Project factsheet information

Project title	Interactive, Structured, Multi-modal Clinical Guidelines to Improve Quality of Care by Rural Healthcare Providers in India
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Dates covered by this report	01 – 06 – 2010 / 30 – 06 – 2011
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Country of implementation	India, IND
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Partner organizations	Optra Systems, Pune, India Tribal Health Initiative (THI), Sittilingi, Tamil Nadu Centre for research in New International Economic Order (Crenieo), Chennai
Total budget approved	40,000 AUD
Project summary	Non-physician rural health providers (RHPs) deliver health care in large parts of rural India, but most have not been trained formally; thus the quality of health care they deliver may not be standardized. This project was designed with the objective of enhancing and standardizing RHPs' quality of care through use of disease management guidelines/protocols available on a user-friendly mobile phone platform. We used a system called GuideView to develop the multi-modal 'how-to' advice for performing simple procedures in a step-by-step way. We adapted WHO's existing protocols to local conditions. We then field-tested the Guidevues (GVs) developed through this system on 16 RHPs from two different parts of rural Tamil Nadu in southern India. Half the RHPs were assigned to an experimental group and the other half to a control group. Overall mean protocol compliance of the experimental group (57.21%) was higher than that of the control group (52.70%). An overwhelming majority of the RHPs found the system useful and usable. The overall mean workload index (TLX) was 5.18 implying that they faced only a moderate level of difficulty. There was a high level of patient acceptance for the system and the majority did not think that it interfered with the treatment process. We conclude that mobile phone based GVs have significant potential for scaling up in underserved rural areas with different types of frontline health workers.

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Project Summary

Non-physician rural health providers (RHPs) deliver health care in large parts of rural India, where physician density is low and access to proper health facilities is poor. Most RHPs have not gone through a formal training programme and the quality of health care they deliver may not be standardized.

This project was designed with the objective of enhancing and standardizing RHPs' quality of care through use of disease management guidelines/protocols available on a user-friendly mobile phone platform. We used a system called GuideView to develop the mobile phone based protocols. Dr Sriram Iyengar, University of Texas at Houston, and our project collaborator is the inventor of the technology. GuideView technology is designed to provide multi-modal 'how-to' advice and teaching for performing simple procedures in a step-by-step way. The system also enables integration of rich media (audio, pictures and video clips) into each step of the protocol. The technology is easy to use by non-technical local teams to develop their own local adaptations of disease management protocols.

Our specific objectives were to develop and field test multi modal cell phone based disease management guidelines for frontline RHPs in India.

The project was implemented by the Garhwal Community Development and Welfare Society (GCDWS), an established non-governmental national organization with expertise in implementing community based health programmes. Our multi disciplinary team that was one of our greatest project strengths, included medical, public health, and technology specialists.

From research evidence and through discussions with RHPs and with our medical experts, we selected 3 main conditions as entry points into the flowcharts: fevers, diarrhea and respiratory conditions. The algorithms or flowcharts for these were linked with the commonest etiologies including malaria, typhoid, TB, respiratory infections, urinary infections etc. We adapted World Health Organization (WHO) existing protocols for Integrated Management of Children's Illnesses (IMCI) -from one week to 2 months and from 2 months to 5 years-, and Integrated Management of Adult illnesses (IMAI).

Optra Systems, the local technical partner trained the Project Director in use of the GV software, who was then able to work with two of the medical experts on the team to create the protocols on the Guideview system. The basic written steps were enriched with audio, visuals and video clips. These were first created on a computer and then executed or transferred onto windows mobile phones, with Optra's assistance. The first mobile GVs were developed in English and were then converted into Tamil, the local language by enabling the system for the conversion.

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16 RHP were finally included in the project. They were from two sites in Tamil Nadu, a state in southern India. One group of 8 RHPs was independent male practitioners in district Tirupattur. The other 8 RHPs were all female community health workers linked to the outreach centre of an NGO hospital known as Tribal Health Initiative or THI hospital.

All 16 RHPs were trained over 2 days in a classroom setting in the use of the mobile phone GVs. Our team of medical experts guided the RHPs in understanding and navigating through all the health content in the mobile applications. The group picked up the new skill of navigating through a touch-screen phone faster than we expected. We also observed that the mobile devices assisted in captivating the RHPs' attention and made them receptive to listening to best practices in health – practices that are simple yet logical, and call for cutting down of irrational medicines. After the classroom training, the Sittilingi group received some more field training (facilitated by THI senior staff) with patients in the outreach clinic and the Tirupattur group received trouble-shooting support over the phone.

For the purpose of field-testing we used a randomized controlled study design and randomly assigned 8 RHPs to the experimental group and 8 to the control group. All 16 were trained on mobile phones, but after the training only those in the experimental group received the application on their mobile phones while those in the control group received only the mobile phones without the applications, but with written protocols (paper based).

Approximately 2 months after the training, the RHPs were assessed for their use of the mobile GVs by a team of field investigators. We used 4 study tools to assess different components of use: 1) usability, 2) workload index, 3) protocol compliance, and 4) patient feedback. Protocol compliance was assessed using a patient –provider observation tool on 8 patients (4 child and 4 adult) per provider for all the 16 RHPs.

We found that the overall mean protocol compliance of the experimental group (57.21%) was higher than that of the control group (52.70%). Due to the small sample size the study lacked sufficient power for statistical significance but we will be doing a more in-depth analysis to look at significance issues. An overwhelming majority of the RHPs found the system useful and usable, were eager to have protocols for many more conditions loaded on the system, and interestingly found the audio instructions as the most useful part of the system. The one big challenge for them was to navigate through the phone screen before starting the Guidevue. The overall mean workload index (TLX) was 5.18 with a standard deviation of 2.13. This means that the RHPs encountered only a moderate level of difficulty inspite of being faced with a new technology. There was a high level of patient acceptance for the system and the majority did not think that it interfered with the treatment process.

There were a few challenges too: the available Tamil font was not very easy to read by the RHPs and some of them also asked for the English versions that they could refer to

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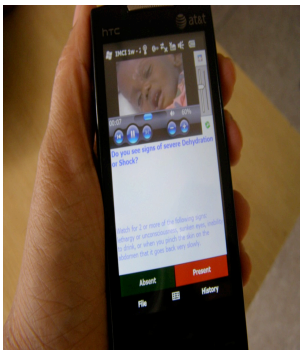
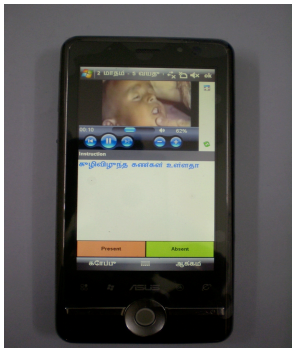
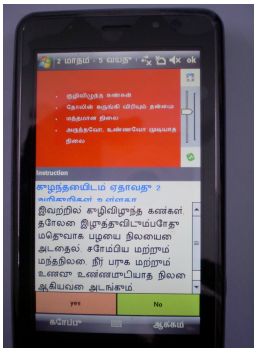
alongside. A few RHPs reported that they might not use the protocols for each and every patient for common illnesses after they had mastered the protocols, but they liked the multimedia system to check their memory against – rather like a training tool or a reference tool. In Tirupattur as there was no regulatory or supervisory for the independent RHPs (and they were not much interested in linking up with their local doctors), we found continued use of irrational drugs and injections. These however can only be tackled with larger systemic changes.

