

UNDERSTANDING THE INTRODUCTION AND USE OF A MOBILE DEVICE-SUPPORTED HEALTH INFORMATION SYSTEM IN NIGERIA

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ABSTRACT

This paper presents an in-depth analysis of efforts to introduce a mobile health information system in Nigeria as part of a development initiative aimed at improving maternal and child health. Specifically, it examines the use of mobile devices to facilitate maternal health information accessibility and exchange among health practitioners in order to reducing maternal, newborn and child mortality. Further, it also looks at the challenges raised while introducing mobile devices into work practices in the healthcare sector.

The study adopts a case study approach, relying on semi-structured interviews and document analysis as its main methods for collecting data. The specific case examined is a mobile phone-based information system introduced to support a national government effort in Nigeria, known as the midwives service scheme. The findings of this study show that this integrated approach of using mobile phones to support (health) information systems has vast potential; for instance increasing the timeliness of (health) data available to stakeholders for monitoring and planning purposes. However, we also find that over time, attaining the potential of development efforts such as this remains difficult as initiatives involving the use of mobile devices is not just about getting the technical aspect right. It is equally dependent on deep seated social-cultural influences such as poor political and financial commitment. These two mutually reinforcing influences have been identified in this study as significant impediments to efforts of this kind. Therefore, this paper argues for, first a strong political commitment across all levels of government whereby their words are backed with action. Second it is important that the government maintains financial integrity by releasing the funds budgeted to support the smooth running of these efforts, for such initiatives to thrive and ultimately contribute to development.

KEYWORDS: Development, Developing Countries (DC), Mobile phones, Nigeria, Mobile-Supported Health Information Systems, Primary Health Care.

1. INTRODUCTION

Over the last decade, mobile phones (mobiles) have become known as one of the most rapidly diffusing technologies, changing the way people work and live. Particularly, within the context of developing countries (DC), the proliferation of mobile phones has led to the emergence of a wave of efforts to introduce this technology, in various sectors of development work including; education and health for the delivery of information and services to the world's poor.

More recently, mobile phones are being widely adopted in one important development area namely healthcare services. The underlying assumption has been that the introduction and use of mobiles in this area can better support processes of communication across the different health hierarchies resulting in better health services to citizens.

Within the information systems (IS) and development literature, there is a growing body of literature (Donner, 2011; Purkaystha *et. al.*, 2010; Khan *et. al.*, 2010; Braa and Sanner, 2011) that focuses on understanding the application of mobile phones within health systems in a DC context. Notably, previous accounts in this area tend to highlight the use of this technology within this context in a conventional manner. By this, we mean that these

accounts centre largely on the technical capabilities of using mobile devices (mobiles) as a "stand alone technology" to support the delivery of information and health services.

Despite the usefulness of these efforts, it has been noted by Purkaystha and Braa (2010) that mobiles has so far been little understood in terms of how it can be used in an integrated manner to support the delivery of health services. They go on further to explain that this integrated approach, involves exploiting existing functionalities of mobiles and using it as a supporting health information infrastructure for the well-functioning of public health systems. This means, that, mobiles can offer health systems of developing countries the opportunity of handling health information even at the grass- root level in a digital format. This digital handling of health data has the potential to bring about efficiency in the process of communicating health information across various levels, making information readily available for decision making and actions.

Given that little has been understood in terms of using mobiles in an integrated manner to support health information systems (HIS) in DC, it is important that we study this process. By doing so, we can generate an evidence-based understanding for conceptualising the relationship between mobile technology and development goals.

This paper proposes that such an understanding holds significant potential for understanding the place of mobiles in contributing to development particularly as regards using this technology to improve the health of disadvantaged people. On the other hand, the absence of such an understanding portrays the decision to adopt and use mobiles in this way as merely jumping on the bandwagon that is to say "because others are using it we must be seen using it too as it doesn't look hard to make this work".

Therefore this paper contributes to this area of work as it explores the process which mobiles are used to strengthen health information systems. Specifically, it examines a case in Nigeria a DC in the Sub-Saharan African (SSA) region where mobile-devices have been recently introduced to support a national HIS for maternal and child health.

Our analysis of this case, acknowledges the recursive relationship of technology. This implies that when in action or used by people, technology shapes and is also shaped by various socio-technical influences within a given context; hence we employ a socio-technical approach. This means that, the focus of the analysis pays consideration to the close interdependencies between the technology and other social influences such as people, work practices and particularities of the context. The decision to adopt this socio-technical approach follows a tradition that has prevailed in several science and technology studies (Bowker and Star 1999, Law and Callon, 1995).It is now being used in IS research to better understand how various influences such as organisational culture, policies, infrastructure etc. might shape the process of introducing (mobile) technology within a particular context.

The research questions underlying this paper therefore are: 1) how do people within this setting experience the introduction of mobiles and what issues are experienced? 2) is this system able to contribute to health development? In this study, mobile-supported health information system (henceforth referred to as m-HIS) refers to the applications of mobile devices in the management of health information and service delivery.

The remainder of this paper is organised as follows. Section 2 looks at three things: First, the importance of HIS in development; Second, the important role of mobiles in strengthening health systems; Third, an overview of the public health system in Nigeria (the research setting for this study). The research approach and methodology adopted is briefly discussed in section 3 while section 4 provides a brief narrative of the case. Section 5 provides an analysis of the case, while section 6 discusses the findings and concludes with implications for practice.

2. BACKGROUND LITERATURE ON HEALTH INFORMATION SYSTEMS

2.1 The Importance of Health Information Systems (HIS) in Development

Health and health service provision are recognised as major development issues facing DC. Presently, health systems within this region are constantly grappling with a wide range of challenges. Of particular concern is the high burden of infectious diseases such as HIV/AIDS as well as the emerging problem of chronic conditions; the need for expediting progress towards achieving the health millennium development goals (MDG) 4 and 5 which seeks to achieve a 75% reduction in maternal and child deaths; and ultimately the modernisation of health systems to meet the present day needs of citizens.

In many ways, challenges such as these can be viewed as a significant impediment to the development and socio-economic progress of a country. The 1993 world development report from the World Bank subscribes to this view by highlighting a mutually influencing relationship between development and the health status of a population. According to this report, addressing health is one way to accelerate development as good health increases the economic productivity of individuals and ultimately the economic growth of a country (WDR, 1993).

