Using mobile phone text messages (SMS) to collect health service data: Lessons from social franchises in Kenya, Madagascar and the Philippines

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Abstract.
Aim: To identify the key factors for success in using mobile phone text messages (SMS) to collect health service data.
Methods: The SMS data collection systems implemented in Marie Stopes International social franchises in Kenya, Madagascar and the Philippines were examined. Semi-structured interviews were conducted with key programme staff and social franchisees (the end-users) to assess system design, implementation and evaluation. Direct system observation, review of system documentation and analysis of system data were also conducted.
Results: The SMS data collection systems were designed and implemented separately; each system primarily aimed to improve the timeliness of service data collection from social franchisees. Some systems included automated data validation and/or reporting functions. In all settings some paper-based reporting was retained alongside the SMS system. In Madagascar the system enabled access to service data at the end of each month instead of two months later; in the Philippines the system permitted weekly rather than monthly collection of service data. The primary difficulty experienced by end-users was the requirement to submit data in a specified and inflexible format.
Discussion: Although the SMS data collection systems did not eliminate the need for paper-based reporting, they increased the timeliness of health service data collection in Madagascar and the Philippines, thus increasing program efficiency. Based on our experiences, we suggest that organizations consider local and flexible system design, adequate support and training, simple and intuitive input messages and inclusion of automated data validation and reporting functions when designing SMS based data collection systems.

Keywords. Mobile phones; SMS; text message; developing countries; data collection.

Introduction

Global penetration of mobile phones has increased dramatically in the past decade; in January 2011 it was estimated there were 5.2 billion mobile phone subscriptions worldwide.(1) Growth in mobile phone ownership has been most rapid in low- and middle-income countries, with a 1500% increase in subscriptions between 2000 and 2009.(2) Accounting for individuals with multiple subscriptions and shared use of phones, there are an estimated 4.4 billion mobile phone users worldwide (over sixty percent of the world's population), making mobile phones the most widely used technology in human history.(1) Short message service (SMS), or text messaging, is one of the most popular functions of mobile phones, with an estimated 18 billion SMS sent each day by the world's 4.2 billion global SMS users.(1) SMS is believed to be so popular because messages are generally cheap to send and enable communication with an otherwise occupied individual.(3)

The wide use of mobile phones, and SMS, have led to a variety of health specific mobile phone applications (mobile health, or 'mHealth').(4-7) mHealth applications have the potential to increase access to health and healthcare, improve disease diagnosis, treatment and surveillance and expand access to ongoing medical education and training.(4, 7) However many mHealth applications developed to date remain in pilot phase, and have not been scaled for wide reach or integrated into existing health systems.(7, 8)

In this paper we describe the use of mobile phones to collect health service data within three social franchises affiliated with Marie Stopes International (MSI). MSI is one of the largest global providers of voluntary family planning, delivering services primarily via static centres, outreach teams and social franchises. The social franchises are a form of fractional franchising, where services or products (in this case, specific sexual and reproductive health services) are added or strengthened within an existing business (in this case, private medical clinics) to provide a social benefit.(9, 10) This arrangement promotes the availability, quality and use of services, and benefits the franchisee (the clinic) by generating additional income and training opportunities from the franchisor (MSI).(9) Often social franchises involve the provision of subsidised services to increase service uptake.(11) There are currently ten MSI-affiliated social franchises delivering services via 1,500 health service providers in Africa and Asia under the brands BlueStar (majority), Suraj and AMUA.(12)

The aim of this paper is to describe MSI's experience in using SMS to collect health service data in social franchises in Kenya, Madagascar and the Philippines. Based on MSI's experiences in system design, implementation and evaluation we provide recommendations for other organisations considering integrating similar systems into health services in low-resource settings.

1. Methods

1.1. Rationale

This study was initiated as an internal investigation to document the experience of MSI's country programmes in developing and implementing SMS data collection system. The aim of the exercise was to synthesise lessons learnt in order to guide the development of future SMS data collection systems in low-resource settings.

1.2. Settings

1.2.1. Kenya

The AMUA (ki-Swahili for "Decide") social franchise was established in 2004 and offers sexual and reproductive health services via medical clinics to low-income earners in peri-urban and rural areas. The AMUA franchise currently includes 286 franchisees across five of the eight provinces in Kenya.

