Evaluating challenges and opportunities for sustainability of computer-based health information system in Ethiopia: case study from Addis Ababa

Master thesis
60 credits

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October 2007
Evaluating challenges and opportunities for sustainability of computer-based health information system in Ethiopia: case study from Addis Ababa

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This thesis is submitted as partial fulfilment of the requirements of the degree of Master of Science in Information Systems

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Submitted in October 2007
ACKNOWLEDGMENTS

My deepest gratitude must be extended to my main supervisor Prof. Margunn Aanestad for her continuous follow up, guidance, encouragement and confidence building support. She gave me support to each of the difficulties encountered, starting from writing the research proposal to the finalisation of this thesis, filled with sharp intelligence, understanding and humility.

Many thanks to Prof. Sundep Sahay, who has been my second supervisor providing me guidance at important stages of the writing process.

Sincere gratitude must go to HISP international coordinator, namely Prof. Jørn Braa for providing financial support to carry out this study and for opening the opportunity to work on this full fledged international research project.

I am also very grateful to all my instructors at University of Oslo for sharing me worthwhile knowledge and skill that is helpful to deal with today’s knowledge society.

Special appreciation goes to many people at Addis Ababa sub-city health offices, hospitals, health centres and HISP-Ethiopia for willingly providing valuable data for this study and for their kind support in many respects.

I would like to thank Vincent Shaw, Inger Elise Østmo and Honest Kimaro for their encouragement, inspiration and for giving me relevant articles which are helpful to finalise this thesis.

I thank Nigusse Tadesse for commenting on one of my chapters and Louisa Williamson for proof reading my English on two of my chapters. I also thank Violeta Sun for her warm company and caring.

In addition, I would like to express my gratitude to my classmates Mulugeta, Hailu, Seid and Yeshambel for their sense of humour and wonderful company.

I would also like to thank my dear mother for her concern and advice for my academic success and my sisters and brothers for their love and concern.

Shegaw sweetie, my dear husband and my mentor, deepest, warmest and gracious gratitude are forwarded to you for your all rounded support. I thank you for the academic support you provided me, your love, understanding, encouragement and patience.

Oslo, October, 2007
Sofia Lulseghade
Sustainability of computer-based health information systems especially in less-developed countries is crucial because of its importance in empowering health care managers at different levels to provide effective and efficient health care services to the neediest in a resource constrained setting. However, sustainability and adequate use of newly implemented health information systems in the context of developing countries depends up on wide range of context sensitive factors.

The purpose of this study was to investigate the challenges that may exert influence on the sustainability of a computer-based health information system in Ethiopia. Specifically, the study was carried out at different levels of the Addis Ababa health bureau, which is authorized by the central government to manage and administer public health institutions in Addis Ababa, the capital city. The purpose of this study was done as part of a broader Health Information System program (HISP) research initiative in Ethiopia.

The study followed the qualitative research tradition using an interpretive research perspective in order to gain deeper understanding of the health information system in the context it operates. Consequently, data was collected through interviews, observation and documents/artifacts analysis. The empirical data obtained as a result of the qualitative techniques were analyzed using contemporary literatures drawn from the information systems field.

From the empirical data, practical challenges and opportunities for the sustainability have been identified and possible suggestions to overcome the challenges are discussed. The challenges and opportunities for sustainability are multiple and are categorized in terms of (1) human resource related (2) Technological infrastructure related and (3) managerial/organizational related and (4) information related factors. Some of the specific challenges identified include; from a human resource dimension issues such as lack of perception about the connection between information and managerial action, lack of motivation among HIS workers and lack of adequate technical staff; from infrastructure related issues such as emergence of new data elements and reporting forms which are not included in the existing software; from managerial/organizational dimension such as lack of top-level support and lack of data quality controlling mechanisms; from information related dimension issues such as presence of poor quality data due to several factors in the health information system itself.

It is concluded that sustainability of computer-based health information systems is a phenomenon influenced by a multiplicity of factors. These factors exert their influence directly and, or indirectly. It is also noted that sustainability of computer-based health information systems can be improved by understanding and managing possible difficulties and which will eventually contribute to the improvement of health care delivery.
The study also contributed to information system research by emphasizing: how the identified factors can exert influence on sustainability of health information systems.

Key words: Sustainability, Health information system, Evaluation, Developing Countries, Ethiopia
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<th>Description</th>
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<tbody>
<tr>
<td>AACA</td>
<td>Addis Ababa City Administration</td>
</tr>
<tr>
<td>AAHB</td>
<td>Addis Ababa Health Bureau</td>
</tr>
<tr>
<td>AAU</td>
<td>Addis Ababa University</td>
</tr>
<tr>
<td>AU</td>
<td>African Union</td>
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<tr>
<td>CDC</td>
<td>Control of Communicable disease</td>
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<tr>
<td>DHIS</td>
<td>District Health Information System</td>
</tr>
<tr>
<td>ETC</td>
<td>Ethiopian Telecommunication Corporation</td>
</tr>
<tr>
<td>FMoH</td>
<td>Federal Ministry of Health</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>HC</td>
<td>Health Center</td>
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<td>HEWs</td>
<td>Health Extension Workers</td>
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<td>HIS</td>
<td>Health Information System</td>
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<td>HISP</td>
<td>Health Information System Program</td>
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<td>HMIS</td>
<td>Health Management Information System</td>
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<td>HSDP</td>
<td>Health Sector Development Program</td>
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<tr>
<td>MoH</td>
<td>Ministry of Health</td>
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<tr>
<td>NGOs</td>
<td>Non Governmental Organizations</td>
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<tr>
<td>OAU</td>
<td>Organization of African Unity</td>
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<tr>
<td>PMTCT</td>
<td>Prevention of Mother-To-Child Transmission</td>
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<td>RHB</td>
<td>Regional Health Bureau</td>
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<td>RHISs</td>
<td>Routine Health Information Systems</td>
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<td>SHO</td>
<td>Sub-city Health Office</td>
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<td>SNNP</td>
<td>Southern Nations Nationalities and People</td>
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<td>VCT</td>
<td>Voluntary Counseling Testing</td>
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<td>World Health Organization</td>
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1

INTRODUCTION

This thesis investigates the challenges and opportunities for sustainability of the computer-based health information system in developing country setting, Ethiopia. The case study on which this research is based was aimed at understanding various contextual factors that influence sustainability of the computer-based health information system which is currently in use at different levels of the public health care system of the Addis Ababa health bureau. This empirical study also contributes to the expanding literature and discussion on development and implementation of sustainable health information systems in developing countries by examining and emphasizing how the specific factors influence the sustainability of health information systems.

This chapter is organized into seven sections. Section 1.1 presents background information to the issue researched by discussing major issues on: the need for well designed health information systems, the status of existing health information systems in developing countries and the role of Health Information System Program (HISP) network, in the design, development and implementation of health information systems initiatives in developing countries. Section 1.2 describes the research problem that calls for the study. Section 1.3 provides the purpose of the study and the research questions guiding the case study research. Section 1.4 highlights the study context and methodology used. Section 1.5 presents the expected contributions of the study. Section 1.6 describes personal motivation for the study. The last section of this chapter, section 1.7 provides outline of the remaining parts of the thesis.
1.1 Background to the Issue Researched

The importance of health information systems for the health care sector has been identified by international organizations working on global health matters such as WHO, since the establishment of primary health care approach as a strategy to achieve equity in health care worldwide (WHO, 1978 and Sandiford et al, 1992). To achieve this grand vision, it became evident that information is a key input to ensure rational allocation of scarce resources and for arranging priorities in the health care (Sandiford et al, 1992; WHO, 2006). A well established health information system results in information that is relevant and adequate for policy-makers, managers and health practitioners to inform strategic decisions, health services planning and delivery (Azubuike and Ehiri, 1999). Availability and use of such information contributes to efficiency, equity, proper allocation of scarce resources and proper provision of health care services (Ibid).

Health information systems are more vital to the health care systems in developing countries because scarcity of resources is more severe and equity in health remains largely unfulfilled compared to developed nations (WHO, 2006). Nevertheless, in most developing countries, the existing health information systems are not effective in providing adequate information needed for managers to make sound decisions (See for example Sauerborn and Lippeveld, 2000; Braa et al, 2004 and Azubuike and Ehiri, 1999 etc). Reasons for this inefficiency includes: irrelevance of the information gathered for the task at hand, poor quality data, presence of fragmented parallel health information systems, lack of timely reporting and feedback and poor use of information (Sauerborn and Lippeveld, 2000).

Governments in developing countries are increasingly dealing with restructuring of their health care systems. Part of this process is the restructuring of their health information systems, pushed and supported by various international health organizations, academic institutions and development partners and donor organizations. Health Information System Program (HISP) is one of these international institutions dealing with development and implementation of sustainable health information systems according to local needs.

HISP’s history stretches back to 1994 when researchers from University of Oslo, Norway and University of Western Cape and University of Cape Town, South Africa started small collaborative research project with the aim to furnish health care workers in pilot sites in Cape Town with basic information and to empower them to provide better health services (Braa et al, 2004; Braa et al, 2007b). The important aspects of the collaborative project were the development of standards for health data and development of a desktop database application called the District Health Information System (DHIS) software (Ibid). After the successful implementation of DHIS in two selected HISP pilot districts, agreements were reached at different times with health authorities of South Africa to adopt the software as the national standard and make
extensive country-wide implementation of national standard of data sets and implementation of DHIS software (Ibid).