For many DC countries like Nigeria, one of the major obstacles to addressing the challenges of health and healthcare provision is that of a weak and ill-functioning national health information system (WHO, 2005a). Weak HIS are a critical challenge to reaching health development outcomes or even the health related millennium development goals because in most cases, it produces data that is sometimes incomplete, inaccurate or untimely, making it difficult to adequately monitor or assess the performance of health systems.

As emphasised by a world health report (WHO, 2004), since a country's HIS is recognised as one of the key building blocks of its health system, strengthening its capabilities to enhance the functionality of its HIS is indeed a strategic solution as well as an imperative for countries seeking to address healthcare challenges. One primary benefit of a well functioning HIS is its ability to provide timely information of health determinants and health status and its ability to analyse this information to guide the planning of health activities.

Considering that most DCs are faced with a large poor population solely dependent on publicly provided health services, strengthening the functioning of HIS as well as utilising the information generated for decision making is vital, otherwise the goal of driving development through better health services, particularly for the poor within DC like Nigeria, is unlikely to occur anytime soon.

The importance of ICTs in strengthening the capabilities of health systems is well recognised, particularly by both the practitioner and academic communities (Madon *et al.* 2007; Braa *et al.* 2004; Kimaro, 2006). Further, its adoption and use is an essential strategy that has the potential to improve the functioning of HIS. The underlying assumption is that incorporating ICT in HIS will improve the accessibility of health information resulting in the availability of reliable data for health planners to make evidence-based decisions.

2.2 Role of Mobile Phones in Supporting Health Information Systems

One specific ICT that appears to offer unique opportunities for strengthening health information systems (HIS) particularly for countries within the DC region is mobile phones. According to the International Telecommunication Union (ITU) data, there has been a dramatic rise in the uptake of mobiles in less developed regions, such that the estimated penetration of this technology is about 79% of the population (ITU, 2013). Notably, within this region, the past few years have witnessed a significant increase in the use of this technology not only in areas such as banking and agriculture but also more recently within

national healthcare systems for the purpose of facilitating data communication and health information service delivery.

The introduction and use of mobiles to support national health information systems has been recognised as a possible solution that can address some of the problems facing HIS in DC. For example, mobiles can instantaneously support the reporting of routine and non-routine data from the lower levels of the health system upwards resulting in increased data timeliness and reduced need for travel. Additionally, the use of this technology makes it easy for large data sets to be analysed, a task that is difficult to perform within a paper-based system.

While on one hand mobile devices are being promoted as a technology that can play a vital role in enhancing socio-economic progress in developmental domains like health, on the other hand a considerable body of research literature suggests that most efforts to introduce and use mobiles innovatively are failing to produce the expected development outcomes (van Herdeen *et al.*, 2012). For instance, Braa & Nielson (2013) draw on their field experience from participating in mobile health projects particularly in India (Braa and Purkayastha, 2010; Braa and Sanner, 2011), to argue that while the potential of using mobiles to support HIS have become widely recognised, in practice realising this potential tends to be difficult owing to a number of socio-technical challenges that emerge during this processes. Heeks (2002) takes the argument a step further by emphasising the view that, giving full consideration to socio-technical influences is a prerequisite for effective outcomes of using mobiles in development efforts. Agreeing with this view, this study pays attention to the interplay between the political, technological, economical and social influences within the environment where this system is been introduced to better understand this process.

Presently, there has been an increase in the use of ICTs for public service delivery in Nigeria in a bid to improve its socio-economic status. For example, there has been a recent attempt by the government to adopt an integrated approach in harnessing mobiles to improve public health information service delivery. Specifically, this mobile information system is being used to support a national maternal, newborn and child mortality effort in Nigeria known as the midwives service scheme (MSS). This effort has been set up because Nigeria is home to one of the greatest burden of maternal and child deaths worldwide and its government is increasing its effort toward addressing this developmental issue. As part of this scheme, mobile phones were introduced to support the capturing of key maternal and child health information HIS from the lowest level of the health system to be sent to the highest level for monitoring, planning and actions.

Currently, empirically grounded knowledge about this integrated approach of using mobiles on a large scale to support health information system, particularly within the SSA region is relatively low. Therefore, this research will contribute towards that body of knowledge. Further, this research has significance by providing an empirically based socio-technical understanding that could be of value to health practitioners seeking to use mobile technology to improve public information service delivery. In sum, this study is significant as: a) it makes a theoretical contribution by allowing us know more about the process of introducing mobiles to support a public HIS in a developing country context like Nigeria b) it makes a contribution to practice by highlighting how best mobile-supported HIS can contribute to development based on sound empirical evidence.

To better understand the setting where this effort is taking place and to understand how the current situation under study materialised, the following section (2.3) provides a short overview of the historical and social context.

2.3 Overview of the Nigerian Healthcare System

The empirical setting for this research is Nigeria, a country located in the SSA region. With an approximate population of about 169 million, Nigeria is the most populous country on the African continent (World Bank, 2012), with about 71% of its population still living well below the international poverty line (Chen and Ravallion, 2004). Politically, it can be described as a nearly stable democratic country (although in recent times there have been frequent bouts of unrest and violent attacks, mainly in northern parts of the country that has claimed so many lives). Nigeria has a fairly well enforced rule of law and sadly an almost non-existent control on corruption (Akindele, 2005). The country is made up of a federal capital territory (FCT) and 36 states which are grouped into 6 geopolitical zones namely: North-Central, North-East, North-West, and South-South, South-East and South-West (see Figure 1). These 36 states are further subdivided into approximately 776 recognised Local Government Areas, with some of them having a population approximately less than 80,000 (DfID HSRC, 2000).

