LEARNING PAPER

Implementing mHealth solutions

To improve community health worker motivation and performance

inSCALE
Innovations at Scale for Community Access and Lasting Effects

malaria consortium
disease control, better health

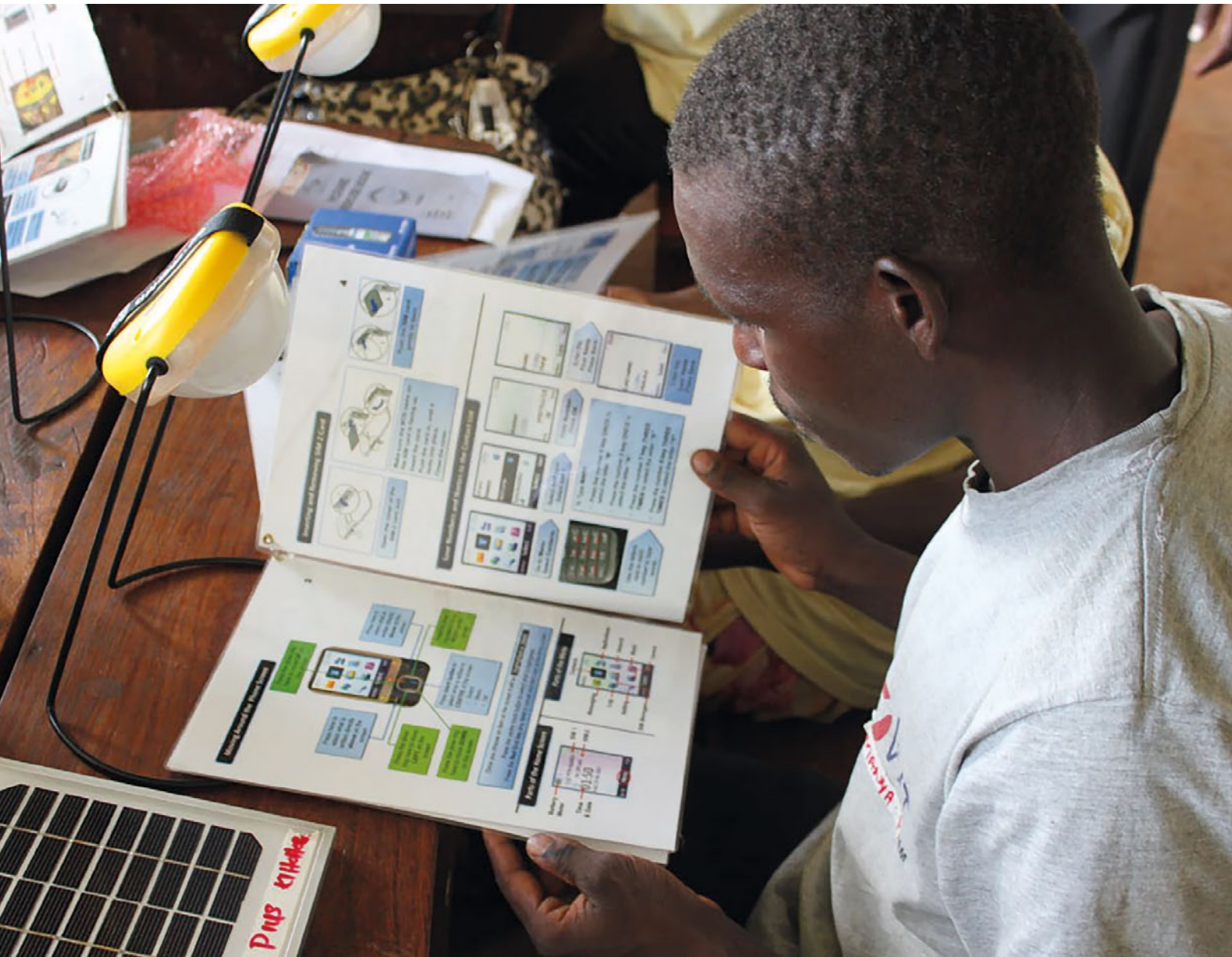
About the learning paper series

Since starting operations in 2003, Malaria Consortium has gained a great deal of experience and knowledge through technical and operational programmes and activities relating to the control of malaria and other infectious diseases.

Organisationally, we are dedicated to ensuring our work remains grounded in the lessons we learn through implementation. We explore beyond current practice, to try out innovative ways – through research, implementation and policy development – to achieve effective and sustainable disease management and control. Collaboration and cooperation with others through our work has been paramount and much of what we have learned has been achieved through our partnerships.

This series of learning papers aims to capture and collate some of the knowledge, learning and, where possible, the evidence around the focus and effectiveness of our work. By sharing this learning, we hope to provide new knowledge on public health development that will help influence and advance both policy and practice.

www.malariaconsortium.org/learningpapers



A community health worker in Uganda receives training for using the mobile phone support system.
Photo: Tine Frank

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Executive summary

Malaria Consortium's inSCALE project has been working to scale up quality integrated community case management programmes to improve child health in Uganda and Mozambique. This Learning Paper details the process of establishing mobile health (mHealth) interventions in Uganda and Mozambique, to improve community health workers' (CHWs) motivation and performance, as part of the 'technology intervention' arm of the inSCALE project.

Using a theoretical review method and formative research, the project identified that interventions supported by information and communications technology could facilitate easy communication, provide context-specific technical support, and increase community health workers' (CHWs) connectedness to the health system. Such interventions were found to be acceptable to CHWs and likely to increase their motivation, performance and retention.

Based on inSCALE's formative research, potential components of a technology intervention that would be of value to CHWs were assessed to develop an innovative mobile phone software and feedback system. Because CHWs in Uganda and Mozambique have distinct needs and work in contrasting settings different intervention packages were implemented in the two countries.

The technology interventions were implemented through a process of stakeholder discussions, developing and testing job aids and training of CHWs (1,277 in Uganda and 132 in Mozambique) using the training-of-trainers approach. A series of follow-up activities ensured maximised and correct use of the inSCALE mobile systems.

To understand the challenges and successes of the interventions, regular progress reviews and process evaluations were conducted in both countries. The results showed increased communication between CHWs, their peers and supervisors, and that data submission and receiving feedback messages were highly motivating to CHWs. However, at full implementation strength, the reporting rate rarely reached more than 50 percent in Uganda. In Mozambique, where there were fewer technical challenges which were more quickly resolved, the reporting rate remained at 60-70 percent during full implementation strength.

The majority of the challenges faced owed to software and network issues, but they also included hardware issues and medicine stock-outs. To address these challenges, Malaria Consortium recommends contracting software partners with experience in mHealth initiatives, using an easily customisable platform and choosing tailor-made network provider packages to retain control of service adjustments.

Malaria Consortium continues to engage with mHealth partners in Uganda to determine how components of the inSCALE technology arm can be incorporated into other systems. The organisation is also working with partners in Mozambique to scale up the inSCALE technology intervention, and is in the process of handing over the system to the Ministry of Health.

The inSCALE Learning Papers

As part of the project's advocacy and communications components, inSCALE aims to promote 'coherent and coordinated policies' to advance best practices and innovations to improve CHW programmes delivering iCCM at country level. In support of this, inSCALE has been capturing knowledge and learning from the implementation of inSCALE interventions and sharing these through Learning Papers. Three complementing inSCALE papers have been published:

Developing intervention strategies (to improve community health worker motivation and performance) (2012), documents inSCALE's research and intervention design process.

Establishing Village Health Clubs (to improve community health worker motivation and performance) (2015) summarises knowledge and learning from the implementation of inSCALE's community intervention in Uganda.

