Designing and Implementing Hospital Management Information Systems in Developing Countries: Case Studies from Tanzania – Zanzibar

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Abstract:

Research and development projects have shown the need for strengthening hospital management information systems (HMIS) [1][2], but this has proven a difficult task, especially in developing countries [3][4][5]. The hospitals in Zanzibar have experienced problems in collecting and managing health care data due to fragmented structures and lack of standardisation. This paper analyses an on-going participatory design effort involving computer experts, health workers and hospital mangers in joint development of an integrated health information system the hospitals in Zanzibar. The challenges encountered during the process were related to the negotiation of standardised data collection, the busy schedule of health workers hampering a participatory process, the low level of computer knowledge among the health workers, the difficulties of getting correct data from the lower level's register books, and the continuous process of establishing a culture of information use. Key lessons learned from this case study are the need to provide sufficient time to implement HIS in this context due to the difficulty of health workers and mangers to understand the logics of a computerised information system, which is needed to take full advantage of the technology. A long-term mutual training process where technical and medical/managerial personnel work together on improving information use is proposed to overcome this challenge.

Keywords: Action research, Participatory design, Hospital Management Information System (HMIS), integration, data management, Health Information Systems Programme (HISP).

INTRODUCTION

Appropriate information and Health Information Systems (HIS) are seen as crucial to strengthen the health system in developing countries [1] and in pursuing the MDGs [2]. On the ground, however, HIS and especially hospital information systems development in developing countries has proven difficult due to organisational complexity [3], fragmented and uncoordinated organisational structures all maintaining their own HIS [4], and unrealistic ambitions [5].

Zanzibar, the focus of this paper, has one referral hospital, three district hospitals and four Cottage hospitals which provide both outpatient and inpatient services. These hospitals have experienced problems in collecting and managing its health care data. Given the resources situation in Tanzania-Zanzibar and in Africa in general, it is important to find a simple, inexpensive but an efficient and effective way for hospital data management and use.

This paper reports from in-progress research conducted in Zanzibar. The research is part of a project known as the Health Information Systems Programme (HISP) that uses Action research and Participatory design approaches towards designing and implementing health information systems (HIS). With its origin in South Africa, HISP aims at strengthening and further developing HMIS in public health in an expanding network of developing countries including Mozambique, Malawi, Tanzania (mainland and Zanzibar), Ethiopia, Botswana, India and Vietnam [6]. Along with strategies for addressing the problems of fragmentation and multiple data standards, HISP has developed a District Health Information Software (DHIS) for collecting, processing and analysing routine health information. The DHIS is open source software and can easily be customized according to a specific setting's requirements. This paper presents HISP experiences in Zanzibar so far and discusses how the challenges encountered were addressed in the continuation of the development process. The authors are part of the HISP team in Zanzibar and some of them have experiences from working with HISP in other countries.

The rest of this paper is structured as follows; the next chapter provides background information on HIS in developing countries and outlines a strategy for designing such systems. Then follows the case study and its analysis, and finally the concluding remarks summarises the experiences and useful insights from the case study in Zanzibar.

ACTION RESEARCH, PARICIPATORY DESIGN AND HISP

The action research and participatory approaches used by HISP in Zanzibar and HISP in other countries more generally draws on the Scandinavian tradition where the first projects aimed at empowering workers and their participating unions [7].

The experience from the HISP network has revealed a number of problems and challenges in following participatory approaches in the design and implementation of HISs in developing countries [6][8][9]. Such problems include the need for integrating multiple levels and programs with different needs and plans at the same time follow the national and international standards [6][8]. Furthermore, it has proven to be difficult to apply participatory approaches in a centralized and politically controlled organizational setting like what happened during the HISP work in Cuba [9].