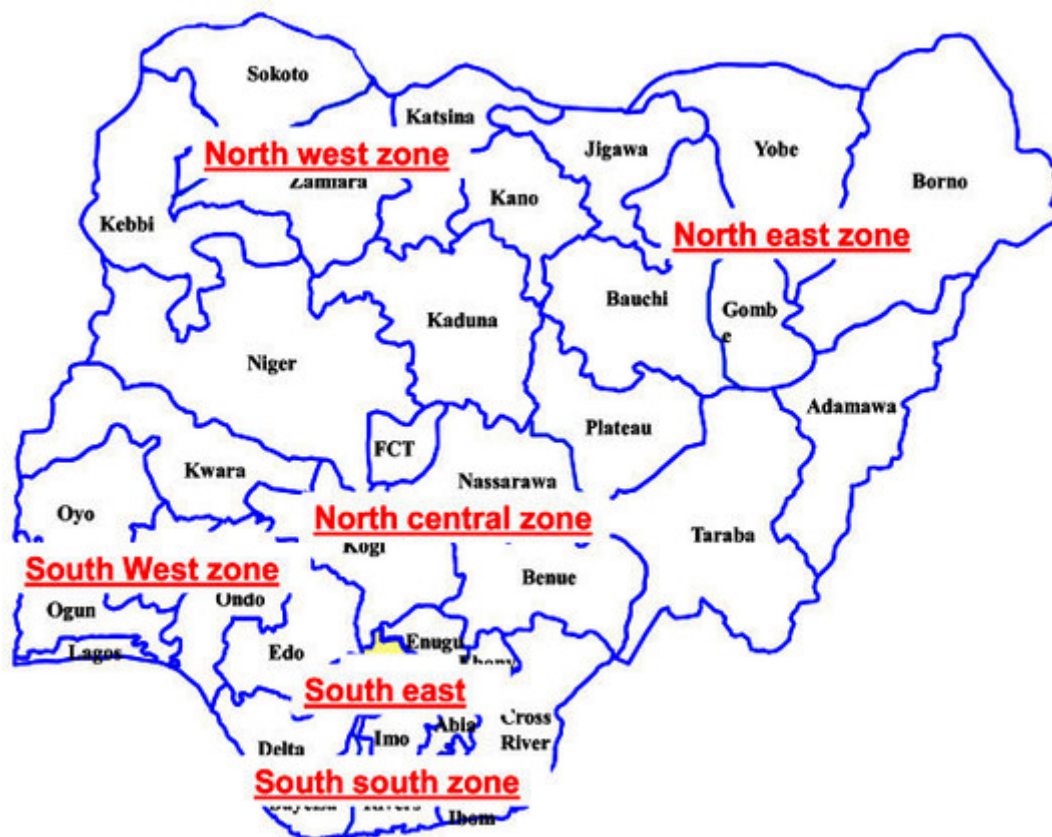


Figure 1 Nigeria's 36 States and the Six Geopolitical Zones (Dineen et. al. 2008)

Since inheriting a weak colonial health system at independence in 1960, Nigeria has gone through phases of unsuccessful plans to develop its health system (Asuzu, 2004). Notably, it was only in the late 1970's, when a primary health care (PHC) system was decided at the international conference on PHC in Alma-Ata that the country's health system started heading for reform. This reform included the decentralisation of the health sector in a manner that provided management and budgetary control to those at the community level.

Subsequently, in 1988, in furthering the process of reform, the Nigerian civil service was reorganized leading to the creation of the department of health planning, research and statistics. Additionally, at about this time, the first national policy was adopted. This policy, led to the establishment of a robust health management information system (HMIS) by all

levels of government. This system (mainly paper based) became fully operational in 1999 with the hope that it would create accountability through increased community participation and also provide better access to local information to make better informed health decisions.

The delivery of healthcare in Nigeria occurs at three levels, namely: the primary, secondary and tertiary levels. These are managed by the local, state and federal governments respectively. By Nigeria's constitutional arrangement, both the federal government and the state government run ministries of health that are for all purposes autonomous on matters concerning policy making and programme execution. The head of the federal government, under the leadership of the federal minister, is responsible for health services at the tertiary level; the state governments, under the leadership of the state commissioner for health, are responsible for secondary health services. The local governments, under the leadership of the chairman of the local council, are responsible for healthcare services at the primary level which is the lowest level of healthcare delivery in the country. In 1992, in order to strengthen the process of developing health services at the primary level, the federal government of Nigeria established a body known as the National Primary Health Care Development Agency (NPHCDA). This agency helps to support health programmes throughout the country at the primary health care (PHC) level.

One of such major programmes recently established by the federal government of Nigeria under the leadership of this agency is known as the midwives service scheme (MSS). This initiative was launched to accelerate progress in addressing a key developmental health issue facing Nigeria, that of maternal and child mortality.

Over the years, maternal mortality has been notably high in Nigeria. Estimates by development agencies such as the WHO and UNICEF reports that Nigeria has the second largest number of maternal deaths in the world (WHO, 2005b). They also argued that two thirds of maternal and child mortality in Nigeria are among women living in rural areas communities and that with better healthcare service, most of these could be prevented. According to a 2010 report by the NPHCDA in Nigeria, maternal mortality ratio (MMR) stood at 545/100,000 live births while infant mortality ratio and under 5's mortality ratio stood at 75/1000 births and 157/1000 births respectively (The MDG- DRG funded MSS: Concept, Process and Progress April 2010). It is important at this point to mention that there are wide variations across the 6 geo-political zones in the country with higher mortality rates recorded in the northern zones. For example the north-east zone has the highest MMR with 1549 recorded cases of mortality per 100,000 live births. Given this alarming trend on maternal mortality, not only in Nigeria but in some countries within SSA as well as other parts of the world, the United Nations (UN) in 2000 made improving maternal health an important agenda for member states. This agenda formed part of the eight Millennium Development Goals which are regarded as crucial for the UN as it aims to alleviate poverty, improve health, education as well as foster gender equality world-wide by the year 2015.

Against this backdrop, the MSS was launched using funds from debt relief gains in 2009 as part of Nigeria's commitment to the UN's Millennium Development Goals (MDGs) 4 and 5 which seek to reduce child and maternal mortality by 75% by the year 2015. For the MSS to achieve this goal, eight (8) strategic components were designed by the NPHCDA to guide the implementation process of this scheme. These processes include, capacity building and training of midwives, monitoring, evaluation and the ICT support component, deployment of midwives to health facilities to improve the coverage of skilled attendance at birth and strengthening PHCs with basic equipment and supplies.

The specific focus of this paper is on the ICT support component - relating to the ICT strategy that is the mobile-supported information system. This system takes advantage of GSM technology and mobile devices to improve the upward reporting of key maternal health

information captured from primary health facilities nationwide to improve monitoring and decision making at the national level.

3. RESEARCH METHODOLOGY

3.1 Research Approach

The nature of this inquiry as well as its focus on investigating a contemporary event taking place within the health care system in Nigeria suggests that a case study method is appropriate (Yin, 2014). Within the case study, this research adopts a broadly interpretive approach where the subjective meaning that people create within their environment is studied and analysed (Walsham, 2006), with the aim of understanding the social context of an information systems in use (Oates, 2006).

