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policy brief

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Evidence for the feasibility, acceptability, accuracy and use of electronic data-collection-methods for health in KwaZulu-Natal

> ... the ICT (Information and Communications Technology) and HIS (Health Information System) within the health system is not meeting the requirements to support the business processes of the health system, thus rendering the healthcare system incapable of adequately producing data and information for management and for monitoring and evaluating the performance of the national health system.
> (Department of Health 2012: 9)

Executive summary

Accurate and timely information is essential to the surveillance and delivery of healthcare that meets the needs of a population. Decision-makers need confidence that the data on which they base their fiscal allocations are both accurate and recent. The South African District Health Information System (DHIS) is known to suffer from a number of challenges relating to quality, accuracy and timeliness of the data, which limits their usefulness (Garrib et al. 2008). Double counting, undercounting, out-of-date data-collection forms and staff shortages all erode the quality of data collected and, by implication, throw into doubt budget decisions made on the strength of their analysis.

Electronic data collection has been proposed as an alternative that has the potential to overcome many of the traditional challenges faced by pen-and-paper registers. Evidence exists in high-, middle- and low-income settings for the feasibility, acceptability and increased accuracy of health information collected using electronic data-collection-methods (Lester et al. 2010; WHO 2011).

Although these methods come with an additional upfront cost, they could be offset by the savings incurred by the Department of Health through, for example, better stock management resulting in reduced wastage. There could also be improved service to patients who often visit primary healthcare facilities at great cost to themselves.

The policy brief makes two recommendations, namely:

- Of the various options currently available, mobile phones are the currently preferred hardware for the electronic collection of health data.
- Software vendors need to be carefully evaluated to ensure they align with the National eHealth Strategy Plan, which calls for the adoption of

shared standards. This will ensure interoperability between systems and foster data sharing between various health programmes.

The use of mobile and wireless technologies to support the achievement of health objectives (mHealth) has the potential to transform the face of health service delivery across the globe. (WHO 2011: 1)

Background and context

In response to the myriad of health solutions designed to harness technological advances, the South African government recently introduced the eHealth Strategy Document (DoH 2012). This document aims to support and guide decision-makers who have the task of assessing new products and technologies. It lays out a number of principles and areas of benefit within the six domains of healthcare quality (IOM 2001). These principles include:

- getting the basics right first;
- looking for early wins;
- taking an incremental approach;
- ensuring patient information is secure, private and confidential; and
- adhering to the National Health Information System of South Africa (NHISSA) principles of information management (DoH 2012).

Although touched upon in the eHealth policy, one domain where further input is necessary is legislating privacy and confidentiality standards for electronic health data in South Africa, similar to the Health Insurance Portability and Accountability Act (HIPAA) that regulates these data in the United States.

This policy brief aligns itself with these broad principles but adds value by offering guidance to policy-makers in one particular area of eHealth – namely, mobile health (mHealth) data collection.

Mobile phones are widely available, inexpensive, robust and able to connect to the internet from all but the most remote parts of South Africa. This unique constellation of attributes has generated a great deal of excitement about the possible applications of mobile phones to the domain of health in low- and middle-income country settings (WHO 2011; Waegemann 2010). In the past five years a broad base of evidence has emerged to suggest that mobile technologies are both feasible and acceptable in low- and middle-income health settings. Table 1 summarises the three primary mechanisms through which data can be collected using mobile phones.

According to the International Telecommunication Union (ITU), there are now over 5 billion wireless subscribers; over 70% of them reside in low- and middle-income countries. The GSM Association reports commercial wireless signals cover over 85% of the world's population, extending far beyond the reach of the electrical grid. (WHO 2011: 5)

Although the field known collectively as mHealth is criticised for the preponderance of pilot projects, the evidence in support of mHealth solutions grows stronger each year. From case studies by corporate and not-for-profit organisations to peer-reviewed literature, it is clear that opportunities exist to harness mobile phone technology across a number of health initiatives. Three broad mHealth domains exist in the literature, namely:

- data collection and tracking of health behaviours;
- infectious-disease surveillance; and
- treatment monitoring (DeRenzi et al. 2011).

This brief focuses on the first of these areas by describing the use of mobile phones in the collection of health information in KwaZulu-Natal, South Africa. The brief then outlines conclusions drawn from this study and makes recommendations based on such conclusions.