We conclude that mobile phone based GVs have significant potential for scaling up in underserved rural areas with different types of frontline health workers, and a major reason is that the Guidevue technology makes it possible for non-technical teams to develop extremely location specific guidelines.

Above (left to right): English and Tamil GuideViews of Integrated Management of Children's Illnesses (IMCI) protocols on mobile phones developed for RHPs in India.

Justification

In many rural areas of India where physician density is low and accessibility to proper health facilities is poor, non-physician rural healthcare providers (RHPs) are the major providers of healthcare to millions. Most RHPs have a high school education, but their sources of training in health care are usually informal and thus not standardized. The quality of care they provide may be technically deficient and not aligned with standard disease management guidelines for community health workers.

RHPs' quality of care can be enhanced and standardized through use of disease management guidelines appropriate to their level. These guidelines offer special relevance in low resource settings where diagnosis cannot be confirmed through laboratory investigations. If available on a user-friendly platform, these guidelines can help improve

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disease recognition, initial treatment, management, and referral. The greatest benefit of health care improved in this way will be seen in the health status of populations who are at greatest risk of mortality and morbidity and who access health care from the provider group for whom these guidelines are intended.

This project seeks to develop interactive and structured clinical guidelines for RHPs, executable on mobile phones, by adapting and field testing a system called GuideView[1] that has been developed by our project partner Prof. M. Sriram Iyengar, PhD, University of Texas Health Science Center at Houston.

GuideView technology is designed to provide multi-modal 'how-to' advice and teaching for performing simple procedures. It has been tested for use on multiple Windows-based platforms including Windows cell phones and Personal Digital Assistants. However, since the J2ME (Java-based) cell phone has become a ubiquitous communications device even in low-income countries such as India and others in Africa, we proposed to develop and field test a GuideView version for Java enabled mobile phones.

As a tool, GuideView has been designed to help improve medical care to under-served and indigent communities typically located in urban slums, or in rural villages. Here, reliable electricity and high-bandwidth communications are rarely available. Well-trained physicians and nurses are scarce and community health workers, and other non-physician care providers have, at best, very basic training in clinical diagnosis and treatment.

While half the RHPs in our sample were clinic based independent private practitioners and all male, the other half were female community health workers recruited (about 6-8 months ago), trained and linked to an NGO hospital in a tribal region, called Tribal Health Initiative or THI hospital. The latter were being trained to deliver basic health care in their communities and also in an outreach clinic managed by the THI hospital. A few of the former group of RHPs were mobile, traveling through multiple villages every day or running more than one clinic. All these RHPs provide care to rural communities at the very bottom of the pyramid who are socially and economically impoverished and who have poor or no access to professional healthcare.

For such communities GuideView can assist in multiple ways. It can assist RHPs to perform accurate triage, correctly referring complex cases to physicians and clinics since the referral decision can be encoded in GuideView itself. If cell phone communication exists at the point (and time) of care, the RHP can also communicate with remote clinicians and transfer

[1] Guideview Website: http://GuideView.shis.uth.tmc.edu/

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patient data using GuideView. The remote experts can then synchronously assist the RHP. This component of the system, although it was available and working, was not fully tested because the private independent RHPs were not too keen to be linked with their local doctors. In case of the second group of THI linked RHPs, at the time we did the field-testing, either the THI doctors or senior nursing staff was always present.

Our organization and its key team members have an abiding interest in improving delivery of health care services to rural and underserved populations. GCDWS is associated with a rural hospital in a hilly region that provides a range of surgical and non-surgical secondary level healthcare to the rural population in the district. Dr Rajesh Singh, the founder of GCDWS and the hospital is the only qualified surgeon in the district. Dr. Meenakshi Gautham has been working as an academic and health activist to bring greater recognition for frontline health workers and simultaneously to help strengthen their services through enabling technologies. To further our goals we have linked up with other experts who share our values and commitments and who are at the same time achievers in their own fields, like Dr. Sriram Iyengar and Dr Shyamprasad.

Project objectives

This project was designed to meet the following two objectives:

1. To develop cell phone based clinical guidelines for frontline RHPs in India, using the GuideView system

2. To field-test the clinical guidelines using a randomized controlled study design.

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Project implementation

Objectives	Activities	Timeline	Overall assessment
To develop cell phone based clinical guidelines for frontline RHPs in India, using the GuideView system	Development of CGV content	The content was developed over 4 months following project initiation (June-September, 2010)	This activity included selection of the most relevant health conditions seen by the RHPs, and identification and adaptation of the standard management guidelines/protocols for them. We selected the health problems after looking up research evidence, and through consultations with the RHPs and our medical experts. We finally selected 3 symptoms that present most frequently at the primary level. These included fevers, diarrhea/dysentery and respiratory conditions, and the management protocols for these included the most common epidemiologies like malaria, typhoid, TB, bacterial infections and Acute Respiratory Infections. For developing the standard guidelines/protocols, our medical experts recommended that we review and adapt WHO's international protocols for these 3conditions that are found in – (1) Integrated Management of Children's Illnesses (IMCI) and (2) Integrated Management of Adult Illnesses (IMAI). We used the Indian version of these protocols. Our medical experts then reviewed in detail the IMCI and IMAI protocols and provided specific inputs for their adaptation to local conditions in Tirupattur and Sittilingi. So, in the first phase of this activity, we reached consensus with our medical experts on which conditions and guidelines to select and how to adapt these. This lasted for roughly 2 months. In the next 2 steps described below, we developed the CGVs based on the protocols, and after the project leader had been trained in using the Guidevue author.
	Project leader's orientation to the Guidevue system	2 days (August 2010)	Our local technical support organization, Optra systems, trained Dr Meenakshi Gautham, the project leader, in how to use the Guidevue authoring tool to build the computerized multimedia guidance system. The purpose of this training was to enable the project leader to sit with some of the medical experts and then create every step of the selected protocols, which would then be executed on the mobile phones.
	Development of CGV applications for cell phones and Windows PCs, and Tamil translations Training of project staff in Guidevue software, and publication of developed Guidevues on mobile phones	2 months (August-Sept, 2010) as part of the 4-month process described in the first activity under this objective. The Tamil conversions and final execution took another 2 months, and were ready only by end of Nov, 2010.	After the project leader became proficient in the use of the Guidevue author, she worked on a one to one basis with some of the medical experts – with a paediatrician, a general physician cum surgeon and a general surgeon cum medical educationist. 3 GV application files were created: 1. IMCI for one week to 2 months; 2. IMCI for 2 months to 5 years; 3. IMAI. The files were created in English. The software was then enabled for Tamil, the local language. The files were converted into Tamil. Even though the protocols were available in a written form, it required a laborious and thoughtful process to create each step in a computerized, logical sequence, and to fit in pictures and video clips and to record the audio for each step. Each of the 3 protocols – IMCI for infants from birth to 2 months, IMCI for children from 2 months to 5 years and IMAI, took about 10-15 days to be completed. In the meanwhile the steps in the protocols were translated into