1.2.2. Madagascar

The BlueStar Madagascar social franchise was established in 2009 and offers reproductive health services via medical clinics to poor and low-income earners in peri-urban and rural areas. This Bluestar franchise currently includes 135 franchisees across ten of the 22 regions in Madagascar.

1.2.3. Philippines

The BlueStar Pilipinas social franchise was established in 2008 and offers reproductive health services via private midwives to low-income earners in peri-urban areas. This Bluestar franchise currently includes 282 franchisees across 37 of the 80 provinces in the Philippines.

1.3. Data Collection and Analysis

Each SMS data collection system developed were examined during country visits by the authors (Kenya – authors GA & HA; Madagascar – author NC; Philippines – author JG) between April and September 2011. During each visit, interviews were conducted with key stakeholders, including MSI programme staff from the social franchising, information technology and finance teams. In both Madagascar and the Philippines two social franchisees (the system end-users) were visited and interviewed Purposive sampling was used to select staff members for interview, while due to logical constraints, convenience sampling was used to select social franchisees. Six interviews were conducted in each of Kenya and Madagascar and seven were conducted in the Philippines.

The specific questions asked varied according to the role of the interviewee and by setting. However all interviews included questions related to:
- **System Design:** system development, hardware and software
- **System Implementation:** end-user training, data collection and reporting
- **System Evaluation:** system usage, system impact, and challenges

On average, interviews took between 30 and 60 minutes to complete, with notes taken by the interviewer.

In addition to the interviews, technical specification and other key documents related to each SMS system were reviewed. The operation of the SMS system was directly observed in Madagascar and the Philippines; the Kenyan system was no longer operational when visited.

Data from each information source (interviews, documentation, observations) were collated by MSI staff into system reports for each country and extracted by the lead author for inclusion in this manuscript. The message data from the Madagascar system for October 2011 were downloaded and analysed by the lead author.

As this investigation was conducted as an internal quality monitoring and improvement exercise, approval was not required from a human ethics review board. All those interviewed provided informed verbal consent.

2. Results

2.1. System Design

2.1.1. Development

MSI's programmes in Kenya, Madagascar and the Philippines developed SMS data collection systems to improve the timeliness of service data collection from social franchisees and to reduce the number of visits required to franchisees to collect service data. MSI's programmes also sought to reduce the burden of paper-based reporting and increase reporting accuracy (Kenya), support other aspects of the social franchising network (voucher reimbursement and client satisfaction surveys in Madagascar, report payments and perform stock orders in the Philippines) and facilitate communication with social franchisees (Philippines).

The three SMS systems were developed independently of each other. In each country a different technology provider was contracted by the programme to develop the software (Table 1). In Kenya, system development was initiated by MSI's support office in London, and a technical provider with an existing SMS platform contracted to build the system. In Madagascar, system development was initiated locally and a technical provider was contracted to design a new system. In the Philippines, unlike the other two settings, the SMS system was implemented alongside the development of the social franchise, with the technical provider modifying their existing SMS platform (Table 1).

2.1.2. Hardware and Software

In Kenya, the technical provider acted as the SMS receiver, with messages received accessible to programme staff via an online interface. In Madagascar and the Philippines, the systems were installed within the country programmes central office

using a computer connected to a SIM modem and aerial. The Madagascar system included an online interface; the Philippines system was only accessible from the computer where the system software had been installed. Madagascar retained ownership of the source code for their system, while the systems in Kenya and the Philippines relied on proprietary coding developed by the private technical providers. All systems required a programmer to change any aspect of system architecture or data collected.
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Table 1. Key characteristics of SMS data collection systems implemented in Kenya, Madagascar and the Philippines

	Kenya	Madagascar	Philippines
Overview			
Year Developed	2008~	2011	2008
Currently operational?	No	Yes	Yes
Type of mobile number for incoming messages	Short code and standard mobile phone number*	Standard mobile phone number	Standard mobile phone number
Cost to send in message	Premium SMS cost* (~USD $0.05)	Standard SMS cost (~USD $0.05)	Standard SMS cost (~USD $0.02)
Sender reimbursed for message?	Yes (plus incentive)	No	No
Software			
Technical developer	Voxiva	Human Network International (HNI)	Mozcomm
Developer location	Kenya and India	Madagascar	Philippines
Ownership of source code	Voxiva	Marie Stopes Madagascar	Mozcomm
Operating system	Windows	Linux	Windows
Programming language	VB.net	PHP	VB.net
Database	MySQL	MySQL	Firebird
Development cost *(approx)*	USD $60,000[%]	USD $30,000	USD $1,200
Data			
Incoming message types	Aggregate service data reporting (monthly)	Aggregate service data reporting (monthly) Voucher code verification^	Aggregate service data reporting (weekly) Stock orders Payments[#] Enquiry messages System registration
Online entry of data possible?	Yes	No	No
Inbuilt reporting	Yes; online	Yes; online	No
Data export options	Yes; spreadsheet format and PDF	Yes; line-listed spreadsheet format	Yes; line-listed spreadsheet format
Outgoing message	Automated data error messages	Automated data error messages	Automated data error messages