Implementing mHealth solutions (to improve community health worker motivation and performance) (2015) documents implementation of the inSCALE technology intervention in Mozambique and Uganda.

To read the Learning Papers: www.malariaconsortium.org/inscale

Introduction

When two-year-old Letitia came down with a fever, her mother, Autilia, carried her to their community health worker, Marcelino. Using his inSCALE smartphone, Marcelino entered the details of Letitia's symptoms and received instructions through the inSCALE APE CommCare application to carry out a malaria test. The test indicated no malaria parasites, and Marcelino prescribed paracetamol to bring down the fever. He then played a pre-recorded message about fever to Autilia.

Relieved that she did not have to walk the two hours to the health centre, Autilia said, "This is why I like to come here for treatment."

Community health worker, Marcelino, follows instructions on his inSCALE phone to diagnose Letitia
Photo: Ruth Ayisi

About the inSCALE project

The Innovations at Scale for Community Access and Lasting Effects (inSCALE) project was a five-year multi-country study in Uganda and Mozambique funded by the Bill & Melinda Gates Foundation. Malaria Consortium conducted the project between 2009 and 2014 (and extended to 2016 in Mozambique) in partnership with the London School of Hygiene & Tropical Medicine and University College London.

The aim of the project was to demonstrate that government-led integrated community case management (iCCM) programmes in two African countries could be scaled up while maintaining quality of care by addressing the barriers to iCCM implementation, namely the lack of supportive supervision and community health worker (CHW) motivation. This would be achieved by:

1.
Identifying best practices and innovations with the potential to increase CHW motivation and supportive supervision.

2.
Assessing the feasibility and acceptability of these innovations among different user groups.

3.
Evaluating the impact of the innovations through randomised controlled trials.

4.
Costing iCCM implementation and the innovations.

5.
Promoting the implementation and spread of iCCM by sharing findings and best practices with key national and international stakeholder.

Integrated community case management

Integrated community case management (iCCM) is an approach whereby community health workers (CHWs) are trained to identify and treat pneumonia, diarrhoea and malaria in children under five years, as well as to refer severely ill cases to the nearest health facility. Evidence from African countries shows that CHWs, if properly trained and equipped, have the potential to reduce child deaths from these sicknesses by up to 60 percent through the delivery of iCCM[1].

However, iCCM programmes have faced challenges in scaling up. The Bill & Melinda Gates Foundation, through a series of consultations with country programme managers and development partners, identified three main implementation barriers to iCCM: lack of supportive supervision; weak CHW motivation – through remuneration or otherwise; and lack of monitoring and evaluation data for programme planning.

Developing the intervention strategies

Step 1

Existing experience and theory

- Literature review
- History and context reviews
- Expert consultations

Step 2

Creating interventions informed by theory

- 'Best bets'
- Pile sorting
- Formative research

Step 3

Materials and monitoring tools

- Pre-testing of materials

Between January 2010 and August 2012, through a rigorous research, review and evaluation process*, the inSCALE project developed two intervention packages that were evaluated through randomised controlled trials.

Both intervention arms were compared with control arms that received the standard Ministry of Health iCCM package, implemented with support from Malaria Consortium[2].

The two interventions were:

1.

The 'technology intervention'**

Implemented in Uganda and Mozambique, the intervention promotes CHW learning and support. This approach aimed to use low-cost technology through the development of tools and applications for mobile phones, to increase CHWs' feeling of connectedness to the wider health system. The mobile phone software developed by inSCALE promotes CHW motivation and performance through job aids that support decision-making, data submission and performance-related feedback.

2.

The 'community intervention'***

Implemented in Uganda, the intervention promotes CHWs as key village health assets to improve motivation and performance. This community-mobilisation approach focused on the formation of Village Health Clubs as a platform for participatory and locally-owned identification of health problems and solutions, followed by a learning and action cycle.

* This is described in detail in the Learning Paper 'Developing intervention strategies to improve community health worker motivation and performance', www.malariaconsortium.org/resources/publications/167/

** This Learning Paper focuses on inSCALE's technology intervention

*** For more information, see the Learning Paper 'Establishing Village Health Clubs to improve community health worker motivation and performance'. www.malariaconsortium.org/resources/publications/628/

Uganda and Mozambique were selected for implementation of the inSCALE project because both countries:

- were among four countries where Malaria Consortium had implemented an iCCM programme between 2009 and 2012;
- have shown a willingness to commit to community-based care as a way of reducing morbidity and mortality in children under five years;
- have different models of community-based health delivery; and
- have demonstrated its ability to be regional leaders in this field.

In both countries, inSCALE's in-country assessments identified an urgent need for strategies that improve performance, motivation and retention of CHWs in order to successfully scale up iCCM programmes that provide high-quality care to sick children.

Uganda

In Uganda, where CHWs are known as village health team members (VHTs), iCCM became a nationwide strategy for reducing child mortality in 2010. Under this programme, each village was required to have an average of five VHTs, two of whom have been trained to distribute medicines under iCCM. There are no literacy or education requirements, although ideal candidates are able to read and write the local language. VHTs receive five days of basic health training, with six days of additional iCCM training for the iCCM VHTs.

VHTs in Uganda are volunteers, receiving US$5 a month to cover travel costs, and have an average catchment population of 250 people. Treating children aged two months to five years, a VHT typically sees 20 cases per month.

Mozambique

In Mozambique, the programme for CHWs, who are locally known as *agentes polivalentes elementares* (APEs), has been in existence for more than 30 years.

In contrast with VHTs in Uganda, APEs are required to have completed primary education (minimum Grade 4), and to know basic maths and speak Portuguese. APEs are trained for four months, using a curriculum with three modules, one of which is iCCM. On completion of training, APEs spend two weeks working at a health facility. APEs receive a monthly stipend of US$40 and cover on average a catchment population of 2,000 to 2,500 people. They provide iCCM for malaria, pneumonia and diarrhoea for children aged 2-59 months and detection and referral for acute malnutrition cases, newborns and pregnant women with danger signs.

In 2014, TB and HIV treatment adherence counselling, provision of contraceptives and provision of misoprostol for post-partum haemorrhage were added to the APE curriculum. Health promotion activities are an integral part of the APE work and should comprise 80 percent of activities.

Typically, an APE sees more than 100 patients per month, of whom nearly half are children under five years. Compared with VHTs in Uganda, APEs cover a larger area as households are spread out, requiring considerable travel time and transport costs.

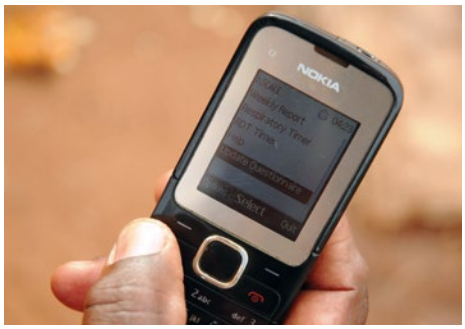
Community health workers in Uganda and Mozambique

Uganda	Mozambique
Village health team members (VHTs)	**Agentes polivalentes elementares (APEs)**
• No minimum educational requirements (preferably able to read and write)	• Minimum Grade 4
• 5-11 days' training (iCCM training 5-6 days)	• 4 months' training (iCCM training 4 weeks)
• Volunteers	• Receives monthly stipend ($40)
• Catchment population of 250 people	• Catchment population of 2,000-2,500 people
• Only treats children under 5 years	• Treats all age groups
• Sees 20 cases/month	• Sees 116 cases/month
• inSCALE area: 3,036 VHTs/1.2 million population	• inSCALE area: 275 APEs/1.8 million population

CHWs in Uganda and Mozambique differ in terms of their caseload, training and coverage. Therefore, the intervention packages were designed differently in the two countries.