Key research findings and policy implications

Feasibility

Over the course of a five-year clinic-based cluster-randomised trial, 13 653 mobile-phone-assisted questionnaires were completed in primary healthcare facilities and submitted over the mobile network covering South Africa to an online data store (Van Heerden, Norris, Tollman, Stein & Richter 2013). Data were captured for a thorough health assessment; the patients carried maternal health cards and daily clinic attendance registers. All clinics had good network coverage and data were

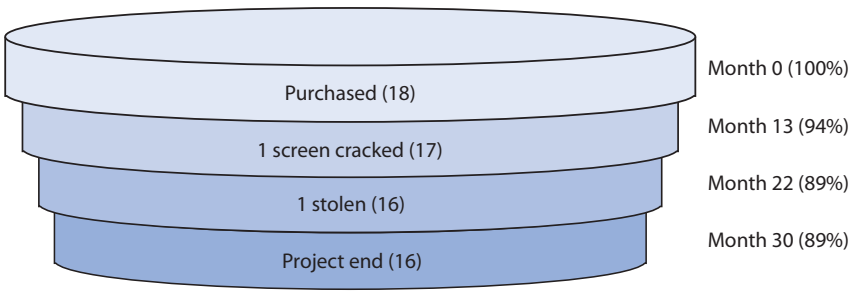
Table 1: Mobile phone technologies available for the collection of survey data

Mobile technology	Description	Supported handsets	Example tools	Key data-collection literature
SMS	The short message service (SMS) allows the sending and receiving of short alphanumeric messages to and from mobile telephones. Data collection can be achieved through the use of simple single-item questions.	All	RapidSMS, Frontline	Patnaik et al. (2009)
USSD	Allows for the transmission of information via the cellular network. An interactive service can be set up between mobile phones and an application on the network. The use of USSD menus allows the asking of simple single-item questions.	All	No user-friendly tool available	Medhi et al. (2011)
On-device application	Survey applications allow full-featured, multi-item surveys to be administered on a mobile phone. Was pre-dated by personal digital assistant (PDA) based survey software.	Any device that is running the version of operating system that the application was designed for.	EpiSurveyor, JavaRosa, Mobile Researcher, REDCap	None to date

received on average 4.2 minutes after questionnaires were completed. Only three of these submitted surveys were unaccounted for in the final data set (99.99%). Participants were identified through the capturing of two unique numeric identifiers. Of the 3 012 unique participants, 57 (1.9%) could not be linked to their patient record due to an error in the 11-digit unique identifier. All 57 cases were resolved by referring to the second five-digit identifier.

Of the 18 mobile phones that were bought for the study, one handset was stolen and one became unusable 13 months into the study after a hardware failure. The remaining handsets remained functional and in use until the end of the study (Figure 1).

Figure 1: Functionality and usability of mobile handsets for the study

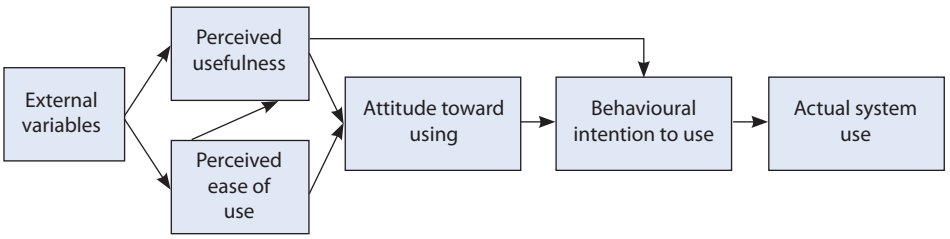


Source: Van Heerden, Norris, Tollman, Stein & Richter (2013)

Acceptability

There are a number of studies across Africa that have shown mobile phones to be an acceptable means by which to communicate with patients about a broad range of health topics (Crankshaw et al. 2010; Davis 1989). Data also exist to support the perceived usefulness and ease of use of mobile phones by primary healthcare facility staff. Based on the Theory of Reasoned Action, Davis (1989) formulated the technology acceptance mode (TAM) (Figure 2) as a means by which to understand why people adopt or discard a new technology.

Figure 2: Application of the Theory of Reasoned Action to understand why people adopt or discard a new technology



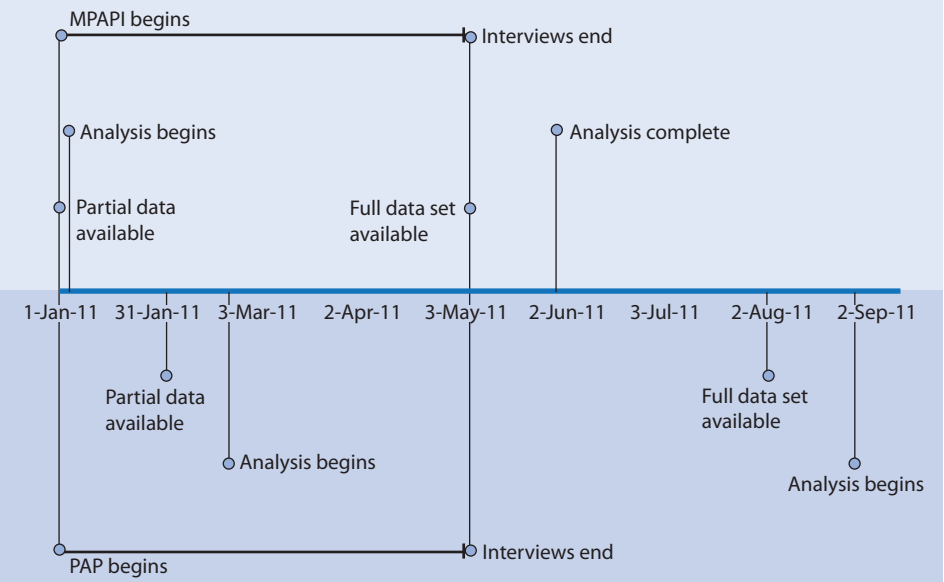
Source: Adapted from Davis (1989)