Currently, the HISP international network is participating in strengthening of HISs in developing countries across Africa and Asia through research, development of computer-based health information systems and development of human resources through training in diverse settings including Mozambique, India, Tanzania (including Zanzibar), Malawi, Botswana, Nigeria, Namibia, Zambia, Vietnam and Ethiopia in which this case study is grounded.

In Ethiopia, HISP is participating in health information system restructuring efforts in various regions of the country namely, Addis Ababa, Amhara, Oromia, Benshangul Gumuz and Tigray. As it is indicated above in the South African case, and as it is the case in many other country’s HIS restructuring process (Sauerborn and Lippeveld, 2000), the process of health information system restructuring in Ethiopia was coupled with implementation of DHIS software in order to facilitate health data management through standardisation of data elements (Woldeyohannes and Molla, 2005 and see Chapter 4 for details).

### 1.2 Research Problem

Application of systematically designed Information and Communication Technologies (ICTs) in health information system makes a health information system an increasingly powerful management tool by radically improving the availability, dissemination and use of health data (See Shrestha and Bodart 2000; Lippeveld, 2001; WHO, 2006; Raghavendra and Sahay, 2005; Walsham and Sahay, 2006; Stansfield et al, 2006). However, despite the significant impact of ICTs on the public sector such as health, education and governance, expanding literature on application of ICTs in the settings of developing countries indicated that, the potential of ICTs are not fully realized. For example, Bjørn-Andersen (1990) point out that many studies from all parts of the world found disappointing results about introduction of information technologies in developing countries. Similarly, Heeks (2003) argue that in developing countries, 85 percent of e-government projects falls short of expectations.

Educators, information system professionals and other researchers working on health information systems pose similar arguments that the development and implementation of computer-based health information systems in developing countries is truly a challenging task. For example, Braa et al (2004) point out that the process of design, development and implementation of computer-based health information systems in the context of developing countries where resources are scarce is indeed a complex task since it requires a struggle to make the information system work in practice, in local settings and overtime. Similarly, Lippeveld et al (1997) indicated that several attempts to strengthen health information systems in developing countries fail to achieve their
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objectives because of methodological, political, socio-cultural and administrative contexts which influence the outcome.

On the other hand, apart from the struggle of developing and implementing computer-based health information systems in developing countries settings, the issue of sustaining successfully implemented health information systems is also a challenge that hampers computer-based health information systems from supporting the overall objective of the health care sector in developing countries. For example, Korpela et al (1998) indicates that it is possible to develop useful computer-based health information systems in Africa and he emphasized the challenges of sustaining useful systems in this severely constrained context. Similarly, Heeks et al (1999) identifies four types of computer-based health information system failures and he emphasizes sustainability failure as one type of failure that particularly threatens health information systems in developing countries. Furthermore, Sapisie (2001) strongly argue that sustainability of computer-based health information systems in developing countries is not yet achieved due to reasons such as high turnover of computer-literate staff and lack of experienced computer system developers to manage and sustain the established system.

Studies on sustainability of computer-based health information systems tend to approach the issue by identifying factors that influence its' sustainability. And the underlying factors that influence the sustainability of computer-based health information systems in developing countries are extremely diverse and context sensitive. For example, from the study conducted in Tanzania, Kimaro and Sahay (2007) discussed decentralization of health information system as important factor for sustainability of health information systems and identified institutional factors which emanated from the political, administrative, health management and health service delivery systems. Similarly, from their comparative study on Mozambique and Tanzania, Kimaro and Nhampossa (2005) identified factors such as inadequate digital and physical infrastructure, lack of skilled manpower and donor policy that encourages establishment of disease-specific health information systems as factors that contributes to unsustainable computer-based health information systems.

Despite an increased interest and concern in understanding the factors and other issues concerning sustainability of computer-based health information systems in developing countries, there is so little empirical research conducted on this topic especially in the context of the Ethiopian public health care system.

Scantiness of empirical studies on issues of sustainability of computer-based health information systems in the context of Ethiopian public health care system poses difficulty in identifying potentials risks and context specific challenges up front and in designing potential strategies to deal with the challenges and problems. The result of such studies is important for managers, information systems people and practitioners to understand the contextual factors that threaten sustainability of the computer-based
system. Such an understanding would help them to manage the problems in advance and thereby to increase chances of success.

Therefore, this study attempted to address the problem of making computer-based health information system sustainable by undertaking an in-depth multi-level empirical investigation on the challenges that are hampering and opportunities that would promote the sustainability and long term viability of the computer-based health information system which is embedded at different levels of the public health care system of the Addis Ababa health bureau since 2004.

1.3 Purpose of the Study and Research Questions

The purpose of this study was to explore contextual factors that may have influence on sustainability of the computer-based health information system which exists at Addis Ababa health bureau. The study also examined and sought explanations as to how the factors identified influence its’ sustainability. The solution to the described research problem is generated through the following three research questions:

(a) What conditions are influencing the sustainability of the health information system?

(b) How do these conditions affect its’ sustainability?

(c) How should the identified problems be solved?

1.4 Study context and Methodology

This study was conducted in the public health care system of Ethiopia. Ethiopia is a developing country located in East Africa and is one of the poorest countries in the world. Specifically, this study was conducted in Addis Ababa health bureau which is the regional health bureau of the capital and responsible for administering health and health related matters of public health institutions in Addis Ababa.

The overall aim of this study was to investigate and understand a computer-based health information system in the context where it exists. Accordingly, to develop deep understanding about people, social, cultural and other contexts in an organization where the information system operates, it is appropriate to adopt a qualitative research tradition (Myers, 1997). Thus, this study adopts qualitative research tradition and uses multiple qualitative data collection methods and techniques. Data was collected through interview, observation and document/artifact analysis to gain deeper understanding about the research questions which guide the study.
1.5 Expected Contribution

This study develops an understanding about the multiple factors that exert influence on sustainability of the computer-based health information system which exists at Addis Ababa health bureau. It explicitly shows how these conditions are affecting the sustainability of the system.

The recommendations drawn from the empirical evidence and analysis of the existing challenges can be used as baseline information to support the ongoing efforts of developing sustainable computer-based health information systems in developing countries in general and in Ethiopian public health care system in particular.

The research contribution does not aim at generalizations on the factors that affect sustainability of a given system. Rather it seeks to develop an understanding of the context-specific factors that might hinder/promote systems’ sustainability. This provides an insight to other studies which are conducted in developing countries on the diversity of the contextual factors which are unique to the context of the study.

The study also contributed to the information systems research by developing a new conceptual model which helps to examine how the identified factors exert influence on sustainability of health information systems.

1.7 Personal Motivation

The original motivation to work on health information systems area stems from my exposure to the research activities of the HISP network at University of Oslo, Department of informatics when I received admission as a masters student. In the second year of my stay and during the initial stage of topic selection, I had a discussion with professors and colleagues at the department of informatics, University of Oslo. As a result, I decided to write my thesis by participating on action research project at Addis Ababa which at the time was planning a transition from DHIS 1.3 to DHIS 2.0. However, implementation of the transition project in Addis was delayed. In exploring an alternative research topic, I found the issue of evaluating factors that have influence on the sustainability of newly implemented computer-based health information systems in developing countries to be a very interesting area to work on and to pursue writing my thesis.
1.8 Thesis Outline

This thesis is composed of 7 chapters. Following this introduction chapter, the next chapter (2):- presents literatures reviewed on: meaning and nature of information systems in organisations, the rationale for health information systems, major issues and setbacks on health information systems and application of information and communication technologies in developing countries, the concept of sustainability in general and in the field of information systems in particular, factors that promote/hinder the sustainability of computer-based health information systems and approaches proposed to attack sustainability problems, concepts and rationale for evaluation and framework of evaluation. Chapter 3:- describes research approach chosen, research strategy followed, data collection methods and techniques used to provide insight and understanding about research problem, modes of analysis adopted, mechanisms used to enhance the validity of the findings of the study and ethical considerations made at different phases of the present study. Chapter 4:- presents background information about the research site and research context. This chapter provides information on geographical, administrative, demographic and economic profile of Ethiopia as well as Addis Ababa where this study was carried out in particular. In addition, background information about the initiation and current status of the Health Information System Program (HISP) (which is an extensive research project under which this study conducted) is also presented. Chapter 5:- reports the empirical investigations and findings from the study conducted at different levels namely: Sub-city health offices, Hospitals and Health centres in Addis Ababa. Chapter 6:- presents the analysis and discussion of the key findings and lastly Chapter 7:- highlights major conclusions drawn from the study and contribution of the study and introduces active research area for further research.
2

LITERATURE REVIEW

The purpose of this literature review is to convey to the reader: established knowledge, ideas and concepts that have relevance to the topic of this thesis i.e. sustainability of health information systems in developing countries. The chapter has five main sections which are further divided in to sub-sections. The chapter opens with definition and perspectives on information systems since it is appropriate to understand the nature of information systems in organizations. The next section discuss the question “why health information systems” and present major issues on health information systems in developing countries. The third section present recent research works done by different scholars on potentials of ICTs for the healthcare sector and challenges for not realizing the potentials specifically in the context of developing countries. The fourth section discusses key issues and concepts of sustainability in general and in information systems field in particular. Under this section institutionalization of health information systems, factors that affect sustainability and approaches proposed to tackle sustainability problems of health information systems are presented. The last section presents concepts and ideas on evaluation of health information systems and present analytical framework that allows to see factors that affect the performance and sustainability of health information systems.