In Uganda, a community intervention, in addition to a technology intervention, was seen as valuable. In Mozambique, only the technology intervention was implemented due to time constraints and because community components already existed in the national APE strategy through established community health committees.

The technology intervention – referred to as the inSCALE VHT mobile phone support system in Uganda and the inSCALE APE CommCare application in Mozambique – differed in the two countries. In Uganda, a simple feature phone was used; and a smartphone allowing the use of applications with added features was used in Mozambique.



The inSCALE VHT mobile phone support system in Uganda

The inSCALE APE CommCare application in Mozambique

Designing the inSCALE technology intervention

A growing body of evidence demonstrates the potential of mobile communications to improve healthcare services, even in the most remote and resource-poor environments. inSCALE's theoretical review and formative research indicated that information communications and technology-supported interventions could facilitate easy communication, provide context-specific technical support and bring about connectedness to the health system. In addition, such interventions would be feasible and acceptable to CHWs in Uganda and Mozambique and would likely increase CHW motivation, performance and retention.

What is mHealth?

Mobile health or mHealth is a medical or public health practice that is supported by portable devices, such as mobile phones and tablets[3].

The inSCALE technology intervention

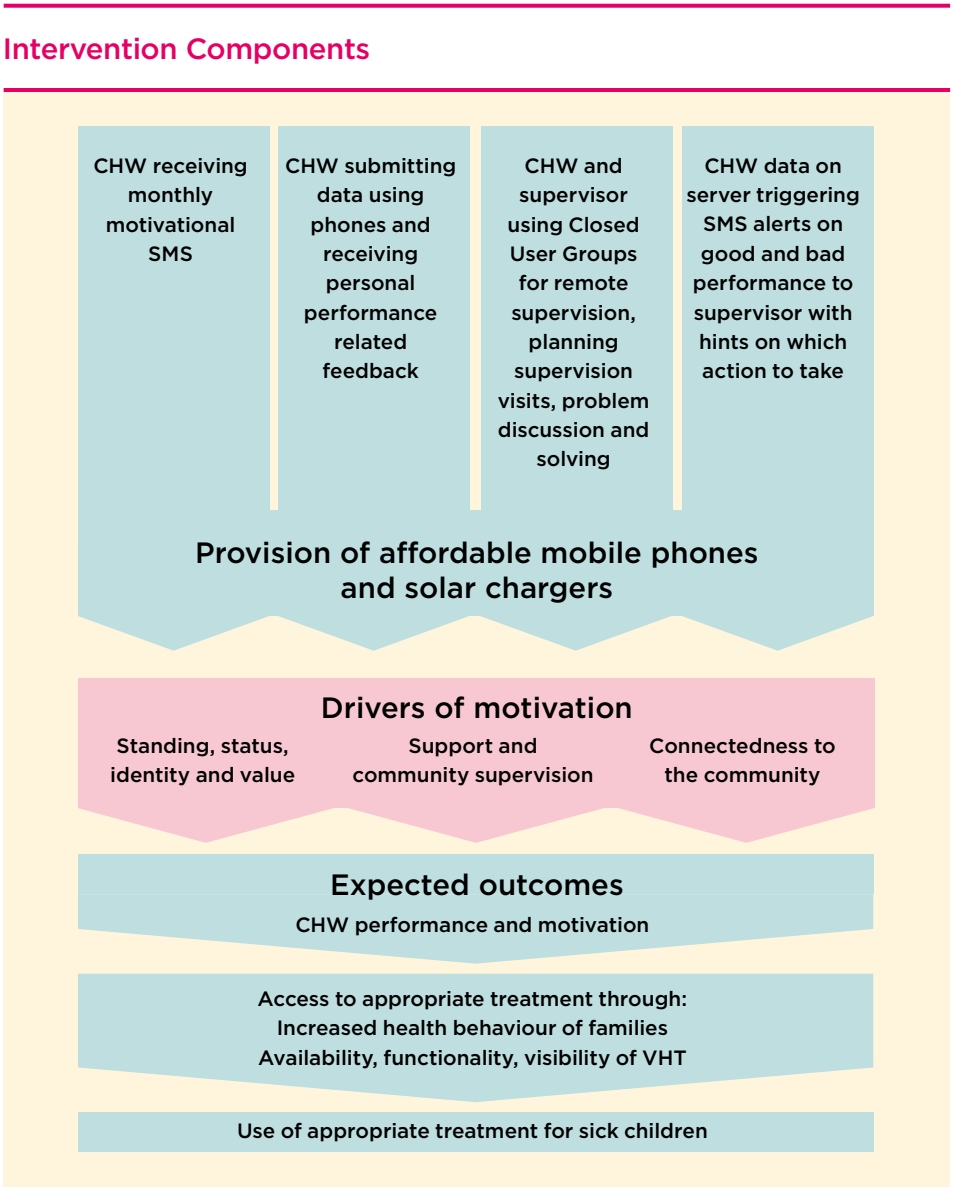
Formative research	Intervention design
CHWs are motivated by their status and standing in the community.	Owning a smartphone or feature phone – which is branded as inSCALE and marked with an individual code to identify each CHW – will add to the CHWs' status and standing in their community.
CHWs value technical feedback and supportive encouragement.	Software developed to provide regular and individual performance-based feedback and encouragement messages will be greatly motivating to CHWs. Performance data sent to supervisors allows them to provide targeted feedback and remote supervision.
Feeling connected to the health system motivates and validates the CHWs in their role.	Software developed to ease report submission and feedback, as well as facilitating regular and free calls between supervisors and CHWs, will create a feeling of connectedness to the health system.

In Mozambique, the APE programme was relaunched in 2010 resulting in new recommendations in the Ministry of Health's iCCM policy. inSCALE adjusted its implementation in Mozambique to a later date to allow time to incorporate these recommendations.

The intervention was therefore implemented in Uganda first, and the lessons learnt were applied to the implementation in Mozambique. Consequently, the formative research that informed the design of the intervention in Mozambique was focused on how to tailor the intervention to the Mozambique audience[4].

Components of the inSCALE technology intervention

During the formative research, potential components of a technology intervention that would add value to CHWs' performance and motivation were weighted and assessed. Following selection of the components, an innovative mobile phone software and feedback system was developed, which is outlined in detail here. When combined, these components have the potential to influence CHW motivation, performance and retention.



The inSCALE technology intervention

Affordable mobile phones

The provision and use of mobile phones with the inSCALE software was intended to increase the status of the CHWs in their communities. It would allow for frequent feedback and support from supervisors and peers and promote connectedness to the health system – key factors which were identified as motivating for CHWs.

In Mozambique, the formative research showed a need for a multimedia job aid to assist APEs; this required the use of a smartphone. A Samsung Galaxy Y android smartphone was the device chosen based on cost, operating system, user-friendliness, durability, battery life, weight, screen type, data transmission provision and provision for user-specific applications.

In Uganda, as VHTs were already using job aids in hard copy, a phone with simple features was used. The device chosen was a Nokia C2-00 phone with a dual sim card; this type of phone was more familiar to VHTs, was considered user-friendly and had a longer battery life.

Closed user groups

Closed user groups (CUGs) allow for free, unlimited calls within the network for CHWs and their supervisors. It promotes increased frequency and quality of contact between CHWs and their supervisors, as they do not need to worry about costs and calls being disconnected when credit runs out. As such, the CUGs enable remote supervision, planning of supervisor visits, discussion and problem solving. The CUGs also help minimise the time CHWs spend collecting drugs from health facilities by allowing them to confirm stocks beforehand. Having a phone available and being able to make free calls is likely to improve referral adherence, as CHWs can call the health centre in the presence of the caregiver.

