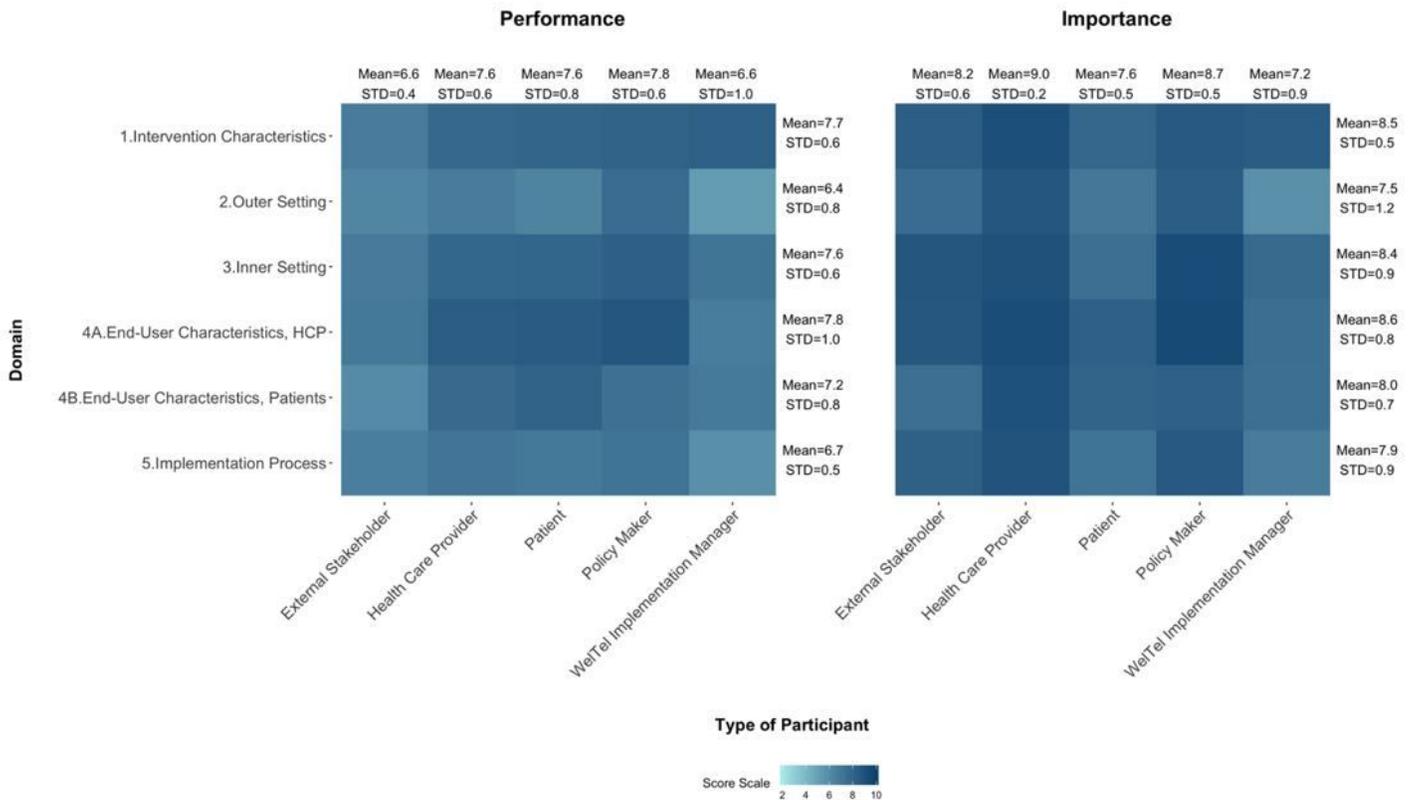


Figure 3

Heat map of the reported scores Performance & Importance per Domain and per participant type

