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CME

Use of Mobile Phones as Research Instrument for Data Collection

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Background:

Data collection is a crucial step in any research design or program. In order to be analysed, this collected data needs to be entered into a spreadsheet or statistical software. Transcribing paper based data is time consuming and often associated with errors. Such errors may be due to an inability to read the data-collector's handwriting, human mistakes during data entry etc. A system wherein data automatically gets transcribed and uploaded in a database during data collection would be of immense use in this situation. A possible solution for this is mobile phone based data collection, a type of electronic data capture method wherein the processes of data collection and data entry are merged¹. Initially electronic data collection was done by hand-held devices such as Personal Digital Assistants (PDAs). However with the entry of the newer and more sophisticated smartphones in the market, there is a growing possibility of extending the success achieved on PDAs to a phone-based platform². With the advent of newer technology software solutions this process can even be done on a standard entry level mobile phone. This paper discusses the use and advantages of using mobile phones for data collection and also provides information about resources for mobile based data collection.

Examples and evidence for use of mobile based applications as research instruments

Mobile phone based data collection can be used in any research design as well as in health service monitoring, disease surveillance etc.

Household Surveys: Mobile phone based data collection for household surveys in African countries has already been reported by researchers³⁻⁶. Apart from being less time consuming and user-friendly, mobile phone based survey systems provide access to real-time data. It also gives an opportunity for quality control and supervision of data collector which makes it an

attractive management option and preferable to a pen and paper based approach³. Cost-effectiveness in terms of reduction in interview cost by 70-71% and duration of interview by 3.5% with use of mobile phone has been demonstrated in Guatemala and Kenya⁴⁻⁶.

Clinical Trials: Electronic Data Capture methods are also increasingly being used in clinical trials. Initially tablet computers were used, but were later replaced by PDAs and smartphones. Randomized trials comparing electronic data capture and paper based data collection methods were conducted and found that the electronic methods were preferred by users, were faster, equally or more accurate and cost-effective with a potential to reduce research associated costs⁷⁻⁸.

Surveillance: Curioso et al have used cell phones for developing real-time surveillance system for adverse events in a clinical trial⁹.

Spatial/Geographical Data Collection: Utility of mobile phones for epidemiological data collection and display, and their application in ecological and community data collection for spatial data analysis have been described by Aanensen et al¹⁰.

These applications are also used in monitoring of different programs by the World Health Organization, World Bank, Pan American Health Organization, and the International Federation of the Red Cross.

For more examples of mobile phone use, an inventory of mobile phone data collection projects is developed by Global Pulse and MobileActive.org¹¹. It illustrates how mobile phones are being increasingly used worldwide in a variety of sectors and programs.

The working of mobile phone based data collection applications

The process of data collection by paper based system and mobile phone based system is shown in Figure 1. Any mobile based application has three components viz. 1) questionnaire /form creation software, 2) hosting

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questionnaire/form on mobile phone/ handheld by which researcher/field worker collects data, and 3) web-based or offline data compiler or central database.

Users have to create a data collection form by using 'Form Creation Software'. Form Creation Tools come with facilities like drag and drop graphical user interface for which one doesn't need to be trained in software programming. Some applications also provide prebuilt mobile data collection forms that can be edited and used as per individual requirement. Also these forms can be previewed in various web-browsers that gives an idea on their appearance in a mobile-phone.

'Data Collection Form Applications' are a part of software solutions that allow us to enter data of different types like textual, numerical, date and time stamps, select one answer from a list i.e. single best from multiple choice, select multiple answers from a list. Mobile phones with features of Global Positioning System (GPS) can record location coordinates, while those with camera can take pictures, record video clips, record audio notes, scan barcodes. For improving data accuracy and completeness certain questions can be marked "Required," which will make data entry into the field mandatory to proceed further. On the other hand, "skip" logic can be used for questions which are relevant for particular responses only.

Once a 'Data Collection Form' has been created, it needs to be transmitted to mobile phone of the person collecting data. These solutions can be used in mobile phones with different operating systems such as Symbian, iOS, Android, Blackberry and Windows Mobile. However advanced data capturing (geographic co-ordinates, pictures, videos, voice data etc.) can be done with smartphones or tabs.

Captured data sent from one or more mobile phones is aggregated on a web-based central database. Data from central database can be then processed and analysed. Some mobile software solution vendors provide website server software that can be installed, run and maintained on one's own server hardware. Other mobile software solution vendors provide fully hosted websites. These are generally priced on a subscription basis, can be implemented almost immediately, and require less maintenance work.

Features of deployment and support, remote deployment, control who receives which forms, automatic mobile form updates, control who can see or change data, technical support services are available with commercial packages.

Advantages of mobile based data collection

Economical and Environment Friendly: Conventional methods of data collection use printed forms. The collected data is then transcribed from forms into spreadsheets or statistical packages. Costs implied in this process are expenses on paper, printing and transcribing. Mobile phone based data collection methods save on all these costs because data can be directly sent to database. One doesn't need specialized mobile devices for simple data collection; further almost all of us routinely use mobile phones for communication. Cost effectiveness of handheld based data collection has been reported by researchers^{4-6,8} and illustrations of saving in terms of money, carbon-dioxide emission and trees are also available¹².

Faster reporting with accuracy: Practically data can be transcribed and stored moments after it is collected which gives opportunity for timely analysis and rapid dissemination of findings. We get more accurate data using check codes, validation rules and reducing errors while transcribing.

Potential for Enriched Data Collection: Mobile phones provide opportunity for enriching data by taking pictures, recording audio questions, and getting geographic co-ordinates for spatial analysis which is not possible with paper based methods.

