A comparison of paper-based questionnaires with PDA for behavioral surveys in Africa: Findings from a behavioral monitoring survey in Kenya

Simon Pierre Tegang[a], Gideon Emukule[a] , Samuel Wambugu*, Inoussa Kabore[b] and Peter Mwarogo[a]

[a]Family Heath International
Nairobi
Kenya

[b]Family Health International
Arlington
USA

*He has since moved to Macro International, Nairobi, Kenya

Abstract

Background
The concept of using personal data assistant (PDA) software for survey data collection is not new. However, usage is not widespread, especially in sub-Saharan Africa where paper-based questionnaires remain the main data collection tool. In 2007, FHI[1] conducted a behavioural survey among high-risk groups in three provinces of Kenya. To assess the strengths and weaknesses of different data collection methodologies, paper questionnaires were used in one province and PDAs were used in two others.

Methodology
The PDA-based questionnaire was designed using Visual CE, with controls to guide data entry and reduce errors. Additional resources required included PDA equipment and accessories, necessary software and design applications to suit the survey, and PCs for downloading and backing-up data.

Results
Use of touch-screen PDAs revealed several challenges, including power outages, slow downloading in database format, accidental loss of data or damage of equipment, and security of PDAs. However, quality of data from PDAs was better and more quickly available for analysis than from paper questionnaires. Using PDAs was more expensive, but startup costs could be reduced over time as rental or purchase fees are spread among many surveys or other uses. Significant differences in managing PDA and paper questionnaire by data collection teams were identified. Main lessons were the need to design relational databases ahead of time, download data in text format, develop or adapt manuals and standard operating procedures for data management, procure sufficient supplies of back-up batteries and accessories, and strengthen technical skills of the data collectors.

Conclusion
This experiment showed that PDAs may be successfully used in implementing surveys in the African context. Use of PDAs *speeds data collection*, *improves completeness* and, most importantly, *increases data quality*. If all PDA challenges were addressed ahead of time, their use, as opposed to paper-based questionnaires, may cut down the cost and processing time needed to get to the report-writing stage.

[1]Family Heath International

Introduction

The concept of using personal data assistant (PDA) software for survey data collection is not new. However, usage is not widespread, especially in sub-Saharan Africa, where paper-based questionnaires remain the main data collection tool. PDAs have been more frequently used for clinical research, where they provide healthcare professionals the ability to access real or near-real time patient information and evidence-based resources at the point of care (1). From the early 1990s, several assessments show that levels of patient care were enhanced through use of PDAs in medical environments.

For example, in 1991, physicians from the Department of Anesthesia and Critical Care, University of Chicago, Illinois, used an automated method to aid preoperative assessment of 239 patients as one way to reduce the number of

unnecessary preoperative tests ordered. In this exercise, the "HealthQuiz," a small hand-held device containing a computer chip and video screen, used a decision tree to ask 60 health-related questions. For HealthQuiz to be shown effective, responses should be the same as those to similar questions asked directly by a physician. This study tested that premise and found that laboratory tests suggested by responses to the two methods of questioning did not differ (3).

In 1992, another study from the Department of Anesthesia and Critical Care, University of Chicago, found that physicians' acceptance of a method for obtaining health data from patients was improved if there were an individualized printout of the data. It also determined that patients will readily complete a health status questionnaire on a computer when the computer does not look like a computer.

Furthermore, it found that the numerical health status derived from answers to the automated presentation of questions was similar to that derived by a physician after a patient-physician interview (6).

A 2002 study revealed that use of handheld computer technology to computerize patients' records made access to the records very easy and quick to access, providing immense benefit to healthcare professionals and patients, as treatment decisions could be made more accurately, concisely, and in a timely manner. Evidence-based resources could be made available on a PDA in the form of textbooks, journal abstracts, and clinical practice guidelines that were specially formatted (5). In 2003, it was found that use of a PDA enhances gathering of patient data on an acute pain management service (4).

In 2005, VanDenKerkhof et al. compared paper with electronic patient-completed questionnaires in a preoperative clinic. Their conclusion was that touch-screen computer technology is an accurate, efficient platform for patient-administered pre-admission adult anesthetic questionnaires (PAAQ) (2).