In Mozambique, additional guidelines on phone use for APEs were introduced. This was to address concerns of some supervisors that APEs would use the CUGs to contact them for issues not related to their work.

Solar products

In order to keep inSCALE's technology intervention cost-free for CHWs, a solar charger and lamp were provided. The solar lamps enable CHWs to treat patients at night and improve their working conditions at night. The solar chargers, mainly used to charge the inSCALE phones, also presented potential to generate income for CHWS. As the chargers had a six-pin adapter, CHWs are able to utilise it to offer phone-charging services to the community.

In Uganda, where VHTs welcomed this opportunity, guidelines were developed on how to generate an income from the solar chargers.

In Mozambique, however, APEs did not feel they could ask community members to pay for this service.

Motivational messages

Upon submitting their reporting data, CHWs receive automated feedback through personalised SMS messages, which acknowledge them for their work and highlight its importance in their context. CHWs also receive automated motivational messages monthly. These provide guidelines, advice and other information relevant to their work. Through performance data analysis, weak areas that need reminders or refresher trainings are identified. Motivational messages are developed based on this, and using language that would positively impact on CHW performance and motivation.

In Mozambique, supervisors also receive monthly motivational messages, to address the formative research findings of low motivation among supervisors. In Uganda, this was not highlighted as an issue.

Job aid software

In both countries, the inSCALE mobile phones are programmed with a respiratory rate timer to facilitate improved detection of pneumonia symptoms, as well as a timer for performing malaria rapid diagnostic tests (mRDTs).

In Mozambique, an audiovisual step-by-step guide, based on existing job aids and tools, is included in the inSCALE APE CommCare application. This was to address findings from the formative research that iCCM job aids were not used effectively by APEs.

The application was designed to take the APEs through each step of a consultation, to ensure that APEs do not miss the danger signs or symptoms of malaria, diarrhoea and pneumonia. Once all the steps are completed, the application provides counselling and guidance for treatment. Images and audio in Portuguese are used in the application to refresh APEs skills to identify and treat illnesses, and to reinforce messages to caregivers regarding prevention and treatment. The application is also used to identify danger signs in newborns and pregnant women, as well as guiding malaria treatment in adults.

In Uganda, VHTs are already equipped with laminated job aids that are considered user-friendly and are widely used for the identification, classification and treatment of illness symptoms. A multimedia job aid, therefore, was not added to the mobile phone software as it was not considered likely to enhance CHWs' performance.

Competency checklists

Competency-based checklists were developed to allow supervisors to observe, provide feedback, support and coach CHWs in their work by rating their proficiency over time across five competency areas:

1.
Correctly assess, classify, refer, treat and report all iCCM patients under five years.

2.
Give caregivers accurate referral, treatment and prevention counselling.

3.
Use the mobile phone to send weekly patient reports.

4.
Use the mobile phone to send accurate stock balances of medicines and supplies.

5.
Follow the mobile phone and solar charger usage policies and guidelines.

In Uganda, supervisors were trained to conduct competency-based supervision using paper checklists. In Mozambique, the checklists were programmed into a supervisor CommCare application, allowing supervisors to fill in and submit proficiency to the central server for performance monitoring over time.

Data submission

The inSCALE mobile phone software collects aggregated community patient data – such as number of patients treated, births and deaths – as well as CHW drug stock levels and, in Mozambique, the number of community health talks (palestras) conducted. This data is submitted to a server on a weekly basis. It is made accessible online to district statisticians for forecasting and to use to integrate into regional and national health information systems.

In Mozambique, using a smartphone that is capable of more advanced features allows for individual patient data to be submitted in real time to a server using a 2G or 3G network.

Performance alerts

Automated messages from the server flag up any problems or strengths in the data submitted by the CHWs. These messages are sent to supervisors and alert them on which CHWs require more support and supervision.

In Uganda, simple performance benchmarks were developed to generate automatic SMS messages to send to the health facility supervisor. The software triggers these messages when data submitted show discrepancies – for example, in the total number diagnosed with a sickness and the total number treated for the same sickness.

In Mozambique, the smartphone allows for data submission to the health facility and district supervisors via email in an accessible reporting format. These weekly and monthly reports rate individual CHW performance against five to eight benchmarks based on real-time patient data, such as appropriate management of individual cases. The indicators relevant to a supervisor's catchment area generate information to help with their decision-making and in providing direct and personalised supervision to CHWs.

Implementing the inSCALE technology intervention

As implementation timelines were adjusted in Mozambique due to the new iCCM policies, there were benefits in implemeting the intervention in Uganda first. For instance, the lessons learnt from Uganda, combined with the formative research and existing knowledge in Mozambique, helped to speed up the development of the intervention in Mozambique.

In both countries, the implementation period was planned for 18 months. However, in Uganda, the implementation period was reduced to 12 months; this was due to set-up delays largely related to technical issues. In Mozambique, the adjusted timeline resulted in a costed extension up to 2016, allowing for an implementation period of 18 months.

The intervention in Uganda covered 13 sub-counties, 1,277 VHTs and 37 health facility supervisors. A further 13 sub-counties implemented the community intervention, and 13 sub-counties with 879 VHTs served as the control area for both interventions. In Mozambique, six districts implemented the technology intervention, involving 132 APEs and 47 health facility supervisors, and six districts with 141 APEs served as the control area.

The differing numbers of community health workers in each country meant that different approaches were required to establish the interventions in both countries.

In Uganda, more than 50 trainings were conducted for 1,277 VHTs. Due to this large number, it was not viable to deal with individual VHTs experiencing technical issues; instead, supervisors were trained to troubleshoot and VHTs received instructional SMS messages and printed troubleshooting guides.

In Mozambique, there were six APE training sessions, one for each district, held for 132 APEs. The smaller number meant that each APE could be supported directly. However, this became costly and time-consuming. Hence, training on how to resolve phone problems was given to supervisors and district coordinators.

When Yese Muzinguzi's one-year-old son, Peter, fell sick with a severe cough, he brought him to Stephen, their VHT. In this instance, however, Stephen was out of stock of Amoxicillin to treat Peter.

"I used my inSCALE phone to call my fellow VHT, to check if she had the drugs, and referred the patient. They took him straight there and Peter was treated and recovered."

Community health worker, Stephen, follows up on a patient he referred using his inSCALE phone.

Photo: Tine Frank

Establishing the inSCALE technology intervention

Activities	Uganda	Mozambique
Stakeholder engagement	Discussions were held with national Ministry of Health representatives, district health teams and other stakeholders, including the United Nations Children's Fund (UNICEF) Technology for Development Department, to produce operation and implementation guidelines. An advocacy and communications strategy was developed to keep key stakeholders engaged and updated on project progress throughout.	Discussions were held with national Ministry of Health representatives and provincial and district health directorate stakeholders to produce operation and implementation guidelines. An advocacy and communications strategy was developed to keep key stakeholders engaged and updated on project progress throughout.
Procurement	A locally-based consortium comprising the companies TTC Mobile (formerly Text to Change) and Scyfy Technologies was sourced to develop and manage the software package. Halfway through project implementation, the contract with TTC Mobile was ended.	An international and locally based company, Dimagi, was sourced to develop and manage the software package. Mcel was first procured as service provider based on network surveys. It was later switched to Movitel due to Movitel's expansion of their services in the first year of implementation.
Phone and server software programming	Scyfy built the inSCALE platform with unique programming and coding (Java Mobile Environment and Ruby on Rails framework).	Dimagi used CommCare, an easily customisable open source platform, used in many countries for CHW programme support, to develop the inSCALE software.
Software content design	Development and pretesting of the broader concept of phone package tools was based on formative research findings. Pretesting of motivational and feedback messages were evaluated on their acceptability, comprehension, and usefulness, and adapted accordingly.	Tailoring and pretesting of motivational and feedback messages were evaluated on acceptability, comprehension, and usefulness, and phone functionalities were adapted accordingly. Email report formats were pretested with supervisors and simplified. A series of action-oriented tips were developed based on a range of common performance-related scenarios.
Job aids and tools	Development, pretesting and finalising were carried out with training guides and DVDs, checklists and job aids in English.	Materials were adapted to Mozambique's context and android phone software, and translated into Portuguese.
District sensitisation	District and community consensus dialogue meetings were held to introduce the technology and community interventions and to seek views on planned innovations from district and community leaders.	District and community consensus dialogue meetings were held to introduce the technology intervention and to seek views on planned innovations from district and community leaders.