types	Communications messages	Communications messages	Communications messages

~ At the time of system implementation there were approximately 160 social franchisees (now 282)
* Depends on the telecommunication provider of the end-user. Sending messages to the short code was charged at a premium SMS rate.
^ Vouchers for subsidised family planning services can be redeemed at social franchisees; when clients present a voucher the code is sent via the system to verify that the voucher presented is valid. Payment for the voucher redeemed is made via separate mobile money payment system.
% Included hosting and support costs as well as software development
 # Franchisees report via SMS when they have made payments (for stock orders and franchise fees) using the banking or mobile money system.

2.2. System Implementation

2.2.1. Training

Training provided to social franchisees in using the SMS system varied between countries. In Kenya, the technology provider initially provided system training to social franchise field officers. These officers were then expected to train the social franchisee clinic member who would be responsible for submitting the data via SMS, however this 'train-the-trainer' approach was not successfully implemented. Some programme staff believed that the system would reduce their job security as manual collection and entry paper reporting would no longer be required. In Madagascar and the Philippines, a phased training and implementation process was used whereby groups of franchisees were trained to use the system during ongoing network training activities (Madagascar) and initial franchisee orientation (Philippines).

2.2.2. Registration

In all settings, users were required to register their mobile phone number on the system to submit data. In Kenya, initially only one mobile number per franchisee was registered. This created difficulties when different mobile phones were used to send in data. The system was later modified to accept multiple mobile phone numbers from each franchisee. In Madagascar a franchisee can have multiple numbers registered concurrently while in the Philippines franchisees can change the number they have registered with the system via SMS.

2.2.3. Data Collection

Each SMS system included the facility for social franchisees to periodically report aggregate service data from the registered mobile number(s) using a set format (Table 1 and Appendix 1). Data submitted via the Kenyan system initially required manual review and validation by social franchise field personnel and the social franchising manager before it was accepted into the system (this requirement was later removed). The Madagascar system includes an automated data validation step which identifies (in red text) any service numbers reported outside of the expected ranges of service delivery. In the Philippines, data validation is performed manually by a staff member who reviews all incoming messages.

All three SMS systems enable MSI's programmes to send SMS to social franchisees. These messages are typically reminders to social franchisees, for example, to submit service data. The Madagascar system also enables social franchisees to verify

health voucher codes presented by clients via SMS; if the voucher code is valid, the social franchisee is reimbursed for providing that service using a (separate) mobile money payment system.(13) The Philippines system also enables social franchisees to automatically register to use the system, place stock orders and report any payments made . Social franchisees in the Philippines can also use the system to send in any questions or enquires to the central programme office.

2.2.4. Data Reporting

The Kenyan and Madagascan systems are able to generate automated summary reports of correctly submitted data (see Appendix 1 for details of data requirements). The system in the Philippines does not include an automatic reporting function; incoming messages are reviewed by a staff member and data periodically exported and transposed into a separate reporting spreadsheet. Although the programme wishes to add automated data reporting, the provider that built the system is no longer providing system updates and support.

All countries retained a paper system for recording service numbers to support the SMS-based system. In Kenya, franchisees were required to complete daily service registers which MSI field personnel collected monthly for reporting purposes. In Madagascar and the Philippines the data collected by SMS are used for ongoing program reporting and management functions, while the paper daily service registers used by franchisees are still completed and periodically collected and cross-checked against the data collected via SMS.

