

IDRC FINAL TECHNICAL REPORT

Project Number: 104618

Project Title: Improving data collection and management for health surveys in developing countries using new information and communication technologies.

Dates covered by report: 7 August 2007 to 9 January 2009

Submitted by: Peter R Berti, HealthBridge, 14 January 2009.

Table of Contents

Summary.....	2
Introduction:	3
Objectives	4
<i>General</i>	4
<i>Specific</i>	4
Progress:	4
Progress over and above the original Objectives	7
Human Resources	8
Future Projects	9
Impact and Recommendations.....	10
References	10
Annexes	11
Annex 1. Pilot Test of PDAs used in Food Frequency Survey in Rural Ecuador.....	12
Annex 2. Incorporation of PDAs into Ongoing Nutritional Survey in Bolivia.....	15
Annex 3: Materials from Training, “Programming and preparing of PDAs for Field Surveys”, October 2008.....	17
Annex 4. HealthBridge Experience Using PDAs in Field Surveys. A presentation to workshop participants.....	22

Summary

HealthBridge is an international, non-profit, non-governmental organization, active in health programming around the world, who, along with our many partners, has diverse data collection and management needs. Hand-held computers (PDAs), can be used to collect data in field surveys and thereby have the data entered into a database at the same time it is collected, greatly increasing efficiency, and accuracy of field surveys. While the use of PDAs is increasingly common, at the start of this project there were no organizations in the international health sector in Canada skilled in their deployment. Therefore, with IDRC support, HealthBridge proposed developing expertise in the application of PDAs for field surveys, initially for use in its projects worldwide, and eventually to provide technical assistance to other organizations wishing to utilize a PDA-based data collection and management system.

The specific objectives of the project were to develop a user-friendly PDA-based data management system for collection and analysis of field survey data; to field test the system; and to develop training materials for field workers and health professionals on PDA use. Excellent progress was made against all three objectives. An existing PDA-based data management system developed by CDC, using Visual CE program language and using PDAs with a Windows Mobile platform, was adopted and adapted for our purposes, allowing us to quickly meet the first objective. The system was successfully field tested, within this project, in nutrition surveys in Ecuador and Bolivia. The system was also successfully field tested, outside of this project, through national malaria control surveys in Mali and Madagascar. Finally, training materials were developed and two training workshops were supported by this project. Given the ever-changing nature of the technology there is a need to continually update the training materials and find ways to train partners on an ongoing basis. Online training centres have the potential to help us meet the training needs and we plan on developing online training centres in 2009, resources permitting.

In the coming year, HealthBridge plans on continuing to work with PDA-based systems in three areas: training, application development, and technical assistance. We plan on developing an online training room, we have started discussions about developing various applications for nutrition field work, and we will continue to provide technical assistance to our partners, helping them to incorporate PDAs into their work.

Currently there are two HealthBridge staff working with PDA-based data management systems. Through the network of students and professionals trained through this program, and seeking to be trained in the coming year, and past staff members still associated with our program, there is a sufficiently large number of staff, associates and partners, around which to continue developing the team, continue advancing the technology and continue providing a supportive role to Canadian and international health partners.

Introduction:

HealthBridge is an international, non-profit, non-governmental organization that aims to identify, understand and bridge gaps in public health, including gaps between: Needs and technologies, Evidence and policies, and, Policies and practice. Formerly called PATH Canada, HealthBridge has been working since 1982 with partners in Asia, Africa and the Americas, to improve the health of vulnerable populations, including those at risk of malnutrition, infectious disease (particularly malaria and HIV/AIDS), and emerging epidemics, such as obesity and tobacco-caused disease. It works with partners, communities and local governments to develop and implement appropriate solutions, apply innovative and sustainable practices, and promote effective policies.

HealthBridge staff are currently located in Canada, Bangladesh, Vietnam and India, and additionally support projects and conduct research in Latin America and Africa. Managing data collected in different locations presents a particular challenge, therefore the organization decided to experiment with new data management systems, currently focusing on the use of hand-held computers for “direct data capture”, i.e., data collection in the field.

Hand-held computers, also called personal digital assistants (PDAs), can be used to collect data in field surveys (e.g., health, demographic, agricultural) and thereby have the data entered into a database at the same time it is collected. The data can be wirelessly or physically transmitted to a central location for archiving and analysis. PDAs can greatly increase the size, efficiency, and accuracy of field surveys, which are often limited by the burden of data collection and entry with paper and pen (1, 2). Evidence of the utility, speed, accuracy, and widespread acceptance of direct data capture using PDAs is becoming increasingly common and widely reported (3-5). Integrating PDAs with global positioning system (GPS) receivers, allowing the field-collected data to be geo-referenced, and thus subject to spatial relationships analysis using geographic information systems (GIS) is also increasingly common and accessible for developing country researchers (3, 6).

While these skills and technologies are increasingly common (and became more so during the course of this project) there are no organizations in the international health sector in Canada (NGO, government, university or private) that had the skills and equipment to use PDAs or train others how to use them. Therefore HealthBridge proposed developing expertise in the application of PDAs for field surveys, initially for use in its projects worldwide, and eventually to provide technical assistance to other organizations wishing to utilize a PDA-based data collection and management system. This was to be achieved through staff training, system development and system validation through field testing. In addition, a core package of training materials was needed, which could be adapted to different field survey applications and geographic locations.

Objectives

General

To develop the expertise and tools needed so that HealthBridge can use a personal digital assistant (PDA) based data management system for its own field surveys and for providing technical assistance and training to other researchers.

Specific

1. To develop a user-friendly PDA-based data management system for collection and analysis of field survey data;
2. To validate the data management system in a HealthBridge research programs;
3. To develop a core package of materials to train field workers and health professionals in PDA programming, data handling and analysis, and system maintenance.

Progress:

Shortly after this project began HealthBridge was invited by the Canadian Red Cross (CRC) to take over from the Centre for Disease Control and Prevention (CDC) the role of leading the monitoring surveys of the CRC's Long-Lasting Insecticidal Net (LLIN) distribution program. With IDRC support, three HealthBridge staff (Peter Berti, Ismael Teta, Manisha Kulkarni) attended a one-week training session provided by the CDC (Adam Wolkon and Jodi Vanden Eng) to learn the survey methods that CDC (Adam and Jodi) pioneered (including using Windows Mobile OS-based PDAs, Visual CE as the program to transfer the questionnaire from paper to PDA, a proprietary GPS program, and various accessories). Manisha then joined the CDC to monitor the CRC LLIN monitoring program in Sierra Leone in October 2007, getting experience in running a national survey using GPS-equipped PDAs. In January 2008, HealthBridge signed a contract with the CRC to conduct similar surveys in Madagascar (April 2008, results at http://www.healthbridge.ca/malaria_redcross_e.cfm) and Mali (August 2008, results at http://www.healthbridge.ca/malaria_redcrossmali_e.cfm). This contract allowed HealthBridge to hire a full-time Monitoring and Evaluation Program Director, Ms. Jenny Cervinkas, and an IT specialist, Ms. Jo-Anne Mandy. These activities collectively contributed to the General Objective "to develop the expertise and tools needed so that HealthBridge can use a personal digital assistant (PDA) based data management system for its own field surveys and for providing technical assistance and training to other researchers."

