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Challenges in Implementing a Computerized Name-based Information Tracking System: Practical Experiences from Maternal Health Care

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Abstract: This paper presents challenges encountered in implementing a computerized name-based system for tracking information of pregnant women and children in rural clinics. Results indicate that the implementation of a computerized name-based system faces potential challenges that include; understanding the complexity of local healthcare practices within the community as well as correlating standardised and improvised data collection tools used in health facilities. Other challenges are; application of localised and standardised procedures in healthcare provision, replacing the paper-based system and lastly gradual learning curve during the implementation. These are initial findings drawn from a qualitative research study conducted in the Coastal region of Tanzania. This study intends to improve data reporting and utilisation of health facility services for pregnant women, children and other key community members.

Key Words: Maternal healthcare system, computerised systems, name-based systems, health information systems, implementation, developing countries

1. Introduction

The implementation of computerized Information Systems (IS) in organizations adds potential in information storing, processing, retrieving, and presenting it more efficiently and effectively [1, 2]. However, the implementation of these systems at the lowest levels of Health Information System (HIS) has to realize practical potentials of communication and

information needs. In their study, Ngoma et al. [3] describe that at the community level, incomplete information on maternal health is reported to the health facility levels not because it is not available, but because of weak information links between the community and other organizational hierarchies. Creating an integrated information infrastructure that combine the use of paper-based tools, computers and mobile phones indicate prospects in strengthen these links.

In developing countries, implementation of computerized systems in most cases and specifically in the health domain has been challenging [4-8]. The remarkable challenge faced by implementers and designers of the systems is the complexities of healthcare processes and healthcare cultures. Heeks [4] indicates that, understanding magnitude of the gap between future expectations and the current realities of the system can lead to a successful implementation of health information systems. According to Braa et al. [8], creating flexible standards can help unpacking the complexities.

Name-based systems add another challenge as compared to systems that collect aggregated data. Confidentiality is important and data security is an essential element. The work practices as well are intertwined in the processes of collecting, aggregating and reporting the data [9-11]. It is evidenced that, a deeper understanding of the context where the system will be used, contribute to a better design. Therefore, this study is adding knowledge on practical challenges encountered in implementing a computerized system for maternal healthcare at the lowest levels of HIS in Tanzania. This knowledge can be useful for designers and implementers of similar systems in related context of use.

The organisation of this paper is as follows; objective of the study follows in section 2, research setting is presented in section 3 and the methodology employed in data collection is presented in section 4. Thereafter, the case description is presented in section 5 and lessons learnt in section 6. Conclusion and recommendations are presented in section 7.

2. Objective

This paper aims at presenting lessons learnt from a case of implementing a computerized maternal health system in a rural context. These lessons were learnt from designing and implementation of the system which is intended to improve reporting of mother and child health data from the community level to the health facility level in rural settings. The system is also perceived to improve clinic attendance of pregnant women and children. These will eventually contribute to the improvement of maternal health and reduction of child mortality rate in the country.

3. Research Setting

This research is conducted in Kibaha and Bagamoyo districts in the Coastal region of Tanzania under the Ministry of Health and Social Welfare (MoHSW). In the health management information system, data is collected from communities and health facilities (dispensaries, health centers and hospitals). In the health facilities, health professionals collect patient data while providing healthcare services. Provision of health services in the community is dominant in rural and semi-urban communities in the country. In the community, data is collected by community health workers who are non-medical professionals. Community health workers in this context are village health workers and traditional birth attendants.

Village health workers with the supervision of health facility nurse in-charge provide preventive health services in the community. These include; family planning (educate community and distribute pills and condoms), registration of pregnant women and monitoring their condition until they give birth, registration of new born babies, follow-up

on the growth status and childhood diseases for children under five years of age, mobilization and monitoring immunization status of pregnant women and children, reporting maternal and child deaths to the health facility, and reporting disease outbreaks.

Traditional birth attendants provide delivery services in the community. In addition to provision of delivery services, traditional birth attendants register babies at birth. They also mobilize mothers to take their babies to health facilities for immunization. Trained traditional birth attendants are supervised by a traditional birth attendant coordinator at the district level.