This study is exploratory in nature and aims to understand efforts to employ mobile devices to improve health service delivery for citizens (Yin, 2014). This study is an interesting one as it is the first of its kind to use mobile devices to support the activities of health information systems in Nigeria and as such, its findings will be vital to the development of mobile health information systems in Nigeria.

3.2 Data Collection

This research started in June of 2012, with a combination of data collection techniques including interviews, document study and numerous informal and formal discussions with participants. In accordance with the first principle of conducting interpretive field research in information systems (IS), (Klein and Myers, 1999), the process of collecting data and its analysis involved gaining in-depth understanding of the larger context where the phenomenon under study is taking place in order to better understand the IS phenomenon under study. Information on the data collection methods and participants for this study are summarised in Table 1.

The primary method of collecting data was via semi-structured interviews. However, formal and informal discussions were useful as they provided coherence to the various pieces of the story. Additionally, the various documents and reports studied helped to provide a historical understanding of this m-HIS in Nigeria as well as key background information from the time of its inception in 2009.

Between June 2012 and November 2013, approximately 70 personal interviews were conducted with key actors concerned with this effort. The key actors include: health administration personnel's at sub-national level who were responsible for the reporting of data using mobile devices and programme managers working for the NPHCDA at the national level. Health administration personnel's at sub-national level include primary healthcare workers in health facilities (the primary users of the mobile device during the first phase) and Monitoring and Evaluation officers at the local government offices (the primary users of the mobile device during the second phase). The programme managers and personnel at the national level include: Monitoring and Evaluation officers at the national level, programme officers, management personnel of the NPHCDA, ICT staff of the NPHCDA and the ICT solutions personnel of the ICT company responsible for providing the technological framework of this m-HIS.

In total, 10 ICT and data management personnel (otherwise referred to as Monitoring and Evaluation officers) were available for interview. This number accounts for more than half of the ICT and data management personnel working on this initiative in the national office of the agency. Also a total of 7 programme planners/co-ordinators were interviewed, primarily due to access and also because the number involved with this project are not so many either.

A total of 29 primary facility workers plus a total of 24 monitoring and Evaluation officers (M&E Officers) were interviewed respectively. The selection of the health facilities and local government offices for interviews with these personnel was based on two factors namely: those facilities easily accessible and close enough for the field researcher to travel to and those facilities where workers were available and consented to participating in the study. However during the course of the field work, the interviewer made effort to visit at least four facilities from each of the 6 geo-political zones in the country.

The personal interviews carried out were semi-structured in nature and were conducted with the full consent of participants. The participants were told that the focus of the study was to understand (through their experience) the process involved in introducing and using a mobile –supported health information system. Participants were motivated to contribute because they wanted to talk about their feelings, share their experiences and also their achievements in this novel technological change process. Interview questions focused on understanding, through the eyes of the participants, the process of how mobiles were introduced within this system, the challenges experienced, effectiveness of the system in terms of improving access to data and the overall impact on maternal and child health outcomes.

Table 1 Summary of Data Sources

Data Sources	Description
Formal interview All interviews were held in June of 2012 and November of 2013	<p>A total of 70 semi-structured interviews were conducted, with each being between 45minutes to an hour long. While notes were being taken in some of the interviews, majority of the interviews were recorded and later transcribed. Different professionals who include: Primary Health workers (29), M&E officers at the local government offices (24), ICT personnel and M&E officers (or data management Personnel) at the national level (10) and project managers/planners at the national level (7) were interviewed to allow for multiple interpretations.</p> <p>The interviews with the primary health workers were conducted in primary health facilities across selected states within Nigeria. These states include Imo state, Rivers-state, Lagos state, Abuja, Delta-state, Nasarawa, Osun-state, Akwa-Ibom state. With respect to choosing these facilities, this process was limited to facilities that the researcher could access easily considering that Nigeria is a geographically large country (However, efforts were made to ensure these primary health facilities were selected from across the 6 geopolitical zones in Nigeria).</p> <p>All the interviews with ICT/Data management Personnel and programme managers/planners took place at the national office of the NPHCDA in Abuja.</p> <p>The interview covered questions concerning the key encounters of the actors in relation to the implementation process, nature of the events that took place as well as the events that challenged this effort.</p>
Project documentation June of 2012 and May of 2013	The research project was provided with project documentation such as policy documents, progress reports and design documentation of the system.
Email and phone Between June 2012- November 2013	Different informal conversations and updates via email and telephone with members of the NPHCDA as well as some health workers took place.

3.3 Data Analysis

A thematic data analysis approach was used to build themes inductively (Braun and Clarke, 2006), beginning with open coding. This involved going through the raw data line by line several times, so as to become familiar with it. Important concepts found in the data were highlighted and descriptive codes were assigned to them. Once the coding process was completed, the codes were then analysed to find similarities. Similar codes were then grouped together to form broader categories. Finally, patterns within the categories were identified leading to a set of high level themes (Braun and Clarke, 2006) which formed the basis for the discussion, as shown in this paper.

4. CASE STUDY

This section presents a narrative of key encounters during the implementation effort involving the introduction and use of the m-HIS in Nigeria.

4.1 The Introduction of a Nationwide m-HIS

As discussed earlier, the development of this first nationwide mobile -supported HIS is largely attributed to the need to provide technical support to the midwives service scheme (MSS). It was envisaged that the introduction and use of mobile information system would enhance timely reporting on key maternal and child health indicators from various primary health facilities across the country upward to guide the planning of actions, allocation of resources, monitoring of problems etc. Additionally, it was meant to be a cost saving strategy for capturing maternal health data regularly.

In 2009, a high level technical working group was formed to discuss and begin the conceptualisation of this project. This working group was chaired by the then Honourable Minister of Health and comprised of other key players involved in maternal mortality reduction efforts in Nigeria. This working group provided leadership to a team (henceforth referred to as the programme management team) within the agency that was primarily responsible for the day to day management of this initiative. This team, chaired by the then Executive Director of the NPHCDA, was comprised of a national co-ordinator and a team of technical officers which included management staff as well as operations personnel of the agency. The team sought a way to capture data regularly from the field in order to monitor key maternal health indicators. The initial idea was to send out personnel's from the NPHCDA to go out regularly to various health facilities across the country to capture this data. When the budget was made, it was discovered that the cost of sending out officers to the field regularly was extremely expensive. At this point, the big idea to use mobiles emerged as an economically viable alternative of capturing key maternal, neonatal and child health (MNCH) information nation-wide. Interview discussions did reveal that the cost of sending officers out to bring in data regularly was three times more than the cost of capturing this data digitally using mobile devices. So in addition to improving the timeliness of data, another major reason for the introduction of mobile phones to support this health information system was that it cost significantly less making it a cost effective strategy for data capturing data from facilities under the MSS.