Furthermore, these events, running in parallel to this Project allowed HealthBridge to progress much more rapidly and more broadly than planned when the project began. It also allowed us to change the way in which some of the project resources were used, as described below. Thus, the progress against the objectives is reported below, but additionally, progress in other areas, not originally planned is also described at the end of this section.

Specific Objective 1: To develop a user-friendly PDA-based data management system for collection and analysis of field survey data.

As HealthBridge was trained by CDC, we adopted and adapted their system, rather than attempt to develop a new one of our own. The system includes the following:

Hardware:

- Windows Mobile based PDAs (as opposed to Palms).
 - We initially used a Hewlett Packard Ipaq, with an add-on GPS receiver, but then switched to the Asus MyPal, which has an integral GPS receiver (approximate cost \$500).
- Extended life battery by Mugen Power.
 - The battery that is supplied with the MyPal lasts about 3-4 hours. The extended life battery lasts 10+ hours between charges. (approximate cost \$100).
- Otterbox protective covering.
 - The PDAs are somewhat fragile. The Otterbox places them in waterproof, dustproof and somewhat shockproof containers (approximate cost \$150).
- SD card for data backup (any brand, (approximate cost \$20)).
- Backpack with solar panel, car-charger, AC charger and battery.
 - Surveys often take place where there is no reliable electricity. The backpacks have a built-in battery which can be charged by solar power, car chargers or an AC outlet, and that battery can be used to charge the PDAs battery (approximate cost \$140).
- Styluses
 - Extra styluses are provided to the interviewers (approximate cost \$3 each).

Software

- Visual CE
 - This software was chosen by CDC due to the power it gives the investigator to control the skips, checks built within the questionnaire and the overall appearance of the questionnaire. HealthBridge did basic (though not exhaustive) testing on some other software options (PenDragon, EpiHandy) and they were not near as satisfactory as Visual CE (approximate cost \$500).
- GPS2
 - This software was developed by CDC for GPS-enabled random sampling in surveys (see the Madagascar survey report (referenced above) for more detail (provided *gratis* by CDC).
- Tweaks
 - This software allowed “tweaking” of the appearance of the PDA, putting tighter controls on what the interviewer could do with the PDA (i.e., they could do nothing but the survey) (approximate cost \$3 each).
- SPB Backup
 - A tool used for backing up and “ghosting” PDAs (configure multiple PDAs with the same settings for field surveys) (approximate cost \$25).
- MS Access
 - The data are collected on the PDA in a Visual CE-specific format, but are then exported to MS Access, which most users would already have on their PCs.

Collectively this hardware and software make for a very effective tool box permitting efficient, accurate data collection. It is very “user-friendly” for the interviewers, who were able to quickly learn how to use them and, without exception enjoyed using the PDAs. It is also user friendly for the data analyst, to whom the

data can be delivered quickly and cleanly. The system may not be considered that user-friendly for the lead investigator, as many days of training are required to be able to prepare a PDA for a questionnaire. HealthBridge felt that this sacrifice of “low user-friendliness” for the lead investigator in exchange for the power of a tested system was a worth-while exchange to be made.

Specific Objective 2: To validate the data management system in a HealthBridge research programs.

As already described, the system was tested in the national malaria surveys which HealthBridge led in Madagascar and Mali. It was also field tested, within the mandate of this project, in nutrition surveys in Ecuador and Bolivia, as part of ongoing HealthBridge research projects. Detailed reports are provided in Annexes 1 and 2.

In brief, in Ecuador HealthBridge has been evaluating an INIAP (Instituto Nacional Autónomo de Investigaciones Agropecuarias, an Ecuadorian government institute) program promoting the cultivation and consumption of quinoa and lupine bean. The evaluation involves collecting data about the frequency and quantity of consumption of these two foods, as well as recipes used, locations consumed and sources of home cooked quinoa and lupine bean. For the field test, Peter Berti prepared the PDAs, reviewed the questionnaire with INIAP staff, revised according to feedback, trained the interviewers (community volunteers) on how to conduct the interviews with the PDAs, and then left the survey in the hands of the interviewers and INIAP staff to complete. The survey was conducted with no problems and the cleaned data were analysed within a week of the completion of the survey.

In Bolivia, HealthBridge is involved in a similar research project to that in Ecuador, working with the NGO World Neighbors to promote legumes in northern Potosi. The research involves ongoing data collection of child growth status and frequency of consumption of various legumes. For the field test, Jo-Anne Mandy traveled to Bolivia where she worked with World Neighbors staff (including Ross Borja from Ecuador) and a Cornell PhD student working on the project, Andy Jones (travel for Jo-Anne, Andy and Ross was covered by this IDRC funding, according to an approved change in the budget). Jo-Anne programmed the PDAs while teaching Andy and Ross how to use them. The three of them, and other World Neighbors staff, then carried out the survey. While there were numerous logistics problems, the PDAs themselves and associated software performed very well.

Specific Objective 3: To develop a core package of materials to train field workers and health professionals in PDA programming, data handling and analysis, and system maintenance.

Training materials for programming the PDAs have been developed for the two workshops and numerous informal training sessions that have been conducted.

A presentation of HealthBridge experience (Annex 4) and training materials (Annex 3) from an October 2008 workshop conducted by HealthBridge are shown. Example Visual programs were developed for training purposes (not shown, but soft copies available upon request). A guide to field-based surveys has been developed (submitted separately). This guide is relatively brief; a much more elaborate guide would be necessary to enable an individual to make use of the PDAs without hands-on assistance from an expert.

While these materials were useful to the workshop attendees, there is still much to be done in terms of developing the training program and materials. HealthBridge plans on seeking support to develop an “online training room/learning centre” where we can provide fully elaborated training materials, and tutor partners, initially, and eventually open it up to all interested parties.

Progress over and above the original Objectives

Due to efficiencies gained from the parallel work done with CDC and the Canadian Red Cross, HealthBridge was able to use the IDRC resources to progress in areas that were not part of the original project objectives. This included training of partners, introduction of PDA-based systems into partner's research programs, and equipment acquisition and lending, described below.

1. Training of partners

Project resources were used to bring partners to Ottawa and provide training on programming in Visual CE and the use of PDAs in field surveys in two separate workshops in Canada. The first was conducted in July 2008 and the second in October 2008. (The attendees, their affiliations and their relationship to HealthBridge are described below. Those individuals for whom travel costs were covered by this project are indicated with an *). Jo-Anne Mandy led the workshops and Peter Berti assisted. Jenny Cervinkas of HealthBridge also attended both workshops.