Using the TAM model, data were collected from 16 clinic-based healthcare workers at three different time points – namely, pre-training for mobile phone data collection, post-training and six months into field use. With a maximum score of 14 indicating high positive perception, mobile phone data collection was found to be highly acceptable at all three time points. Mobile-phone-based health data collection was perceived to be slightly more useful and easy to use. These findings tie directly to the recommendation made for careful evaluation of the software chosen, for if a device is not perceived as both easy to use and useful, then adoption will be low (Van Heerden, Norris, Tollman, Richter & Rotheram-Borus 2013). Although perceptions were lower three months into field use than in pre-training, no statistical significance was found to exist between these two time points.

Quality and timeliness

When compared to pen-and-paper (PAP) data collection, electronic data collection has some well-established benefits (Van Heerden, Norris, Tollman & Richter 2014). Some of the advantages include improved data accuracy, reduced time to availability of captured data and increased access to information. Figure 3 introduces the result of a comparative study undertaken by the author of this policy brief into the data accuracy of PAP and mobile-phone-assisted personal interviews (MPAPI). The strictly controlled environment produced a low number of data-entry errors for both methods. PAP interviewers made 204 'mistakes', giving an error rate of 1.9%, while MPAPI interviewers introduced 177 inaccuracies into the data, for an error rate of 1.7%. These low rates meant that no significant difference was observed for the two methods.

Figure 3: Result of a comparative study into the data accuracy of PAP and MPAPI



Source: Based on Van Heerden, Norris, Tollman & Richter (2014)

One significant feature of the MPAPI survey was that there were no missing data fields as compared to the 77 that occurred in the PAP surveys. An interesting age difference was noted, with the younger age group making twice as many errors in the PAP surveys than in the mobile phone surveys. Error rates were similar for the two methods across the two other, older age groups. No significant gender differences were noted. The speed at which data were available for use was also dramatically improved through the use of MPAPI. Data from this arm of the study were available immediately on completion of the first interview, while it took over a month to begin receiving captured data from the PAP arm. The lag was exacerbated the longer the study went on. By the end of the study the PAP arm was almost three months behind the MPAPI. These results relate to a small sample and it can be expected that real-world results would be even more dramatic.

These data strongly suggest that electronic data collection using mobile phones is feasible and perceived by data collectors as both easy and useful to them in their work. It was also found that this mode of data collection improves data quality by reducing errors, decreasing time in terms of availability and promoting sharing and collaboration of data sets.

Alternatives

The current method for health information collection within the Department of Health is paper registers. These registers are known to suffer from a number of limitations including double counting, undercounting and the use of outdated indicators. Aggregated count data also limit the scope and usefulness of current paper-based systems. As an example of the problems introduced by collecting only aggregated data, consider the tracking of a patient through the referral pyramid. By requiring facilities to submit only static counts of the number of patients seen, it becomes impossible to monitor the movement of patients through the health system. A community caregiver has no idea whether the HIV-positive patient referred to a clinic is linked into care or not. District hospitals are unable to report on the catchment areas from which their patients come, and tertiary hospitals are unable to map the geographic burden of disease to which they are responding.

Any of a range of electronic data-collection options may improve and address a number of the above-mentioned challenges. Pens that digitise the written word are one of the electronic alternatives proposed. Ruggedised laptops, netbooks and tablets are others. Each of these options is less well suited to both task and environment than the mobile phone. For example, digital pens are not widely available and in South Africa technical support is often limited. Digital pens also require a computer (or mobile phone) with an internet connection in order to upload the recorded data. Finally, many of the devices currently in the market require consumables, such as specially marked paper, in order to function. A stock shortage of this paper would bring data capturing to a halt. Mobile phones suffer none of these limitations. They are inexpensive to repair and require no other parts or components, and their ubiquity significantly flattens the learning curve.

Conclusion and recommendations

This research provides evidence that electronic data-collection methods are feasible, acceptable, accurate and usable. After reviewing the literature and weighing up the evidence, two recommendations can be made to district- and provincial-level health management:

1. The mobile phone and the telecommunication networks to which they link are mature and robust technologies that are widely available in South Africa. There is strong evidence supporting the readiness of these mHealth technologies to be incorporated into the eHealth strategy of South Africa. Mobile phones present a strong case for being the preferable electronic data-collection tool for this setting and at this time.
2. The most critical decision facing policy-makers is the choice of software. Software should comply with NHISSA standards and, in alignment with the South African eHealth strategy, should be interoperable with currently deployed health information systems. To achieve this will require strong cooperation, meaningful collaboration and adherence to agreed-upon standards.

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