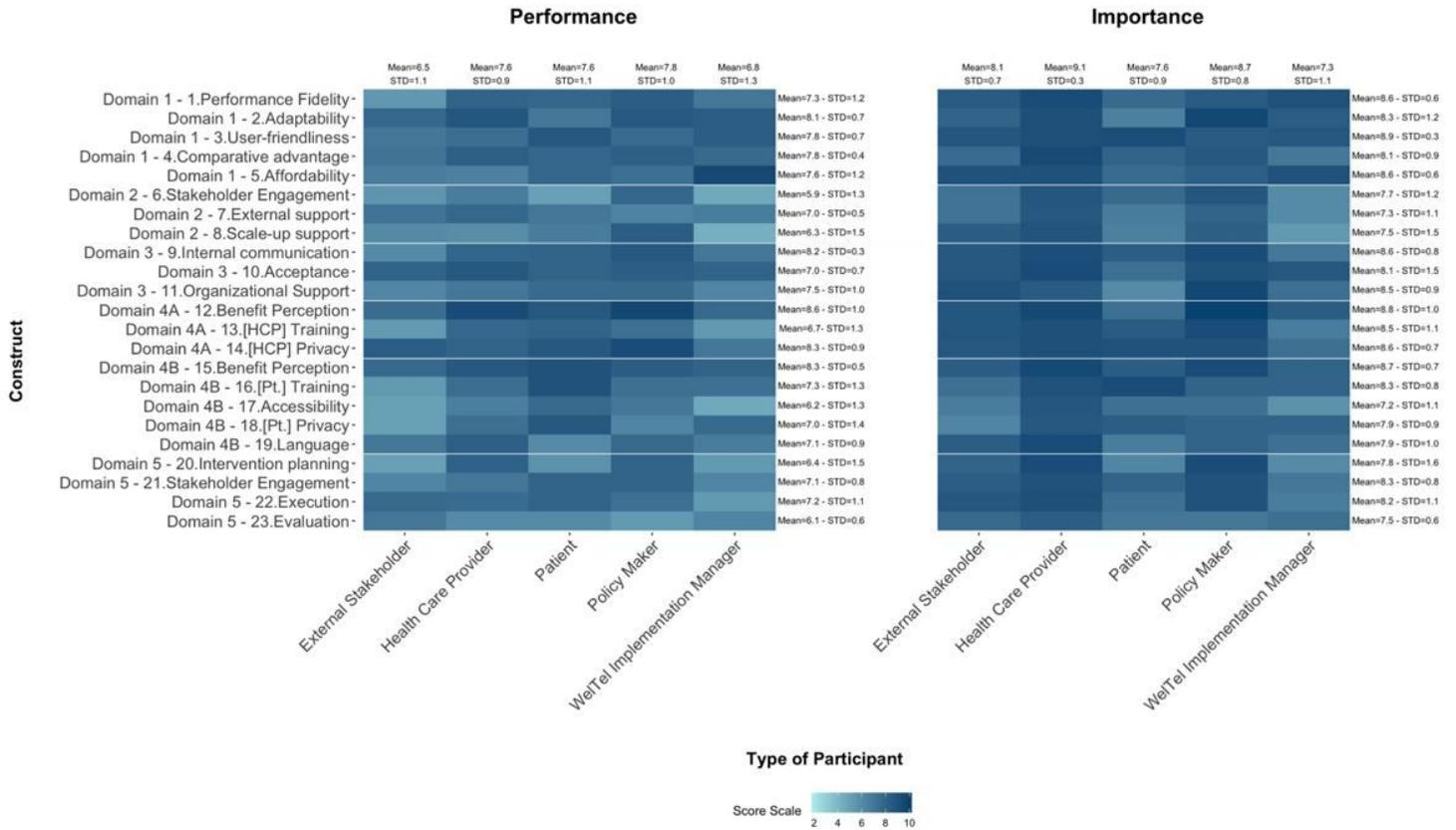


Figure 4

Heat map of the reported Performance & Importance scores per Construct and per site for all three East African sites