*Rachel Bezner-Kerr, Assistant Professor, University of Western Ontario,
PI of IDRC-funded *Soils, Food and Healthy Communities* project (SFHC), Ekwendeni, Malawi

*Laifolo Dakishoni, Ekwendeni Hospital
Assistant Coordinator of *SFHC*

*Paul Mkandawire, PhD Candidate, University of Western Ontario
A student of Rachel's, he attended both the July and October workshops, and his field work will be in the Ekwendeni area

Christine Bonatsos, PhD Candidate, University of Western Ontario
A MSc student of Rachel's, her thesis is on the SFHC project

Kendra Siekmans, PhD Candidate, Université de Montreal
Peter is a member of her advisory committee

Jim Klaas, Education Specialist, Dev Ed International
Jim was introduced to HealthBridge through Kendra. We have not worked together previously, but are looking forward to partnering in the near future.

*Ross Mary Borja, M&E Specialist, World Neighbors, Ecuador
World Neighbors is key partner of HealthBridge. We work together in the Ecuadorian, Bolivian, and, soon, Peruvian Andes.

*Andy Jones, PhD Candidate, Cornell University
Andy is working with HealthBridge and World Neighbors, conducting his PhD research in Bolivia.

Ivania Mena, Ottawa-based MD and health researcher
Ivania used this training as a first step in moving back into international development work.

2. Introduction of PDA-based systems into partners' research programs

SFHC: The SFHC project invested resources in getting staff members trained, and in purchasing PDAs. They are now using PDAs, with occasional support from HealthBridge, in their surveys.

World Neighbors (WN): HealthBridge is providing support and lending equipment to the WN project in Bolivia, so that Andy Jones can equip a data collection team for his upcoming surveys. WN is purchasing PDAs for their Peruvian program and will borrow HealthBridge equipment for their work in Ecuador.

Also, HealthBridge is advising a CIP (International Potato Centre) project on how to incorporate PDAs into their research.

3. Equipment Acquisition and Lending

Through the work with the Canadian Red Cross, HealthBridge acquired 30 PDAs + accessories, in addition to the 5 that were purchased through this project. When the equipment is not needed for our own projects we are lending out equipment to partners. At present the following loans have been made:

- 10 PDAs are on loan to Andy Jones/World Neighbors Bolivia;
- 5 PDAs are on loan to Alimentate Ecuador (an Ecuadorian government program with whom we are now partnering on a national nutrition survey);
- 1 PDA is on loan to Jim Klaas, as we work together to develop future applications.

Human Resources

The contributors from HealthBridge on this project included Peter Berti, Ismael Ngnie Teta, Manisha Kulkarni, and Jo-Anne Mandy (whose salary was not covered by this project).

Berti: project manager; was trained on all aspects of PDA system; contributed to the development (or, more accurately adoption and adaptation) of the data management system; led the field test in Ecuador and contributed to the field test in Bolivia; contributed to the development of the training materials; coordinated the training workshops and co-delivered the training; assisted partners adopting PDAs into their projects; developed proposals and networks for future opportunities.

Ngnie Teta: Left HealthBridge and the project in July 2007 to take employment elsewhere.

Kulkarni: Trained on all aspects of PDA system; contributed to the adoption and adaptation of the data management system; drafted field guide; led HealthBridge efforts in the Sierra Leone and Madagascar surveys. Manisha left full-time employment with HealthBridge in December 2007 to accept a Post-doctoral Fellowship at the University of Ottawa. She continues to work with HealthBridge on PDA-based surveys in her ongoing role as Malaria Advisor.

Mandy: Hired as an intern under the Canadian Red Cross contract, and quickly contributed at far beyond “intern” levels, becoming our main computer programmer and technical resource person. While her work was focused on the Canadian Red Cross surveys in Madagascar and Mali, she also contributed to this project through doing the programming and PDA preparation for the Bolivia field test, leading the training workshops and drafting the training materials appearing in Annex 3. Left HealthBridge in December 2008, but is available to work as consultant with HealthBridge, assisting with programming and PDA preparation.

While it is unfortunate that three of the four staff who worked on this project have left HealthBridge, the team is strong and capacity for doing PDA-based surveys remains high. In addition to Berti, Jenny Cervinkas is now working full-time at HealthBridge, as M&E Program Director. Kulkarni and Mandy

continue to contribute to the team. Other individuals who have been trained through this project (particularly Andy Jones, Ross Borja, and Jim Klaas) strengthen our team and extend our reach, as does Rachelle Desrochers, a PhD student at University of Ottawa who worked with the team in Madagascar and Mali, and brings GIS skills, survey skills, and data management and analysis expertise. While maintaining a roster of full-time M&E team members may continue to be a challenge for HealthBridge in this field, we plan on addressing our M&E team needs largely through a building a roster of consultants and partners, and by helping to train our partners, as discussed below under “Future Projects”.

Future Projects

HealthBridge is developing related work in three different themes: training, application development, and technical assistance.

Training

- As mentioned in the discussion of progress under Objective 3, HealthBridge will be seeking support to develop an “online training room” where we can tutor partners, initially, and eventually open it up to all interested parties. Future possibilities could also include training and knowledge exchange on the use of cellphone and smartphone technologies for areas such as research, health promotion and health information management.

Application Development

- We have been asked by HarvestPlus (part of the CG system) to develop a PDA-based approach to conducting dietary surveys (based on the method in the Gibson and Ferguson book “An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries).
- We are seeking funding from the Micronutrient Initiative to develop more user-friendly PDA-based methods for conducting “Food Frequency Questionnaires”.
- We are seeking funding from the Micronutrient Initiative and GAIN to develop a PDA-based method for carrying out “FRAT” (Fortification Rapid Assessment Tool, a paper-based survey technique that HealthBridge (then PATH Canada) developed about 10 years ago.
- We have developed a concept paper on “Improving health management information systems: using information and communication technologies” to be submitted to InDepth. The approach will draw upon Canadian expertise and experience in using e-health to improve the Canadian health system.

Technical Assistance

- In November and December 2008 we assisted Alimentate Ecuador with a PDA-based six province nutrition survey. This will continue in 2009, as HealthBridge manages the data and analysis, and assists with the development of a PDA-based ongoing monitoring system.
- We have had discussions with the Micronutrient Initiative about providing technical support to a national nutrition survey planned for Bolivia in 2009.
- The Canadian Red Cross will be requiring surveys to evaluate insecticide-treated bednet coverage and usage in Nigeria and Togo in 2009, and HealthBridge may play a lead role in those surveys.
- We will continue to use PDAs in our work in Ecuador and Bolivia.
- We will actively seek out opportunities to support the work of other Canadian NGOs (preliminary discussions have been held with World Vision and Plan).
- We will actively seek opportunities to carry out impact evaluations in the health sector, in areas such as malaria prevention and control, nutrition and food security, tobacco, and reproductive health.

Impact and Recommendations

Through this project there has been significant impact on HealthBridge operations and partner operations. HealthBridge's own work in Ecuador and Bolivia has become more efficient through adopting PDA-based data capture methods. We will use PDAs in other projects, other locations and other areas of work (tobacco control, ecocities, etc) as appropriate. HealthBridge is already increasingly recognized as a main (or the only?) resource in the Canadian international health community for PDA-based surveys. Our partners in Malawi (SFHC) and Ecuador (Alimentate Ecuador) have experienced similar improvements in efficiency of their work.