4. Data Collection

This is a qualitative research study where data was collected through interviews, observations, attending trainings and meetings, document reviews and software testing. The qualitative method was chosen because it gives a strong grounding on understanding people from their own perspectives [12]. We needed to understand the context so we can develop a system that will support the current work practices.

Interviews were conducted between January 2010 and March 2011 with six village health workers, seven traditional birth attendants, ten health facility workers and three district health managers. These interviews went hand in hand with observations. The objective of interviewing village health workers and traditional birth attendants was to understand how they collected and recorded maternal health data and where it was reported. Health facility workers were interviewed with the objective of understanding their work practices in recording data on different clinic visits and management of these visits, what data collection tools they used, and procedures employed in retrieving information for follow-up and provision of care. These practices were studied before and after the implementation of the system. The objective of interviewing district health managers was to assess procedures they used in designing register books and report forms, and providing feedback and supervision to the health facility and community health workers. Another objective was to investigate what they learnt from this pilot study and how they will apply this knowledge.

We also attended training and participants and conducted training as trainers where we were involved in different discussions that gave us an understanding of the context and the design of the system. We participated in training sessions where district health managers provided training to village health workers and traditional birth attendants. In these sessions we were contributing our views. We also conducted training with health facility workers on using the name-based maternal health system. The aim of this training session was to familiarize health facility workers with the system and to evaluate the design of interfaces and flow of activities in the system. From this training we gained knowledge on redesigning the interface and reorganising the flow of activities in the system.

This study was also involved in several meetings with village health workers, traditional birth attendants, district officials and health facility workers. In these meetings we engaged in several discussions with the aim of understanding the context and what and how to translate it into the design of the system.

Documents reviewed include data collection registers, clinic cards and report forms. Registers ranged from old to new registers, whereby the initial design of the system was based on the old registers which were later revised and started to be piloted in January 2011. We also reviewed locally improvised registers that were not standardized but were created by health facility workers to be used locally in their health facility. Pregnant women and children clinic cards were also reviewed. These cards contained personal information that the clients (women and children) moved with them and no other similar record was kept in the health facility. We also reviewed monthly and quarterly reports generated at the health

facility to be sent upwards to the district level and other reports created by health facility workers for local utilization of data.

Data was also collected during system testing in the pilot site. In this site, a computerized system had never before been implemented to be used by health facility workers. This was the first time for some health facility workers to use a computer and for all health facility workers it was their first time to use a computer in daily activities as part of the procedure. While health facility workers were experimenting with the system, all the strengths, shortcomings and overlooked requirements were noted.

Furthermore, through research collaboration with different stakeholders, we have been able to gather information on experiences in developing and implementing similar systems from other local and global stakeholders. These include the HISP network (Malawi, Guinea Bissau, Ghana, Vietnam, India, Kenya, Norway), OpenMRS (Malawi), DTree (Tanzania) and ITIDO (Tanzania). We also utilised research results from Masters students [13] engaged in different aspects of the project.

5. Case Description

This study is part of the global network for HIS research and development, Health Information System Programme (HISP). HISP started in South Africa in 1994 and thereafter it was extended to other developing countries such as Ethiopia, Vietnam, India, Botswana, Tanzania, Malawi, Nigeria and counting. In all the countries, the primary goal of HISP is to design, implement, and sustain HIS to support local management of health care delivery and information flows [14]. In Tanzania, HISP started in 2002, since then it has undertaken a number of activities such as standardization of data sets, redesigning of data formats and standards, adaptation of a District Health Information Software Version 2 (DHIS2) software standard, and institutionalization of these standards at different levels of the health system. DHIS2 is free and open software which is generic and once adapted; it is tailored to fit local requirements. For further details please visit: www.dhis2.org.

In Tanzania, DHIS2 operates from the district level, upward to the regions and to the ministry level. At the district level, aggregated data reported in paper based reports from health facilities are entered into the system where they are analysed and further aggregated. From the districts, data is sent electronically to regions and further to the Ministry. So far DHIS2 is operational in all districts of Coast, Lindi, and Mtwara regions in Tanzania.