The next step in this process was the partnering of the NPHCDA with the developers an Indigenous company called Dabarobjects. Dabarobjects provided the mobile solution known as MADEX (mobile to application data exchange) to support the communication of maternal health information. Put simply, MADEX is an electronic reporting tool built under the Midwives Service Scheme. It is used mainly for timely retrieval, storage of data and processing of data captured from primary healthcare centres under the scheme.

Basically, MADEX which is built on SMS platform consist of three major components namely: the mobile client, the SMS gateway and the storage server. The mobile

client of MADEX 1.0 consists of a handheld device (Nokia GSM phone) with the MADEX mobile reporting platform installed on it. As earlier mentioned, Dabarobjects Nigeria in 2010 were awarded the contract to implement this mobile system to support the reporting of MNCH information. During the first phase of the project, technical personnel's from Dabarobjects worked alongside the ICT personnel of the NPHCDA to deploy this pre-programmed Nokia to officers at the primary health facilities and to also provide them with training on usage. Officers at the facility were shown how to enter data onto the reporting platform. This platform was menu driven and was made up of modules on MSS core indicators such as mortalities, immunisations etc. (see figure 2).

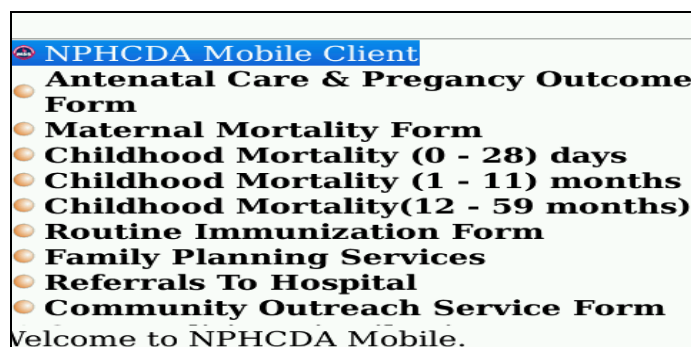


Figure 2 Screen shot of the user interface depicting the main modules

Further, each of these modules consisted of a form that catered for specific MNCH information related to the key indicators. The primary health facility worker who is responsible for keying in the relevant data on to the digital forms, captures this information from the HMIS register, fills it into a form specifically for the MSS programme before uploading it digitally. Figures 3 and 4 are screen shots of the user interface application showing the antenatal care and community outreach forms respectively.

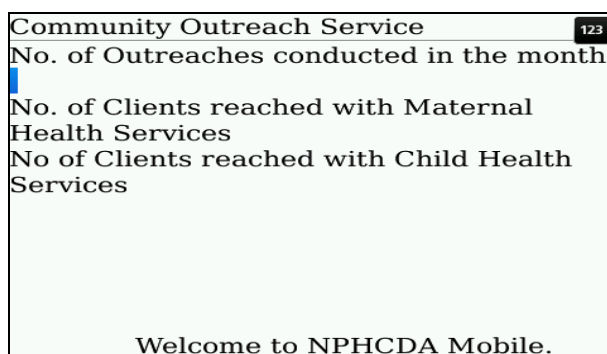


Figure 3 Screen Shot of the User Interface Depicting the Community Outreach Service Form Screen

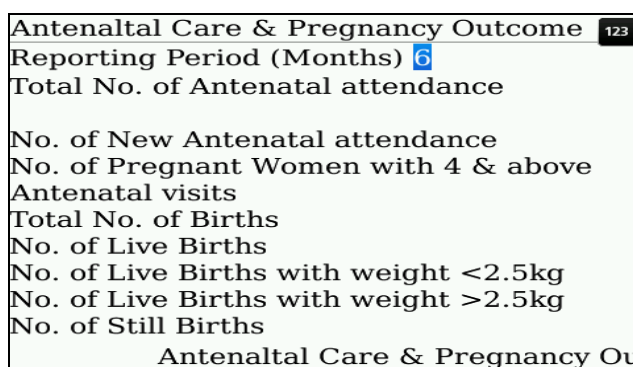


Figure 4 Screen Shot of the User Interface Depicting the Antenatal Form Screen

The first batch of mobile phones installed with the MADEX application (version 1.0) was made available to about 652 selected primary health facilities across the country. As mentioned earlier, the programme management team enlisted the support of designated primary health officers in each of these health facilities to become members of this maternal health information network. These officers were given the new task of uploading key MNCH data from their facilities registers onto the MSS forms and then onto the mobile platform. In order for them to successfully carry out this task, the management team ensured that these key user group i.e. primary health officers were provided with the necessary training from the onset. They were strictly instructed to forward their report of the previous month within the first seven days of the new month. After inputting the data captured onto the MADEX phone, the officer forwarded their report as SMS, which goes through the SMS gateway where it is processed in real time, interpreted and then sent off to the storage server to be stored. (see figure 5). This data is what is made available to programme managers and other key stakeholders involved in this maternal mortality reduction effort for monitoring and planning purposes.

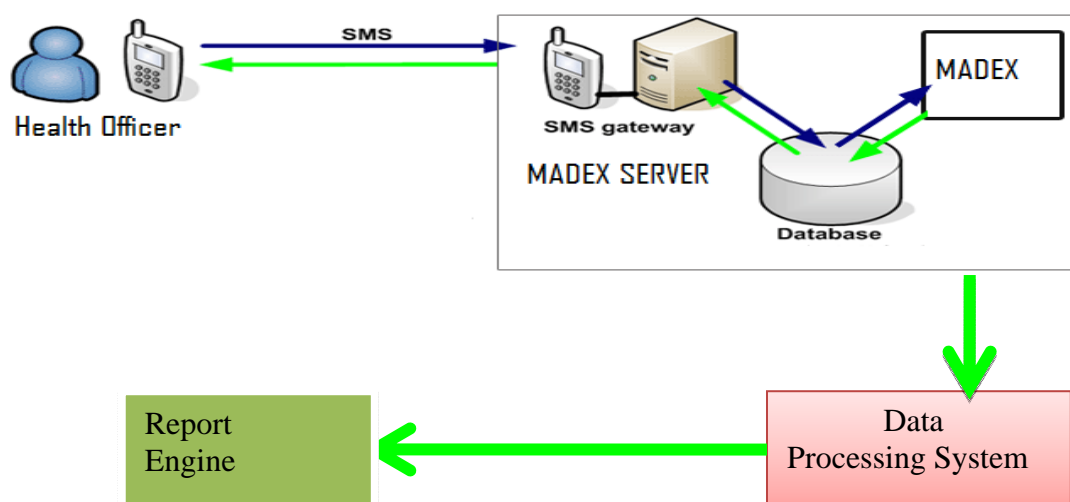


Figure 5 Overview of the Mobile Phone-Based Health Information System (Adapted from the NPHCDA Report)