Our recommendation to the international health community is to eagerly embrace mobile technologies for improving the quality of their work. However this is clearly happening without our recommendation and the recommendation is largely redundant. At the same time, users need to keep in mind the limits of the technologies – a sophisticated and efficient data capture technology cannot make up for weaknesses such as a poor study design, poor questionnaire design, and insufficiently trained interviewers.

We endorse IDRC providing continued support to the use of such technologies.

For HealthBridge, we will continue to take advantage of mobile technologies in our own work, as we work on the three themes of training, application development, and technical support.

References

1. Lane SJ, Heddle NM, Arnold E, Walker I. A review of randomized controlled trials comparing the effectiveness of hand held computers with paper methods for data collection. . BMC Med Inform Decis Mak. 2006;6:23.
2. Byass P, Hounton S, Oue'draogo M, Some H, Diallo I, Fottrell E, Emmelin A, Meda N. Direct data capture using hand-held computers in rural Burkina Faso: experiences, benefits and lessons learnt. Trop Med Int Health. 2008;13:25-30.
3. Vanden Eng JL, Wolkon A, Frolov AS, Terlouw DJ, Eliades MJ, Morgah K, Takpa V, Dare A, Sodahlon YK, et al. Use of Handheld Computers with Global Positioning Systems for Probability Sampling and Data Entry in Household Surveys. Am J Trop Med Hyg. 2007;77:393–9.
4. Shirima K, Mukasa O, Armstrong Schellenberg J, Manzi F, John D, Mushi A, Mrisho M, Tanner M, Mshinda H, D. S. The use of personal digital assistants for data entry at the point of collection in a large household survey in southern Tanzania. Emerging Themes in Epidemiology. 2007;4:5.
5. Missinou MA, Olola CHO, Issifou S, Matsiegui P, Adegnika AA, Borrmann S, Wypij D, Taylor T, Kremsner P. Piloting paperless data entry for clinical research in Africa. Am J Trop Med Hyg. 2005;72:301-3.
6. Dwolatsky B, Trengove E, Struthers H, McIntyre JA, Martinson NA. Linking the global positioning system (GPS) to personal digital assistant (PDA) to support tuberculosis control in South Africa: a pilot study. International Journal of Health Geographics. 2006;5:34.

Annexes

Annex 1. Pilot Test of PDAs used in Food Frequency Survey in Rural Ecuador

Annex 2. Incorporation of PDAs into Ongoing Nutritional Survey in Bolivia

Annex 3. Materials from Training, “Programming and preparing of PDAs for Field Surveys”, October 2008

Annex 4: HealthBridge Experience Using PDAs in Field Surveys. A presentation to workshop participants

Annex 1. Pilot Test of PDAs used in Food Frequency Survey in Rural Ecuador

INTRODUCTION

One of the objectives of the project has been to pilot test the use of PDAs and our newly learned skills. As this was to be the first trial of PDAs for HealthBridge (as it turned out we have also conducted other surveys in Africa), the plan was to pilot test the PDAs in a fairly simple and small survey. The ongoing work that HealthBridge has been involved in with INIAP (Instituto Nacional de Investigaciones de Agropecuaria) in Ecuador, on the promotion of the Andean grain quinoa and the Andean legume “chocho” (lupine bean), was an ideal setting. We have been conducting Food Frequency Questionnaires (FFQ, in which the consumption of quinoa and chocho over the previous week is recorded) every six months and the next was scheduled for May 2008. INIAP agreed to be involved in the pilot testing, recognizing the benefits of learning about this new technology, as well as the labour savings of not having to enter the data from paper questionnaires into a database.

METHODS

Ethics

The protocol for the use of PDAs and the overall study was submitted to the HealthBridge Research Ethics Board and approval was received on 14 May 2008.

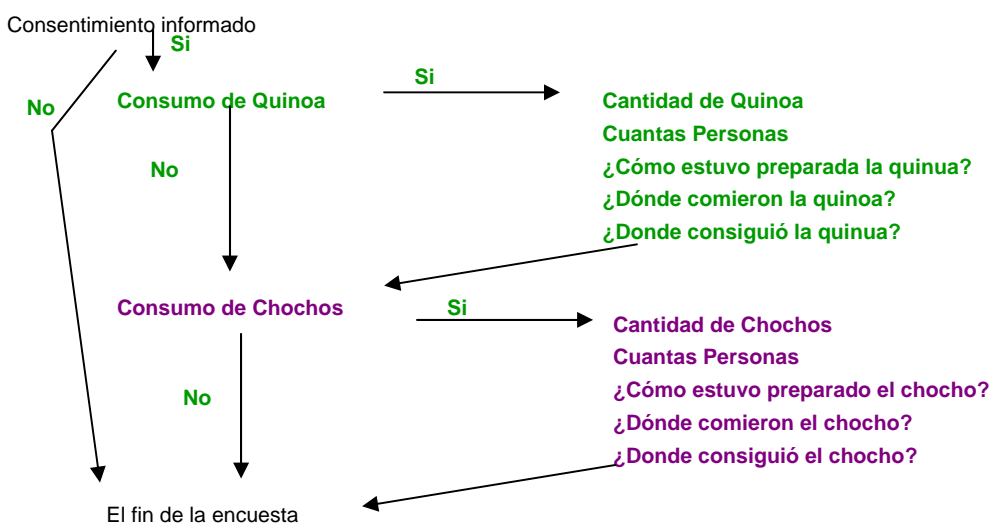
FFQ

The methods for FFQs are straightforward and adaptable to different situations. For this survey we asked the subjects if they ate quinoa in their house in the previous seven days, and if so, on how many days, how many people ate it, the total amount served, where they ate it, and if their own home, where they acquired the quinoa, and how it was prepared. The questions were then repeated for chochos. The paper version of the questionnaire has already been used three times.

Programming

HealthBridge completed most of the programming prior to arriving in Ecuador. As it was the programmer’s (PRB) first experience programming an entire survey, it took a long time to prepare (approximately 10 days of work). It is expected that the next time it would be two to three days of work.

After arriving in Ecuador, two days additional work were required to familiarize the INIAP technical team with the PDAs, to correct the translations of the questions and the pop-up messages, to adjust some of the questions’ formats, to test each question and the flow of the questions to make sure that every question functioned correctly, and to make the final “lock-down” changes to the PDAs that prevent the interviewers from making any changes to the PDAs function or appearance. The questionnaire flowchart used in training appears below.



Training

Training took place on two occasions. The first training took place on Friday 2 May in a training centre, located centrally for the participating communities. Two interviewers from each of four communities attended, as well as three technical staff from INIAP, two staff from CODESCOP (a local NGO which partners with INIAP), and two “testistas”, students completing their undergraduate theses under the supervision of CODESCOP.

HealthBridge originally planned for a two day training session, but the INIAP partners were certain it would take no more than one day. In fact, the training was accomplished easily within six hours, with the INIAP staff leading the training and the interviewers picking up the concept and the practice almost immediately.

In addition to the remarkable ease with which the interviewers learned how to use the PDAs, less training time than expected was required due to an unexpected adjustment to the logistics. INIAP decided that they would accompany the interviewers to all interviews, providing transport and technical support (as it turns out, technical support was not needed), and taking the PDAs back with them at the end of the day to recharge the PDA battery. Thus, we did not need to train the interviewers on how to use the solar packs to recharge the battery.