With the current need of meeting the Millennium Development Goals (MDGs), especially goal number four (Reduce Child Mortality) and five (Improve Maternal Health), an emerging need arose to bridge the gap between the community (informal HIS) and the formal HIS so as to support complete and accurate data collection in remote communities and timely reporting to health facilities and further to the district. One of the obvious initiatives was to extend the use of DHIS2 to the health facility level where data collected in the communities which is name-based data (not aggregated) will be captured. A generic module Name-bases Information Tracking System (NBITS) was developed for this purpose.

NBITS can be used for case-monitoring, reporting and planning. As a case-monitoring tool, NBITS can be used to support timely service delivery and monitoring of individual case/client. This functionality is also extended to be used by a mobile phone client. As a reporting tool, NBITS enables aggregation of individual case data and import it into district based HMIS (DHIS). NBITS can also enable planning of activities (weekly, monthly) for community outreach activities. NBITS has been adapted in several countries for different purposes; in Malawi, India and Vietnam for monitoring and following-up service delivery to pregnant women and children. In Guinea Bissau, NBITS is used for monitoring and following-up service delivery to pregnant women, children and TB patients. In Ghana,

NBITS is used for monitoring and following-up service delivery to pregnant women, children and TB patients and in Kenya for death registration.

The implementation of NBITS was first done in India with an objective of supporting routine health facility reporting by involving community health workers in sending reports from the community using mobile phones. They capture information on pregnant women and immunised children while providing the services and send it to the health facilities.

The implementation in Tanzania is targeting monitoring and following-up service delivery to pregnant women and children. Pregnant women are registered and their information is monitored throughout the ante-natal care visits (ANC), during delivery and 42 days after delivery in post-natal care visits (PNC). Children are registered from when they are born and their health status is monitored until they are 5 years of age with the emphasis on immunization and growth assessment. The system registers and makes a complete service delivery and follow-up on all visits to the health facility. The system also sends Short Message Service (SMS) to women and key person(s) around pregnant women and children to remind them on their next clinic visit and give emphasis on health education given. Furthermore, the system aggregates data in different intervals to produce reports such as monthly, quarterly and annual reports. Further research is continuing to extend the functionality of the system to incorporate the use of mobile phone to collect data from the community level and send it to the database. Figure 1 depicts a pictorial illustration of the flow of activities in the system.

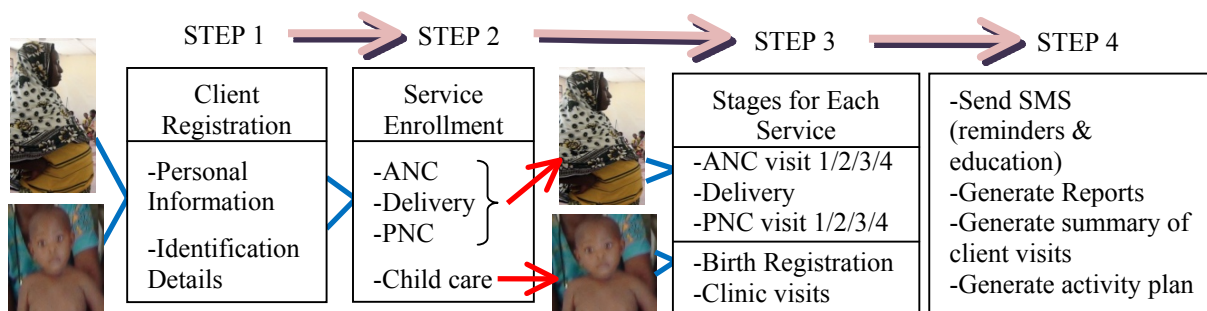


Figure 1: Flow of Activities in the maternal health care system

This is a pilot implementation where the system is installed in one health centre and it is used in parallel with the current paper-based system. In the pilot site data is entered by health facility workers after their working hours and not on direct encounters with their clients. The system can operate at the point of service delivery, however it is not used so because of the current work practice whereby they record on paper-based registers. And with a high number of clients, recording both on paper and on computer can compromise provision of the health services. Data are entered into the computer system from one week to one month after the provision of the service.