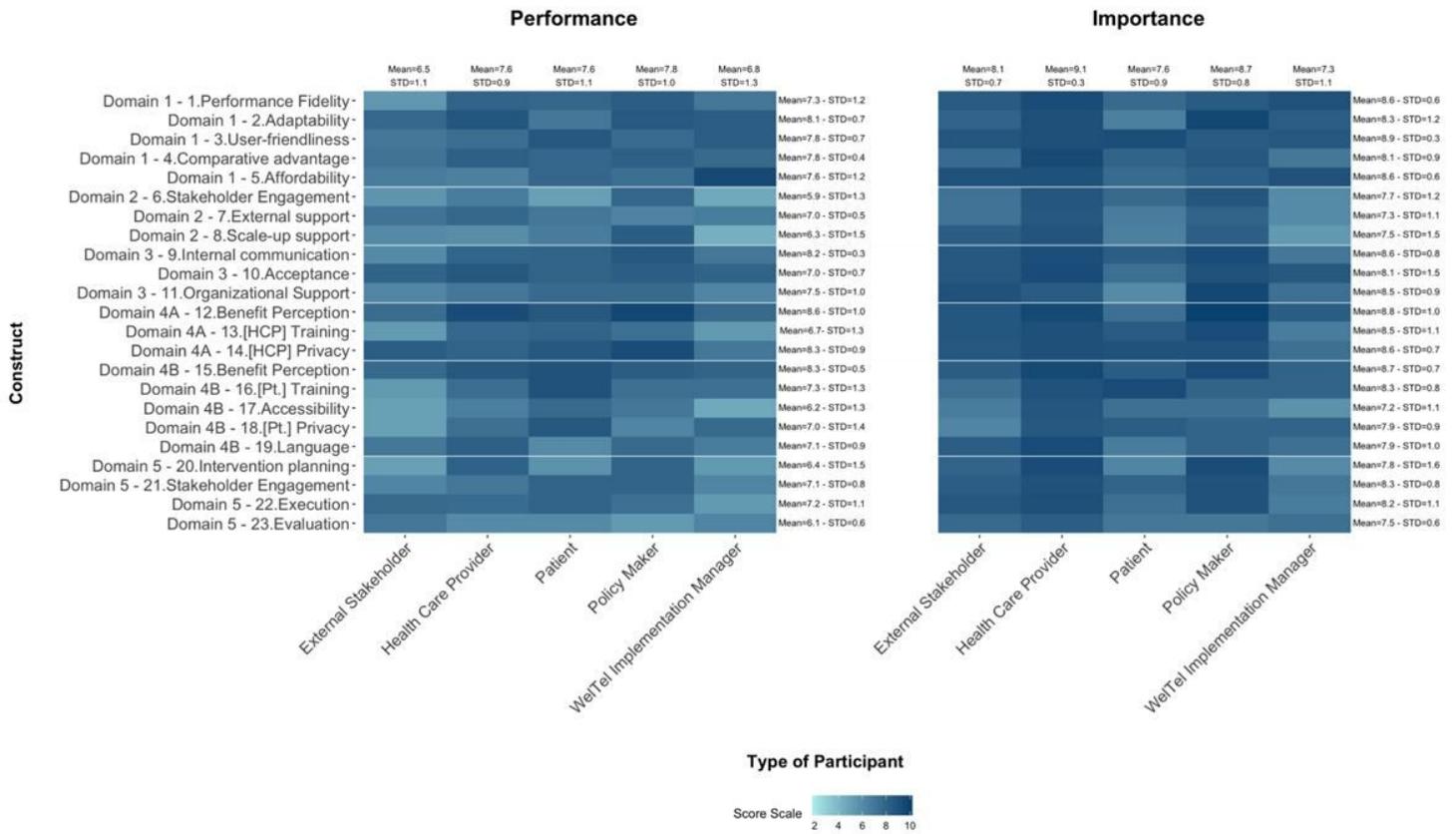


Figure 4

Heat map of the reported Performance & Importance scores per Construct and per site for all three East African sites