The participatory design and action research applied by HISP in Zanzibar and other countries is targeted at designing routine HISs which collect, report and analyse aggregated (statistical) data on most health care activities within the health care organization [10]. In these systems there tends to be fragmentation between different health programs and services leading to overlaps, gaps and lack of standard definitions for data elements and indicators. As a result of all these factors, the HISs are in general not meeting the basic information needs of health services management at various levels [10]. Furthermore, development of more sophisticated health information systems have proven to be difficult both in developed and developing countries, and a large number of failures are reported [3][11].

The need in the health sector to involve multiple levels and to scale up to cover large areas will involve multiple communities of practice and many organizational units or workplaces [6]. This poses a challenge to the "traditional" participatory design techniques which are emphasizing intense interaction with a restricted number of users. In South Africa this problem was addressed by an informal 'activist' oriented prototyping strategy [8].

The DHIS software - flexible design to enable integration

Very often a computerised HIS is a direct computerisation of the various forms and reporting structures that exists in the paper-based HIS. A result of such an approach is often lack of flexibility to modify the systems when the paper-based equivalent changes or to incorporate new needs like integrating additional programmes or additional indicators arise. Such approaches, which strengthen the existing structures of fragmentation, are typically found in the various health programmes where focus is often on reporting huge amounts of detailed data upwards in the hierarchy to the national level and to donor agencies.

To integrate information at the district level and to provide flexibility to meet the rapidly changing requirements of the health care domain, the DHIS design strategy is based on a more flexible model that goes beyond the typical "computerise the forms"-approach. In stead of computerising the form, the DHIS is computerising every data item or data element in the form independently. By breaking up the form into more fine-grained building blocks of data the software also breaks up the fragmentation the forms represent and provides the possibility of manipulating and presenting data across health programs and forms, a prerequisite for integrated data analysis. This design enables the user to define custom reports, tables and graphs for analysis that are completely independent of the collection forms and can in stead be understood as user-defined assemblies or reconstructions of the data (elements) that was captured using the forms.

A key challenge when integrating HIS from various sources (health programmes, hospital wards and clinics etc.) is how to standardise the data. Following the DHIS design approach outlined above it is the *data elements* and not the forms that need to be standardised, as the forms are only representations of the data elements. When different units (ward/clinic etc.) report the same data, but in different forms, such as through-put (total admissions/discharges/deaths/laying days etc.) data from the hospital wards, the various forms make use of the same data elements. This enables automatic integration of shared data from various sources, and in this case a hospital manager to view the aggregated through-put information for all wards in the hospital. The case study provides more detailed examples of how this design strategy is implemented in the hospitals.

THE CASE OF ZANZIBAR

Zanzibar's HIS

Zanzibar is administratively divided into two islands – Unguja and Pemba which are known as zones. Zones are further divided into districts of which 6 districts are located in Unguja and 4 located in Pemba. In line with on-going Health Sector Reform (HSR 2004 - 2009), the health infrastructure and health care services are provided through three main levels:

1) Primary level comprising of 1st and 2nd line Primary Health Care Units (PHCUs) and Primary Health Care Centres (Cottage Hospitals). Cottage hospitals serve as referral points for the PHCUs.

2) Secondary level consisting of district hospitals serving as referral points for the Cottage hospitals.

3) Tertiary level consisting of one specialized hospital (Mnazi Mmoja Hospital) located in Unguja Island. This hospital provides a full range of specialized services for referred and emergency conditions. It is also the teaching hospital in Zanzibar.

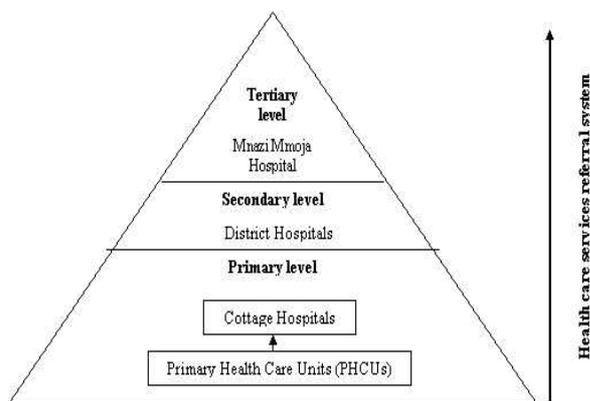Health care services structure can be summarized in figure 1.