The second training took place on Wednesday 7 May at the offices of CODESCOP in Saquisilli (near the study communities), attended by three interviewers from two communities. Learning from the earlier training, we were able to proceed more quickly and completed training in three hours.

Data Collection

Data collection took place within days of the training, with the final day of data collection being 11 May 2008.

RESULTS

Data Collection

Data collection proceeded quickly and smoothly, with no subjects refusing to participate, and the average interview taking 6.5 minutes. Data were collected from 115 families, and were downloaded from the PDA to a laptop without difficulty. Preliminary analyses were completed the same day the last data were completed. While the actual results of the survey are not of relevance to this report, the team is quite encouraged to get feedback so quickly, and to see that consumption of quinoa and chocho is increasing in the participating communities.

Interviewer Feedback

Without exception the interviewers enjoyed using the PDAs, preferred them to the paper version that they had previously used, and found them quicker than the paper version.

DISCUSSION

The PDAs in this survey were an unqualified success and all involved were very happy with their performance. If this were the only survey to use the program written specifically for this survey, then it would not be worthwhile aside from the learning value. Spending 10 days on programming (or two days that would be required the next time) to save approximately two days on data entry is not sensible. However because this program will be used for at least one more survey (May 2009), the savings in data entry time and the improved quality of the data (presumed improved due to the logical checks programmed in that make illogical answers impossible to enter) make the use of the PDAs worthwhile. Additionally, while the data entry only takes two days of labour, previous experience was that it took a few months for the team to get around to entering the data.

Given the ease with which the interviewers learned how to use the PDAs, it makes me much more confident that they could also be used on more complex surveys. For example, in nutrition surveys the “24-hour dietary recall” involves collecting a large amount of data and data entry can be such a burden as to discourage researchers from using it. If the PDAs can be programmed for entry of 24-hour recall data, it will be a tremendous savings in time and labour. HealthBridge plans on working on the programming in the coming months.

LESSONS LEARNED

Almost everything involved in the survey was a lesson learned for HealthBridge, including programming in Visual CE, how to prepare a PDA for use by interviewers, and data management of PDA-collected data. Other specific lessons learned include:

- The similarities between cell phones and PDAs, and the widespread use of cell phones in Ecuador, apparently made the PDA technology familiar and easy to learn for the INIAP team, and even for the interviewers who are all farmers with less than high school education.
- Although a minor point, and perhaps not appreciable to the reader, it would be a good idea to provide a check-box that the interviewers could select to indicate that they are practicing. Otherwise it can be difficult to distinguish “real” data from “practice” data.

Annex 2. Incorporation of PDAs into Ongoing Nutritional Survey in Bolivia

**By Andy Jones, PhD Candidate, Cornell University
July 2008**

INTRODUCTION

Following on the successful use of PDAs for data collection in Ecuador, Sierra Leone and Madagascar HealthBridge incorporated this data collection technology into an ongoing nutritional survey being conducted by World Neighbors in the highland region of northern Potosí, Bolivia. This most recent survey, conducted during the first two weeks of June 2008, constitutes the sixth round of data collection in a survey measuring preschool-aged children's heights and weights, the frequency of household consumption of four different legume varieties, and individual 24-hour dietary recalls (though 24-hour dietary recalls were omitted in this round of data collection). The survey is designed as a monitoring and evaluation tool to understand changes in child nutrition and household diet as part of a larger intervention to promote the increased production and consumption of legumes by smallholder farmers in the project region.

METHODS

Ethics

The protocol for the use of PDAs and the overall study was submitted to the HealthBridge Research Ethics Board and approval was received on 14 May 2008.

Child Anthropometry

Children's heights and weights were assessed using a cloth measuring tape affixed to a measuring pole and spring hanging scales, respectively. In most cases, the *length* of children under two years of age was assessed in a recumbent position and the vertical *height* of children older than two years of age was assessed. However, on several occasions uncooperative children older than two years of age were measured in a recumbent position and anthropometrists were asked to subtract one centimeter from their measurements. Children's ages were almost completely assessed via maternal recall.

FFQ

Interview subjects were asked to recall the frequency of consumption of four different legume varieties (i.e. tarwi, fava beans, peas, and common beans) for the entire household for the past four weeks. Subjects were asked to recall:

1. the number of times per month each legume variety was consumed,
2. the average number of times per day each legume was consumed, and
3. the total amount of legume prepared per meal as indicated by one of four serving container options.

Gram equivalents of legumes consumed by each household were calculated from the collected frequency and serving size data.

Programming

HealthBridge staff member Jo-Anne Mandy completed the programming for the survey over the course of eight days while simultaneously training two colleagues on the use of the Visual CE programming language (the language used to program the PDAs) and PDA functionality. This programming time included making several revisions to the structure and order of survey questions, translating questions from English to Spanish, "locking down" final changes, and ghosting the four field PDAs.

Training

Six World Neighbors-employed nurses administered the survey and all nurses attended a training session in the World Neighbors, Bolivia office in Cochabamba on May 29, 2008. One hour of the meeting was devoted to training on proper anthropometric assessment techniques and two hours were spent familiarizing the nurses with the PDAs and reviewing the administration of the survey through the programmed PDA form. The nurses quickly learned to use the PDA stylus and navigate the touch-button format of the survey. Most of the nurses' questions involved using

the number pad to enter data and how to correct mistaken entries flagged by the survey program. All questions were clarified and the nurses expressed confidence in their ability to use the PDAs to conduct the survey.

Data Collection

Data collection took place from May 31 – June 9, 2008 in thirty communities in the northern Potosí region of Bolivia. A follow-up survey was conducted from July 21-29, 2008 in three of the original thirty communities to collect data on those children missed in the initial survey round.

RESULTS

Data Collection

Anthropometric data on 335 under-five children and food frequency data on 240 households were collected throughout both survey periods. Data were uploaded to a laptop at the completion of the survey, and were cleaned and ready to be analyzed a few days later.

Interviewer Feedback

Field nurses administering the survey with the PDAs reported that they were able to use the PDAs with ease, and aside from a few questions about PDA functionality during the first day of the survey, no nurses reported other difficulties using the PDAs.

Prior to using the PDAs, a paper survey had been used to administer the nutritional survey. Four of the six nurses had participated in previous data collection efforts and were quite accustomed to the paper survey format. Many of the nurses expressed resistance to changing that system of survey administration and preferred it to the PDAs despite their observations that the surveys were completed in less time using the PDAs. A communication failure between office staff and the nurse team resulted in the nurses finding out about the use of PDAs only immediately before the start of the survey. This relative surprise at a change in survey format may have contributed to the resistance to using the PDAs in the field.

DISCUSSION

The PDAs used in the above-described survey were quite successful in collecting the required survey data quickly and easily, guarding against entry errors (i.e. through pop-up window checks in the survey program that prevented entry of unreasonable data), and obviating the need for tedious data entry from paper survey forms. The time spent programming the PDAs could have been much reduced had the programmer not been training others on the use of Visual CE and had the survey format been finalized prior to the beginning of programming. The use of PDAs likely saved four weeks on manual entry of data from paper forms (which may have taken months to actually get done).