2.3. System Evaluation

2.3.1. Usage

In Madagascar and the Philippines, all of the MSI social franchisees use the SMS-based system. The majority of franchisees are reported to send their data to MSI as requested (weekly in the Philippines, monthly in Madagascar); MSI programmes send SMS messages to remind those who have not submitted data by the required deadline. Analysis of data from the Madagascar system found that 102 of the 132 franchisees (76%) reported their service data for September 2011 via SMS; of these, 87 (85%) reported this data within seven days of the end of the month. In Kenya, while all franchisees were trained in the system, not all elected to use it. At the systems peak, approximately 70% of the social franchisees sent monthly service data to MSI via SMS.

2.3.2. Impact

In Madagascar, the introduction of the SMS system greatly increased the efficiency and timeliness of service data collection. Prior to the system it would take over two months for service data to be physically collected, entered and analysed. With the implementation of the SMS system, no collection and manual entry of data is required, and the data is available immediately after the end of each month.

The SMS system in the Philippines was implemented alongside the establishment of the social franchise network. As a result, it is not possible to directly assess the impact of the system on timeliness of service reporting. However the implementation

of an SMS system permits weekly reporting from social franchisees, as opposed to monthly paper-based reporting used by most MSI affiliated social franchises in other countries. This rapid reporting cycle enables quick identification of, and early intervention with, franchisees that are not performing as expected.

In Kenya, the SMS-based system increased the timeliness of reporting from some franchisees. However, the partial uptake of the system prevented the intended elimination of the paper-based reporting system. System timeliness was also impeded initially by the requirement for regional programme staff to approve incoming data before it was accepted by the system and could be accessed by staff in the central office.

2.3.3. Challenges

A common difficulty experienced in all countries was the requirement to use a specific (and inflexible) format to report service data (see Appendix 1 for detail). Many social franchisees reported getting frustrated when the messages they had compiled were rejected by the system. Less frustration was reported by social franchisees in the Philippines where social franchisees knew that their message would still be viewed by the system operator and that the cost of sending messages was low. In Madagascar, the programme sought to reduce the frustration of social franchisees by reducing the number of data items collected and by introducing specific error messages. Analysis of data from Madagascar reveals a minority of providers (n=17, 17% of those submitting service data) submitted service data messages for September 2011 in an incorrect format.

Relationships with the technical provider varied by setting. In one setting there were challenges in managing the relationship with the technical provider, with delayed timelines and budgetary overruns contributing to the tension.

3. Discussion

This paper demonstrates that is possible to implement SMS data collection systems into health services in low-resource settings. While each system was developed independently, the systems shared design and implementation similarities. Although the systems did not eliminate the need for paper-based reporting, they had a demonstrated positive impact on data timeliness in both Madagascar and the Philippines. We recommend that other organisations developing SMS data collection systems include local development, detailed and ongoing training, simple and flexible input messages and automatic data validation and reporting to maximise the likelihood of system use and sustainability.

Based on the experience within MSI's social franchises, it appears that systems that are initiated and developed locally, with 'buy-in' from program staff are the most likely to be successfully implemented. Local design and development assists in ensuring that the needs of all system users are met, and that any changes required can be quickly initiated. For sustainability, systems that can be eventually owned by organisations are preferred as they limit the reliance on one provider, preventing the

current situation in the Philippines where the provider is no longer able to provide system upgrades and maintenance.

This investigation found that effective system training was critical for system success. The main challenge of the system in Kenya was the incomplete training of social franchisee clinic members responsible for submitting data via SMS. Ideally, training on the SMS system can occur concurrently with program commencement, as occurred in the Philippines, as it minimises the amount of required behaviour change from all users. If this is not possible, on-site and ongoing training and support of staff using the system should be considered in addition to practical training sessions.

The systems implemented in Madagascar and the Philippines have demonstrated positive impact on service delivery. The systems enable timelier reporting of service data and reduce the frequency of required visits to social franchisees, which are commonly dispersed over a wide geographical area. Nonetheless, some form of paper-based reporting for auditing purposes is still required, as are periodic management visits to social franchisees. Thus while SMS systems, with their very restricted content limit, may not completely eliminate all forms of paper-based reporting, they may provide useful program management functions as well as reduce the burden of paperwork required. In addition, SMS systems can be used for other aspects of program delivery and management, as occurred in Madagascar and the Philippines. All the systems reviewed presented challenges to users, most commonly the inflexible format of data messages. However implementing processes such as ongoing training and support, specific error messages and reduction of data collected greatly assisted in reducing end-user frustration and improving the quality of submitted messages. Incorporating a pilot phase, or using a phased implementation process, is likely to be useful in ensuring success of wide-scale implementation.