In this pilot site we are in a process of collecting more requirements while experimenting with the system in real-life working environment. The system has been operating in this health facility since March 2011. We are planning to extend the pilot to one rural health facility so as to collect and understand the requirements from different settings. Further research is also continuing to explore the potentials of scaling the use of the maternal health system for supporting data collection, and provision of services such in Prevention of Mother to Child Transmission (PMTCT) clinics, Care and Treatment Centers (CTC) clinics and TB clinics. This is perceived to facilitate data flows, sharing and reporting between different clinics attended by pregnant women and children.

6. Lessons Learnt

In the process of requirements determination, customization, training and testing the name-based Information Tracking System for maternal health, the encountered challenges are presented in this section as lessons learnt.

6.1. Complex local practices at the community level

In most developing countries, community based systems collect and report data on individuals. This information can loosely be called patient-based, however un-standardised it is. When it comes to implementing computerized patient-based system, there is a need of understanding what data is collected at the community level and procedures therein.

In this study, it was challenging to get hold of community health workers because they operate in an informal sector and they do not have an office where they can be met. Also the informal ways of conducting their activities became difficult to be captured and translated into the design of an automated computerized or mobile phone system.

However this has been possible through the involvement of district officials who were willing to introduce us to the village government head and health facility in-charge in the village. After they understood our intentions, the village head and health facility in-charge arranged a meeting where the village health workers and traditional birth attendants were invited. From that meeting, we started learning from them on what data they collected regarding mother and child health, and how they processed, reported and utilised it.

6.2. Catering for Standardized and Improvised tools

At the health facility level, data are collected using standardized paper-based system. Due to the dynamic nature of HISs, data requirements keep on changing and in most cases new data collection requirements are not specified in the standardized registers in use. In these cases health facility workers create their own improvised registers that capture new requirements so they can collect the additional data and aggregate it and report it upwards as needed. While trying to understand what data is collected it became important to review both standardized and improvised registers.

In this study, the design of the system included data collected both on standardised and improvised registers. Inspired by health facility workers, we drew a balance by including the data that was needed to be reported upwards and that was needed for local utilisation. Figure 2 presents a sample of screenshot for data entry.

Program Stages History/Plan

- ANC Registration Stage Scheduled For 2011
- ANC First Visit Scheduled For 2011
- ANC Second Visit Scheduled For 2011
- ANC Third Visit Scheduled For 2011
- ANC Fourth Visit Scheduled For 2011

Full Name: _____
 Gender: F
 Date of Birth: 1991-07-08
 Age: (20 yr)

Program: Antenatal Program
 Program Stage: ANC Second Visit
 Complete data entry Validation Use def

Due Date: 2011-06-03 Report Date: 2011-06-01

| REKODI YA MAHUDHURIO | | | | |
|-----------------------|--------------------|------------------|------------------|-----------------|
| | Hudhuria la Kwanza | Hudhuria la Pili | Hudhuria la Tatu | Hudhuria la Nne |
| Tarehe ya Vipimo | 2011-04-04 | 2011-06-05 | | |
| Uzito (Kg) | 78 | 80 | | |
| Blood Pressure (mmHg) | 90/70 | 147/80 | | |

Provided by: _____
 Program stage

Figure 2: Data entry Screenshot

Similarly the design of computerized system to be used in this context needs to be flexible in such a way that, new requirements can be taken on board with a minimum involvement in changing the code structure of the system. These changes need to be done at the local level by health facility workers with minimum effort.

6.3. Balance between Localized and Standardized work practices

Provision of maternal health services in Tanzania follows standardized procedures set by the MoHSW. For example pregnant women attend four ANC visits and four PNC visits. In reality however, the arrangements of the intervals between visits and services to be provided follow localized procedures. For example the procedures for arranging clinic visits and immunization schedules are locally defined depending on the activities of health facility workers.

The local arrangements, which reflected the daily work practices posed a challenge in the system design because the systems needed to capture the lived practices without compromising the standardized procedures. In addressing this challenge, the flexible design of the system was the answer where health facility workers could adjust dates for clinic visits depending on their plans on provision of the health services.

6.4. Replacing the paper-based system

Health facility workers are required by the MoHSW to use paper-based registers for data collection, storing, and data reporting to higher levels. Introducing a computer-based system as a pilot implementation, the two systems needed to operate in parallel. The health facility workers are already overworked with a high number of clients to attend to. The computer system increased their workload, however important it is to test the requirements for the computer system.