2.1 Information Systems

Information systems in organizations can be defined as a set of people, resources, and procedures, that use computer technology as a means to collect data and produce information for improving organizational efficiency (Boddy et al, 2005). According to Davis (2000), an information system can be defined from two perspectives: a system-oriented definition and a definition that describes the organization and activities of the information system function. A system-oriented definition describes information systems based on its components and the purpose it serves. According to this perspective, Davis defines information system as:

“Information system consists of the information technology infrastructure, application systems, and personnel that employ information technology to deliver information and communications services for transaction processing /operations and administration/management of an organization. The system utilizes computer and communications hardware and software, manual procedures, and internal and external repositories of data. The systems apply a combination of automation, human actions and user-machine interaction”
On the other hand, Davis (2000) defines information system based on the processes of system development, management and system evaluation. This process involves not only the technical components, but also organizational and human aspects such as: strategic planning, management of information system function, information system personnel, systems development processes, and system evaluation (Davis, 2000). Strategic planning activities involves co-alignment of organizational strategy with information system strategy; management of information system function refers to process such as selecting and managing outsourcing contracts; information system personnel includes selecting, motivation and training human resource for information system analysis, design, and development; system development processes comprises specifying user requirements and producing prototype; and system evaluation deals with assessing satisfaction with systems in terms of economical or organizational effects (Davis, 2000).

The field of information systems, therefore, deals with systems for developing information and communication services in an organization and activities and management of the information systems function in planning, designing, developing, implementing and operating the systems and providing services (Davis, 2000). Such systems are used to capture, store, process and communicate data, information and knowledge. In doing so, information systems combine technical components, human operators and users, work procedures, and organizational issues (Ibid).

**INFORMATION SYSTEMS AS SOCIAL SYSTEMS: A PERSPECTIVE**

According to Walsham et al. (1988), problems of information systems implementation can not be properly understood without conceptualizing information systems as social systems. The authors disputed the notion of considering computer-based information systems merely as technical systems and suggested a perspective of viewing information systems as social systems in which the technology is only one component. Similarly, Braa and Hedberg (2002) argue that social contexts influence the design, development and implementation of health information systems and vice versa. According to Walsham (1993) context refers to multi-level understanding of organizational structure such as social structures (inside mind of the human participants), organizational department where the information system is in use and the organization as a whole within which the information system is one element. According to this social system perspective, information systems are conceptualized as a part of broader social system in which technology constitutes only one of the components. Boddy et al (2005) describe information system and its context using the following diagram.
Thus, information systems constitute a holistic unit in which human, organizational and technical components interact to capture, store, process, and communicate information (Walsham et al. 1988; Heeks, 1998 and Boddy et al, 2005). As to Walsham et al. (1988), conceptualizing information systems as social systems offers opportunities to understand historical, social and political issues in which the technology is embedded. Furthermore, the authors argue that this perspective is particularly suitable for organizations in developing countries where contextual constraints such as social (such as lack of skilled labor), organizational (such as lack of suitable equipment and infrastructure) and technical (such as shortage of technically competent staff) are more severe.

Moreover, Doherty and King (1998) argue that addressing organizational issues during systems design is more important and critical factor to successful development and implementation of information systems than traditional systems development.
methodologies which gave due emphasis to the technical aspect only. The authors cited contemporary studies that explicate organizational issues as major contributors to systems development failure or under performance. According to Doherty and King (1998) organizational issue is:

... any distinct area on the interface between a technical system and either the characteristics and requirements of the host organization or its individual employees, which can lead to operational problems within the organization.

In this study, the computer-based health information system at Addis Ababa health bureau is conceptualized as a social system, since this perspective gives me the opportunity for an in-depth and proper investigation of social and organizational contexts where the health information system exists. It should also be noted that conceptualization of information systems as social systems implies that development and implementation of integrated district-based health information systems in Ethiopia is a process of social and organizational change. In summary, thinking information systems as social systems offers me the opportunities for a deeper and proper understanding of the challenges and opportunities for sustainability of the computer-based health information system within the context in which it is applied (in this case the Addis Ababa health bureau).

2.2 Health Information Systems (HIS)

World Health Organization (WHO) declared the policy “Health for All by the year 2000” in 1978 at a conference held in Alma-Ata and endorsed Primary Health care (PHC) approach as a new strategy that responds more equitably and effectively to basic health needs’ world wide (WHO, 1978). The main agenda behind primary health care approach is to achieve equality in health status and equitable distribution of resources (Declaration of Alma-Ata 1978; Sandiford et al, 1992). The role of information towards achieving the goal of primary health care programs has long been identified by WHO and it is seen as one of the key input to ensure rational allocation of scarce resources and for setting priorities in healthcare sector (Sandiford et al, 1992; Azubuike and Ehiri, 1999; Lippeveld and Sauerborn, 2000). In line with this, WHO (2006) indicated that the need for health information is even more acute in developing countries where resources are very limited and unwise allocation of funds can mean the difference between survival and death. Similarly, Braa and Blobel (2003) pointed out that without reliable and relevant health information, health care managers and practitioners in developing countries can not make decisions to allocate resources effectively, improve the quality of health services, or address epidemics such as HIV/Aids, Malaria, and TB. Therefore, health information can play meaningful role in improving existing poor health status of many developing countries including Ethiopia.
Accordingly, HIS became an integral part of the health sector of many developed and developing countries and its ultimate objective is to enable various health system managers at different levels to make proper allocation of scarce resource based on situated-evidences obtained from the ground (WHO, 2006). WHO (2003b, pp 116), defined health information system which is driven by primary health care as “Integrated effort to collect, process, report and use health information and knowledge to influence policy-making, program action and research”. Health information systems can also be classified in to two: Routine Health Information Systems (RHISs) and non-Routine Health Information Systems.

RHISs are health information systems which produce routine health information. Routine health information is defined as: “information that is derived at regular intervals of a year or less through mechanisms designed to meet predictable information needs” (RHINO 2001, pp.11). Statistical report is one example of routine health information which is useful for health care managers at facility, district, regional and national levels of the health structure to make informed decisions and improve health services. According to WHO (2003a), health care statistical reports provide information on:

♦ Type of diseases treated by the health facility
♦ Type of diseases occurring within a community and/or country
♦ Number of births and sex of newborns
♦ Number of deaths and age of death, including maternal, prenatal and infant deaths
♦ Utilization of health care services within a community.

Information presented in such statistical reports offer possibilities for managers at different levels to compare present and past year performances of health facilities; to compare health status at national or international level; for assessing work performed by health care providers such as doctors and nurses and for efficient planning and evaluation of funding requirements of health facilities (Ibid). Thus, health information allows managers to access facts and to make decisions which are responsive to the happenings at the ground level.

Nevertheless, to generate such health information that augments managerial efficiencies in the health care, the data collected must be of good quality and there must be consistent use of health information.

According to WHO (2003a) guide on data quality, good quality data can be described in terms of its components: accuracy of data, its completeness, its readability, accessibility when it is required and its usefulness for the intended users. Similarly, to facilitate consistent use of health information among decision-makers, WHO (2003a) suggests presentation of information using visual aids such as graphs and charts which has the potential to show what figures are representing. Thus, producing good quality
data and presenting information in a palatable way may motivate health managers to make intelligent decision.

**HIS IN DEVELOPING COUNTRIES**

Health information system is useful when it allows a wide scope of health and health related data making it possible to integrate data from different departments such as HIV/Aids, family planning, malaria and tuberculosis for overall analysis routinely so as to reduce the burden of health workers, eliminate duplication of data and minimize waste of financial resources (Braa and Blobel, 2003). However, health information systems in most developing countries are weak in providing the information required for decision-makers to identify problems and needs, track progress, and make evidence based decision on health policy, effective program design and resource allocation (WHO, 2006). Furthermore, Sauerborn (2000) cited Rodrigues and Israel (1995) and indicated that incidence of information-based decision making in the health sector is lower, than other sectors in developing countries. Such facts imply the existing lack of understanding about value of information especially in healthcare sector where the primary task is saving lives of individuals.

Related with this, Sauerborn and Lippeveld, (2000) stated their observation of existing routine health information systems in several developing countries as follows:

…data driven and often not helpful for management decision making since they are incomplete, inaccurate, untimely, obsolete, and unrelated to the task and function of local health personnel.

With this kind of inadequate and unreliable health information, program planning and implementation in most developing countries are often based on estimation, tradition, and guess work and regrettably, scarce resources are inappropriately allocated which ultimately results in health services that can not respond to the neediest (Sandiford et al, 1992; Azubuike and Ehiri 1999 and Sauerborn and Lippeveld, 2000).