This paper builds on the nascent literature examining data collection by mobile phone in developing countries.(14, 15) It provides an in-depth analysis of three separate, but similar, systems, used by private providers, unlike previous publications which have not described systems in detail (14) or have described systems based in the public sector.(15) Based on the experiences within MSI's social franchises, we suggest that organisations in low-resource settings consider local and flexible system design, adequate support and training, simple and intuitive input messages and inclusion of automated data validation and reporting formats when designing SMS data collection systems. These simple sounding, yet challenging to implement, recommendations are critical in ensuring system uptake at least in low-resource settings.

As with all studies, this investigation has some limitations. The comparison of systems emerged from internal monitoring and evaluation exercises, with assessments conducted by different authors (JG, GA & HA, NC) at different times, which may have influenced the information collected. However the findings of each assessment were discussed in detail between the authors, and with the relevant staff from the local program office, to ensure the information collected was comprehensive and accurate. However the involvement of staff involved in system implementation with the evaluation may have biased results of the assessment, especially as only system data from the Madagascar system was available for analysis. Due to time and logistical constraints, only a small number of social franchisees could be interviewed in each

location and thus the information collected may not be representative of all those using the systems. Despite these limitations, this evaluation provides unique, and useful, lessons for organisations considering developing SMS-based data collection systems.

As local and global initiatives continue to expand access to health services in low-resource settings, it is critical to establish systems that can support these activities. With greatly increasing mobile phone penetration, mobile phone based data collection systems have great potential to increase program efficiency and reach. While such systems may not completely eliminate all forms of paper-reporting, they can greatly increase timeliness of service data reporting and in turn improve program management and outcomes. Our investigation contributes to the evidence-base for developing successful mobile phone data collection systems in low-resource settings, and provides practical detail for others considering implementing their own systems.

4. Conclusion

SMS-based data collection systems enable service delivery organisations to gather service data systematically, accurately and efficiently, leading to improved programme monitoring and management. Certain elements in system design and implementation, such as message structure and validation, support and training, and system output, are particularly important to consider when designing such systems in low-resource settings.

Appendix

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Appendix 1. Detail of SMS service data reporting from social franchisees

Kenya	
Data required	Aggregate monthly reporting of number of services delivered (12 possible services)
Reporting formula	<month>,<year>,<number of service 1>,<number of service 2>,<number of service 3>....<number of service 12>
Example Message	06,09,10,30,0,0,40,10,7,11,15,0,23,6
Message meaning	In September 2009 this franchisee performed 10 family planning counselling services, 30 insertions of intrauterine devices, no tubal ligations, no vasectomies, 40 implant insertions, 10 voluntary HIV counselling services, 7 prevention of mother-child HIV transmissions services, 11 pap smears, 15 provisions of condoms, no injectable contraceptives, 23 provisions of the contraceptive pill and six services related to sexually transmitted infections
Message validation	All 12 services must be reported, and all commas and spaces must be in correct location for message to be accepted by the system. If the validation rules are not met, the sender will receive an automated error message and data from the message will not be incorporated into the system database
Madagascar	
Data required	Aggregate monthly reporting of number of services delivered (originally 19 services to report, reduced to 13 in June 2011)
Reporting formula	<number of service 1> <number of service 2> <number of service 3>....<number of service 13> <month> <year>
Example Message	5 25 4 0 0 0 0 22 3 0 0 0 0 9 11
Message meaning	This franchisee had five new clients to BlueStar family planning services (25 family planning clients overall), four under 24 years or younger, zero IUD insertions, zero IUD follow ups, zero implants inserted, zero implant follow ups, 22 provisions of injectable contraceptives, three provisions of the contraceptive pill, zero provisions of emergency contraceptives, zero provisions of condoms, zero provisions of medical post-abortion care, zero provisions of non medical post-abortion care in September 2011
Message validation	All 13 services must be reported, and there must be one (and only one) space between each service number recruited If the validation rules are not met, the sender will receive an error message (informing them of what type of error has occurred) data from the message will not be incorporated into the system database
Philippines	
Number of services reported	Aggregate weekly reporting of number of services delivered (six possible services)
Reporting formula	<message type> <servicetype> <number>, <servicetype> <number>, <service type> <number>/<number new clients>-<number existing clients>^
Example Message	Report IUD 20, dmpa 30, condom 30/2-10, coc 26/0-26
Message meaning	In the past week this franchisee preformed 20 IUD insertions, provided 30 injectable contraceptives, had 30 provisions of condoms (2 new clients and 10 existing clients) and 26 provisions of the oral contraceptive pill (no new clients and 26 existing clients)
Message validation	All service types must be spelt correctly, and commas and spaces in correct locations for message to be included in data exports. Only services delivered need to be reported If the validation rules are not met, the sender will receive an automated error message. The message will still be received on the system interface, and viewed by the system operator, but will not be included in data exports from the system