To motivate the computerized system to be used, the feature provided by the system such as report aggregation and generation of summary report on client visits have been encouraging them to use the system. To be able to generate ready made aggregated reports which took them days to make one, they found it useful to enter the data for this purpose. The system also provides colourful reports on status of visit of each client, with these reports they can make a thorough follow-up on missed visits. Figure 3 presents an example of a report on summary of visits.

| Full Name | ANC Registration Stage | ANC First Visit | ANC Second Visit | ANC Third Visit | ANC Fourth Vis |
|-------------|------------------------|-----------------|------------------|-----------------|----------------|
| N | 2011-04-03 | 2011-04-03 | 2011-04-03 | 2011-08-01 | 2011-10-03 |
| i | 2011-05-02 | 2011-05-02 | 2011-06-27 | 2011-08-22 | 2011-10-17 |
| N | 2011-06-01 | 2011-06-01 | 2011-07-27 | 2011-09-21 | 2011-11-16 |
| At | 2011-07-01 | 2011-07-01 | 2011-08-26 | 2011-10-21 | 2011-12-16 |
| C | 2011-08-01 | 2011-08-01 | 2011-09-26 | 2011-11-21 | 2012-01-16 |
| h | 2012-04-26 | 2012-04-26 | 2012-06-21 | 2012-08-16 | 2012-10-11 |
| V | 2012-05-27 | 2012-05-27 | 2012-07-22 | 2012-09-16 | 2012-11-11 |
| J | 2011-12-26 | 2011-12-26 | 2012-02-20 | 2012-04-16 | 2012-06-11 |
| E | 2012-06-27 | 2012-06-27 | 2012-08-22 | 2012-10-17 | 2012-12-12 |
| Log summary | 2012-05-27 | 2012-05-27 | 2012-07-22 | 2012-09-16 | 2012-11-11 |

Figure 3: Sample report of summary of visits

6.5. *Gradual user learning curve during implementation*

Implementing a computer-based system at a health facility level in a rural setting has never been done in Tanzania with exception of a few cases. Health facility workers at this level have never used a computer let alone integrate it in their daily activities of service provision. Together with the impossible practicalities of using a computer at the point of service provision, the implementation of maternal health system in this study focused on using the system after working hours.

Health facility workers need more time to get used to the idea of using computer and then it will be easier for them to integrate it in their daily practices. This study found out that the learning curve in using the maternal health system in this context is gradual. But the health facility workers are eager to take advantage of what the system can offer and even more features that will simplify their work and support them in providing better services.

7. **Conclusion and Recommendations**

In the HIS, mother and child health data comprises above 60% of all routine data. Managing these data incorporate complex procedures starting from data collection, analysis, and reporting across the organizational hierarchy. In addition, the context of use is complex in nature due to large number of clients both women and children attending the health facilities on daily basis as compared to a small number of available health facility staff. The capacity of health facility staff to manage data process and provide healthcare becomes inefficient.

Designing and implementing computerized systems to operate in this setting and become sustainable over time, this study underscores the importance of profound understanding the context. This understanding can help in creating flexible standards [8] and reducing the gap between system realities and future design expectations [4]. Flexibility is needed to accommodate changing requirements (both planned and unplanned) in data collection, processing and reporting. The knowledge about the current lived experiences of health workers will determine how the expected future practices should be modelled. This study has revealed that informal practices and improvised data collection tools are important components to be incorporated in designing and implementing computerised name-based systems.

Therefore, from our experience of designing and implementing a maternal health name-based information tracking system, this study recommends system designers and implementers to:

- Acquire a deeper understanding of the real life work practices of health workers at community and health facility levels on how they organise and manage data collection, recording and provision of healthcare services while adhering to standardised (formal) and localised (informal) procedures.
- Find a compromise between improvised and standardised data collection tools in designing data entry forms. Findings indicate that, improvised data collection tools reflect on the daily practices better than standardised data collection tools.

Working around the challenge of gradual learning in a complex context of use is still an empirical question. Further research is needed in this area. Furthermore, while the pilot study is operating in parallel with the paper-based system, understanding the full potentials of using a computerized system at the point of service delivery is yet another challenge that this study is trying to address.

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