Although a wide range of literature provides evidence that use of PDA or computerized systems in a medical environment provides several advantages over paper-based systems, little literature can be found about the use of PDAs or a comparison of their use versus paper-based tools in behavioral surveys.

This paper tests our assumption that if use of PDAs can support better patient management and care in medicine, similar advantages should be possible in data gathering for behavioral surveys. We also believe that as prices for handheld devices drop, and their computing power increases, PDA data collection technology should not be limited to corporations and wealthy businesses. In Kenya, we used PDAs to conduct baseline assessments for two USAID-funded projects in some provinces, and paper-based questionnaires in others as a way of comparing the strengths and weaknesses of each technology. These projects are a) the second AIDS, Population, and Health Integrated Program (APHIA II), implemented in Coast and Rift Valley provinces by Family Health International (FHI), and b) the Regional Outreach Addressing HIV/AIDS through Development Strategies (ROADS), implemented in Western Province, also by FHI.

Objective

The aim of this study was to analyze the strengths and weaknesses of PDAs versus paper-based tools in behavioral survey data collection.

Methods

Three provinces of Kenya, Coast, Rift Valley, and Western, were targeted for baseline monitoring surveys. Multiple target populations, including female sex workers, truckers, police officers, public transport vans (*matatu*) crews, youths in and out of school, men in worksites, and women in low-income areas were interviewed (7).

At the design level, the survey questionnaires were written on PDA-compatible software, Visual CE, with controls to guide data entry and reduce errors. Such controls included skips patterns, inconsistency checks, and message prompts. There was a questionnaire for each target population, with varying number of variables. The men-in-worksites questionnaire was the shortest, with 433 variables occupying a memory space of 262 KB, and the longest was for truckers, with 493 variables occupying a memory space of 303KB. These were quantitative survey questionnaires that asked a limited number of open-ended questions.

Rented PDAs were used for data collection in Coast and Western provinces, while paper-based questionnaires were used in Rift Valley. Data collection was conducted concurrently in both Coast and Rift Valley provinces. After completion of data collection in Coast, the same PDAs were used in Western. PDA-related challenges that were noted while collecting data in Coast Province were addressed prior to data collection in Western Province. In both PDA and paper-based interviews, trained field research assistants administered the questions. The research assistants who used the PDAs had computer skills. In addition, all research assistants were trained on data collection techniques and methodologies. A total of 4,954 respondents were interviewed using PDAs, and 2,722 interviewed using paper questionnaires.

To minimize chances of loss of data and ensure availability of sufficient memory on the PDAs for continued data collection, data from the PDAs were progressively downloaded to laptops while enumerators were still in the field. The data were backed up onto a database on centrally stationed PCs and compact disks by field supervisors, who also had acceptable computer literacy.

Results

Challenges
There were several challenges in using PDAs at the start-up of the survey in the Coast Province. Among the most important were battery outages. PDAs could only hold power for four to five hours of continuous use, leading to disruptions in the data collection process. To overcome this challenge, spare batteries and additional PDAs were carried to the field.

PDAs were prone to slowing down. Because of the length of the questionnaires, as the amount of data on the PDAs grew, the speed gradually deteriorated, and it took time to move from one question to another, sometimes making respondents impatient. To overcome this challenge, questionnaires were split into smaller files during the Western Province data collection. Finally, some PDA features were misused by research assistants (cameras and sound recording), using up valuable

memory. On average, a PDA could handle data for up to eight completed interviews, but only if the memory was not misused.

PDA-PC data synchronization was not always smooth. There were occasions when the supervisors in the field could not download the data from the PDAs onto the laptops. This was largely a technical problem related to the link between Pocket Access and MS Access. This was resolved by downloading data in text format in the subsequent data collection using PDAs rather than synchronizing directly to MS Access on the PC. The other alternative would have been to restrict the number of characters allowable for a text variable at questionnaire design level on the PDA to within 244 characters. It was also observed that initially PDAs questionnaires rejected some participant IDs or other data with more than five digits; this was a design issue and was easily sorted by extending variables to the relevant number of digits.

PDAs were more fragile when used in field surveys. In medical experiments, PDAs are used in health facilities with a less harsh environment, whereas conditions in the field were sometimes less hospitable. For example, on one occasion, a PDA was accidentally dropped and the screen cracked, rendering it useless.