The solar-powered packs used during the survey to recharge the PDAs each evening were very successful as they were easy to train nurses to use, and took full advantage of the sunny, cloudless skies found in the survey region during the time of the survey.

LESSONS LEARNED

1. PDAs may be used successfully for data collection in remote, highland regions and for the collection of both child anthropometry and food frequency data.
2. Introduction of PDA technology into established paper format surveys should be a gradual process with stakeholder sign off on the use of the new technology at several stages throughout the introduction and adoption process.

Annex 3: Materials from Training, “Programming and preparing of PDAs for Field Surveys”, October 2008

a. Schedule

Day 1	Understand the benefits of a PDA-based survey
	Learn about equipment needs
	Basics of the PDA
	Basics of Visual CE
	Programming
	- Planning and understanding the db, tables, and survey
Day 2	- Getting started with programming
	- The importance of the UniqueID
	- Asking a question
	- Validating a response and moving to the next question
	- Backing up the table at the end of a form
	- Skipping a question
Day 3	- Creating a show/hide macro
	- Creating a dependent drop down list
	- Creating a jump to another form & using global variables
	- Looping through a form
Day 4	Preparing the PDA for survey
	Synching data

b. Equipment Needs:

PDA

Software requirements

- Windows Mobile 5 or Windows Mobile 6 for compatibility with Visual CE

Hardware requirements

- Size: Must be able to fit comfortably into Otterbox 1900 case with extended battery
- GPS: Preferably GPS enabled or CF Card Slot for GPS unit
 - * note that if a GPS unit is needed it cannot interfere with any other functions i.e. IR beam
 - * GPS system must be SiFR Star III chipset
- Expandability: SD card slot for data backup
- Connectivity: IR port for beaming of data
 - * must be either on top or bottom of PDA for easy access through Otterbox case
- Programmable buttons: Minimum 2 programmable buttons to program quick launch of survey and GPS programs
- Battery life: Extended battery available that will provide 8-10 hours of use
- Reset Button: Reset button on either the top or bottom of PDA to allow for easy access if needed
- Screen: Touch screen with powersave options for screen brightness
- Accessories: Power adaptor, USB adaptor, car charger, and extra stylus pen all included to save costs on extra purchases

Charging Equipment

- Wall chargers will come with each PDA
- Car charges are useful when surveyors have access to a vehicle. A simple car charge splitter (available from CT) will allow for charging of multiple devices at a time.
- Solar options for off the grid (Backpacks, Solar panels + battery pack)

Protective Equipment

- OtterBox for protection of the PDA

Software

- Visual CE for programming the survey
- Visual CE tools for data backup
- Microsoft Access for synching data
- SPB backup for ghosting and creating backups of data
- ActiveSync for connecting PDA to computer
- CDC GPS Sampling program if necessary
- Pocket Controller for training and screen captures
- PowerOff and other necessary add-ons.

HealthBridge Choices & Costs

Product	Retailer	Price	Estimate +20%	Units needed	Total
<i>PDA Equipment</i>					
Asus A696	Dell.ca	\$449.99	\$539.99	1	\$539.99
OtterBox 1900 Series	OtterBox.com	\$99.95	\$119.94	1	\$119.94
Mugen Power Extended Battery	LionBattery.com	\$80.95	\$97.14	1	\$97.14
<i>Charging Equipment</i>					
Car charge splitters	Canadian Tire	\$11.99	\$14.39	1	\$14.39
Voltaic Solar Backpack	Voltaic	\$199.00	\$238.80	1	\$238.80
<i>Consumables</i>					
Screen-Saver Replacement Kit	OtterBox.com	\$20.00	\$24.00	1	\$24.00
1900 Latch Replacement Kit	OtterBox.com	\$10.00	\$12.00	1	\$12.00
Asus Stylus (Pack of 3)	Dell.ca	\$13.99	\$16.79	1	\$16.79

c. Basics of the PDA

Start Menu

- Contains static list of programs, dynamic list of recently used programs, settings, and help.
- Contents can be altered through *Settings > Menus*
- Will not show files that are not programs therefore the form must be added as a program

File Explorer

- Works the same as Explorer in Windows
- Highest level is *My Device*
- Gives access to SD Card
- This is where you can move, copy, paste, and delete files/programs/folders on the PDA

Device ID

- Accessible through *Settings > System > About > Device ID*
- Very important when creating a UniqueID for the survey especially when using multiple PDAs
- If using multiple PDAs in a survey it is critical that each PDA is named differently
- Format of Device Name will depend on what is required of the survey

Date & Time

- Accessed through *Settings > System > Clock & Alarms*
- If you are tracking the date/time in the survey it is important that this is entered correctly

Power save options

- Backlight accessed through *Settings > System > Backlight* can be adjusted to save power
- Power options accessed through *Settings > System > Power* can be adjusted to save power

Reset Button

- Found on the bottom of the PDA and used to reset the device if it is not responding

ActiveSync

- Used to connect the PDA to your computer through the sync cable
- Files can be moved from PDA to Desktop or Desktop to PDA through the File Explorer on your desktop

d. Programming

Starting a survey

Planning and Understanding

- Planning out your db. How do you want to separate your forms/tables? Think about looping
- Planning your survey and determining skip patterns
- Designing the db to be used for the underlying table, index keys – what will link the tables together?
 - Identifying and naming columns
 - Defining column types
- Setting up the table
- Changing the form size
- Creating spacers

- How visual CE works – explanation on Forms and Frames
- Table to control relationship
- Types of controls & relationship with column types
- Command buttons

Getting Started

- Start Button
- Insert record
- Get PDA name – assigning vs. entering
- Get AutoNumber
- Get DateTime
- Assign Unique ID – go over importance of Unique ID
- Assign the Unique ID into a Global Variable for future use
- Move to next screen

Asking a question

- Simple dd list (not dependant – but we will come back to this)
- Validation – programming If statements, when to validate
- Consent – what is it used for? How to close a form with no consent

Starting a new form

- Creating a table for form 2
- Using the Unique ID to connect the forms
- Creating back buttons
- Looking again at validation and going to the next question
- Creating a skip pattern (pregnant)
- Creating a show/hide macro

e. Basics of Visual CE

Naming

- For simplicity and ease it is best to name your Form (the .vce file that will rest on your computer) and your table (the table you create in Visual CE) the same.

Opening your form

- Visual CE does not allow you to open a form by double clicking on the file. You must first open Visual CE and then open your form
- You cannot use Visual CE properly without your device connected. Check the small green icon on the bottom right of your computer to ensure you are connected.

Table

- Every Visual CE form needs an underlying table. This table will hold all the data that is collected in the survey
- Ensuring that columns are named correctly and have the right data type is important and can be difficult to change after programming has begun

Frames

- Each form can contain one or many frames. The frame is what the user will see and is defined by the dotted rectangle.
- We will work horizontally and place items for the user to see within the frame and other programming items below the frame
- To move to a new frame you simply call an action and tell the program which frame to move to (i.e. Left:250, Top:0)
- Creating labels to identify frames is very useful and definitely recommended

Form Size

- By default the form is the size of one frame as defined by your device. In order to expand the area you can use you will have to change the size of your form.