At this point, it is worth mentioning that this new system did not replace the pre-existing process of manually reporting data. As revealed by our interviews with staff at various health facilities, in addition to them capturing data manually and entering it into the HMIS register, they also had to support the new m-HIS by being responsible for entering data into the MSS forms before also entering it on the MSS MADEX phone. Hence these officers were supporting this new m-HIS while at the same time managing the existing paper-based system by capturing similar MNCH data alongside other health data and entering it by hand into the HMIS registers and sending it up the healthcare hierarchy manually.

5. CASE ANALYSIS

This section presents key findings which centre on the experiences, views and attitude of different actors towards the introduction and use of a m-HIS. These suggest that the introduction and use of mobiles in this health system brought about efficiency in the process of reporting and analysing key MNCH data. It was noted that initially, officers from the various health facilities across the country reported data to the central office as was required of them. Hence, one of the key goals of the system, to improve the timeliness of the data reported to the health officers at the central office, was achieved. Also at the initial stage, the overall reporting rate was said to be about 90% to 95%. As a result, information on MNCH

indicators was available for health planners to have a clear picture of how different geopolitical zones or states were performing in terms of improvement in maternal health. For example an ICT personnel based in the operations centre of the NPHCDA noted:

“Mobile phones have greatly enhanced the process of accessing maternal health information across the country. The use of mobile phones to report data is cost effective. It also makes analysis and representation of this data in charts and table format quick and easy...”

While another ICT personnel based in the operations centre of the NPHCDA in Abuja had this to say:

“It is very difficult to manage data in a manual HIS... In order to get useful information we have to comb through lots of papers which can be time consuming and prone to lots of errors. By introducing this m-HIS, health facilities workers can now share data on key indicators and stock levels with us at the national office. In turn, we can easily analyse this information and share it as well with stakeholders. For example, we use them at state governor’s forums or share them with strategic partners to monitor progress in the fight against maternal and child deaths”.

The benefits realised were short lived, as after barely two years of using this system a number of things started to go wrong which could be attributed to the issues detailed in the following sections.

5.1 Limited Involvement of Users, A Lack of Incentive and Financial Support

Although they were identified as the key users of the application, during the first phase of this effort, the designated officers in the health facilities responsible for capturing and reporting key MNCH data had not been adequately involved in the various phases of this effort. The findings suggest that in part, this had to do with the strong top-down manner in which this technological change effort was introduced.

In almost every interview with officers at the health facilities, they maintained that although they were provided with training on how to capture and report data using mobiles, there had been no prior consultation with them by the project management team regarding taking on this new role and additional responsibility or even the vision surrounding this new way of working. Interview findings also made it clear that this group of users had very little if no real influence on how this new system was introduced or even used.

Additionally, they had little or no motivation as the financial incentives promised to them at the onset for taking on this additional role were never made available to them. Further, to be able to report this data monthly by SMS, stipends were supposed to be made available to buy air-time to recharge the phone and send the information monthly. Sadly, the majority of the officers interviewed said this stipend was either irregular or non-existent. This meant that in the absence of any stipends, sometimes they had to use their own personal money for the cost of sending the data by SMS. Even though the cost to send the information by text was quite little, that they had to use their money to do this was not motivating. Consequently, with no motivation, incentives and no clear vision of the long term benefits of this new system, the majority of officers responsible for reporting data at the facilities expressed their lack of interest in this new system implicitly. For instance, by not sending their reports on time.

Below are excerpts of what some of the health officers at the facilities had to say:

“Those at the national level who receive this data are not connecting with us. There is no proper communication... It should not just be about us sending the information. We need to see results also... Before this new system was introduced, no one consulted with us, or even asked for our opinion. ... We would have liked a forum to share ideas and also understand the vision of this new system and the new role we would play.”

“I know my report for the month is overdue. But I do not have the phone here with me at the facility, it is at home..... But I will bring it so we can report the information.”

“...We have now been given additional work of collecting and reporting this information.... Nobody said take something oh (meaning incentive) for this additional work we want you to do. It would have been nice to receive something”.

5.2 Material Attributes of the Technology

Possibly the strongest benefit of this handheld computing device is its attribute of being portable/mobile. Unlike traditional computing devices such as desktop computers which cannot be easily carried about and used anywhere, the portability of mobile devices has been praised as being beneficial particularly when used in contexts where quick response times in communicating information is crucial. However, within the context of this study, this attribute had a negative influence on the success of this system. Interview findings highlighted that a major issue experienced as part of this effort was the high frequency with which the MADEX phones were lost or misplaced by users because of its mobile nature. In the majority of facilities visited while conducting this study, the phones were not on the premises as they were either misplaced or were said to be at home (i.e. of the officer in charge). For those facilities that had reported their phones lost, it was almost impossible to get it replaced because the registration of each of the mobile phones to the backend system of MADEX 1.0 was a quite rigid and did not take into account this kind of issue. The following excerpt is from what one of the data management personnel based in the NPHCDA office in Abuja said about this:

“At some facilities, the signal (network coverage) received on the phone is very weak. The officers in the health facilities made us understand that at such times, for them to send us their monthly report, they have to place the phone high up on a tree to be able to get signal. Because this is a regular practice, the probability of the phone going missing is high. This is one of the reasons we get when we ask how the phones got misplaced”.

5.3 Infrastructural and Technical Issues

Infrastructural limitations such as software and hardware problem with the MADEX technology as well as telecommunication network issues influenced the process of successfully reporting data with this m-HIS. Some of the technical issues such as unreliable telecommunications connectivity relating to poor service at the time by providers of GSM in the country and poor network reception affected the regular reporting of data. Additionally, some limitations of MADEX 1.0 contributed to data anomalies and fragmentation in the reporting of data. Some of these issues include limitations of supporting no more than 160

SMS characters, complexity involved in generating reports from the backend system, inability to replace lost phones owing to the rigidity of the technique used in registering the phones to the server and local server problems.