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Objectives	Activities	Timeline	Overall assessment
			Tamil by one of our Tamil speaking technical staff. Optra worked on enabling the software for Tamil. The project leader trained the Tamil technical person to type in the Tamil text and record the Tamil audio in the Tamil versions of the 3 Guidevues. After the Tamil versions were ready, a staff member from Optra Systems worked with our Chennai based technical person and helped her to execute the final Tamil GVs on 16 mobile phones bought as part of the project funds for the 16 RHPs who were to be part of this study. The Tamil conversions required more time, labour, and funds than we had anticipated at the start of the project. An important finding of this activity was that the GV author is extremely easy to learn and use by any non-technical person and teams to develop their own computerized protocols. It has enormous cross-cultural potential and is an efficient tool for developing applications that have local relevance in different locations. However all this was made possible only through the expert support that we had from our technical experts: Dr Iyengar and his local partner Optra systems, and from the knowledge and commitment of our medical experts, each of whom had been especially hand picked for this project.
	Selection of subjects	15-20 days between July 2010 and August 2010.	We selected our RHPs from two field sites in two neighboring districts in rural Tamil Nadu, a southern Indian state. One of these – Thirupathur in district Sivagangai- was the original field site as proposed in the project. We recruited 8 independently practicing RHPs (all male) from this field site. Another group of 8 were all female health workers from a tribal area who were linked community health workers of a small NGO hospital (Tribal Health Initiative or THI hospital) in a remote tribal region – Sittilingi in district Dharmapuri. They worked under the supervision of the THI hospital's medical directors and were being trained to manage an outreach clinic that was around 70 kms from the main hospital. These two different groups of RHPs – one a group of independent practitioners and another a group that was directly linked to a formal hospital set up – were selected because we assumed that they would provide us with valuable additional lessons on the contribution of local contexts in the way our application is finally used and its sustainability and success. We had originally proposed 20 RHPs all from Tirupattur, but not all were available for our project, so we decided to include health workers from another field site also.
	Orientation activities		Dr Gautham and Ms Anshi Zacchariah traveled to both field sites to meet with and orient the participants and the referral physicians in Tirupattur and the THI hospital's doctors in Sittilingi. In one of the sites we also met with one of the local leaders – the president of the RHPs' association – to explain to him and get him on board with respect to our programme plans. He also became one of our study participants.
	Training of RHPs	2 days in Chennai + 2 days in Sittilingi (during January – Feb 2011)	RHPs were trained in using the mobile application over a 2-day residential training programme in Chennai. 12 RHPs (8 from Tirupattur and 4 from Sittilingi) attended this programme. The training, which was part medical, part technical, was conducted by our medical experts, Dr Srinivasan, Dr Shyamprasad and Dr Rajesh Singh, and our technical support team. From the very beginning the

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Objectives	Activities	Timeline	Overall assessment
			RHPs were handed the mobile phones and were trained on the medical content using the mobile phones. The RHPs were administered a short knowledge assessment questionnaire before and after the training. At the end of the training the RHPs in the experimental group retained the applications on their mobile phones, while for the ones in the control group the data card with the application was taken out and they were given only the phone plus the paper guidelines to use in the field. After our study is over and complete, the applications will be reloaded for all the RHPs. The doctor cum medical director from the Sittilingi hospital also attended one day of the training. 4 RHP from THI hospital, Sittilingi who could not attend this classroom training (due to unavoidable reasons) were trained during another 2-day training that was carried out in THI Sittilingi by two of our team members and the local THI staff. We found that beginning the training by handing over the mobile phones from the very beginning was a good strategy because they helped us capture the full attention of each of the RHPs. Our medical experts were able to communicate the smallest and simplest details about good practices in managing medical problems, the need for using standardized protocols and the explanation fro each step in our protocols. To start with however, we had to spend a few hours orienting the RHPs to the general functioning of the touch screen mobile phones, a type that many of them had never used before. The fact that the basic menu options were all in English was a challenge as the RHPs had extremely limited knowledge of English. Nonetheless through a combination of intuition and individual assistance (done by all our team members and also one members' adolescent son!!) we did manage to have RHPs familiarized with basic phone functionality. If resources had permitted, an additional training day for phone usage would have been useful. One of the THI health workers came accompanied with her 2-year old child, and we welcomed and accommodated the child during the entire training. We recognized and appreciated her high levels of motivation as a learner and as a mother! The Tirupattur group of RHPs raised questions and concerns about the very limited choice of drugs that was included in our protocols and that one of them, septran (a broad spectrum antibiotic) that was included in the national child protocols even though it was generally not recommended by paediatricians for children below 5 years. Our medical experts first helped the RHPs understand that it was in their own safety as well as patients' safety to use a limited choice of drugs. Our medical experts also recommended 2-3 alternative drugs that the RHPs could use for specific conditions, and especially if a referral source was far away or not immediately available. They could do so as recommended by our medical experts.
	Pre data collection support to the field sites	2 days in Sittilingi and over phone to Tirupattur	Dr Iyengar, Dr Gautham and Ms Zachariah made a short visit to Sittilingi to find out how well the mobile application was working in the field. We found that the phones had been maintained very well and the health workers had also practiced on them, but they had had limited patient practice. We therefore requested the THI doctors and other THI health staff to arrange for supervised field training of the

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Objectives	Activities	Timeline	Overall assessment
			health workers with real patients. A monthly schedule for this was worked out and implemented. With the Tirupattur group we provided telephonic troubleshooting. The application was giving problems in 2 of the phones so we brought the phones back and fixed them. The practitioners were also encouraged to call our Tamil speaking staff in case of any problems and to practice the mobile phones with patients before our final data collection. During this time we also realized that the first screen of the application, which contained a template for patient data, was time consuming for the RHPs to complete first, and during patient encounters it was not possible for them to spare so much time filling up patient data (and also little motivation). So we asked them to skip that page and move on to the main protocol steps. Simplification of this patient data form is an issue we will have to address in the future.
To field test the clinical guidelines using a randomized controlled study design.	Development of research instruments for the final field study.		We addressed 3 main research questions through the field assessment: 1. What is the usability and workload status of the cell phone guidelines? 2. Do cell phone guidelines lead to greater protocol compliance, than do paper based ones? 3.What do patients feel about use of the cell phone guidelines during treatment encounters? The following tools were developed to study the above objectives: 1. A usability questionnaire with mostly structured but some open-ended questions. This was administered on RHPs in the experimental group. 2. A workload assessment tool originally developed by the National Aeronautics and Space Administration, USA (NASA). This was administered on RHPs in the experimental group. 3. A patient-provider observation tool to assess real time protocol compliance with real patients. This was used to observe all RHPs – in the experimental and control groups. 4. A patient exit interview tool to assess patient views and satisfaction. Patients at the clinics of the experimental group RHPs were interviewed using this tool. The tools were pre-tested with 4 RHPs in Sittilingi during our pr-data collection field visit. To avoid any conflict of interest we excluded Dr Sriram Iyengar, the inventor of the Guidevue system from the final data collection activity. The data generated will also be used to address a few other in-depth research questions (for a journal article) that are currently beyond the scope of this report due to the limited time for an in-depth analysis.

