m-STEMPS: Developing and implementing a smart innovative android tool for noncommunicable disease risk factor (STEMPS) survey in India

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Smartphone technology has penetrated significantly into the society, capturing the entire age spectrum of users, from children to the elderly. They are increasingly viewed as handheld computers rather than phones, due to their powerful onboard computing and communication capability, capacious memories, large screens, and operating systems that encourage development and running of various applications. In the field of noncommunicable disease (NCD) risk factor surveillance, collection of data on NCD risk factors using WHO recommended STEPS methodology has gained momentum worldwide.[1] However, conducting the STEPS survey is expensive, time consuming, and technically demanding. If conducted in the traditional way, it involved face-to-face interviews using paper-based formats and manual data entry of huge datasets. Offsetting these challenges required modern, innovative technologies. The need was realised by the WHO STEPS surveillance team and they adapted the questionnaires for use in personal digital assistant (PDA) using eSTEMPS.[2]

Although there is substantial evidence describing the potential advantages of PDAs over the conventional paper-based data collection,[3–5] there is no evidence of the application of smartphone application for STEPS surveys in recent times. PDAs are an outdated technology with the smartphones giving a definite edge over the PDAs in terms of operability, ease of use, processor speed, internet connectivity, battery life, screen resolution, etc. However, as the digital technologies are evolving fast, scope of replacing older systems by newer, better, and cost-effective alternatives has expanded.

Driven by nonavailability on hiring/donation basis of PDAs, an android-based application software was developed in Punjab STEPS survey,[6–9] wherein all the data were collected and entered in the field, but at a device cost much lower than PDAs. We intentionally developed the system as an open-source methodology to lower the cost of future implementations. The application software can work in a variety of smartphones to facilitate the selection of hardware with the least cost for future implementations. An advantage over traditional systems and PDA-based systems is the ability to operate the application software in smartphones which have inbuilt global positioning system capability. This would allow for mobile tracking of field teams. We expect that revising STEPS survey implementation with this android application software would yield reduced costs at comparable or even higher effectiveness in terms of higher number of correctly completed questionnaires. This application was designed by School of Public Health, PGIMER, Chandigarh with development support from Biosense Technologies Pvt. Ltd., Thane, India. The salient features of the application include an integrated algorithm to run a Kish method, Intelligent Page Navigation System, automatic data synchronizing to the server during data collection, export option for incomplete data, ability to resume an incomplete survey from any point, incompletion alert, drop-down menu, etc. Apart from the regular features of any data application, the exported file can be opened or imported into any spreadsheet and statistical analysis software, for example, Excel (Microsoft Inc.), SPSS (IBM Corp.), or R-project (R foundation for statistical computing).

The application saves the data in the database and sends it to the online server. The web end of the database is based on the Active Server Pages.NET Framework version 4.5, which is an open-source server-side web application.
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framework for creating dynamic server pages. The web portal for m-STEPS provides easy-to-view data with inbuilt intuitive cluster id search to find a particular data set. Along with this, the whole data set can be exported on a local computer for statistical analysis. Android phone clients are the main data collection ports that automatically synchronize with the m-STEPS database server. Individual phone client’s data can also be assessed on a computer by manually downloading from the phone client [Figure 1].

The m-STEPS application was piloted in two primary sampling units during NCD Risk Factor Survey (NCDRFS) in Punjab in the year 2014. In-depth interviews using semi-structured questionnaires were conducted with the interviewers and coded to identify major themes in strengths and limitations of this novel application and experiences of the interviewers regarding the use of mobile application. Interview duration was recorded and compared between both the methods. Financial as well as economic estimates of paper-based and android application software were estimated separately using health system perspective and were compared for incremental cost-effectiveness.

In pilot testing of application, ease of use, user friendliness, time saving, and security of data were some of the advantages of m-STEPS. Poor battery life was a limitation as driven by low budget we used very low-cost smartphones. m-STEPS application could work on various android phones with Android version 4.1.3 or more. The survey using application took 26 min whereas a conventional paper and pencil survey took 38 min for each household (P < 0.001). A scenario analysis of conducting the NCD STEPS survey using m-STEPS application as compared to m-STEPS revealed that the total financial as well as economic costs of conducting survey using this application software would decrease by 21% and 18%, respectively, as compared to paper-based survey. The cost per participant interviewed using m-STEPS would be USD 9 from an economic perspective. The cost is inclusive of data collection, storage, and transmission costs.

Android enabled smartphone applications are the future of health-care surveys. Application of a mobile application for collection, synchronizing, and storage of data in WHO-STEPS-based NCDRFS was the first of its kind in India and perhaps globally. The benefits of mobile technology, combined with the improvement that mobile phones offer over PDA's in terms of data loss and uploading difficulties, make mobile phones a feasible and cost-effective method of data collection that needs to be further explored. The model of m-STEPS can be replicated globally, especially in low-income settings.

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Conflicts of interest
There are no conflicts of interest.

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