Several research reports have shown different factors that contributed for weak performance of health management information systems in most developing countries. For example, Azubuike and Ehiri (1999) discussed the following issues as major impediments to the establishment of effective health information systems in developing countries:

- Inadequate health data collection systems: here they indicated that many developing countries do not have organized and structured data collection system that incorporates village, community, district, regional, and state levels. Consequently, health care managers fail to plan and take decisions.
about public health action since they mainly depend on monthly returns which provide inaccurate and incomplete data.

♦ Resource constraints: lack of resources such as skilled personnel, computer technology to deal with huge amount of data, software to enhance storage and retrieval of data and transportation facility (such as vehicles) for data transmission as impediments to the successful functioning of HISs.

♦ Incentives to collect health information: many health workers do not have interest and motivation to collect health data for reasons such as limited understanding toward the objective of collecting data and lack of incentives (poor wages, low morale and poor working conditions). Under these conditions, the data collected is usually inaccurate and incomplete.

♦ Inadequate trained personnel: shortage of sufficiently skilled health workers such as medical records, officers, statisticians and computer analysts contribute to the existing poor performance of HISs.

Furthermore, Lippeveld (2001) also mentioned impediments such as lack of electricity; essential HIS supplies (printed forms or registers); essential communication technology (telephone line between health unit and the district headquarters) and lack of technical staff (to maintain software and hardware failure) for the well functioning of HISs in developing countries.

In recent years, most developing countries are acknowledging the need for improved health care and are making reform to the overall health system in general and restructuring of health information systems in particular (Sauerborn and Lippeveld, 2000). Ethiopia, as one of the developing countries with poor primary health care system and low per capita income has introduced initiatives to transform the public health care system including the management and reporting of health information since 1994 (HSDP, 2005). In Ethiopia, the process of reforming health information system is facing several challenges including: lack of coordinated effort and leadership, lack of strategy and policy, shortage of skilled human resource and lack of guideline (HSDP, 2005). However, in spite of these challenges, there are several initiatives being carried out in collaboration between the government, academic institutions and international organizations to transform existing paper-based routine health management information system to management support tool. One of such initiatives is the Health Information System Project (HISP) which is an international program exerting particular effort on the design, development and implementation of sustainable and scalable computer-based HIS in many developing countries including Ethiopia (See also chapter 4).
2.3 Application of ICTs in the Health Sector

In recent years, many developing countries have increased their adoption of Information and communication technologies (ICTs) for various applications in different sectors including health, education and public administration. Sahay and Avgerou (2002) point out:

...in poor countries, information and communication technologies (ICTs) are expected to play a key developmental role. Many see in these technologies the potential for turning around uncompetitive industries and dysfunctional public administration and for providing unprecedented opportunities for the information-intensive social services, such as health and education.

Accordingly, many developing countries are attempting to deploy ICTs in various facets of governance, and health is a key focus area. As it is stated in WHO (2006) report, sound health information system depends on organized processes of gathering, sharing, analyzing and using health-related data for decision-making.

Systematically designed ICTs have the potential to make health information systems increasingly powerful management tool for the health sector by radically improving the availability, dissemination/transmission and use of health-related data (Shrestha and Bodart 2000; Lippeveld, 2001; WHO, 2006; Raghavendra and Sahay, 2005; Walsham and Sahay, 2006; Stansfield et al, 2006).

Moreover, Dzenowagis (2005) argue that application of ICTs in health care is not a luxury rather it is about:

♦ Health professionals making better treatment decisions
♦ Hospitals providing higher quality and safer care
♦ People to making informed choices about their own health
♦ Governments becoming more responsive to health needs
♦ National and local information systems to support the development of effective, efficient and equitable health systems
♦ Policy makers and the public to be aware of health risks
♦ People to have better access to the information and knowledge they need for better health.

Studies in the area of health information systems also indicated that the need for the application of ICTs in routine health information systems is derived from two main reasons: first, health care sector in general and routine health information systems in particular generate huge amount of data and this huge amount of unprocessed data prevents decision makers from obtaining useful information, thus, ICTs are becoming the preferred option to process and present this data more quickly and accurately.
(Sandiford et al, 1992; Kleinau, 2000; Shrestha and Bodart, 2000; Lippeveld, 2000; Lippeveld, 2001; Sahay and Avergou, 2002). Second, the falling price of computer equipments is also considered as one additional encouraging factor for the increasing usage and deployment of ICTs even in low-income countries (Sandiford et al, 1992 and Lippeveld, 2001).

Despite the potential of ICTs in solving problems in the health care, developing countries are failing to benefit fully from these innovations (Stansfield et al, 2006). Avergou and Walsham (2000) clearly stated this problem as: “successful examples of computerization can be found, but frustrating stories of systems which failed to fulfill their initial promise are more frequent.” Similarly, Heeks (2003) indicated 85% failure of e-government projects in developing countries.

Causes for failures of computer-based information systems are dependent on a several factors. Lyytinen (1987) classified information systems problems in to two:

1. Problems in information system development process: This incorporates factors such as neglect of behavioral and organizational issues, ambiguous and conflicting goals, high risk of change, lack of financial support and lack of quality control.
2. Problems with the information system use process: this incorporates IS operation problems like slow response time of the system, poor interface design; lack of relevance, systems complex to maintain; systems that fail to solve the intended problem.

Similarly, WHO (2004) has identified several constraints for not realizing potentials of ICTs in developing countries:

- lack of proper needs assessment
- Lack of vision, strategy and national plans
- Lack of information and awareness about ICT applications
- Computer illiteracy
- Insufficient resources to meet costs
- Limited experience in medical informatics
- Weak information and telecommunications infrastructures
- Absence of legislative, ethical and constitutional frameworks.

Heeks et al. (1999) identified four kinds of health care information systems failure. The first one is “total failure” of system development which is never completed or if completed not used. Second is “partial failure” of system development where major goals are unfulfilled and thirdly, “sustainability failure” which refers to a system which is initially useful and productive but fails after some time due to multiple situation-specific factors that interrupts its durability. He further elaborated that sustainability failure is a type of failure that particularly affects developing countries. Lastly, Heeks...
et al. (1999) mentioned “replication failure” which represents an initiative that succeeds in one area but can not be replicated in other areas.

In this study, my focus area is to understand possible challenges that may interrupt the sustainability of the computer-based health information system implemented in Addis Ababa Health Bureau (AAHB).

2.4 Sustainability and Health Information Systems (HIS)

SUSTAINABILITY: A MULTI-FACETED CONCEPT

The concept of sustainable development was initially coined by World Commission on Environment and Development (Brundtland commission) in 1987 (Ben-Eli, 2006). Although this concept has many meanings (mainly due to its multi-dimensional nature as well as on the position taken to define it) the most widely used definition of sustainable development is: “a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” (Brundtland, 1987). According to Bare (2002), sustainable development incorporates social, environmental and economic sustainability. The term sustainability in these domains has different meanings depending on the matter of concern to be sustained. With in the topic of economics the concept sustainability refers to maintenance of capital; in environmental studies sustainability seeks to prolong global life-support systems (atmosphere, water and soil) for indefinite period of time; and social sustainability denotes maintenance of social capital by shared values and equal rights and by community, religious and cultural interaction (Goodland, 1995). Filho (2000) noted that, the term sustainability, due to its multi-faceted nature has become one of the most widely used terms in the scientific field since it is coined in 1987. To many, it implies persistence, durability and the capacity of something to continue for a long time (Filho, 2000; Batchelor and Norrish, 2002). Even though there are several definitions of sustainability in several academic disciplines, I have chosen the descriptive definition forwarded by Bare (2002) as: “…a rational and dynamic continuation of a set of activities or processes that produce desired products and services over long periods of time”\(^1\).

In the field of information systems, the term sustainability has been used by different scholars to describe different aspects of information system development, implementation and use. For instance, Korpela et al. (1998) described the term sustainability as the ability to identify and manage risks threatening to the usability and availability of the information system for the indefinite future. On the other hand, Braa et al (2004) described sustainability challenge as a mechanism of making an information system work, in practice, over time, in a local setting.

\(^1\) [http://faculty.washington.edu/bare/sus1.html](http://faculty.washington.edu/bare/sus1.html)
Heeks (2002) illustrated some examples which suggest causes for sustainability failure of a particular health information system initiative. Contextual factors such as transfer or resignation of key staff from his/her position and termination of financial support from donors are described as examples that cause sustainability failure to useful information systems. In the same way Korpela et al, (1998) also argue that software projects in developing countries may produce highly useful and operational systems but the sustainability of these systems may be problematic due to lack of long-term support or funds for maintenance. Thus, lack of resources such as financial resource and skilled human resource can be described as factors that can adversely affect the sustainability of information systems. On the other hand, (WHO, 1993) indicated that good information systems can also be ineffective after it is implemented due to lack of adequate management and support structure that makes the information system to effectively operate. Therefore, although lack of financial resources and skilled human resource can be considered as factors that hinder the sustainability of information systems in organization, lack of managerial support is also additional factor that can hinders sustainability of computer-based information systems.

Before discussing issues about sustainability of a given information system, it is important to point out that, a given information system has to be institutionalized first or in other words, it has to exist or become part of the day to day routines of the organization.