^ *The number of new and existing clients is only required for short term family planning methods (provision of condoms and oral contraceptive pills)*

References

[1] T. Ahonen. *Tomi Ahonen Almanac 2011: Mobile Telecoms Industry Review (eBook).* Hong Kong: TomiAhonen Consulting. Available from http://www.tomiahonen.com/ebook/almanac.html (accessed 2 Nov 2011), 2011.

[2] *Mobile Cellular Subscriptions (global)*: World Development Indicators. Available at http://data.worldbank.org/ (report generated 8 Aug 2011), 2011.

[3] L. Srivastava. The Mobile Makes Its Mark. In: Katz JE, editor. *Handbook of Mobile Communication Studies*. The MIT Press Cambridge, Massachusetts:15-27, 2008

[4] *mHealth: New horizons for health through mobile technologies. Global Observatory for eHealth series - Volume 3*. Geneva: World Health Organization. Available at www.who.int/goe/publications/goe_mhealth_web.pdf (accessed 29 Jul 2011), 2011.

[5] B. S. Fjeldsoe, A. L. Marshall, Y. D. Miller. Behavior change interventions delivered by mobile telephone short-message service. *Am J Prev Med*;**36**(2009), 165-73.

[6] S. Krishna, S. A. Boren, E. A. Balas. Healthcare via cell phones: a systematic review. *Telemed J E Health*;**15**(2009), 231-40.

[7] P. Mechael, H. Batavia, N. Kaonga, S. Searle, A. Kwan, A. Goldberger, et al. *Barriers and Gaps Affecting mHealth in Low and Middle Income Countries: Policy White Paper*: Center for Global Health and Economic Development Earth Institute, Columbia University. Available at http://www.globalproblems-globalsolutions-files.org/pdfs/mHealth_Barriers_White_Paper.pdf (accessed 5 Aug 2011), 2010.

[8] *Amplifying the Impact: Examining the Intersection of Mobile Health and Mobile Finance*: mHealth Alliance and World Economic Forum. Available at http://www.mhealthalliance.org/content/amplifying-impact-examining-intersection-mobile-health-and-mobile-finance (accessed 22 July 2011), 2011.

[9] D. Montagu. Franchising of health services in low-income countries. *Health policy and planning*;**17**(2002), 121-30.

[10] *Public Policy and Franchising Reproductive Health: Current Evidence and Future Directions*. Geneva: World Health Organization, USAID and PSP-One. Available at http://whqlibdoc.who.int/publications/2007/9789241596021_eng.pdf (accessed 11 Aug 2011), 2007.

[11] T. P. Koehlmoos, R. Gazi, S. S. Hossain, K. Zaman. The effect of social franchising on access to and quality of health services in low- and middle-income countries. *Cochrane Database Syst Rev* (2009), CD007136.

[12] K. Schlein, K. Drasser, D. Montagu. *Clinical Social Franchising Compendium: An Annual Survey of Programs, 2011*. San Francisco: The Global Health Group, Global Health Sciences, University of California, San Francisco. Available at http://www.sf4health.org/sites/www.sf4health.org/files/Social-Franchising-Compendium-2011.pdf (accessed 22 July 2011), 2011.

[13] N. Corby. MSI Innovations: Using mobile finance to reimburse sexual and reproductive health vouchers in Madagascar: Marie Stopes International, 2011.

[14] M. Ganesan, S. Prashant, A. Jhunjhunwala. A Review on Challenges in Implementing Mobile Phone Based Data Collection in Developing Countries. *Journal of Health Informatics in Developing Countries*;**6**(2012), 366-74.

[15] I. Asangansi, K. Braa. The emergence of mobile-supported national health information systems in developing countries. *Studies in health technology and informatics*;**160**(2010), 540-4.