Figure 1. Health care delivery system in

The system of collecting information on diseases and related health services at Mnazi Mmoja hospital was introduced in 1968 when the Ministry of Health and Social Welfare established a Statistics Unit in charge of the compilation of all health care data from the clinics and wards.. Being a big hospital with 14 wards and 18 clinics, serving the majority of the population in Zanzibar, Mnazi Mmoja has experienced problems in collecting and managing its health care data. The main problem was lack of standards in reporting from the wards and clinics. Some wards and clinics do collect health data and others do not. Even those who collect data do not have a standardized way of collecting, keeping and reporting those data. In the wards and clinics health workers use hand drawn registers (which are not standardized) to collect daily data on patients and then summarizes the reports at the end of each month and send to the statistics department. The reports prepared ranged from hand written reports to printed forms filled in by health workers whereby the health workers wrote and as a result fluctuations in the spelling of the diagnosis as the spelling depended on the particular health worker who prepared the report in that particular month.

The main problem with HIS at Mnazi Mmoja hospital was lack of standards in reporting from the wards and clinics and therefore no systematic

overview at the hospital level of the basic indicators for management, such as average length of stay, bed occupancy rate and death rate as well as lack of reports on diseases surveillance.

At the primary and secondary levels of health care services provision Cottage hospitals and District hospitals are collecting daily inpatient and clinics data using hand drawn register books with no system of reporting and therefore data is stored in the respective register within a respective ward or clinic.

Participatory process of defining the HIS

In November 2004, the Ministry of Health and Social Welfare in Zanzibar decided to improve the information system within the hospitals (referral hospital, district hospitals and cottage hospital). The decisions to improve these problems embarked on the HISP project which as well is contracted to improve the health management information system in Zanzibar as a whole (i.e. data collection, information flows and use between various health care administrative level – community, health facilities, districts, zones and national levels) .

The design and implementation process which started in June 2005 and still on-going, involves agreeing and establishing a standardized reporting format for data collection, customising various reports and analysis tools for data analysis, customising the DHIS to meet the hospital's information requirements, and extensive training of users.

Practicing user participation, the design process started by identifying health workers (users) from Mnazi Mmoja hospital to work with the designers' team. The users' team consisted of the head of the statistics department and one doctor who is also the assistant head of the hospital. Furthermore the in-charges from different wards and clinics played a major role throughout the design and implementation process.

In agreeing and establishing a standardized reporting format a meeting was conducted a with in-charges from the wards whereby they were informed about the task at hand and asked them to write the suggested data elements (these are mainly diagnosis) with regard to health care services they provide. Then a group discussion was conducted to discuss the data elements identified as well as the structure of the data collection forms. The data collection forms were put in use for one month and then a group discussion between the in-charges and the designers was conducted to review the forms as there were additional data elements as well as some data elements to be eliminated from the forms. After the first review of the forms, we started to customize the DHIS software to include the

identified data elements.

Design for integration and use of information

While the in-charges of each ward participated in defining their own data collection forms, the designers customised the DHIS software so that the data reported by more than one ward or clinic was standardised and made "integratable". The most important data for the hospital management to integrate was the through-put data from the wards. Each ward reports through their own form their total monthly numbers on admissions, discharges, deaths and laying days. In the DHIS this through-put data was defined as data elements and then assigned to multiple forms so that all the forms from the wards used the same standardised data elements. Even though this means that the same data element names will be used by multiple forms, the name of the ward reporting the form makes the "data values" unique. Furthermore, the DHIS allows for indicators to be defined as formulas based on the data elements. E.g. the indicator "Average length of stay" was defined as a formula of "Total admissions / (Total discharges + Total deaths)". The indicators "Bed occupancy rate" (bed capacity was also collected as a data element in the system) and "Crude death rate" were defined in a similar manner using the standardised data elements. Given this standard data an indicator set, reports could then be generated providing through-put information for the hospital as a whole or as comparisons of the wards.