One of the IT personnel for Dabarobjects commented:

"Like any new system, MADEX 1.0 has its challenges and we are working hard with staff at the agency to find solutions to these challenges".

Additionally, interview findings showed that in addition to areas where telecommunication connectivity was poor, there were areas particularly in northern Nigeria where reporting data was impossible. Political problems in this area resulted in the shutdown of the telecommunications network making it impossible to report data via the m-HIS to the central office at the agency. This was a situation that was not anticipated and one where little or nothing could be done. A management personnel at the national office of the NPHCDA said:

"Due to the political unrest in some of the northern states as you must be aware (to interviewer), protesters have burnt down some telecommunication infrastructures, and the government has shut down all telecommunication in the state until further notice. Because of this, data is not being reported from facilities in those areas and this is a problem..."

5.4 Organisational Culture Issues

The non-existent culture of using technology as part of work practices in this organisational setting in some ways influenced the motivation of primary health officers to not participate actively in this system. The use of technology to facilitate access to health information particularly at the primary level did not fit with the organisational beliefs and existing norms of this organisational setting. As mentioned earlier, in the Nigerian health care system handling of health data particularly at the primary level is predominantly done the 'paper way'. Therefore to gain the interests of primary healthcare officers to use a simple technology such as mobiles as part of their work practices, an important step to take would have been to sensitize them to work in this way. However, from the interviews, while it was apparent that the project management team had a clear vision that involvement of these officers at health facilities was paramount to the success of this new system, there was no sign that they had made efforts to manage the technological change process taking place.

5.5 The Existence of 'Competing Information Systems'

The existence of both a functional manual system, as well as a web-based national health information system alongside this new m-HIS was shown to influence this new system. As the interviews indicated, at sub-national levels, the officers at the primary health facility (key users of the mobile application) were expected to enter health data into the HMIS register, which is the existing manual system. In addition, they had to enter the same data both manually and electronically to support another HIS known as the district health information system (DHIS). The DHIS is a national health management information system recently adopted by the Nigerian government for the management of health data. Although it has not been fully rolled out to all primary health facilities, in most of the facilities where it is functional health facility officers found it very cumbersome to support data entry into - this DHIS system, the existing manual system as well as this new m-HIS supporting the MSS. This is what one of the officer's at the primary health facility said:

“We are supporting three (3) different health information systems... It is a lot of work to enter similar data for all three of them... and we don't get any stipend from the MSS to encourage us for this huge amount of work we are doing.”

Similarly, at the national level, interview findings revealed that the existence of the DHIS alongside this new m-HIS created a bias among some management and senior officers. While some management and senior officers showed support for the new m-HIS others were not keen on it as they preferred the DHIS system to the new system for various reasons some political, financial and also some relating to usability issues. Consequently, this influences the commitment and support at the national level towards this new system.

5.6 A Lack of Demonstrable Benefit by the New System

A major theme identified in the interviews was the primary health officers' unfamiliarity with the direct usefulness of this new m-HIS. Interview findings revealed that this new m-HIS was highly data driven with heavy focus on upward reporting of this data to meet the needs of the bureaucracy. Primary health officers expressed their interest in having some form of feedback which they can use to support local action. For instance a health officer at one of the facilities explained:

“I don't seem to understand why we are now using mobile phones. They just told us to use it and send them (those at the central office of the NPHCDA) information but I don't know the gain for us here in this community... You see, most times, we run out of supplies (delivery kits, medications, etc.) which make our work difficult. I would like a situation where for example we can send messages to say that some of our supplies will soon finish and they can act on that information quickly...If something like that can happen, it will be very good and it will really help us here.”

For this user group, their interest and motivation regarding this new system began to diminish as there wasn't much evidence of its impact especially at the local level of operation. Being constrained by all these issues, this new system started to experience poor reporting rates as reports from primary health facilities were irregular and untimely and in extreme case there was no submission of data at all from facilities. Finally, data anomalies were rampant resulting in reduced data quality.

With the system failing in terms of meeting its objectives, the programme management team reached a decision to suspend the project. This new health information network consisting of the MADEX 1.0 technology, primary health facility officers etc. was disbanded. During this time, the decision was taken to reform the information network which took about 5 months. In an effort to reform the network, various changes were made including: the upgrade of MADEX, changing the handheld device from basic Nokia phones to a portable android tablet, the de-enrolment of primary health facility officers as data reporting officers and the enrolment of monitoring and evaluation (M&E) officers in the local government office to take over the role of data reporting.

After the 5 months period, the new network was put together and ready to continue its operations. This time, the agency purchased about 250 android phones and installed an upgraded version of the MADEX tool i.e. 2.0 and distributed it to the M&E officers in the local government. Each officer is in charge of four (4) primary health facilities and each was provided with training at the beginning to enable them to perform the given tasks. Their key

responsibility was to get data on the key MNCH indicators from these four facilities and to use the android device to report this data upward to the national level, as in the previous system. The rationale to use M&E officers to perform this task was: first, they are trained in the handling of health data and so would do a better job at capturing quality data; second, because of the high cost of the android phones, it would be very expensive to give one to each facility health officer to use. As pointed out earlier, MADEX 1.0 was upgraded to 2.0 and this new version addresses most of the technical issues faced. For instance, this improved version alongside the android tablets offered more flexibility in terms of registering the device to the central database so that in the event of it being lost and stolen it can be easily replaced. Also the issue of 160 character limitation was addressed as this improved version offered improved memory and storage and faster processing of data, etc. With respect to the use of android tablets, the screen size was better leading to better user interaction, while they have increased functionality and larger memory size compared to the Nokia phones used previously.

At this point, while this new network addressed the technical issues earlier faced, little consideration was paid to non-technical influences. Hence being constrained by these influences, about 8 months into this new network, it has started to face the same problems such as irregular and untimely reporting resulting in a data reporting rate of well below 50%. Apparently, data such as this is less useful for any monitoring or planning effort.