Phone software and server programming

In Uganda and Mozambique, the software systems developed for inSCALE were divided into two parts: the 'handset application' and the 'backend'.

Uganda

The '*handset application*' collects and validates data from users, structures a message to the server and then sends it.

The application provides 'network failure' recovery, to ensure VHTs only enter the data once.

It is written in Java, using the Java Mobile Environment (JME) and uses General Packet Radio Service (GPRS) to transfer data to and from the server.

The application is is set up to collect 23 data variables, including weekly number of patients seen, diagnoses, treatments given, referrals made, and drug stock levels.

The '*backend*' is the software that runs on the servers. It processes incoming submissions, presents them to the administrators and generates automated feedback messages to the users.

Data collection forms are fully configurable on the backend and sent to the handset.

The software is written in the Ruby programming language, using the popular Ruby on Rails framework. It has a provision for managing versions of the phone application.

It allows users to make it easier to download new iterations of the software when they are updating their systems.

The software uses an Application Programming Interface (API) to communicate with an SMS system, by receiving messages that are sent to a particular shortcode and sending out messages (usually in response to submitted data or as a triggered message to the VHT supervisor).

Mozambique

In Mozambique, the application developed was built using the CommCare platform. CommCare is an open source mobile health platform that consists of two main elements: CommCare Mobile and CommCareHQ.

The '*handset application*', CommCare Mobile, enables easy electronic data collection, decision support, patient/case management, workflow and behaviour change communication across large numbers of users.

APEs use the mobile application during patient visits as a data collection and educational tool, and it includes audio and image prompts.

The '*backend*', the CommCareHQ web application, provides reports, dashboard analytics, user/domain management, data viewing and performance management analysis to create actionable insight into the collated data.

CommCare uses XForms, a W3C international standard with a significant footprint across mobile platforms that are used in low-resource settings, including OpenXData, EpiSurveyor, JavaRosa and OpenDataKit.

As with the system in Uganda, the data collection forms are also fully configurable on the backend interface and can be sent from there to the handset.

The interface also has a provision for managing versions of the phone application, to make it easier to download new iterations of the software for users when they update their systems.

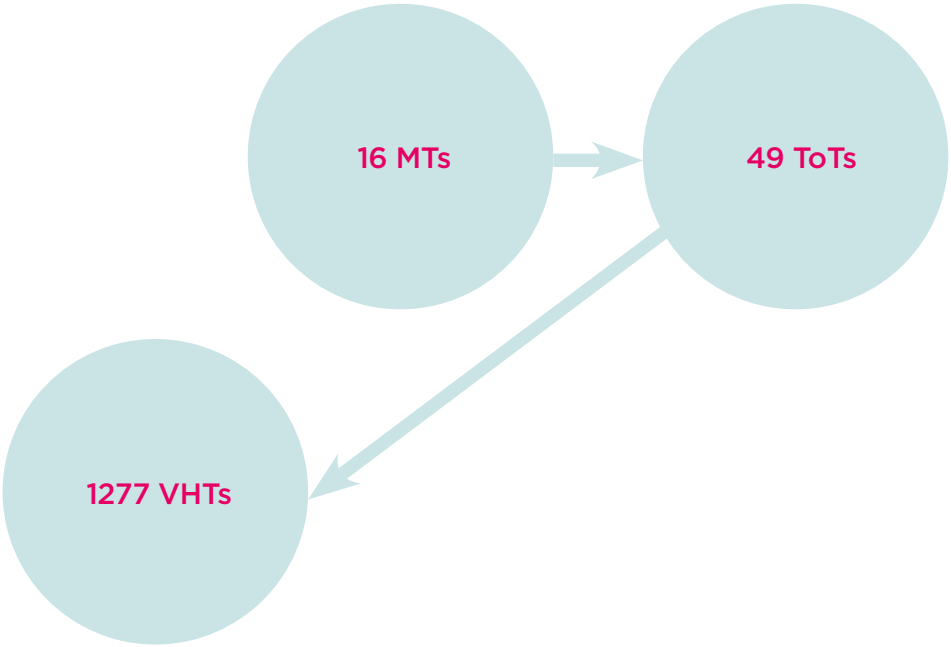
Deploying the inSCALE technology intervention

Training

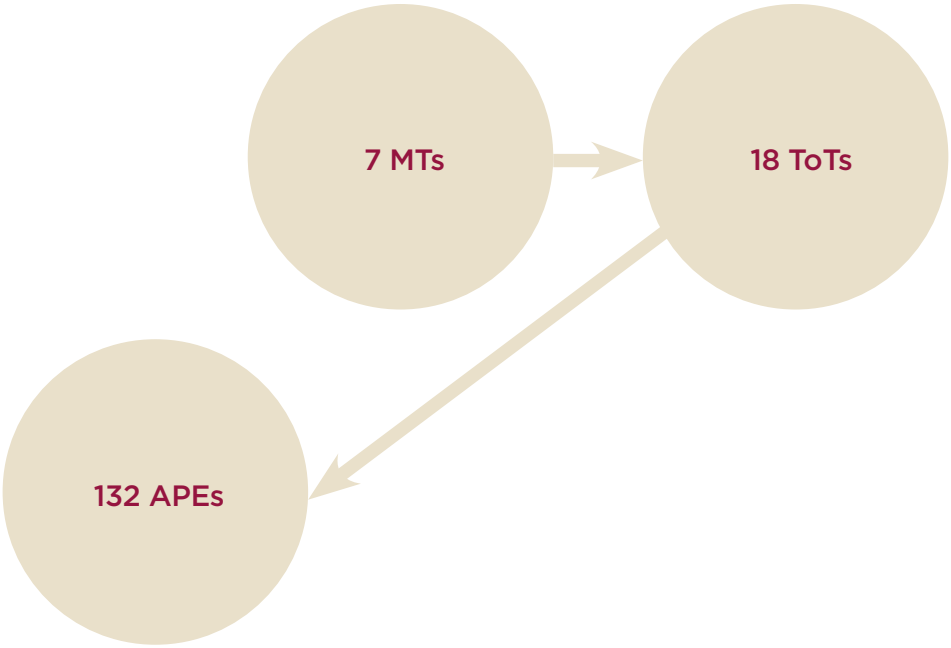
The inSCALE technology interventions were rolled out to CHWs through cascade training using a 'training-of-trainers' (ToT) approach. In both countries, the modules covered project concept and objectives, phone and solar product functions, adult training techniques and effective supervision. The CHW ToT module was first piloted and then refined for the final training rounds with groups of 20-25 CHW participants.