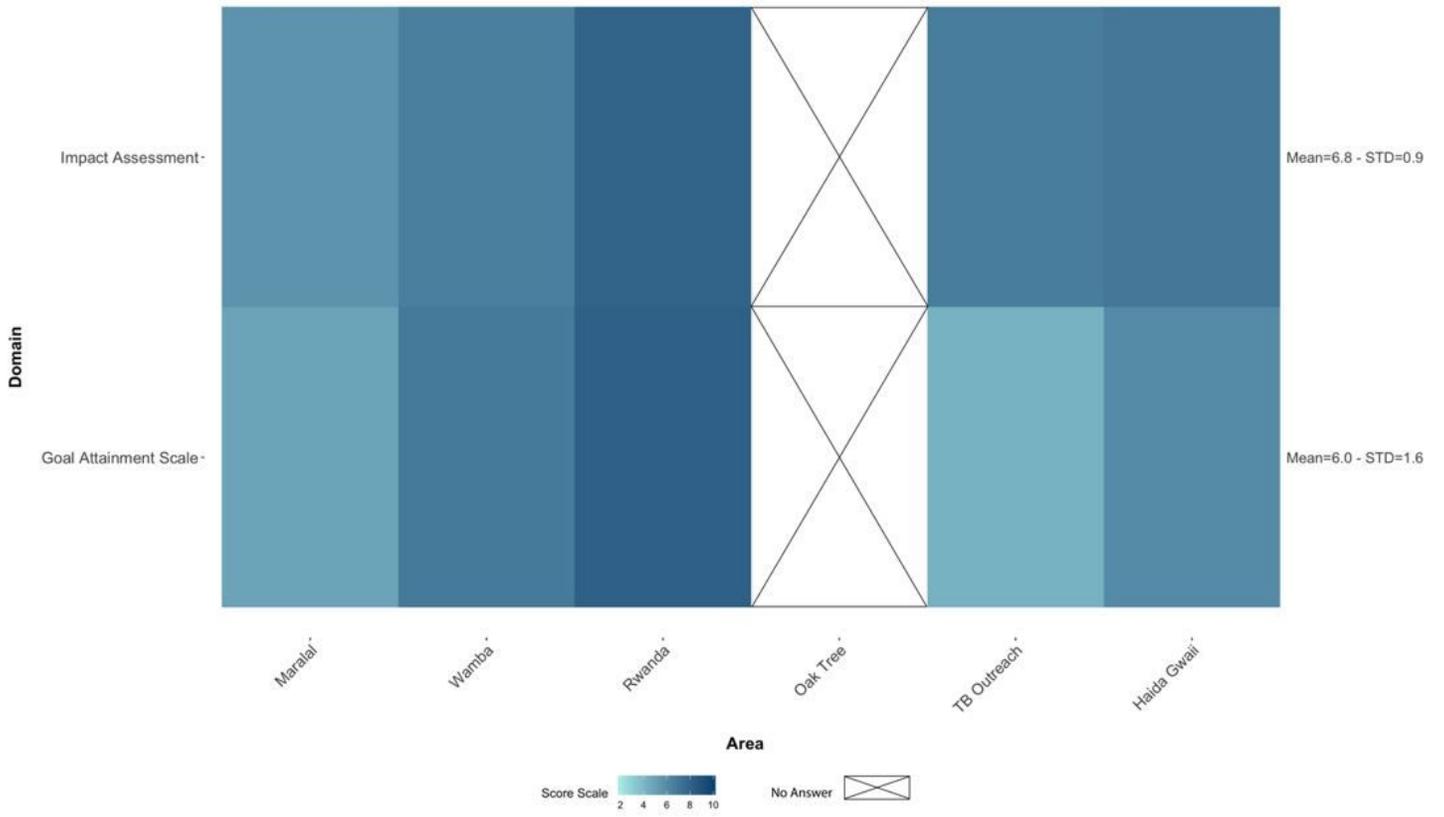


Figure 5

Heat map of the reported scores of Performance for “Goal Attainment” and “Impact Assessment” per site