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Objectives	Activities	Timeline	Overall assessment
	Subject allocations in control and experimental groups	During the 2 day classroom trainings	We used a lottery draw to randomly allocate our 16 RHPs to the experimental and control groups.
	Research Process	25-30 days during April – May 2011	We hired 4 field investigators for the field study. They were supervised and assisted by the Field Manager, the Training Associate and the Project Leader. We placed one field investigator at each provider clinic in Tirupattur for 2-3 days. During this time the investigators interviewed the providers using the usability and the workload assessment tools. They observed 4 child and 4 adult patients who presented spontaneously at the clinics with anyone of the 3 conditions that were included in the mobile GVs: fevers/diarrhea/breathing difficulty. After the patient observation was over, investigators interviewed the patients (or guardians of child patients) using the exit interview tool. The field investigators requested the RHP to first seek consent from the patient or patient's guardians and once the patient agreed, they proceeded to observe the patient provider interaction. Field investigators did not interfere in any way in the treatment process or in the dispensing of medicines. In Sittilingi, we carried out the observations partly at the THI hospital and partly at the outreach clinic (to ensure patient availability), by transporting all the RHPs from their villages to these centres. We encountered the following challenges: -Due to illness seasonality, we could not get an equal number of patients for each of the 3 conditions, and most of our patients were suffering from fevers. Due to resource limitations we could not have the field teams observe for more than 3 days. -Even so, due to erratic patient flows (as this was not peak illness season) we could not complete all observations in either Tirupattur or Sittilingi in one field visit. Some of our field investigators had to be sent again for a second visit to complete the observations at both sites. -As we had to transport the THI health workers from their villages to the THI hospital or the outreach clinic, our field research costs went over the budgeted amount, but there was no other easy solution for this.
	Data entry and analysis, and report writing	Mid May – end of June 2011	Data was entered and analysed in excel 2003/ 2007 for the purpose of this report. We also combined our quantitative analysis with our individual field observations and informal discussions with providers and patients, in order to understand the full story. As our sample size of providers is small the study does not have sufficient power for robust statistical comparisons. And yet the findings that we have provide a range of rich and intriguing insights into how technology interfaces with real health scenarios in low resource settings.

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Our medical experts address the training group

Dr Srinivasan, paediatrician, explains IMCI protocols

THI health workers following the audio instructions

Learning how to navigate through the application

An RHP on a home visit where he uses the mobile Guidevue to treat an adult patient

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Another clinic based RHP using the mobile Guidevues with a child and an adult patient

A THI health worker assesses a child patient with the mobile GV.

Health workers outside THI's outreach clinic in Kalrayan hills in Tamil Nadu

Patient exit interview outside the clinic

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Project outputs and dissemination

Project outputs	Status	Assessment	Dissemination efforts
A set of 3 protocols for RHPs for managing fevers, diarrhea and common respiratory problems, available on windows mobile phones. Include: 1. IMCI for infants 1 week to 2 months; 2. IMCI for children 2 months to 5 years; and 3. IMAI (for adults) Mobile GVs available in English and Tamil.	Completed	The Guidevues provide step-by-step guidance to frontline RHPs to manage common conditions that patients present with at the primary level. The guidance system assists the RHPs in asking the right history questions, assessing danger signs, detecting infectious from non-infectious etiologies, performing triage and treating appropriately where it is recommended they should. Guidevues are enriched with pictures, audio and video clips that enhance the understating of RHPs regarding these conditions (e.g. video clip on fast breathing in a child)	All our RHPs were given mobile phones with the Guidevues and these belong to them now.
Medical content for the above Guidevues, which amounts to new knowledge creation	Completed	We have created very easy to use flowcharts for management of fevers, diarrhea and common respiratory conditions in children and in adults. Although these are based on existing WHO guidelines, our flowcharts are more locally relevant, more comprehensive, easier to use, include multi media and are therefore much more interactive than the paper based guidelines.	See section on weblink access below.
A 2-day training programme to go along with the Guidevue use.	Completed	Based on our own training experience, we have come up with a 2-day training package to go along with the mobile phone guidelines. This training programme can form part of a package in scaling up use of the mobile-based guidelines.	None yet.
Weblink to access and download the developed GVs	In progress (will be ready in a month i.e. by end of July)	We are creating a link on our websites through which interested viewers can access the GVs we have created. The link will be available on the following websites: www.gcdwsindia.in and www.firstcarehealth.in	Until the link is ready, those interested to view can contact either of the following Dr Meenakshi Gautham (Gautham.meenakshi@gmail.com) Dr Sriram Iyengar M.Sriram.Iyengar@uth.tmc.edu
Conference presentations	On-going	Abstracts for presenting the results of the field-testing: An abstract submitted by us for a June m-health conference was not accepted. But we are developing another one for submission to the Dec m-health summit in Washington DC	The next one will be submitted to an m-health conference scheduled for Dec 2011.
Journal article	In progress	Paper describing the in-depth findings of the field study	Will be submitted for a WHO special thematic issue on e-health with Nov 20, 2011 deadline.

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Lessons learned from project implementation
Content related:

Rather than develop medical protocols from scratch we decided to look for existing protocols and adapt them to the needs of our location. By consensus, our medical team agreed to use WHO's Integrated Management of Children's Illnesses (IMCI) and Integrated Management of Adult Illnesses (IMAI) guidelines. This helped us save time and resources. Use of these guidelines will also lend the project greater acceptability and credibility, as they are globally recognized and accepted protocols for health workers in community settings. However, for future scaling up especially with semi-literate health workers such as in Sittilingi, it would be more appropriate and useful to sit with the THI doctors and develop all the content and descriptions, terms etc locally.

Training related:

We handed the mobile phones to all the RHPs from the very beginning of the training. We observed that the entire group was immediately captivated by the new technology and were attentive beyond our expectations to the concept of standardized health care that we were trying to promote through this technology. Our doctors felt that due to the presence of the mobile applications, they were able to communicate simple yet critical information about managing patients (e.g. paracetamol dosage for children, how to use ORS, how to assess dehydration etc) and have a captive group of listeners willing to listen and follow best practices in first level health care delivery. This is a good training strategy.

However, some additional training needs to be allocated for training in basic functions of the mobile phones, as these being in English can be quite complicated.

Use of the mobile phones by practitioners:

The multitude of menu options in the phone can be quite complex for the RHPs. We need to look for ways for reducing or deleting some of the extra and confusing applications.

We have also described a number of lessons about use of mobile phones in the findings/impact section. Broadly, we found that the phones are being used in multiple ways and not just as we intended. They are used as training and as memory aids for the RHPs to check their memory against. As this kind of training tool, the application is appreciated in all of its multi media, but when it comes to ease of regular and quick use, the RHPs would prefer to have only text and audio rather than be slowed down by some of the visuals.

We also found that filling up the patient data screen is time consuming and cannot be done for each patient in its present form. We will be working on ways to simplify that process, perhaps by using voice recognition tools.