**INSTITUTIONALIZATION OF HIS**

From the information systems literature, Avgerou (2000) defines institutionalization as: “the process through which a social order or pattern becomes accepted as a social fact”. Similar with this definition Jacobs (2002) argue that the notion of institutionalizing change represents a particular change that has become part of the ongoing, everyday activities of the organization. He further elaborated that change is institutionalized if employees who had previously used other workflow start to use the steps of the redesigned workflow to do the work without anyone prompting them. In addition, Jacobs (2002) cited Goodman and Dean (1983) and described institutionalized behaviours in organizations as acts that are performed by two or more persons, which persist over time, and exist as part of the daily functioning of the organization. According to Jacobs (2002) it is possible to determine whether organizational change is institutionalized or not by comparing the extent of the change against some previous course of set of actions.

On the other hand, Silva and Backhouse (1997) indicated that new information systems can be pronounced as institutionalized, if the new practice or technology associated with the information system become legitimate and when users operate the system by applying knowledge they take for granted in the same way people use telephone. Besides, Silva and Backhouse (1997) point out that for a new information system to be institutionalized, it has to be legitimate and vice versa. Similarly, Kimaro and Sahay
(2007) also noted that institutionalization of HIS includes creating roles, responsibilities, structures and budget to ensure that the system becomes part of the existing organizational routines. Besides, Norris (2003) argue that institutionalization of information technology refers to an information technology which is adopted by an adopting unit and becomes part of the mainstream operation of the organization. He sited Rogers (1983) who use the term routinization, which has equivalent meaning with institutionalization and argue that a particular information technology is institutionalized when it eventually loses its separate identity and becomes an element of the organization’s ongoing activities. Therefore, institutionalization of new information systems refers to a situation where newly designed social practices and technology become an element of the organization and it is practiced and used by users in their day to day activities within the organization. Thus, it is possible to say that the health information system implemented at different levels of the health structure in Addis Ababa health bureau is reasonably institutionalized since it is becoming part of the day to day activities of the health units since 2004.

**FACTORS AFFECTING SUSTAINABILITY OF HIS**

Sustainability of information systems particularly in the social and economic context of developing countries is hindered by several challenges. The following factors are reported in the literatures reviewed as challenges to sustainability of useful information systems.

♦ **Technological and physical infrastructure**

It is a well known phenomenon that lack of suitable technological and physical infrastructure in developing countries is unavoidable fact and impediment for successful information systems implementation and use. Kimaro and Nhampossa (2005) discuss the significant role of both sound technical infrastructure (such as hardware, software and networks) and reliable physical infrastructure (such as regular electric power supply, roads and transportation facilities) in realizing the potentials and benefits of information technology to the healthcare sector. Furthermore, the authors provide an example of an irregular electric supply and show how this results in computer equipment failure in developing countries where maintenance and replacement costars are in most cases unaffordable. Similar to this, Yusof et al (2006) also strongly argue that health care organizations should be equipped with appropriate technology and infrastructure in order to realize potentials of health information systems. Therefore, failure of either technological or physical infrastructure might minimize the usability of system and thus may be a threat for the sustainability of computer-based HIS.
Several contemporary studies revealed the necessity of trained and skilled human resource for information systems to work effectively. For example, Kleinau, 2000 argue that effectiveness of health information systems in producing good quality information to decision-makers, managers and care providers is highly dependent on availability of adequate and skilled human resource with a capacity to collect, process, report and use valid and reliable data/information.

Similarly, Cibulskis and Hiwawleyer (2002) argue that presence of skilled and well trained human resource as central issue that governs sustainability of health information systems in developing countries. Likewise, WHO (2006) also remark that all other efforts to improve the performance of health information systems are futile if there is no skilled human resource for data collection, reporting and analysis. However, Kimaro and Nhampossa (2005) indicated that absence of skilled, experienced, and adequate human resource with the required capacity to run the HIS is still persistent in many developing countries.

Several factors have contributed to the existing lack of skilled human resource in health information system area in developing countries. Sapire (2001) indicated the cause for high turnover of computer-literate staff due to the marketability in the private sector for much higher salaries once they gain the experience and skills in the public sector.

To tackle with the existing problems of lack of skilled human resource in the context of HIS, different approaches have been suggested by different scholars. Sapirie (2001) propose that external technical assistance will be particularly effective in promoting sustainability of health information systems when assessment, design, and capacity building activities are performed in collaboration with local human resource. Similarly, Kimaro (2006) also indicated participation of key users in system design, development and implementation as one approach to transfer the required skill to local users thereby to maintain sustainability of health information systems. Furthermore, Cibulskis and Hiawawleyer (2002) proposed improved payment and improved working conditions in order to retain staff with the required skill and experience besides to capacity building initiatives.

Therefore, capacity building, user participation and better working conditions and improved salary can play a significant role in introducing knowledge and skills required to maintain system’s sustainability to local users and in retaining skilled human resource in the public sector in developing countries.

Accordingly, as part of its on-going effort on designing, implementing and sustaining health information systems in many developing countries including Ethiopia, HISP (See chapter 4), addresses sustainability problems associated with human resource.
through participatory design and local capacity building by strengthening the capacity of health staff to effectively deal with health information systems and use information to support local action (Braa et al, 2004).

♦ Non-aligned donor strategy

Donors in the health care service provision usually design a strategy that focuses on separate disease-oriented health programs rather than action-oriented integrated health information systems and establish specialized information systems to address specific health problems such as HIV/AIDS and malaria (Chilundo and Aanestad, 2003). Similarly, Kimaro and Nhampossa (2005) mentioned that donor strategies have a plan to design or come up with specific software that fulfils the requirements of disease specific programs. According to Chilundo and Aanestad (2003) this kind of fragmented health information system for specific programs leads to parallel and overlapping information flow, work overload on health workers and “suboptimal” use of data for decision making. Similarly, Braa et al (2007b) have point out that lack of shared standards for data collection as collection of the same data through different systems many times that produce poor quality data and poor use of information.

Non-aligned donor strategy is cited by Kimaro and Nhampossa (2005) as an impediment for strengthening and sustainability comprehensive information systems in developing countries. Therefore, it seems that introduction of new disease specific information flow has negative impact on sustainability of comprehensive and integrated health information systems since this hampers managers to see the rich and real picture of the happenings at the grass root level.

♦ Inappropriate donor policies

Lack of appropriate donor strategies for transferring technical and managerial skill in to the local context is one factor that may hinder sustainability of health information systems (Kimaro and Nhampossa, 2005). Furthermore, the authors argue that most donor policies on funding do not have clear strategy to address problems of skilled human resource. In the same way, Wilson (2000) point out that problems of sustainability of health information systems are more severe in systems which are developed exclusively with technical and financial assistance from donor agencies and proposed a strategy of relying on local human resource for software customization and programming to minimize sustainability problems.

APPRAOCHES TO TACKLE HIS SUSTAINABILITY PROBLEMS

In order to tackle challenges to the sustainability of health information systems in developing countries, several approaches and strategies are proposed by different scholars. For example Braa and Hedberg, (2002) and Braa et al. (2007) indicated the importance of integrating fragmented health information system through flexible
standards as a mechanism to improve efficiency of health management and to ensure sustainability of health information systems. In the same way, Kimaro et al. (2007) indicates that decentralization of the health system at large and decentralization of health information system (which includes development of flexible standards) in particular as one major goal to improve the quality of health care provision. Based on the study conducted in South Africa, Jacucci et al. (2006) argue that local use of information along with deployment of competent and adequate human resource (to produce and use information) is one way to ensure survival of health information systems over time. Local adoption of standards to contextual needs is also particularly suggested as one approach to maintain local sustainability of health information systems (Braa et al., 2007a; Jacucci et al., 2006).

Braa et al. (2004), argue that challenges to sustaining health information systems requires adoption of systems to particular context, cultivating local learning processes and making an information system part of standard practice in organization (institutionalized) over time.

On the other hand, Sapirie (2001) point out that introduction of incentives that tie data collection and quality control have the capacity to improve the effectiveness and sustainability of health information systems. Incentive structures such as motivating data producers with both positive and negative feedback on the status of the data they produce and report is one principle to improve data quality and is described as central task in designing health information systems (Shrestha and Bodart, 2000; WHO, 2004). Similarly, Setzer and Stoops (2003) point out the importance of production of good quality data not only for securing an accurate description of health status, service, coverage and performance but also as a means to buy trust among health care managers and this in turn, will motivate them to use information for their action.

Sapirie (2001) identified four issues that could measure the success and sustainability of health information systems:

1. When 80 % percent of service units are recording and reporting based on the new system formats and procedures two years after the system is implemented;
2. When health service staffs are better able to perform their service and management functions using the new system;
3. If policy makers and program managers are frequently asking data for evaluation and planning purposes; and
4. When the new computer applications are being maintained and improved by permanent staff in the services or in local service bureaus.

To understand factors that affect sustainability of the existing computer-based health information system at Addis Ababa health bureau and to gain an insight on how these contextual factors affect system’s sustainability, it is appropriate to evaluate the overall performance and thus to find valid and acceptable framework to guide the evaluation.
process on the ground. Thus, the following section present concepts and ideas on evaluation of health information systems and highlights the analytical framework that helps to see contextual factors that affect the overall performance and sustainability of health information systems.