Anyone with minimal skills for mobile usage can use these applications. One need not have specialized technical training to use them. Best practices for mobile data collection tool developers¹³ are available which may help in the selection of appropriate application for use.

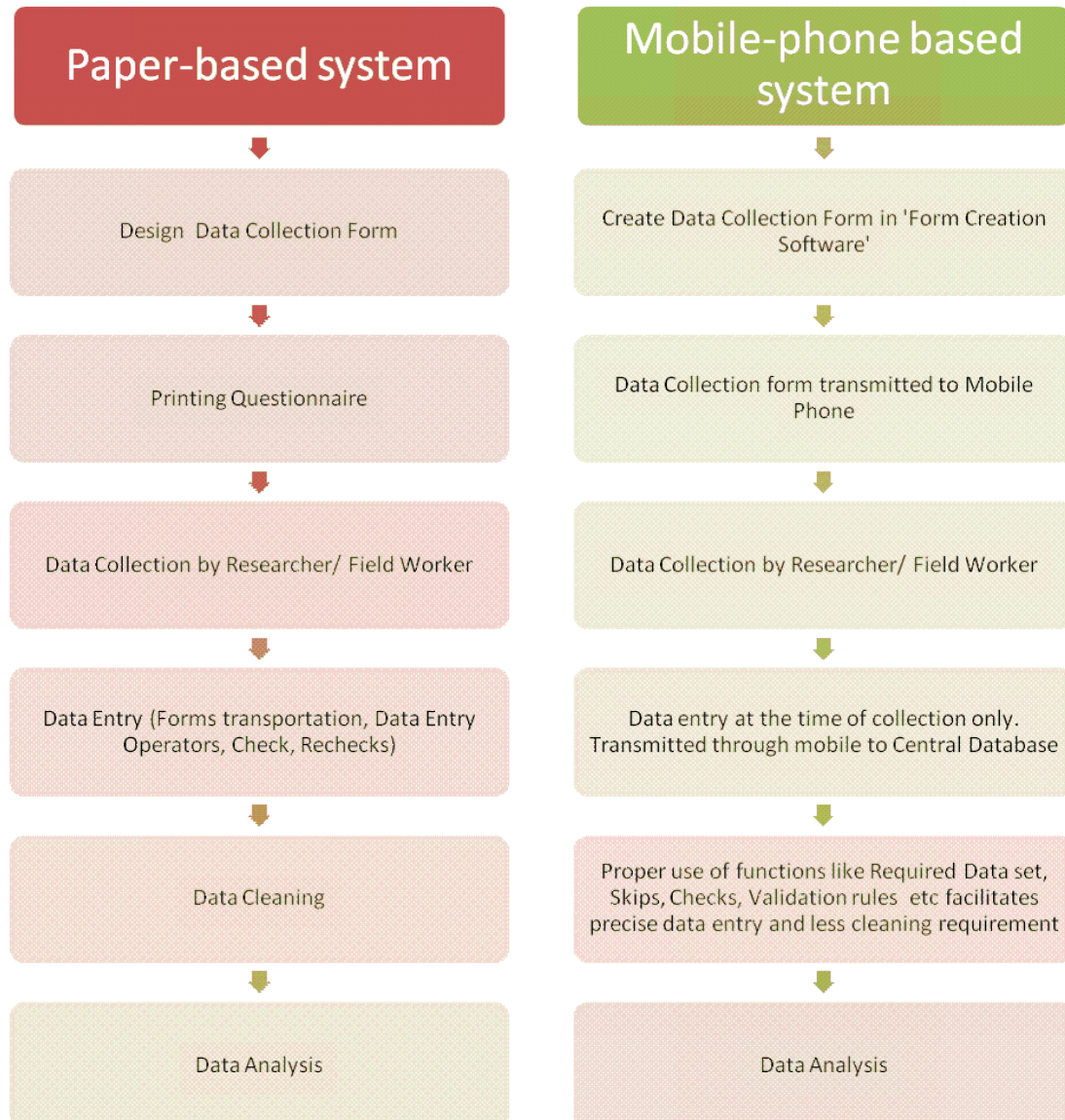
Limitations

Phone based data collection requires one to be familiar with the operating of mobile phones with a possibility of typographical error while recording data. Quantitative evaluation of data entry accuracy on mobile phones in a resource-poor setting by Patnaik et al, has shown data entry error rates (per datum entered) of 4.2% for electronic forms, 4.5% for short messaging services (SMS), and 0.45% for voice².

Maintaining battery power in rural areas, theft, and malfunction are some of the inevitable issues that are limitations worth considering especially in developing nations like India³. Network connectivity³ for data transmission may be an issue in remote areas but that can be tackled by storing data in mobile phone and transmitting when network connectivity is available.

Resources for Mobile phone based data collection solutions

Figure 1: Comparison of Data Collection process by Paper Based and Mobile Phone Based System



Various resources for mobile phone based data collection solutions are provided in table 1. It should be noted that the authors do not recommend or endorse any specific company or organization.

Organization /Company	Website	Access
Open Data Kit	http://opendatakit.org	Open-source, Free
Mobile Active	http://mobileactive.org	Open-source, Directory of Mobile Technology Users
Mobile Data Technologies	http://www.doforms.com	Commercial, Standard Version Free
Nokia	https://nokiadatagathering.net	Open-source, Free
EpiCollect	http://www.epicollect.net/	Open-source, Free
DataDyne	https://www.magpi.com	Commercial, Standard Version Free
Open Clinica	https://openclinica.com/	Open-source, Community edition
WHO, eSTEPS	http://www.who.int/chp/steps/esteps/en/	Open-source, Free

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