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Overall project related:

Technologies need to be truly embedded in the local contexts to be successful, and this means that a lot of time and effort must be necessarily involved in creating suitable content as well as paying attention to local language needs. The Guidevue system is a promising tool for this kind of local adaptation, as it can be used easily by non-technical teams, to create their own local applications.

Contrary to our expectations, we found that the independent private RHPs were also excited by the standardized protocols, were trying to follow them, and were also eager to have more such protocols for other conditions. The greatest challenge with this group of RHPs was that the protocol by itself could not effectively control and regulate the range of drugs and injections that they currently use in their treatment. To do so would need more effective regulatory and motivational systems, and we as a group have been, and will continue to lobby for effective integration and mainstreaming of private RHPs in the health system.

Keeping this in view, the overall experience and the field testing suggest that the application may, in the near future, be easier to scale up and be used more effectively in contexts which have existing strong and sustainable systems for support and supervision such as the THI hospital with its community outreach network, or even a set of independent health workers who are nonetheless operating within a larger health system framework, or where there is scope for easily setting up/strengthening such systems (they could also be developed for grass roots health workers operating within a government health system).

Project management and sustainability
General project administration and management:

In our experience with this project so far, our compact but highly skilled multi disciplinary team ("lean and mean ☺"), has been one of our greatest project strengths.

This project was originally meant to be implemented through a large educational institution, but due to a bureaucratic impasse, that arrangement did not work out. Fortunately, the ISIF Steering Committee accepted a revised institutional arrangement for project implementation, this time with a smaller non-governmental organization with a smaller and tighter community work focus, but with strong research and training expertise. Our external technical and medical collaborators work as a small team in partnership with this organization (GCDWS) as the main vehicle for project implementation.

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With this arrangement our project brings together personnel with solid expertise in various fields – technology, medicine, public health and community/rural development – in a harmonious and efficient implementation framework with clear roles and responsibilities and clear areas of decision making.

Sustainability

The health workers in THI, Sittlingi will continue to use the phones in their daily activities as the hospital also finds the technology useful and will ensure continued monitoring and supervision. They are also paid a small stipend by the hospital for their work.

The Tirupattur RHPs are independent private practitioners (charge a fee for service) and they are all using the mobile phones that we have given them for their personal communication purpose also (with their own SIM cards etc). So the phones will always be with them and used by them whenever needed.

Through the project we have also built good, lasting relationships between the RHPs, and our various staff members and the involved organizations. In case of a problem, we have asked the RHPs to call any of our team (Tamil speaking) and ask for help. Our relationships with most of the Tirupattur RHPs go back 3-4 years (when we first started working with them), and they will also continue into the future.

Future activities

We will mainly carry on with dissemination activities in the future, using our own resources, and also look for fresh funds to develop a new project proposal in collaboration with a local hospital such as THI hospital. The purpose of such a project would be to ensure that the technology becomes an inherent part of the larger health system for which it is developed (which in this case would be the hospital outreach set up).

To scale up with independent practitioners we will need to look for ways to link up with the formal health system so that the practitioners can be brought under some kind of an umbrella, with the supportive and supervisory systems around them streamlined and strengthened. This is so because technology can standardize service delivery only up to a point but it also needs other health system interventions and motivational strategies to bring care to its highest acceptable levels.

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GCDWS

Impact

In this section we present our main research findings in relation to our 3 research questions. We also recognize that this project has left a lasting impact on the skills of our entire team and has taught us what it means to create and work towards the success of an innovation. We report both our findings separately:

Field study findings:

1. **Protocol compliance by experimental and control groups.**

In this study different protocol was used for children versus adults. The total number of steps for children was 18 and that for adults is 7. Not all steps in a protocol are applicable for every chief complaint. The not applicable ones are coded as NA. If a step was performed it was coded as 1 and 0 otherwise.

Based on the above we defined Protocol Compliance (PC) as the percentage number of steps performed for a patient divided by the number of steps that should be performed for that chief complaint.

As seen in Table 1, the overall mean protocol compliance of the experimental group (57.21%) was higher than that of the control group (52.70%). Mean PC was higher for adult patients (62.79%) than for child patients (45.90%) (see Table 2) but for both patient groups the experimental group displayed consistently higher PC than the control group (Table 3).

Table 1: Overall protocol compliance (PC) experimental vs. control groups

	Patient Sample Size	Mean PC (%)
experimental group (n=8)	64	57.21
control group (n=8)	60	52.70

Table 2: Protocol compliance for child vs. adult patients

	Sample Size	Mean PC (%)
children	57	45.90
adults	67	62.79

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Table 3: Protocol compliance for children vs. adults in experimental and control groups

	Sample - children	Sample - adults	Mean PC children	Mean PC adults
Exp group	29	35	48.33	64.57
Control Group	28	32	43.39	60.83

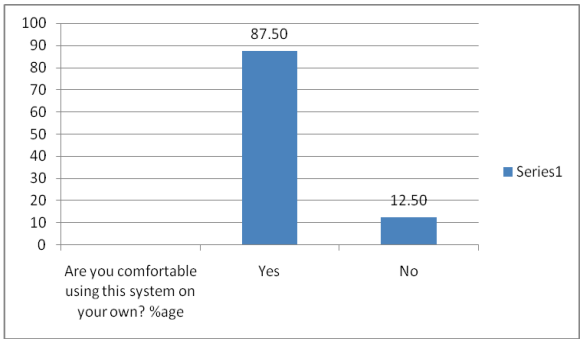
On a closer examination of the data by the two different sites (Tirupattur and Sittilingi) we found that in all cases except one, the protocol compliance in the Experimental group was higher than in the control group (see Table 4). The exception was for adults in TPR for whom the control group displayed higher mean PC than the experimental group. However, we cannot yet determine whether these results are statistically significant.

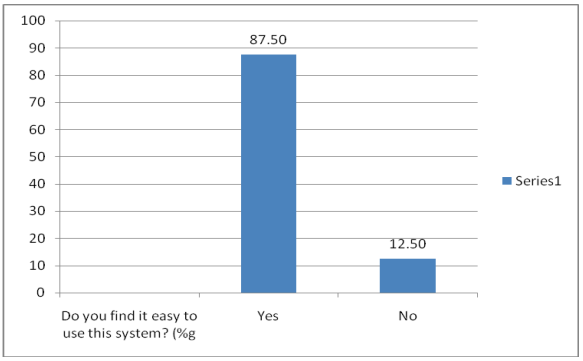
Table 4: Protocol Compliance by exp vs. control groups, children vs. adult patients and Tirupattur (TPR) vs. Sittilingi (STL) provider groups

Mean PC children STL exp group	Mean PC adults STL exp group	Mean PC children TPR exp group	Mean PC adults TPR exp group
52.15	63.14	44.22	65.93
Mean PC children STL cntl group	Mean PC adults STL cntl group	Mean PC children TPR cntl group	Mean PC adults TPR cntl group
44.92	53.06	42.41	70.83

2. Usability and workload assessment

Usability was measured by a series of structured, close-ended responses. The responses are displayed as a series of bar charts below