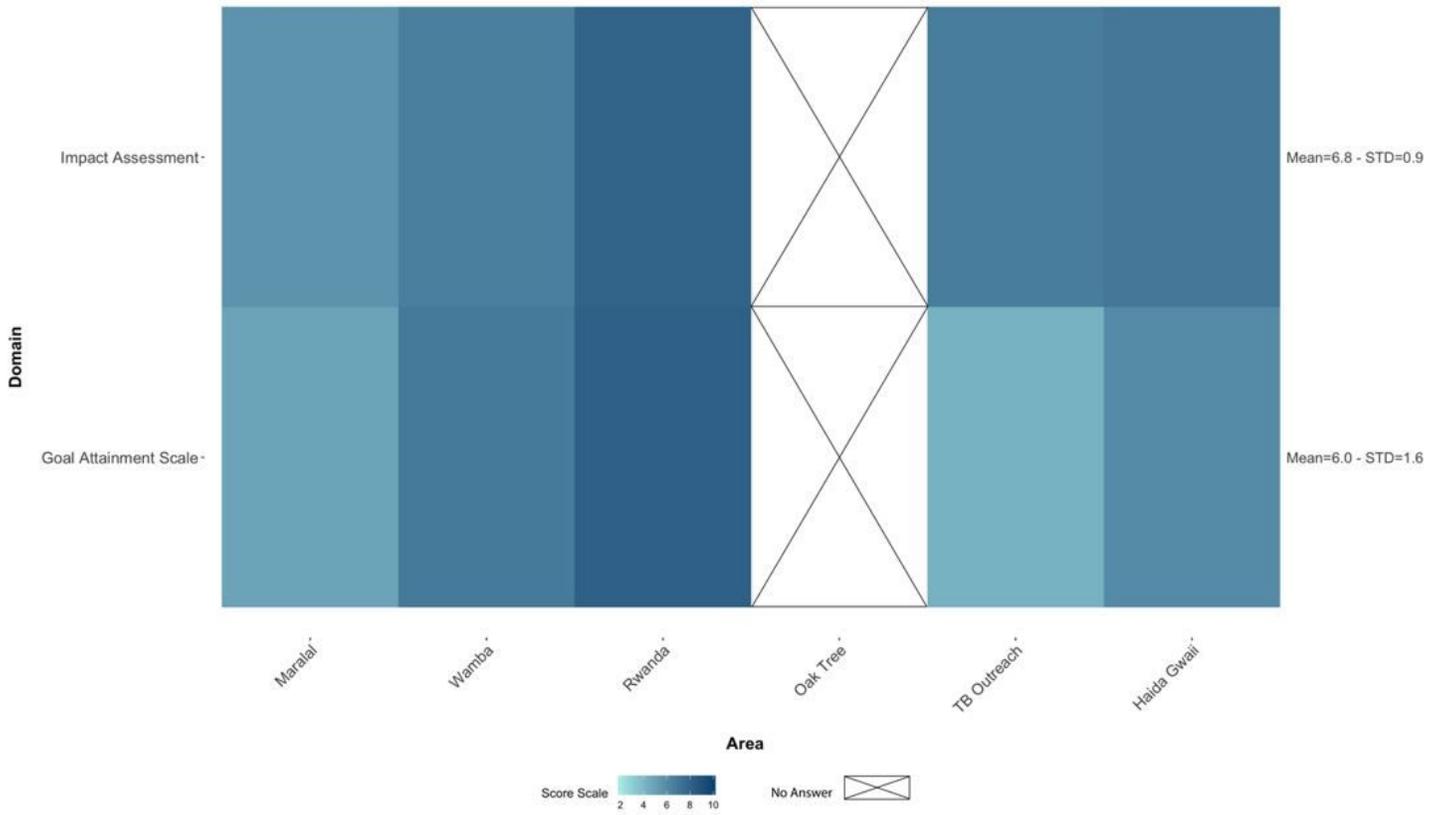


Figure 5

Heat map of the reported scores of Performance for “Goal Attainment” and “Impact Assessment” per site