Cascade training using a training-of-trainers approach

Uganda



Mozambique



In Uganda, VHTs attended three-day workshops. In Mozambique the APE sessions were over four days to allow time for full training on the multimedia job aids and on how to use a smartphone. In both countries, Malaria Consortium staff supported the master trainers (MTs) to ensure quality of the training. A 'micro teaching' approach was used, dividing the CHWs into small groups of five to seven people, with one facilitator for each group and an emphasis on peer learning.

An important part of the project handover process was dedicated to training in managing and using the inSCALE systems. In Uganda, district biostatisticians were trained to download, manage and understand the data. In Mozambique, the project's extension period allowed for in-depth training of district and province APE coordinators and biostatisticians that focused on enabling government staff to take over the CommCare platform completely, including budgeting, running costs, adding users and downloading data for analysis.

Several training and evaluation tools (in English for Uganda and both in English and Portuguese for Mozambique) were developed for the training sessions. These included individual progress charts, workshop evaluation forms, trainer competency checklists and peer observation forms.

Towards the end of the training sessions, the CHWs were handed their individually branded phones and solar chargers.

Follow-up activities

After the initial rollout of the technology interventions, Malaria Consortium conducted a series of follow-up activities with CHWs to ensure maximised and correct use of the inSCALE mobile systems.

1.

Start up SMS:
Frequent SMS messages were sent to CHWs returning from training in both countries to encourage correct use of phone functions, as well as weekly reminders to submit data.

2.

Refresher session:
Three months after training, early refresher and supervision sessions were held at sub-county (Uganda) and district (Mozambique) level. During the sessions, CHWs provided detailed feedback on their phone use, challenges and successes.

3.

Progress review:
Nine months after training, progress review meetings involving all CHWs were conducted at sub-county (Uganda) and district (Mozambique) level to gather detailed feedback and provide refresher training.

In Mozambique, additional refresher trainings were conducted after 18 months. However, refresher trainings were not provided in Uganda due to the cost of training a large number of participating VHTs.

4.

Data monitoring:
During the early stages of implementation the inSCALE team used the 'backend' systems to analyse submitted data and weekly reports from CHWs.

In Mozambique, this task was gradually handed over to government staff following training of district and province APE coordinators and biostatisticians.

In Uganda, because of time constraints, the inSCALE team solely carried out the analyses. To improve reporting rates, follow-up calls were made to CHWs and their supervisors.

Troubleshooting the inSCALE technology interventions

Implementing mHealth initiatives at community level requires considerable support and troubleshooting. A detailed action plan to address these was prepared for Uganda. This plan was fine-tuned for Mozambique based on local context and the lessons learnt from the Uganda implementation. Focal persons for CHWs to contact directly for troubleshooting were identified within the inSCALE Malaria Consortium team.

Technical issues

A number of challenges connected to network operators needed to be addressed.

In Uganda, where the project used standard service deal packages, these challenges were largely caused by network provider upgrades and technical issues, resulting in all 1,277 SIM cards being changed on two occasions. This upgrade had a very high cost to the project.

In Mozambique, because of poor network coverage from the initial service provider, another company offering a tailor-made service package was used. To upgrade to the new provider's software, SIM cards were changed on one occasion. The mobile operator in Mozambique provided the change of SIM cards at no cost to the project.

System rectification

In Uganda, the number of weekly reports received from VHTs were lower than expected. Therefore, each component of the system, including the internet protocol (IP) address configuration and the server, was assessed. To solve these issues, a new server was set up, data was migrated and the phones were reconfigured.

In Mozambique, minor modifications to the system were made, such as those related to fixing erroneous skips in the software algorithm and misconfiguration of the recipient list for district and health facility reports.

Repairs

After a few months of implementation, both countries experienced a number of hardware problems, partly as a result of the user's mismanagement of the phone and hardware failure. The most common problems were:

- missing or damaged SD cards – which stored the smartphone application – resulting in failure to load the application;
- removing SIM card or battery, resulting in phones failing to synchronise with the server as it changed the system's time setting;
- phone batteries failing to charge or losing power quickly;
- user changing smartphone settings (to keypad or flight mode), making it impossible to type or connect to the internet;
- in Mozambique, phones running very slowly or application failing to open because of old and outdated android software.

Where CHWs experienced hardware faults, the repair process was:

- In Uganda, parish coordinators collected faulty phones from VHTs and delivered them to supervisors. Malaria Consortium staff then collected, repaired, and returned the phones.
- In Mozambique, faulty phones were handed over to health facility supervisors, who delivered them to districts. Malaria Consortium staff then collected, repaired and returned the phones. However, the long travel distances in Mozambique meant this process could take up to six weeks.

In both countries, one of the issues that negatively affected the reporting rate was that the chargers, which were selected for their durability, still broke down, failing to charge the phones. As repairs were not possible, some solar chargers had to be replaced.

Uptake of the inSCALE technology interventions

Throughout the Uganda implementation, most components of the technology intervention were functional for users, including the mobile respiratory rate and mRDT timers, CUGs and motivational messages. However, the technical challenges from network operators and software partners, along with the extended time to rectify the system, had a negative impact on the success of data submission. At full implementation strength the reporting rate rarely reached more than 50 percent.

In Mozambique, where the technical challenges were less and more quickly resolved, the reporting rate remained at a constant 60-70 percent during full implementation strength. While this was lower than expected, it was partly caused by hardware and connectivity problems and the frequent lack of drug supplies for APEs, leading patients to seek treatment elsewhere.

Uganda

As part of an overall process evaluation, key informant interviews in four sub-counties were conducted with 24 VHTs and eight supervisors. The interviews, held between January and February 2014, explored whether the intervention was implemented as intended and had the desired impact on VHT motivation.

Data submissions on the server were reviewed monthly to evaluate the reporting rate. Nine months into implementation, a survey was conducted with VHTs to collect data on uptake and use of the intervention's components. Qualitative interviews were conducted by experienced research assistants who had two days of training to familiarise themselves with the study's objectives, concepts and tools. Data were manually coded and analysed using a thematic content data analysis approach.

The main findings from the key informant interviews were:

1.
Increased communication with peers and supervisors: 92 percent of VHTs reported having both made calls to and received calls from their supervisors and fellow VHTs using the inSCALE phone and SIM card.

2.
More targeted support supervision to underperforming VHTs.

3.
VHTs found data submission and feedback messages highly motivating: 95 percent of VHTs submitting weekly reports as well as 95 percent having accessed SMS messages.

4.
Solar lamps were helpful for treating patients at night: 84 percent of VHTs reported that they were able to use the solar lamp 'very well' and 75 percent had used them for charging community members' phones.

5.
Improved skills for diagnosing symptoms of pneumonia and malaria: 93 percent of VHTs were reported to be using the inSCALE timers for diagnosis.

6.
Increased recognition of VHT role through phone ownership.

In addition, the research assistants collected a total of 63 field stories from VHTs across both the technology and community interventions in Uganda to use in a 'most significant change' evaluation. This is a form of participatory evaluation that involves many levels of stakeholders, who rank the changes they consider most important for the programme, along with their justifications. The field stories were reviewed in three rounds, in which organisational, district and national stakeholders went through systematic selection of the most significant stories. These stories provided qualitative data on impact and outcomes to be used to assess the project's performance.

Most significant change, Uganda

"The most significant change to me is getting information fast on the phone relating to treatment of children. We easily share information in our work as VHTs, which makes it easier. Even making reports is now easy; we enter data and send the reports using the phone every week. We have a coordinator who calls to ask for reports or to give information and this has made work easy because before we would move to find him.

"We also use the respiratory timer on the phone, which has helped me a lot in my work, because you set it and wait for the alarm to go before you stop counting the breath rate. With the old respiratory timer, it was difficult for me to treat children brought with a cough suspected to be pneumonia.