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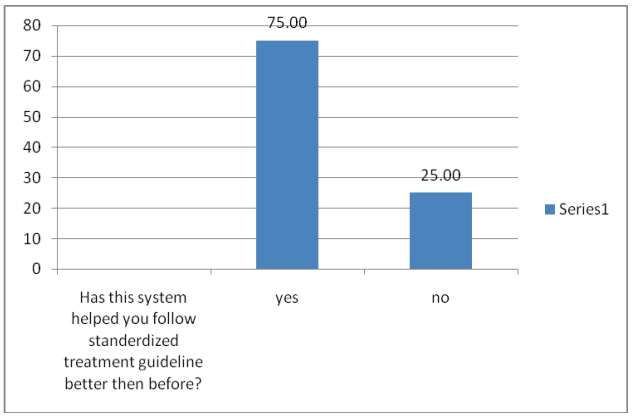

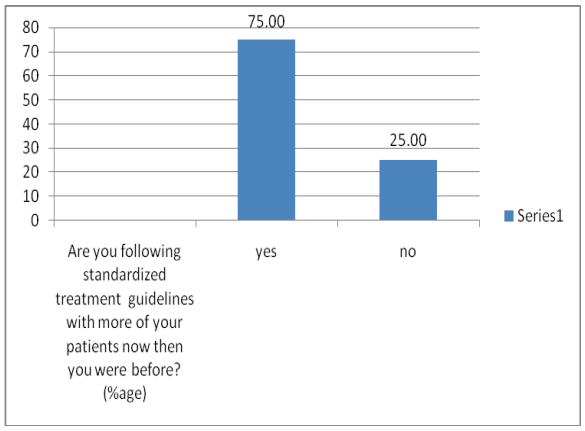

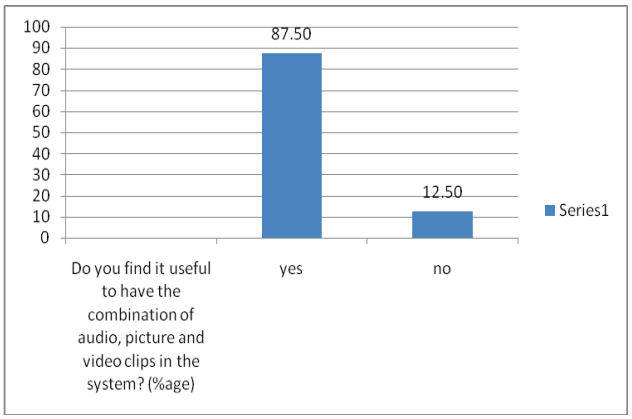

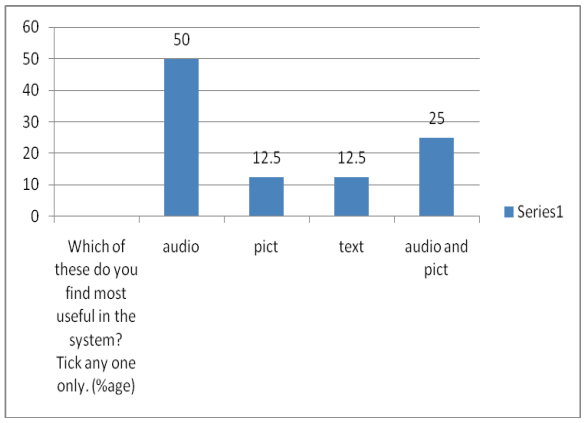

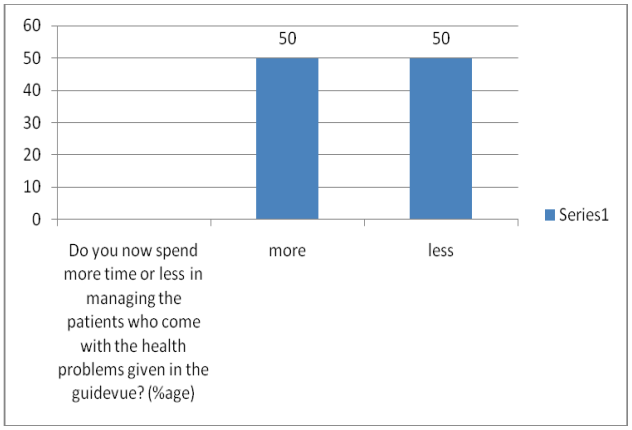

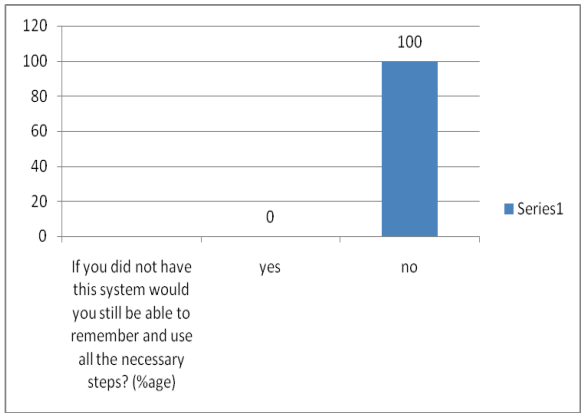

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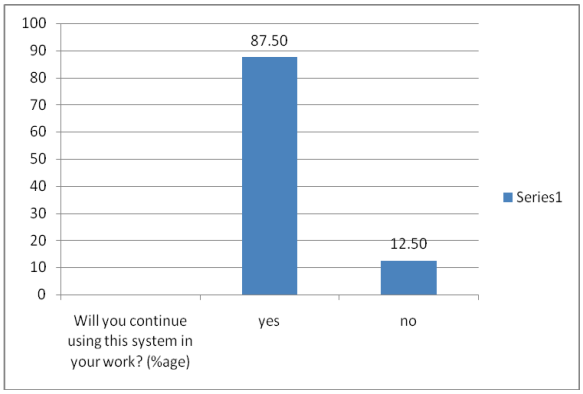