Interview findings suggests that this time, non-technical influences were responsible for this breakdown in the reformed mobile health information system. Two key themes that emerged in this new phase of this effort are: i) what can be described as poor financial integrity and b) poor political commitment. The term poor financial integrity implies that while the government seems to openly profess its commitment to this effort, both nationally and internationally, it has failed to back that commitment with the necessary funding required for this effort to be fully operational. For instance the reporting of information by M&E officers is dependent on a) stipends in the form of travel allowances to visit the respective 4 facilities under their care to capture the data which will be reported on the device and b) the stipend required to re-charge the mobile device with airtime to be able to report this data. Consequently, as revealed by interview findings, apart from the stipend provided at the point of training the majority of the M&E officers said that they have not been provided with stipends to enable them travel out to the facilities under their care to collect data or even to recharge the device to be able to report the data. As a result of this, reporting of data has fallen drastically.

Interview findings further highlighted other areas that have been affected by financing and they include an inability to provide follow up training for M&E officers in the field and the inability to address any post-implementation issues faced by users. For example, field visits showed that some of the android devices have problems such as cracked screens, etc., or are faulty and as a result are not being used to report data. Again because of poor financing which has failed to support post implementation, the funds needed for ICT personnel to travel to the affected local government to resolve this problem so that data reporting can continue is lacking.

However, an interesting finding that emerged during this field visits was that although the M&E officers were instructed to use the device strictly for data reporting purposes, we found some of the officers found other uses for the tablets, for instance to send emails, surf the web etc., did use their own personal money to pay for the airtime as the device was serving some other purpose for them.

For instance, one of the few M&E officer who seemed to be sending her reports regularly said that she used her personal money to buy airtime to send her reports. On probing further, it was discovered that she had found other uses for the device which was

beneficial to her. She went on to explain that she checks BBC news on it every morning and she also downloaded a version of the bible on it allowing her to use it in church on Sundays. This example validates the point that to lock the interest of users into this system, it is important that it presents some form of direct use and benefit.

The second theme identified was that of poor political commitment. At the national level of government this is manifest again in the poor financing of the scheme. Also at sub-national levels, particularly at the state level, interview findings revealed that at the inception of this scheme all 36 state governors signed a memorandum of understanding (MOU) to support this scheme at the state level. Sadly, only a few have honoured this agreement.

With respect to our initial aim of understanding the introduction and use of a mobile supported information systems to contribute to health development efforts, we draw from Heeks (2002a), which states that the contribution of technology such as mobiles to development is in its ability to support the digital processing, communication and management of data for better learning and decision making. Further he states that the specific contribution to decision making arises from the input of information into decisions, which translates into better actions.

From our findings it is evident that while mobiles have the potential to contribute to development, that contribution has been undermined and is being constrained by the presence of strong social influences such as poor political commitment and financial integrity across all levels of government.

6. CONCLUSIONS AND RECOMMENDATIONS

This study has provided a unique opportunity to analyse efforts involving the introduction of mobiles in Nigeria's public health system to address a key development issue i.e. maternal and child mortality. It is unique in the sense that studies focusing on Nigeria are hard to come by in the ICT literature. Additionally, this nationwide effort under study is the first of its kind in Nigeria to adopt an integrated approach in using mobiles for public service delivery on a large scale. Consequently, this particular case serves as a platform for mobile health development in Nigeria as the insights gained can be used to improve the on-going delivery of this particular initiative and also help to inform similar efforts in a DC context. Additionally, it builds on Heeks (2002b) finding about the lack of insights into socio-technical influences as the major cause of problems for ICT initiatives in DC and the need for more studies that illustrate these.

The insight from this study specifically, adds to the body of knowledge on the potential role of mobile-supported HIS particularly within the SSA region and its role in contributing to development in the area of health. It achieves this by: 1) providing an empirically based understanding of the process of introducing and using mobiles - not as a 'standalone' technology but as part of an integrated health information infrastructure in a DC context and 2) underlining issues that need to be taken into account to ensure success when introducing a m-HIS.

The findings of this study show that mobiles can contribute to development efforts in terms of bringing efficiency to the process of communicating and handling information. This information constitutes knowledge that is vital and can be used for public health management in DC and in the monitoring of the health related-MDGs. Also, further reflection on the results presented in this study draws attention to a key point which is, as the application of mobiles in development effort continues to rise, implementers of such effort should bear in mind that it is not simply about getting the technology right. Getting the technology right is only one aspect as other non-technical influences can also impact on this process in various ways resulting in undesirable outcomes. Therefore this paper recommends that stakeholders seeking to successfully exploit mobiles in various areas of development activities should be

aware that such processes even for a simple technology like mobiles are very much socio-technical in nature. Thus, critical social elements should not be overlooked but, as suggested by Heeks (2002b), adequate consideration should be paid to them as well.

In this case, the issue of poor political commitment and financial integrity have been identified as key influencing factors in this new system. Therefore we advise that all level of government act with integrity, keeping to promises or policies such as releasing funds as and when they are due or honouring the conditions of the MOU signed.

More generally, this study highlights less specific issues experienced during this process. In doing so, it echoes some of the issues identified in previous IS studies that are faced when introducing more traditional forms of ICTs, such as poor user involvement and communication during such processes etc. However it does highlight a peculiar issue arising from the material property of mobile phones which programme managers should be aware of i.e. its ability to be misplaced easily. Another critical insight this study provides is the focus of this new m-HIS on reporting data upward to the national level to meet the needs of the bureaucracy with very little usefulness for it at sub-national level. We argue that increasing the usage of this technology through finding uses for it arising from its material property can increase the interest and motivation of users. As the technology is put to use more often and serves a useful purpose it is more likely to be kept in sight and guarded closely. Additionally, because it is serving some important purpose the attitude of users when handling it is likely to be different.

We conclude by acknowledging that with a reporting rate of below 50%, the quality of data and information this m-HIS is producing can be described as being poor. As such, currently, it cannot contribute to proper monitoring or any meaningful or useful decision making or action on maternal and child health issues in Nigeria. However, we choose to describe this case neither as a success nor failure. Rather, we acknowledge that it is dynamic and as such it remains ongoing for the time being (there is some uncertainty around its continuity after 2015 which is the end of the MDG and also about the time the grant may run out); and we still hope to see improvements in terms of its outcome.

On a final note, as the future is becoming increasingly dependent on this pervasive technology because of its relevance in a DC context and how it matters generally in everyday life, we contend, this area of research should also matter for information system researchers, particularly those with an interest in the area of ICTs development. Therefore we recommend more studies on mobile-supported information systems in DC context be carried out to increase insights available to researchers and practitioners in this area.

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