2.5 Evaluation

Evaluation of health information systems is defined as: “the act of measuring or exploring attributes of a HIS (in planning, development implementation or operation), the result of which informs a decision to be made concerning that system in a specific context” (Ammenwerth et al 2004). Several researchers stated that, evaluation of health information systems should be an on-going process throughout the life of a particular health information system project, (i.e. during system analysis, design and implementation as well as when the new system is operational) to realize a system that benefits the health care sector (See Remenyi and Sherwood-Smith, 1999; Lippeveld, 2000; Ammenwerth et al 2004; Kaplan and Shaw, 2004 and Yusof et al 2006). Based on system development life-cycle, evaluation of information systems can be classified in to two groups: pre-implementation and post-implementation evaluation. Kumar (1990) point out post-implementation evaluation as a type of evaluation that is conducted just before, or just after implementation and when the new system is running. With regard to appropriate timetable for evaluation of newly restructured health information system, Lippeveld (2000) proposed first evaluation of newly restructured health information system, to be conducted just after one or two years since the new system has been operational.

WHY EVALUATION OF HIS?

The major purpose of evaluating HISs after implementation is to highlight the positive aspects that make the health information system work as well as to identify the barriers to its successfulness with a view to improving the system (WHO, 2004; Lippeveld, 2000). Several researchers have indicated the need for evaluation of health information systems. Periodic post-implementation evaluation is encouraged in order to minimize problems after the implementation of the new system (Lippeveld, 2000). Besides, Beyonon-Davis et al (2000) stated that summative or post-implementation evaluation: “is likely to suggest a number of ways in which the system may be modified or extended”.

In the same manner, Yusof et al (2006) indicated the need for evaluation of health information system in ensuring its successful implementation and positive impact on health care delivery. Furthermore, Ammenwerth, (2004), point out the need for evaluation of ICT systems that are in operation in a health care environment to identify potential side effects. Therefore, in this research a post-implantation evaluation of the computer-based health information system implemented since 2004 is performed with the objective to understand the factors that facilitate or impede its sustainability.
WHAT SHOULD BE EVALUATED?

According to Lippeveld (2000), during the process of evaluating newly restructure systems, the main focus area for evaluation is the output of the new system. Specifically the evaluation activity should focus on the availability, quality and use of health information (WHO, 2006). Based on the social systems perspective, evaluation studies of health information systems should not only understand the computer technology which is one component, but also the social and behavioral processes that affect and are affected by the technology (Ammenwerth et al, 2003). Furthermore, Yusof et al (2006) encourages information system practitioners to see barriers that impede system use during evaluation since they explain failure and success of a particular health information system.

FRAMEWORKS FOR EVALUATION

There are several frameworks proposed by different scholars for the purpose of evaluating health information systems. For example, Sapis (2000) suggests assessing components of a particular health information system. The components of health information system is described by Lippeveld and Sauerborn (2000) using the following diagram.
According to Lippeveld and Sauerborn (2000) the structure of health information system can be classified into two interrelated components: information process and health information system management structure. They further classified the information process component to include data input/collection, data transmission, data processing, data analysis, presentation and use of information. Again, the management structure is also classified into health information system resources and set of organizational rules.

Based on the above classification of components of health information system, Sapirie (2000) explained what to investigate within each of the components of health information system for conducting assessments as follows:

- Data input: completeness of data collection
- Data analysis, transmission and reporting: processing, and presentation
- Use of information
- Information systems resources: availability, sufficiency and use of critical resources to support: the health information system budget; staff with necessary skills

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training and expertise; facilities such as space for record storage, records and formats; necessary equipment for data communication, storage, analysis and document preparation (faxes, computers, photocopy machines, etc).

- Information systems management: organization and coordination mechanisms for assuring that data and information are properly defined, standardized, produced, maintained, shared and reported.
- A set of organizational rules: definition of staff responsibilities, computer maintenance procedures; data transmission processing and reporting rules; supervisory activities and data quality assurances.

Kleinau (2000) point out that health information resources and set of organizational rules are essential components of health information systems that highly contributes for sustainability of health information systems in developing countries.

In this study, the above perspective which details the components of the health information systems helps me to have an insight about the components of health information system and it allows me to examine data input (i.e. accuracy, legibility and completeness of reporting forms), data analysis and transmission (i.e. how data is analyzed and medium and time for data transmission) and information use at different levels of Addis Ababa health bureau.

LaFond and Field (2003) proposed a comprehensive conceptual framework called “The Prism Framework” (Performance of Routine Information System Management) which can be used as a lens to understand the performance of routine health information systems in developing countries (See Figure 2-2). As to the authors, good performance of health information system is: “sustainable production and use of good quality information”.

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According to LaFond and Field (2003), good performance of health information systems emanates from the synergetic improvement of the three dimensions specified in the framework namely: technical front, human (behavioral) front and organizational/environmental front of health information systems. As to the authors, the framework allows researchers to identify opportunities and constraints for effective data collection, production and information use. These three fronts of the PRISM framework are explained by the authors as follows:

1. Technical factors: such as data collection tools and processes, computer technology, data analysis, data transmission rules etc.
2. Human (Behavioral) factors: such as knowledge and skill to perform health information system related activities, attitudes, motivation and incentives (follow-up or feedback and salary) and job satisfaction etc.
3. Organizational/environmental factors: such as infrastructures like roads, computers, adequacy of human resources; transportation and other resources; clarity of roles and responsibilities for information management, presence of clear job descriptions; and presence of information culture etc.

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**Figure 2-3** The PRISM Framework  
(Source: Adopted from: WHO, 2006)
The authors emphasized that improvement of one dimension amongst the three can not dictate good performance of health information systems due to the fact that the three points are inter-related and influence one to another. For example, in a situation where data collection tools are properly designed but the human aspect of the health information system lacks required skill to operate properly then, this has direct influence on the quality of the data collected. Similarly, presence of well skilled and motivated health information worker by itself can not ensure improved health information systems performance if it is not accompanied by an organizational culture that give due value to information use for example. In the same way, organizational problems such as lack of assigning sufficient human resource to collect data directly affect the timeliness and completeness of reports. In this way PRISM framework provide different perspectives to understand health information system performance and especially it helps to point out specific aspect of health information system which requires improvement (LaFond and Field, 2003).

2.6 Summary

Literatures were reviewed to understand established knowledge, ideas and concepts on the topic of this study i.e. sustainability of health information system in developing countries. Accordingly this thesis reviewed literatures on the following themes.

**Definition and perspective on information systems:** to understand the very nature of information systems in organizations and to take established perspectives which helps me to see performance and problems of information systems in developing countries where resource scarcity is still prevalent.

**Health information systems (HIS) and HIS in developing countries:** to understand the rationale for designing and implementing health information systems in the health care sector and to understand the status, performance of health information systems and other major contextual issues in developing countries. Besides, in this section I made through review of literatures on factors that contributed for the weak performance of health information systems in developing countries.

**Application of ICTs in the health care sector:** to see the potentials and benefits of ICTs in improving the efficiency of health care sector, to familiarize my self about the success rate of ICT projects in developing countries and to understand the constraints for not realizing the potentials of ICTs in developing countries.

**The concept of sustainability, institutionalization of HIS, challenges to sustainability and approaches to tackle challenges of sustainability in developing countries:** to understand the definition, key issues of sustainability in other scientific fields as well as in the field of information systems. In addition, attempts have been made to review and to present research works that articulates factors that have influence on sustainability of useful

Evaluating challenges and opportunities for sustainability of computer-based health information system in Ethiopia: case study from Addis Ababa
health information system and approaches proposed by different contemporary scholars to tackle sustainability problems especially in the context of developing countries.

**Evaluation of health information systems**: to familiarize myself to concepts and key ideas on the benefits and rationale for conducting evaluation of health information systems at various levels of HIS project and to obtain valid and acceptable evaluation framework that helps me to see the performance and problems of the newly implemented health information system.
3

RESEARCH METHODS

The research questions guiding this study are: (a) What conditions are influencing the sustainability of the health information system? (b) How do these conditions affect its’ sustainability? (c) How the identified problems should be solved? The objective of this chapter is to describe the research approach adopted; research strategy used; sites, individuals, documents and other artifacts selected and methods chosen for data collection in order to provide answers to the specified research questions. The chapter is organized in to eight sections. Section 3.1 describes the two major research approaches and the research approach chosen for this study. Section 3.2 presents the research strategy employed. Section 3.3 describes the research design for the study. Section 3.4 presents data collection methods and techniques employed. Section 3.5 describes modes of data analysis and section 3.6 presents validity of findings. Section 3.7 describes ethical considerations. 3.8 limitations of the study and the last section presents brief chapter summary.

3.1 Quantitative and Qualitative Research

Traditionally, scientific research approaches are often classified into two: qualitative and quantitative research. Creswell (2003) indicated that these two broad research approaches are distinguished by their philosophical assumptions, research strategies and data collection methods each follow. According to Maykut and Morehouse (1994) the philosophical assumption underpinning quantitative research is primarily based on measurable variable and provable proposition. This means that the researcher develop knowledge through cause and effect thinking and reduction of a phenomenon into specific variables (Creswell, 2003). Therefore, data is collected in numerical form and is analyzed using statistical methods such as experiments (Walsham, 1993 and Silverman, 2005).