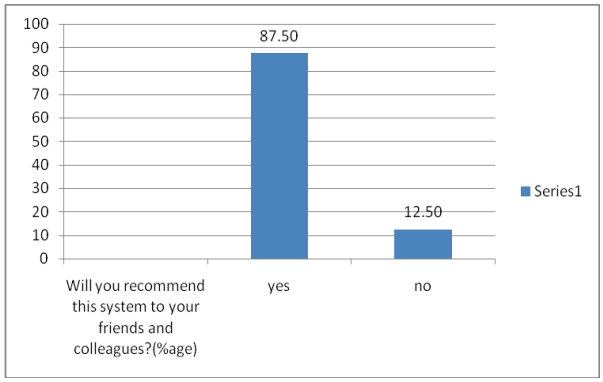

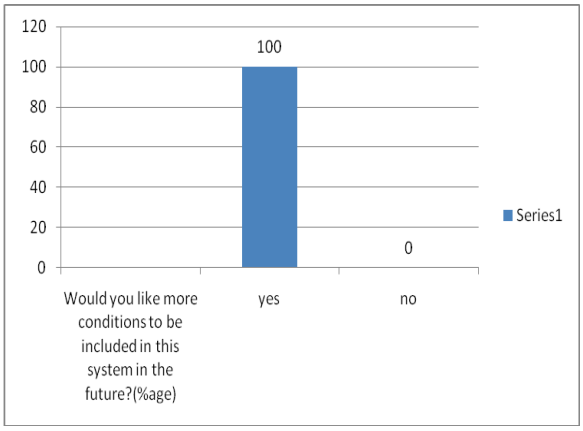

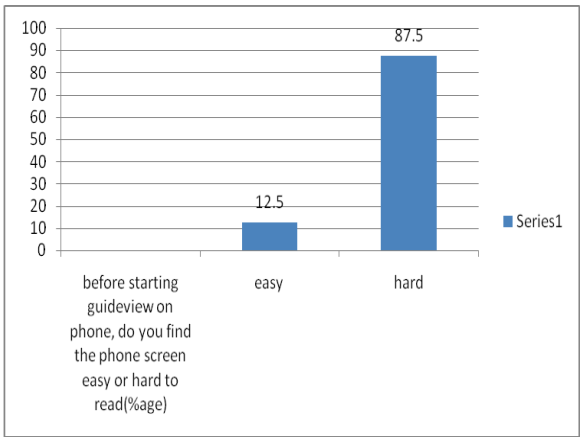

In summary, an overwhelming majority of the RHPs found the system useful and usable, were eager to have protocols for many more conditions loaded on the system, and interestingly found the audio instructions as the most useful part of the system. The one big challenge for them was to navigate through the phone screen before starting the Guidevue. (Taking note of this finding we plan to delete a few of the extra and confusing phone applications in future developments and scaling up programs).

<u>Other findings related to usability of the mobile GVs, obtained through open ended questions and informal discussions with providers</u>

- may not be used for every patient in every common illness once RHPs master the protocols
- but potential to be used thoroughly for more rare conditions that present once in a while

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- pictures and videos interfere with quick navigation through the steps and are not needed for repeated use;
- however the RHPs are unwilling to have these removed as they find the steps and all the material serve a very useful memory aid function– like a reference tool. Thus we may need to develop two sets of each protocol, one as a reference or training tool with all the multi media, and another as a quick and easy tool for real time use, with only text and audio.
- The Tamil font is still not the best and is quite difficult for them to read clearly. This is due to inherent limitations with available fonts. TPR RHPs suggested that we also give them English versions so that they cross check the Tamil ones against the English. This language problem is a big challenge for developing other local language versions. As the Tamil text was difficult, this may be one reason why RHPs reported an overwhelming preference for audio as the best media component of the system.
- Although protocol compliance has improved, continued use of irrational medicines and injections by independent practitioners is still a concern, but this can only be addressed by more efficient regulatory and motivational strategies offered by the health system.
- The TPR group wanted to be guided only by physicians they can respect. They do not have much faith in the local MBBS doctors and a few expressed a desire for having a central call line set up with a good doctor in Chennai who they could call for advice whenever needed. They expressed a strong desire to be linked with our medical experts.

  The STL group was far more controlled in drug use as they are directly linked and supervised by the THI hospital and their services are carefully monitored, including the medicines they have access to and can dispense (only non prescription ones).

- Dr George Regi of THI expressed his views about future scaling up potential – he thought it was a promising and useful technology for expanding standardized health care in far flung areas, but would need to be enormously simplified for THI's semi literate health workers and include plentiful use of symbols and icons rather than text. An implication for us is that that any future development of the application for STL should be done in THI hospital with the staff there, and not in Delhi with other expert physicians.

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Workload index was calculated as the weighted aggregate of 6 different factors on a scale of 1 to 10: Mental Demand, Physical Demand, Temporal Demand, Effort, Performance (self perceived), and Frustration Level.

The overall mean workload index (TLX) was 5.18 with a standard deviation of 2.13. When broken down by the two groups at the two different sites we found that the Sittilingi group reported a lower level of workload (mean TLX of 4.57) than the group at Tirupattur (mean TLX of 6.05) (see Table 5). We conclude that inspite of being faced with this new technology, the two groups encountered only low to medium levels of difficulty. The differences between the two groups need to be explored further in detail, and we will be doing that over the next 2 months. We would like to add a caveat that due to the small sample size the statistical power of the study was low and we recommend that these intriguing results be revisited for a lager sample size.

Table 5: Mean and median TLX by the two groups of RHPs – Tirupattur (TPR) and Sittilingi (STL)

Median TLX TPR	**6.50**
Mean TLX TPR	**6.05**
St Dev TLX TPR	**2.84**
Median TLX STL	**4.57**
Mean TLX STL	**4.32**
St Dev TLX stl	**0.77**

2. Patient views and satisfaction

During patient exit interviews we asked patients/guardians a set of structured questions about their views and perceptions related to the provider's use of the mobile application. The responses are depicted in bar charts below, and suggest that there was a very high level of patient acceptance for the system and the majority did not think that it interfered with the treatment process. The few who gave ambiguous or negative responses explained that they anyway had a lot of trust and respect for these providers, that is why they always approached them in the first place, and a new system was unlikely to alter that long held trust and belief.

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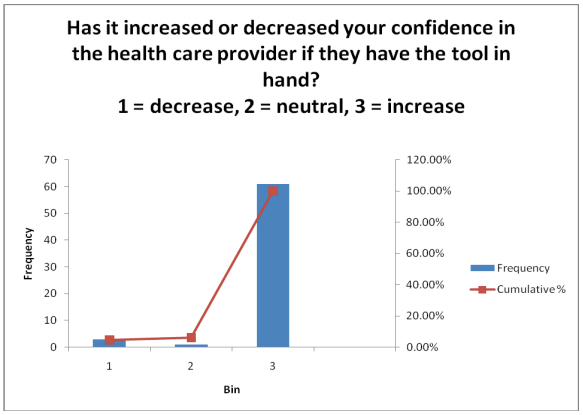