Many people come for treatment at my place, more than before I got the phone. They call to find out whether I am at home and whether I have drugs, so patients don't delay at my place without getting treatment, so that attracts caregivers to bring their children to me.

The lamp helps me treat patients who come at night. I used to struggle to find money for paraffin when patients were brought at night, but now it is easy because the lamp provides the light when I have to treat at night. I don't spend on paraffin. The lamp is charged under the sunshine so I don't incur any costs to maintain it and it also has better lighting than the local lantern."
VHT, Hoima district

Mozambique

Between May and June 2014, 24 APEs and nine supervisors from three districts were interviewed to evaluate the uptake and impact of the technology intervention in Mozambique. Interviews were conducted by qualitative researchers, who had received one week of training which covered the study's objectives; use, challenges, and adaptation of the interview tools; test interviews; and transcription of audio files.

Focus group discussions with an emphasis on the motivational aspect of the project were held. Data submissions on the server were also reviewed monthly in order to evaluate the reporting rate. Twelve months into implementation, a survey exploring uptake among all APEs in the technology intervention was undertaken to collect data on uptake and use of the intervention's components. In addition, the research assistants conducted three rounds of focus group discussions with 12 APEs, for a simplified version of the 'most significant change' evaluation methodology.

The main findings from the key informant interviews were as follows:

1.
Out of 24 APEs, 20 had used the phone regularly to request help or support from their supervisor.

2.
Out of 24 APEs, 18 had received one or more calls in the past month from their supervisor.

The survey on uptake revealed that nearly 70 percent 'always' used the phone to support their work in the communities and 20 percent used it 'sometimes'. A total of 84 percent had called their supervisor in the previous month, and 98 percent were using the solar lamp for consultations at night.

Lessons learnt

Successes

Data collected from the progress review questionnaires and 65 key informant interviews conducted in both countries revealed predominantly positive feedback, especially regarding CHW motivation and performance. Some key outcomes are below:

Aim	Outcome	Outcome
Improved CHW status and standing	**Uganda** Owning feature phones and solar products is perceived as prestigious and increases respect for VHTs, thus promoting their value to the communities. Owning the phones also underlines the VHTs as being connected to the government health system. "You may find that, out of 100 people in the village, only seven people have phones. So, for a VHT to receive an inSCALE phone, it is really important. Some of the community members may even go to the VHT's home to have a look at the phone, it may sound like a joke, but it is the reality on the ground. To a VHT, having this phone is very prestigious." *VHT supervisor, Kyegegwa district*	**Mozambique** The inSCALE APE CommCare application is seen to enhance community perceptions and the legitimacy of APEs, as well as understandings of their work – improving communication between APEs and their communities. "I am very well known now. People say, 'This lady who works with the phone.' Many people want this phone, and the sick people come running to see the phone." *APE, Inharrime district*
Improved CHW support and supervision	Regular phone contact between VHTs and their supervisors improves supervision, reducing the need for frequent supervisor visits and improving relationships. Underperforming VHTs are identified through submitted data and receive more targeted supervision. "We are now in touch frequently, which was not the case before, when it was always a challenge to get in touch with the VHTs. But now, it is just a matter of calling them." *VHT supervisor, Hoima district*	Regular contact and supervision over the phone improves the level of support APEs receive. The phones improve report submission, which in turn improves the level of targeted support. "Not only does the phone have the advantage of facilitating the right diagnosis and correct treatment, but also it helps us supervisors know how the APE is performing." *APE supervisor, Inhambane province*

Activities	Outcome	Outcome
Increased CHW feeling of connectedness to the health system	**Uganda** VHTs feel appreciated and recognised on receiving motivational and feedback messages, and feel they are part of the overall health system. With government-branded phones, communities also view the VHTs as more connected to the government health system. "I can talk and make consultations with other VHTs, my coordinator and supervisor. This makes me proud because, when I ring anyone on the system, I get a prompt response. I don't even need to first introduce myself." *VHT, Kyegegwa district*	**Mozambique** APEs report that the phone indicates that they are an important part of the health system strengthening effort aimed at reducing the burden of disease in their communities. "When we are given so much support, in the form of this equipment, we realise that we have the capacity to improve our work and contribution as an APE towards the construction of programmes headed by Ministry of Health, as well as the local government. You can't ever imagine or consider that at any moment you will be forgotten. Now more than ever, we are connected." *APE, Inhambane province*

Activities	Outcome	Outcome
Increased CHW performance and motivation	**Uganda** VHTs improve their performance through more correct diagnosis of malaria and diarrhoea using the phone timers, refresher training SMS messages and phone consultations with supervisors and other VHTs through the CUGs. Data required for weekly reports increases household visits for follow-up and registration, as well as the quality and timeliness of the data submitted. Motivational messages provide a feeling of appreciation and encouragement for the VHTs, and the phones and solar products themselves are perceived as a reward for volunteering. "If I get a patient and maybe I have forgotten some procedure to follow I call my fellow VHT to remind me of what I should do to treat the patient. Then I treat confidently knowing what I am doing." *VHT, Hoima district* "The VHTs would not pay much attention to the monthly reports they were writing in the past, but now when they make weekly reports they are careful not to make mistakes because they know they are sending them direct and each of their numbers [VHT's code number] is known. This has also helped them make better monthly reports that they give to the parish coordinators to bring to the health facility." *VHT supervisor, Masindi district*	**Mozambique** The inSCALE phones and the visual job aid provide APEs with opportunities to acquire new skills, and many use the diagnosis and treatment guide, which improves their performance and validates their knowledge among caregivers. "So we have been giving health talks to these mothers for a long time, but then we noticed that often they actually didn't understand these messages. But now, with the phone, they can hear and see for themselves. They really like it. You see, now I can show them that the person is sleeping under a mosquito net, not just tell them." *APE, Morrumbene district* "The phones help the APEs conduct a correct consultation and, at the same time, deliver necessary and correct health education. Before, it was normal for the APE to wrongly diagnose a disease, provide an incorrect treatment or make an unnecessary referral, but now by using the phones this is solved." *Supervisor, Inharrime district*

Activities	Outcome	Outcome
Increased access to and use of appropriate treatment	**Uganda** Caregivers can call the VHTs to check their availability, as well as that of drugs. When not available, the VHT can direct the patient to his/her colleague, resulting in more prompt treatment or referral. VHTs can call in the referral to the health centre in front of the caregiver, which increases adherence to referrals, resulting in more prompt and appropriate treatment. "Imagine when a patient brings a sick child in the night and I tell him or her that 'Please I cannot attend to your child because I do not have the light.' They will go away annoyed. Now, when I work on them, they feel happy and friendly to me, and tell other people that I treated their child in the deep of the night." *VHT, Buliisa districtt*	**Mozambique** The inSCALE smartphones improve the status of the APEs, fostering respect among their community members and increasing the number of community members who routinely approach the APEs for care and advice. The confidence and recognition from their communities is also felt to be an incentive for the APEs. "I remember one time there was a pregnant woman in my community who was in pain for two days. I used my phone to communicate to my supervisor because she could not walk and the supervisor sent an ambulance for her. This happened twice." *APE, Inhassoro district* "Because everything is happening on this phone, this has been helping me prescribe the correct medicine and correct dosage and even to appropriately explain how the mother has to give each dosage to her baby. These recommendations have been easy to deliver, as everything is shown on the phone." *APE, Morrumbene district*

In addition to these outcomes, CHWs and their supervisors reported on a number of other key successes:

- In Uganda, VHTs reported that being able to call the health centre to refer a patient, and making this call in front of the patient, increased referral adherence.