On the other hand, qualitative research is surfaced at different philosophical assumption which focuses on understanding the study setting, events, processes taking place in the research site and perspectives of subjects of the study by collecting data in the form of words rather than numbers (Maykut and Morehouse, 1994; Walsham, 1993; Kaplan and Maxwell, 2005). In other words, qualitative research approach is suitable for researchers who want to understand people and their social and cultural contexts (Myers, 1997). This study adopted qualitative research approach and used qualitative data collection techniques since the research questions of this study strives
to understand the human, technological, managerial and organizational issues with in the setting where the computer-based health information system exists.

3.2 Research Strategy

INTERPRETIVE RESEARCH

Interpretive research is one type of qualitative research strategy which assumes, knowledge of reality is obtained only through social constructions such as language, conscious shared meanings, documents, tools and other artifacts (Klein and Myer, 1999). Ontologically, interpretive information systems research assumes that social world is not given or objectively known rather the social world is produced and created by humans through their action and interaction (Orlikowski and Baroudi, 1991). This means that an interpretive researcher must describe, interpret, analyze and understand the social world in organizations merely from the participants’ personal perspective and by avoiding researchers’ prior rigid questions, categories, and methods of analysis that draw statistical inferences (Ibid.). Walsham (1993) clearly stated the relevance of interpretive methods for information systems research as:

Interpretive methods of research, aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context.

Similarly, in this study interpretive research was adopted and I attempted to describe the case, interpret and analyze the challenges and opportunities for sustainability of the computer-based health information system in Addis Ababa health bureau based on: the personal perspectives of subjects of this study which was reflected on the transcripts obtained through less-structured interview questions, field notes and documents and artifacts analysis such as DHIS software.

3. 3 Research Design

This study utilized interpretive case study research tradition. Case study is a research strategy which is extensively used in social science research (Yin, 2003), and it is most widely used qualitative research method in information systems research (Orlikowski and Baroudi, 1991). Case study is an empirical inquiry which focuses on an in-depth understanding of a phenomenon and its actual context by using various sources of evidences like interviews, observation, and document analysis (Yin, 2003). In information systems research, case study is well suited research tradition to understand the interaction between information technology and organizational contexts in a thorough manner (Darke et al, 1998, Walsham, 1993). Yin (2003, pp 12) defined case study as: “Case study is an empirical inquiry that investigates a contemporary
phenomenon with in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.”

**RESEARCH SITE**

This study was conducted within the framework of health information system program (HISP) which is an extensive South-South-North network with a focus on information systems development and use for public health care (Braa, 2007a). To best explore the problems of sustainability in the context of developing countries, I have chosen my country, Ethiopia as my research site.

Before I decided to carry out my study in Addis Ababa, during the first week of October, 2006, I participated on a trip conducted in different sites of Oromia region to evaluate use of DHIS software with two HISP-Ethiopia team members in order to get insight and first hand information about the domain of health information system in Ethiopia. Soon after that, I also made a trip to the southern region (SNNP) (Awasa) in an attempt to take initiatives for the implementation of DHIS software in the region (See Appendix B, for ethical letter specific to SNNP). However, this was not possible due to several reasons including lack of managerial support and existence of other software which is actually in use by the regional health bureau. Then I decided to focus my research area on evaluating and learn aspects of sustainability and use of DHIS software by taking the case of Addis Ababa health bureau. The rationale for choosing Addis Ababa as my study site is two fold:

- Geographical proximity to conduct the research: since Addis Ababa is a city administration it was easier for me to reach all public health institutions using public transport or other cheaper transportation facilities.
- Implementation of the software at all levels of the public health system: DHIS software has been implemented in AAHB since 2004, and they already had two years data during the time of this research. This makes Addis Ababa appropriate study site to collect data about sustainability challenges and opportunities for the computer-based health information system which is the central question of this study.

I started my research in Addis Ababa by going to the Addis Ababa city health bureau and by contacting and introducing myself to HISP- Addis Ababa facilitator. Preliminary Interview was conducted with the facilitator to get the names of the sub-cities which are using DHIS software, and names of the contact person in each sub-city. Names of all sub-cities have been identified and all staffs that are responsible for operating the software were selected for this study with the perception that they have more understanding and answer about the research questions of this study.
The study was multi-level in a sense, to include sub-cities, hospitals and health centers. I selected all ten sub-cities, all five regional hospitals and nine health centers based on the recommendations from the interviewed staff in each sub-city. The rationale for making the study multi-level is to see similarities and differences across and among levels.

3.4 Data Collection Methods

The study combined multiple types of scientifically accepted qualitative data collection methods and techniques that include interviews, observation, document and computational artifact/software analysis.

**IN-DEPTH INTERVIEWS**

Interview is a qualitative research tool that allows the researcher to access data about thoughts, beliefs, feelings and previous experiences of respondents (Silverman, 2005; Creswell, 2003). Interview also allows researchers to pose more questions and to obtain detailed answer and clarification about a topic of interest (Creswell, 2003). Likewise, during the empirical phase of this study, interviews were conducted to understand the personal perspectives of health information workers and managers at various levels of the Addis Ababa health bureau on human, technological, managerial and organizational issues that influence the sustainability or long-term viability of the existing computer-based health information system.

Initially, I had informal discussions and meeting with various HISP-Addis Ababa members to introduce my self to various health information system issues at Addis Ababa Health Bureau (AAHB). Based on the issues raised in the informal discussion and meeting, I select candidates for the interview at sub-city health offices and hospitals which I consider that they can answer my research questions. And the selection of candidates for the interview at health centers was based on recommendations from interviewed staff at higher levels i.e. staff at sub-city health offices.

Interview guide was prepared to cover a wide range of sustainability issues. The questions were open-ended in nature (See appendix G) to gain holistic picture and understanding about challenges and opportunities for sustainability of the existing computer-based health information system in Addis Ababa health bureau which are particularly related with human, technological, managerial and organizational issues. The interview questions were not uniform rather it was articulated to be suitable for different settings for example, to sub-city health offices, to hospitals and to health centers. Efforts have been made to make the interview questions more clear and understandable to respondents. Besides to the guiding interview questions, I have also used probing questions to explore details about issues raised by respondents during the interview time. For example for the question “how do you think about the quality of the...
data you obtain from health centers?” the respondent gives his explanation about the cause for poor quality data and I forwarded probing question “what kind of wrong data for example?” to explore more evidences and facts which are really helpful to gain thick description and understanding in this regard. As I made more and more interviews, the interviews became more focused, interesting and I started to share and use the same language (terminologies) with respondents which really facilitate the communication and understanding on the various issues raised during interview sessions.

Both telephone and mainly face-to-face interviews were conducted for this study. A total of 26 interviews were conducted (See Table 3-1 for the number of interviewees and their job position). Face-to-face interviews were conducted at work places of respondents. Respondents were composed of health information workers at sub-city health offices, manager, statisticians at hospitals and health centers and HISP-Addis Ababa team members. Prior to the interview, all respondents were asked to make a schedule that is convenient and preferable for the interview session. All respondents show willingness to be interviewed after I describe the purpose of the interview and when I explicitly tell them that I came from regional health bureau and HISP-Ethiopia project. Duration of the interviews varied from 20 to 50 minutes. Among 26 interviews, 16 were tape recorded and subsequently transcribed. To all respondents, attempts were made to give more explanation and clarification about the purpose of my recordings. Some of the respondents refuse to do so but most were comfortable and interviews were tape-recorded. Tape recording the respondents offers me the opportunity to access rich data which relatively allows me to make better data analysis and interpretation for this study when compared to the 10 non-recorded interviews. In all interviews, field notes were maintained occasionally to document empirical evidences as well as to motivate respondents for more explanation.