There was occasional accidental loss of data through unintentional erasures and/or overwriting during data download from the PDAs to the laptops or PCs. In addition, team leaders reported complete or partial data loss in the field despite completion of interviews. It was not possible to determine with certainty whether this data loss was due to deficiencies with the PDA operating systems or to human error.

Benefits
In terms of data collection, one of the main advantages of PDAs as compared to paper-based questionnaires was the ability to test and modify questions more quickly than by paper.

The PDAs controlled for skips and prompts for any inconsistencies. There was no room for missing data, since all relevant questions had to be answered on the PDA. Therefore, any inconsistencies were corrected on the spot. For the paper questionnaires, however, inconsistencies were noticed by research assistants or supervisors, but after the respondents were already gone.

With PDAs, the only requirement was to merge and recode the data after collection ready for analysis. On the other hand, data entry of paper-based questionnaires took 60 person days to code. While recognizing that an increased accuracy of data entry cannot be assumed for either method (8), the process of data entry itself introduced data-entry errors. A sample of 5% of the data entered was reentered for data-entry error checks, and the final error was about 1%.

After data entry and cleaning, data from the paper questionnaires was ready for analysis six weeks after data collection, whereas PDA-collected data were ready for analysis seven days after collection.

PDAs were more expensive, mostly because of the challenges experienced at start-up and the fact that all the electronics used, including 30 PDAs and 4 laptops were hired for a joint cost of Ksh. 1,009,000 (US$15,500) for seven weeks. Printing and photocopying of paper questionnaires and data entry had a cost of Ksh.523,748 (US$8,057). PDAs were thus twice as costly compared to paper questionnaires. Nearly 25% of the cost incurred by using PDAs came about because of extended use occasioned by power outages on the PDAs, which was not initially anticipated in Coast Province. This problem was addressed before starting data collection in Western Province and the extra startup costs could be reduced over time as rental/purchase fees are spread among many surveys or purchased PDAs are used afterward in other program areas.

Conclusions

Notwithstanding start-up challenges in the Coast Province, use of touch screen PDAs guaranteed *speedy* data collection, *completeness of data*, and, most importantly, *data quality*. The cost of using PDAs was higher than the cost for using paper-based tools. This was mainly because the PDAs were rented and there were some unexpected challenges at start-up. Of course, the cost would have been even higher if PDAs were bought. However, if all the challenges at start-up are addressed, not only would the cost have been lower, but costs could be reduced over time if the PDAs were used for other programmatic or research purposes afterwards.

In the African context, several questions were raised about further use of the PDAs in other program activities. The first concern was about the possibility of using PDAs in program activities. Other concerns were about staff capacity to use PDAs as well as standardization across program implementation sites. This experiment showed that use of PDAs in program activities is a technological advance that shows potential to be more fully exploited to the benefit of organizations doing community and research work.

Emerging information technology has provided for data transmission from PDAs through the Internet for GPRS-enabled PDAs. Use of GPRS could ensure almost real-time data transmission and afford supervisors stationed at a central position an opportunity to check for errors and liaise with the field team to correct them while they are still in the field, hence further improving data quality. At the time of this survey, this new technology was not ready for use in Kenya.

Also, to limit liability while using PDAs in community surveys, it is important to comprehensively insure the equipment against loss and damage before using them out in the field, as one cannot assume the same level of care and attention will be shown to a departmental PDA as to a personal one.

Acknowledgements

About the authors

Simon Pierre TEGANG is a Regional Senior Monitoring and Evaluation Officer with Family Health International. He is based in Nairobi Kenya and provides Strategic Information technical support to the FHI Public Health Programs in the Africa Region.

Gideon EMUKULE is a data manager with FHI in Nairobi Kenya

Samuel WAMBUGU is a Monitoring an Evaluation Specialist. When the survey was implemented, he was working with FHI in Nairobi, Kenya. He has since moved to Macro International in Nairobi, Kenya.

Inoussa KABORE is the Director of the Strategic Information Division at FHI at the Head Quarters in Arlington, USA

Peter MWAROGO is the FHI Kenya Country Director.

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