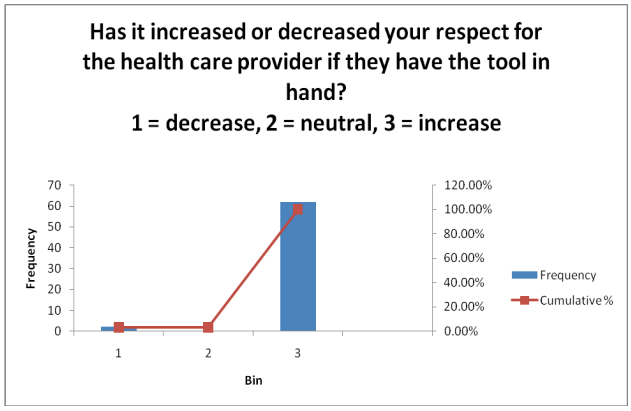

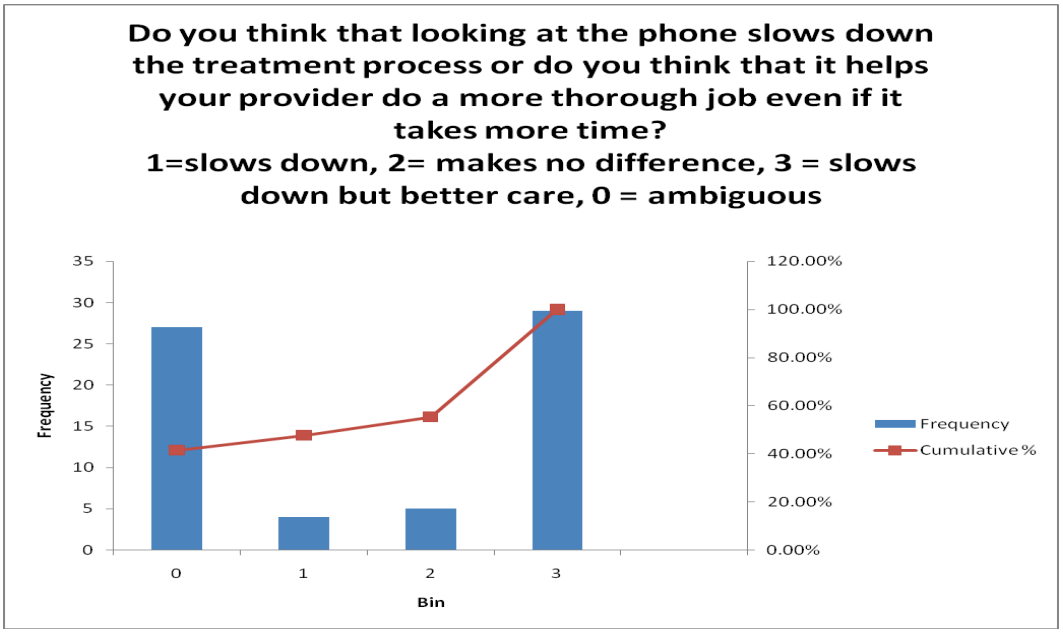

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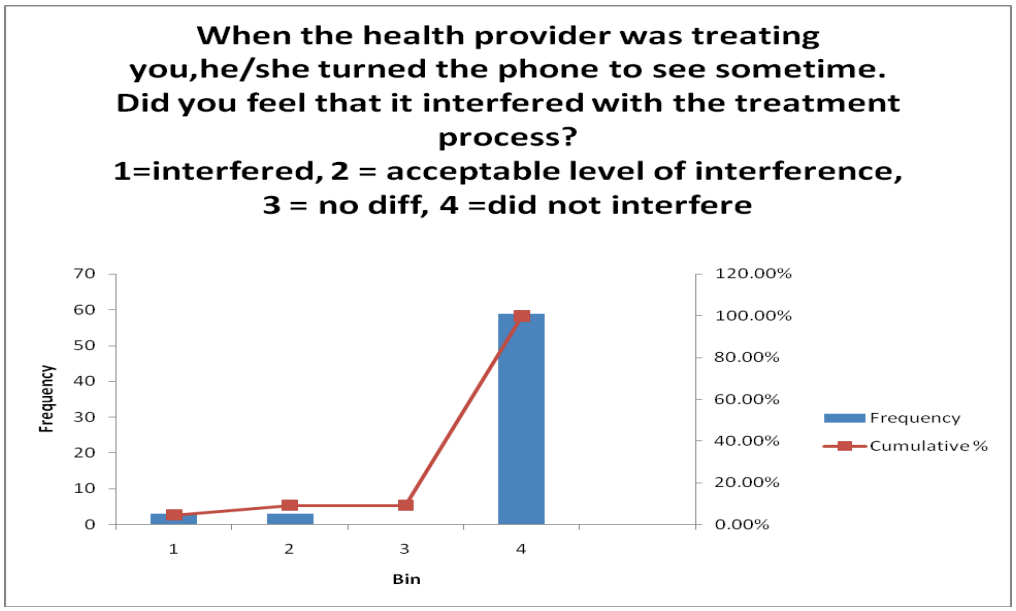

RHPs views about patients' perceptions

From open-ended questions with providers we learned that RHPs' perceptions about patient views tallied somewhat with the responses that patients gave. This was especially true of the Tirupattur group that ran well-established practices over more than 10 years. Most providers reported that while the majority of patients were pleased to have the RHPs use this system, a few – between 20%-30% expressed displeasure and doubts about RHPs' knowledge and skills – skills that they had believed in implicitly so far but that belief was challenged when the RHPs turned to an external technology aid to guide their treatment. (An implication of this finding is that we will need to think of effective patient education strategies to foster 100% technology acceptance by patients for future scaling up endeavours).

Capacity building impact on our teams and the organisations:

1. We now have staff trained in using the GV system efficiently and also in executing the system on mobile phones and trouble shooting/problem solving.

2. Enhanced field research capacity of the team.

3. This project has brought together multidisciplinary experts and different organizations working in different parts of the country: GCDWS in north India, THI

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in Tamil Nadu, southern India, Crenio in Tamil Nadu southern India (who gave us local support in Tamil Nadu). Working together in this project has consolidated this novel partnership and we are exploring this partnership in future projects as well (e.g. gcdws and crenieo are currently implementing a joint study related to informal providers in India. They could do so only because of the confidence and mutual respect that they gained after working together on the GV project)

Overall Assessment

Value and importance of the project

This is the first time that the Guidevue technology has been used for creating protocols for common illnesses for the Indian context. This is also the first time that the protocols developed with this technology have been field tested outside a lab setting with real patients and in real service delivery settings, and we have generated small but good quality data which also includes patient feedback and perceptions.

In our knowledge this kind of a project that seeks to provide mobile phone diagnostic support to frontline health workers has not yet been taken up in India. This small but focused study that we have implemented gives us sufficient, valuable proof of concept about the potential of such an application and how we can work to use it successfully on a larger scale. In the Indian context where frontline RHPs (both government and private) are the mainstay of health care for the rural population, and they have to fall upon their own resources for much of the healthcare they deliver, the application that we have developed can go a long way to enhance and standardize the quality of care that is available for a vast majority of India's rural population. We believe that this study will provide enormous guidance for scaling up m-health in many different parts of India.

Strengths and weaknesses

Strengths:

-Very strong multidisciplinary and committed team to implement this project

-Prior relationships with RHPs in Tirupattur and with the THI hospital management in Sittilingi; thus we did not have to waste any time on location hunting and rapport building

-Good organizational base in Tamil Nadu (with partner organization Crenieo)

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Weaknesses:

-Small sample size, which reduces the statistical power of the study

-Difficulties with available Tamil fonts

-Even the cheaper phone versions that we may want to use in the future (e.g androids) may still be relatively expensive and so a lot will depend on accessing sufficient funds

Steps taken for credibility and reliability

-Linked with THI hospital in Sittilingi which is well respected by the local authorities in Tamil Nadu and is run by a highly qualified and committed team of doctors (a surgeon and his gynaecologist wife).

-Developed the protocols with a team of senior and experienced medical experts, two of whom conducted the 2-day training and also reviewed and commented on all the tools for the study.

-Inspite of the small numbers of RHPs in our study we started out with a rigorous experimental study design with an experimental group and a control group, so that our findings will be considered as evidence of a high level of acceptability.

- To avoid any conflict of interest we excluded Dr Sriram Iyengar, the inventor of Guidevue technology from the final data collection process.

Recommendations

We appreciate the progressive and flexible nature of the ISIF grant, which accepted our initial request for a revised project implementing organization. This kind of support from donors is invaluable for innovators developing proof of their concepts.

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