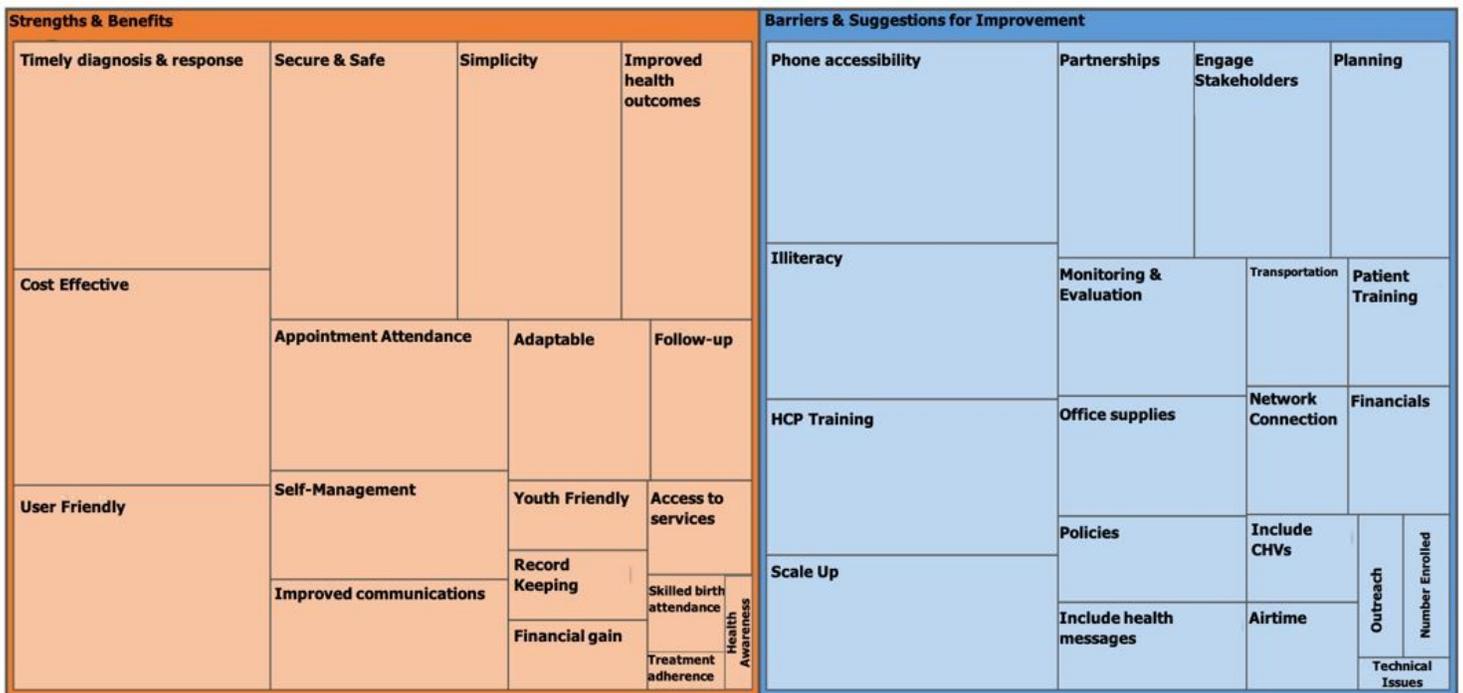


Figure 6

Tree Map of the Identified Strengths and Barriers to the Implementation of WelTel in the East Africa Sites.



Figure 6

Tree Map of the Identified Strengths and Barriers to the Implementation of WelTel in the East Africa Sites.

Supplementary Files

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