- In Mozambique, the provincial APE coordinator used the WhatsApp messenger platform to establish a group, which included all district APE coordinators and biostatisticians who had received the inSCALE phones, so they could communicate about supervision and other issues. Some APEs have also done the same.

Challenges

Most of the challenges faced implementing the inSCALE technology intervention owed to software and network issues, but also some hardware issues and human factors. Some key challenges included:

1.
Network access and internet connectivity presented operational challenges in both countries.

2.
Irregular supply of drugs, at times leading to drug stockouts, negatively affected the progress and improvements gained by the intervention.

3.
In Uganda, frequent transfers of health facility supervisors disrupted the improved relationship between CHWs and supervisors.

4.
Some CHWs, due to their low-level of education and geographical location, continued to experience difficulties using the phones.

5.
Both countries experienced significant challenges with regard to software and hardware maintenance as well as functionality issues related to software and platforms.

6.
In Mozambique in particular, it has been a challenge to ensure automatic uploading of data bundles on the CHWs' phones.

7.
Despite being procured as the most durable solar product, the solar chargers are fragile in a rural setting, with the majority not functioning within a few months.

8.
The high level of uncorrected visual impairment among many older CHWs presented a challenge in navigating phone functions easily, particularly on the smartphone.

9.
Challenging partnerships with contracted software partners (Uganda) and network operators (Mozambique) caused significant time delays to the project.

10.
The limited literacy rate among Ugandan VHTs presented a challenge in terms of their understanding and navigation of phone functions.

11.
In Mozambique, a considerable number of APEs unintentionally switched their phones to flight mode, disabling the reporting functions.

Recommendations

For the successful implementation of similar projects, the following recommendations are made to prevent technical issues related to software, hardware, platforms and network providers:

1.

A reliable software partner with experience in mHealth initiatives and who uses an established platform is essential for successful implementation. In Mozambique, partnering with a locally-based agent that met international standards and used an easily customisable platform greatly reduced software-related challenges. A similar platform could not be sourced in Uganda at the time the project started and had to be built from scratch, leading to considerable delays due to troubleshooting and modifications to the software package.

2.

Tailor-made network provider packages, as opposed to standard package deals, are highly recommended. Despite the added time required by operators to tailor packages, this is necessary in order to retain control. As standard package deals change regularly, and mobile operators do not always communicate changes regarding the data and minutes provided, this can cause significant confusion among both the CHWs and the project implementers.

3.

Initiatives such as the inSCALE technology intervention have the potential to generate additional business for network operators. Ministries of Health should capitalise on corporate social responsibility policies to leverage better package deals for data and minutes from operators, as CUGs may be too costly for governments.

4.

In order to deal with considerable technical challenges, it is highly recommended to establish a monitoring system. This would involve training designated staff from either the project or the Ministry of Health to troubleshoot and to conduct a weekly analysis of incoming data. A monitoring system will also help to ensure quality control in reporting and identify users with software or hardware difficulties.

- Phones with non-removable batteries and a significant amount of internal memory (at least 1GB) are preferred so the inSCALE APE CommCare application can be installed without the need for an SD card.
- To ensure correct and relevant use of the phones, it is recommended to install 'app-lockers' in order to prevent using up the paid-for data on other applications not related to the programme.

5.

In Mozambique, many APEs stopped reporting faults to avoid being without a phone for up to six weeks if it needed to be repaired. To maximise the purpose and use of the phone and minimise disruptions such as these, contracts with locally-based repair services for hardware maintenance are essential.

6.

Using the phones can increase CHW performance in terms of managing patients and prescribing treatment. Where data collection using the phones already happens – such as the mTrac SMS-based disease and medicine surveillance system in Uganda – at minimum, components such as CUGs, supervisor messages, and personalised feedback SMS should be incorporated.

7.

Gradual implementation and scale-up is crucial for an mHealth initiative such as the inSCALE technology intervention. Pilot testing the mobile systems helps identify issues early on, improving the success rate when introducing them as routine practice. Lessons learnt from pilot implementation will be highly valuable in making adjustments and improvements before further scale-up.

Moving forward

Uganda

The inSCALE project in Uganda ended in October 2014. Malaria Consortium hopes to engage with partners who are expanding mTRAC in Uganda, to determine how components of inSCALE could be incorporated into the system.

Malaria Consortium is also exploring whether there is interest in incorporating a simple electronic job aid similar to CommCare.

Mozambique

In Inhambane province, Malaria Consortium started the handover process to the Provincial Health Directorate, which continues under the 2016 upSCALE project.

The upSCALE project in Mozambique

Malaria Consortium is collaborating with the Ministry of Health in Mozambique, UNICEF and Dimagi to further develop and integrate the mHealth system and the inSCALE APE CommCare application (now known as the APE app). The mHealth system will be fully integrated into the APE programme and transitioned to Ministry of Health control. This involves training key individuals at national, provincial and district level to manage the mHealth system functions, including monitoring usage and troubleshooting. Initially, this system will be scaled up to include all districts in Inhambane and Cabo Delgado, with further scale-up anticipated in other provinces.

The application will be patient-focused, rather than disease-focused, in order to promote continuous care and follow-up within the community. It will include the APE services that were added to the curriculum in 2014, which are family planning, pregnancy tracking, antenatal care, post-partum care, healthy child check-ups, and tuberculosis and HIV patient follow-up for treatment adherence counselling. Dedicated modules will be developed to assist APEs with stock management, preparation for community health talks, and vital registration. An additional application for supervisors to manage APE performance is also being developed.

Malaria Consortium is also actively involved in the harmonisation of mHealth activities in-country. This includes support to bridge the mHealth system with District Health Information Software 2 (DHIS2), in order to make community data available on the DHIS2 dashboard.

More information about the upSCALE project is available on the Malaria Consortium website: **www.malariaconsortium.org**

Malaria Consortium continues its efforts to share learning more broadly, for example, by making the inSCALE mobile phone system and application freely available through a public copyright license (Creative Commons Attribution-Non Commercial-ShareAlike licence) which can be downloaded from the inSCALE site: **www.malariaconsortium.org/inscale**

Malaria Consortium will publish an endline paper to establish the impact of the inSCALE technology interventions in Uganda and Mozambique, including costing of the interventions and their various components.

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Malaria Consortium

Malaria Consortium is one of the world's leading specialist non-profit organisations. Our mission is to improve lives in Africa and Asia through sustainable, evidence-based programmes that combat targeted diseases and promote child and maternal health.

We work across Africa and Asia with communities, government and non-government agencies, academic institutions, local and international organisations, to ensure good evidence is used to improve delivery of effective services.

Our uniqueness is in our ability to consistently design and apply tailored, technically excellent, evidence-based solutions, fit for effective implementation, with impact on the wider health system and economy.

Malaria Consortium works with partners, including all levels of government, to improve the lives of all, especially the poorest and marginalised, in Africa and Asia. We target key health burdens, including malaria, pneumonia, diarrhoea, dengue and neglected tropical diseases (NTDs), along with other factors that affect child and maternal health. We achieve our goals by:

- Designing and conducting cutting edge implementation research, surveillance and monitoring and evaluation.
- Selectively scaling up and delivering sustainable, evidence-based health programmes.
- Providing technical assistance and consulting services that shape and strengthen national and international health policies, strategies and systems and build local capacity.
- Seeking to ensure our experience, thought leadership, practical findings and research results are effectively communicated and contribute to the coordinated improvement of access to and quality of healthcare.

www.malariaconsortium.org

An APE coordinator uses the inSCALE APE CommCare application to refer a patient in Inhambane, Mozambique.
Photo: Ruth Ayisi

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