ANALYSIS

During the design and implementation process in the Zanzibar hospitals several challenges and obstacles to the proposed approach were encountered, of some of the most significant are outlined in this chapter.

While the approach followed was of the start simple and grow as you learn kind, the managers and in-charges of the hospital saw no need of having a HIS including only subsets of their daily activities. As a result every month health workers added more diagnosis (data elements) to the initially agreed-upon data collection forms. While these changes were technically manageable by the flexible software, increasing the amount of data to be collected most likely means decreasing the quality at the same time. This is especially noticeable in a start-up phase where the data collection process is new and requires training to master.

Despite involvement in expanding the data collection forms, the busy schedule of health workers made it difficult for them to participate fully in the design process. For example, it was not possible to have all the in-charges from the wards and clinics every time group discussions were conducted. Sometimes we had to follow the individual in-charges in their respective wards and clinics while they were attending patients, to have their comments and suggestions about the designed reporting forms.

Although computers are being used for different activities in organizations in developing countries, the majority of people are still computer illiterate [12]. While limited training in DHIS use was sufficient to master data entry, the more advanced data analysis functionality is still difficult to master for the statisticians. This has been one of the factors contributing to the so far limited use of the information collected in the computerised HIS.

The design process focused on the monthly aggregated forms that is reported from the wards to the statistics unit, and did not include the source of information; the daily register books in the wards being used for daily recording of patients' admissions, discharges, deaths and lying days. While the monthly forms followed a standardised design the register books were hand drawn and followed different designs from ward to ward. As a result the numbers reported from the wards in the monthly forms, especially on laying days, were incorrect and inconsistent. This was an important lesson learned that focus must be put on the very source of information, even though that level is not computerised. Standardisation of the register books and training in how to fill in the forms and how to calculate the aggregated values are necessary steps that must be taken before the computerised system can provide quality data. Despite the fact that the computerised system did not "stop" the incorrect data, the generated reports with indicator values (the bed occupancy rate in this case) and graphs made it easier to spot incorrect values and to track the source of the problem.

To day the most challenging task that remains to overcome is to establish routines for active use of information to support decision-making at the hospital. One obvious reason is the fact that it in a developing country context such as Zanzibar, where there is no tradition of having accurate and efficient information systems, takes time to get used to the fact that data is available and that it can be used to inform decisions. It is a long term process to establish such a culture of information use, and it must start with small steps. One major obstacle met when taking those first important steps was the lack of understanding how a computerised HIS works and how it can support management. The understanding of data as in the traditional way of collecting and reporting data using forms goes deep and is hard to change. As explained in previous sections the DHIS allows for the manager

to freely design reports, tables and graphs with the desired data elements and indicators completely independent of the forms used for collection, and this is often necessary to get integrated reports for the hospital. Making use of this flexible and powerful data analysis tool requires a mutual learning process where the designer or technical experts and the hospital managers work together on the data analysis. This step can not be taken alone neither by the technician with lack of hospital managerial skills or by the hospital manger lacking an understanding of what the software can do to support her. Again slowing down the process, the time available for such training, especially at management level is very limited. Despite these challenges, recent developments on working with the annual reports for the hospital have shown some signs of change. The fact that annual reports must be delivered has opened up for some time and place for the software to be used and training sessions organised at the management level. Through generating these important reports in far more advanced ways and more efficiently than previous year's manual work seem to open up the eyes of the management.

CONCLUSION

The described approach to HIS design and implementation is quite demanding when it comes to participation from the users in the design of the system. While the flexible nature of the software and the philosophy of the designers are encouraging user-participation and increased use of information at all levels, this approach must be seen as a long term learning process where progress is made in small steps along the way. Furthermore, the appropriate use of the system demands extensive training and continuous trial to adapt the computerised HIS to the needs of the hospital and to adapt the working routines of the hospital to take advantage of the new system to improve management and ultimately the health care services.

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