Controls

- Controls are added to the frame for user interaction.
- Controls can be input devices linked to columns in the table such as:
 - Edit Boxes
 - Radio Buttons
 - Dropdown lists
 - Check boxes
- Controls can also be triggers for events:
 - Command buttons
 - Jumps
- Other types include:
 - AutoNumber
 - Calculated
 - Lookups
 - Grids

Control Order

- When working with a series of commands you must ensure that these commands follow each other in sequences
- The control order tells the program 'After I'm finished with this command I need to move to the next one'
- Although it's very helpful to the programmer to have commands visually follow each other it is the control order that will determine the order in which the commands are carried out

Properties

- Each control will have a set of properties.
 - Position: to be very specific you can enter a left and top value otherwise you can move it in the frame by selecting and dragging
 - Size: You can define a width and height or you can grab the edges and change the size.
 - Font: You can change the color, font, and size of the text
 - Background: You can change the color of the background
- There will be other properties that we will look at for each individual control.

Annex 4. HealthBridge Experience Using PDAs in Field Surveys. A presentation to workshop participants

HealthBridge Experience Using PDAs in Field Surveys



World Neighbors/HealthBridge Nutrition survey in Northern Potosi, Bolivia, July 2008

Outline

- **OVERVIEW** of HealthBridge experience with PDAs in 2007/2008
- HealthBridge experience in using PDAs enabled with GPS in **MADAGASCAR**
- HealthBridge/INLAP example of PDA based food frequency survey in **ECUADOR**
- **LITERATURE**: PDAs in Burkina Faso

Overview of HealthBridge experience with PDAs in 2007/2008

- Technical support of CDC-led national survey of ITN program in Sierra Leone (October 2007)
- Lead technical support for national survey in Madagascar (April-May 2008)-coverage and utilization survey; similar plan for Mali (August 2008)
- Led nutrition survey in Ecuador (FFQ; 110 households) (April 2008)
- Led nutrition survey in Potosi, Bolivia (FFQ, child anthropometry, ~500 households) (May-July 2008)

OVERVIEW

HealthBridge in Madagascar (April-May 2008)

A tale of rapid data collection, data entry, analysis, and presentation of preliminary results...

MADAGASCAR-1

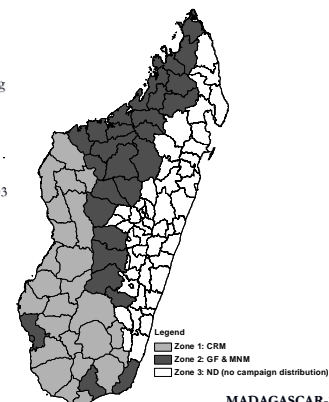
Coverage and Utilization of LLINs in Madagascar

- In Octobre 2007, Madagascar carried out an integrated health campaign (SSME)
- Distribution of LLINs was integrated with measles vaccination, distribution of VA distribution de la vitamine A and mebendazole in 59 of the country's 111 districts
- 1,398,000 children were targeted to receive the LLINs
- An evaluation was conducted in Madagascar six months after the integrated campaign

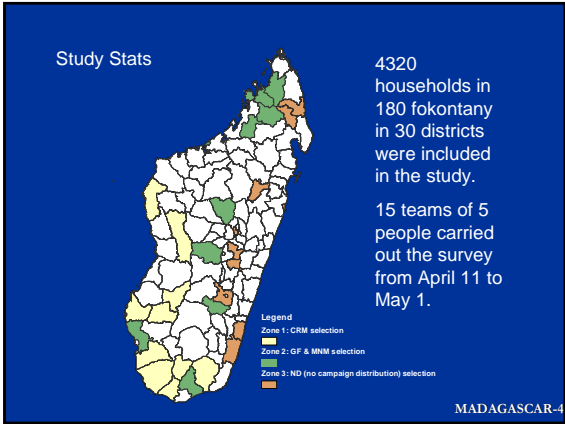
MADAGASCAR-2

Sampling

- At national level, PPS sampling was done in each of three distribution zones:
 - 10 districts selected in each zone
 - 6 fokontany selected in each district
 - Population data from the 1993 census provided by INSTAT
- Random sampling carried out for selection of households
 - 24 households in each fokontany
- Total sample:
 - 30 districts
 - 180 fokontany
 - 4320 ménages



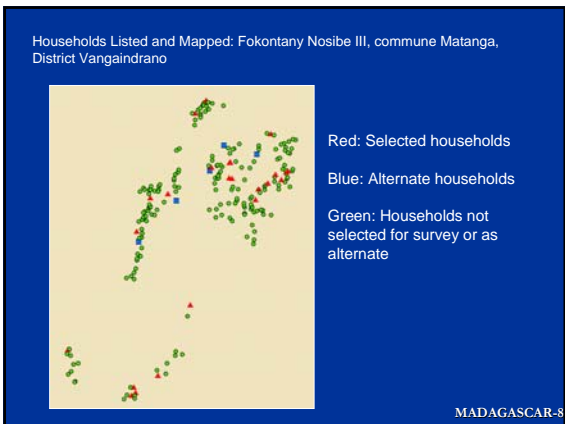
MADAGASCAR-3



- ### Field Team
- Trained 80 surveyors over 5 days
 - 15 field supervisors
 - 60 surveyors
 - Trained Ministry of Health staff
 - HealthBridge technical team supervised surveyors and supervisors during survey
- MADAGASCAR-5

- ### Survey Methodology using PDA-GPS
- Questionnaire programmed onto PDA
 - Survey team trained and teams deployed to field
 - PDA's with internal GPS used to list all households
 - Random sampling done to select households to be surveyed (and alternates)
 - Surveyors entered data directly onto questionnaire on the PDA
 - Data were rapidly available for analysis
- MADAGASCAR-6

- ### Methodology PDA-GPS: Program GPS2
- Navigation:
- GPS helped surveyors to navigate back to selected households
 - Selected households were exported directly to the survey program
 - List of households provided with distance and compass direction/indicator
 - Provides a mapping of the households
-
- MADAGASCAR-7



- ### Rapid Results
- Presented preliminary results within days of return of survey teams to the capital
 - Stakeholder interest was high
 - Final report submitted end of June
 - Publications plan includes submission of papers by early September
-
- MADAGASCAR-9

Coverage of Bednets and LLINs

- Proportion of households having at least one bednet (any type)
 - 67.2 ± 5.1 % national
 - 80.4 ± 3.3 % national-HTC
 - 83.9 ± 2.6 % districts targeted for the campaign
 - 55.5 ± 7.8 % districts not targeted for the campaign

- Proportion of households with at least one LLIN
 - 58.2 ± 5.4 % national
 - 71.0 ± 4.7 % national-HTC
 - 76.8 ± 3.1 % districts targeted for the campaign
 - 45.0 ± 7.7 % districts not targeted for the campaign

MADAGASCAR-10

Conclusions

The preliminary results indicate:

- High rate of coverage and utilization of LLINs in Madagascar
- Equitable coverage of LLINs in the districts targeted for the campaign

MADAGASCAR-11

Limitations

- Requires upfront time to program survey and build in data checks (time depends greatly on length and complexity of instrument)
- Since it is electronic, perception that it is ok to keep changing the survey until the last minute – Not true!

MADAGASCAR-12

Acknowledgements

- Ministère de la Santé, du Planning Familial et de la Protection Sociale de Madagascar
- Service de Lutte contre le Paludisme
- Croix Rouge Malagasy
- Unicef
- INSPC
- INSTAT
- HealthBridge
- CDC
- Croix Rouge Canadienne
- USAID
- Les parties intéressées
- Les enquêteurs
- Les familles enquêtées



Adam Wokon, CDC

MADAGASCAR-13

Using Hand-held computers (PDAs) for field surveys and direct data capture of Food Frequency Data in Rural Highland Ecuador

Appearance of PDA Screen during Data Capture



ECUADOR-1

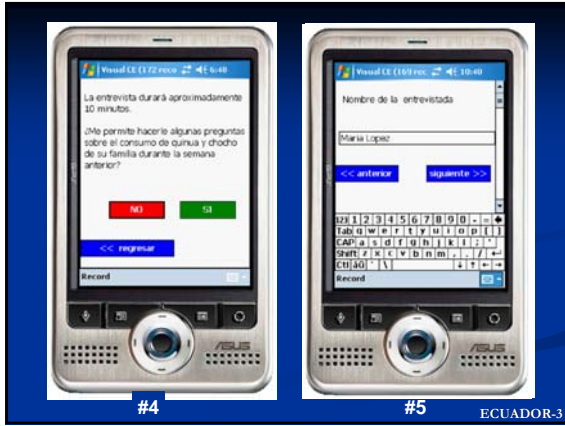


#1



#2

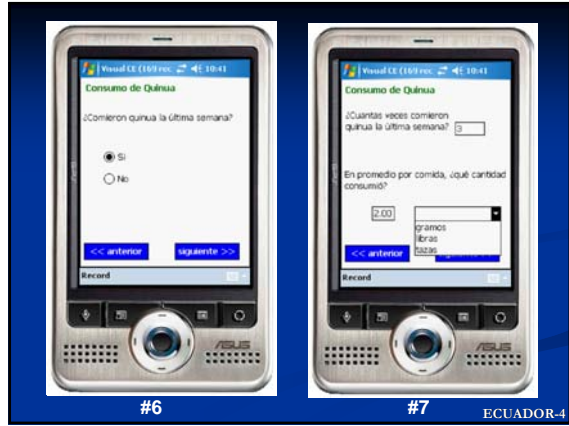
ECUADOR-2



#4

#5

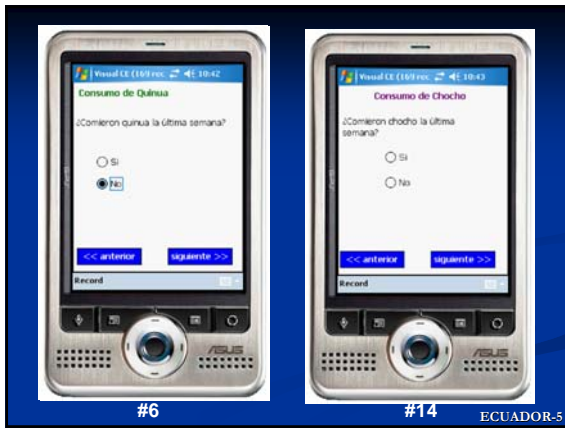
ECUADOR-3



#6

#7

ECUADOR-4



#6

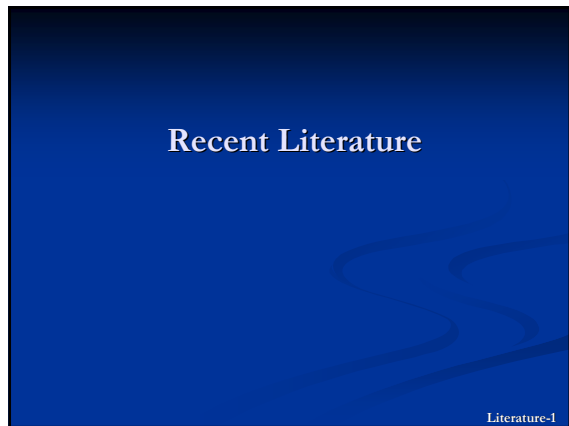
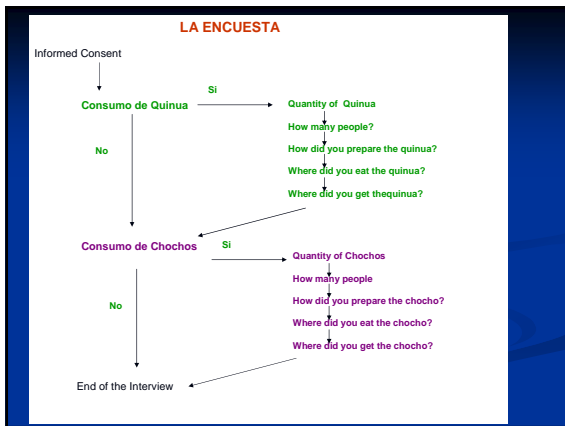
#14

ECUADOR-5



#21

ECUADOR-6



Recent Literature

- Direct data capture using hand-held computers in rural Burkina Faso: experiences, benefits and lessons learnt

- Peter Byass et al.
- Trop Med and Intl Health, Vol. 13, Suppl. I, July 2008

Literature-1

Objectives

- To assess experiences of using PDAs for DDC in a large community-based geo-referenced survey in two districts in rural Burkina Faso

Methods

- A population-based survey of over 500,000 people was done using PDAs with GPS and the resulting database analyzed in terms of successful completion, error rates and interview durations

Literature-2

Results

- No technical problems with PDAs that seriously hampered data collection; 48/151 PDAs encountered some tech problems during course of survey
- Records successfully captured for 86,376 households, by 127 interviewers (survey held Feb-May 2006)
- Household interview successfully completed in 84,861 cases (98.3%)

Literature-3

Results (cont'd)

- Low rates of data input error; evaluation of accuracy of data capture revealed 209/86,376 errors (0.24%)
- Errors not randomly distributed between districts or among interviewers
- 108/209 (51.7%) errors made by 12/127 interviewers

Literature-4

Conclusions

- Feasibility of using direct data capture on a large scale was well-established
- Work involved in designing and setting up a complex survey on PDAs should not be underestimated

Literature-5

OVERALL Conclusions

- PDAs:
 - Are fast, accurate data collection devices, with built-in skips and checks improving quality of data collection
 - Are an option in a wide variety of environments, for a wide variety of purposes
 - No data entry costs or double data entry
- PDAs:
 - Are not a "one size fits all" solution
 - Cannot overcome a poorly designed instrument