Interview data obtained from higher levels such as sub-city health offices, were cross checked through interviews conducted in lower-levels of the health care system such as health centers. For example, I obtained data about statisticians’ educational background in health centers from health information workers at sub-city health offices and the validity of this was confirmed by asking the statisticians themselves at health centers included in this study.
<table>
<thead>
<tr>
<th>Institution</th>
<th>Job position</th>
<th>Interview Duration Time</th>
<th>Face-to-face (F2F) / Telephone (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-city</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addis ketema</td>
<td>Another position permanently and working as health information worker in his part time</td>
<td>40 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Akaki-Kaliti</td>
<td>Another position permanently and working as health information worker in his part time</td>
<td>35-40 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Kirkos</td>
<td>Pharmacist and working health information worker in his part time</td>
<td>45 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Arada</td>
<td>Manager</td>
<td>30-35 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Bole</td>
<td>Health information worker</td>
<td>40 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Gullele</td>
<td>Health information worker</td>
<td>35-40 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Kolfe</td>
<td>Health information worker</td>
<td>40-45 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Lideta</td>
<td>Health information worker</td>
<td>40 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Nifas silk</td>
<td>Health information worker</td>
<td>40-45 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Yeka</td>
<td>Health information worker</td>
<td>30 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ghandi</td>
<td>Worked as statistician (now in different position)</td>
<td>40-45 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Ras desta</td>
<td>Statistician</td>
<td>45 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Yekatit 12</td>
<td>Statistician</td>
<td>45-50 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Menilik</td>
<td>Statisticist</td>
<td>20 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Health-center</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ljeta</td>
<td>Statisticist</td>
<td>20-25 mns</td>
<td>T</td>
</tr>
<tr>
<td>Woreda 7</td>
<td>Statisticist</td>
<td>20-25 mns</td>
<td>T</td>
</tr>
<tr>
<td>Akaki HC</td>
<td>Statisticist</td>
<td>35-40 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Addis Ketema</td>
<td>Statisticist</td>
<td>35 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Selam HC</td>
<td>Statisticist</td>
<td>45 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Kutre 1</td>
<td>Statisticist</td>
<td>20-25 mns</td>
<td>T</td>
</tr>
<tr>
<td>Woreda 17 HC</td>
<td>Statisticist</td>
<td>20-25 mns</td>
<td>T</td>
</tr>
<tr>
<td>Beletshachew HC</td>
<td>Statisticist</td>
<td>20-25 mns</td>
<td>T</td>
</tr>
<tr>
<td>Kazanchis HC</td>
<td>Statisticist</td>
<td>40 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>HISP-Ethiopia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHD-student</td>
<td></td>
<td>50 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>HISP-Addis Ababa coordinator</td>
<td></td>
<td>20-30 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>HISP-Addis Ababa facilitator</td>
<td></td>
<td>45 mns</td>
<td>F2F</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

Table 3-1 Research sites, Number of Interviewees and Their Respective Positions.

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OBSERVATION

Observation is a data collection method that allows the researcher to have first hand information about practices or processes in the research site by studying respondents, what they do and the way they do things (Silverman, 2005; Creswell, 2003). Furthermore, observational data obtained as a result of observation of actual behavior could be used to cross check verbal response of subjects during an interview (Silverman, 2005). I made observation and took field notes during interview sessions to understand various standard and non-standard reporting forms; work practices such as managing health data using DHIS software and other data collection and compilation tools (such as hand drawn tally sheets); illegible and incomplete reporting forms; new data elements and new reporting formats; infrastructure like availability of computers including its processing capacity and availability of telecommunication facilities such as telephones and network connections. The data obtained through observation was also used to triangulate or to cross check the validity of the data obtained through interviews. For example, presence of poor quality data was cross-checked by observing illegible and incomplete data from the reporting forms.

DOCUMENTS AND COMPUTATIONAL ARTIFACT ANALYSIS

In qualitative research, documents are useful sources of data since it can be used as written evidence as well as it enables the researcher to gain more data about respondents (Creswell, 2003). This method helped the researcher to develop understanding about various issues which have due importance for this research. Documents and computational artifact analyzed and the purpose for analysis is presented in Table 3-2.
### Documents/artifact analyzed

<table>
<thead>
<tr>
<th>National policy document on ICT</th>
<th>To understand existing policies on ICTs in Ethiopia</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Health sector Development Program (HSDP III, 2005)</td>
<td>To get data on the initiatives for health and health information system reforms and to understand the economic and infrastructural aspect in Ethiopian health care system</td>
</tr>
<tr>
<td>Publications from FMOH planning and programming department</td>
<td>To obtain health information related issues and statistical data on health and health information system</td>
</tr>
<tr>
<td>World bank public expenditure review</td>
<td>To understand the context of the public health system and public health expenditure in Ethiopia</td>
</tr>
<tr>
<td>DHIS 1.4 manual and the software</td>
<td>To master its functionalities and to facilitate understanding with the subjects of this study and to give support to respondents while visiting for data collection purposes</td>
</tr>
<tr>
<td>Various web pages/sites and e-books</td>
<td>To gain better insight about different issues which have importance to the topic under this study</td>
</tr>
<tr>
<td>Various literatures on Information Systems in organizations drawn from IS literature</td>
<td>To develop conceptual frame work to guide the study</td>
</tr>
</tbody>
</table>

**Table 3-2 Documents and Other Artifacts Analyzed**

### 3.5 Data Analysis

To make analysis of the data collected during the empirical phase of this study, I read all the transcripts and field notes several times at different phases of writing this thesis in order to: draw themes for this study, extract data which are helpful to describe the case and mostly to understand the meanings sedimented in the texts (transcripts and field notes) that can potentially provide answers to my research questions. Accordingly, four themes for sustainability were drawn from the data: human related issues, information related issues, infrastructural issues and managerial and organizational issues. Several attempts and care have been made to avoid and minimize my own biased interpretation and to make my personal interpretation from the perspectives of respondents at various levels of the Addis Ababa health bureau. The following four excerpts are taken from the data collected during the empirical phase of
this study to show how the transcripts and field notes are analyzed and interpreted for the questions of this study.

Human related issue:

To work the task it is important to get training....If I had detailed knowledge in the software, I could have performed the task more efficiently. For example to fill data elements in to the software, I spent considerable time in the manual. This week we opened three new clinics, to enter the name of these clinics in to the system, I am still struggling to get ideas from the manual and I am spending much time on this... another problem is generating reports up on managers request. If they ask for annual report I could not generate and I end up generating monthly report since I am working by trial and error (working as information desk expert, Nov. 2006).

From my interpretive perspective, the above words are interpreted as human resource related challenge to sustainability of the computer-based health information system in Addis Ababa health bureau. This means that, the user lacks appropriate and sufficient training to properly utilize the system (for example, not able to redefine the org-unit functionality of DHIS software and not able to deliver required reports to managers) which through time minimizes system use and decreases the motivation of health care managers towards using and trusting the quality of the report produced from the computer-based health information system.

Another human related issue:

Data collectors at lower levels are Para-medicals. So they do not have the knowledge to track errors and check the accuracy of the data they are reporting. They do not understand the actual meaning of the figures since they do not have health care background. I recommend if the positions are taken by people with health care background so that they can correct possible errors on the spot (information desk expert, Oct. 2006)

The above excerpt in combination with other excerpts taken from interviews in this regard was also interpreted as one challenge to sustainability of the computer-based system. The meaning that can be interpreted from the above excerpt is the influence that professional career/education background exerts on quality of the information produced. More specifically, data collectors’ lack of background from health sciences is contributing to production of poor quality data which is a threat to the usability and sustainability of the computer-based health information system.

The following excerpt together with similar responses from other respondents was interpreted as challenge to sustainability which is related to lack of managerial support and organizational commitment towards providing supervisory and feedback supports to facilitate production of good quality data and information use:

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There is no feedback for example, last month I sent inaccurate data about cholera, but no body traced the problem rather it was me who gave them the correct figure when I recognized that I sent the wrong data (Hospital statistician, 2006).

3.6 Validity and reliability of Findings

Validity of the findings of this qualitative study was critically investigated at various stages of the study. As described in section 3.4, triangulation of various sources of data was undertaken to enhance the quality of the data collected for the study. In addition, personal attempts were made to make the process of data analysis and interpretation valid by re-reading the transcripts and field notes to hear what they are saying about the questions guiding the study. Moreover, a peer-debriefing technique, which is a technique that suggests giving piece of work to colleague/s to conduct critiques of ideas on the work, was also used to minimize researchers’ bias which could be brought in to the study (Creswell, 2003).

3.7 Ethical Considerations

The overall objective of this thesis is to identify challenges and opportunities to sustainability of the computer-based health information system at AAHB and to recommend possible solutions for the problems identified with the objective to empower health care managers at various levels of AAHB to use good quality information for action. Entrance letter written from University of Oslo was copied and used as a means to obtain access to all research sites in AAHB (See appendix A). Besides, all subjects of this study were informed about the purpose of the study. Respondents were also encouraged to ask questions which are not clear for them during interview sessions. Willingness of respondents on tape recording was highly respected. And names of all respondents were masked. Ethical issues were considered not only during data collection and analysis phases but also during the writing phase this thesis. For example, attempts have been made to use gender neutral words.

3.8 Limitations of the Study

The present study has certain limitations. Limitation of time and resources with regard to this study makes the field study of this research to be restricted to sub-city health offices, hospitals and some health centers. The study did not address the situation in some health centers and in the top level, Addis Ababa regional health bureau. Even though, the study conducted at health centers might not have impact on the results of this study (since majority of the health centers are included in the study), the exclusion of the study in Addis Ababa health bureau blunted the political dimension of the research. Nonetheless, this situation allows the present author to provide detailed information on the similarities and differences of the phenomenon by focusing on all
sub-city health offices, hospitals and most health centers. These limitations of the study could also be a source that informs active research area for further study.

The other limitation of this study is related to researchers’ experience on the methodology adopted. To begin with, the research methodology adopted in this study (i.e. qualitative research) is my first experience to work on. This lack of exposure might have its own influence on the richness of the interpretation I made to the raw data. However, several reading and discussion with colleagues have been made to make the interpretation process more valid and ethical.

3.9 Summary

This chapter contains description about methodological issues of the study. It described the research tradition employed, research strategy adopted, subjects and research sites selected for the present study, data collection techniques used and modes of analysis for the raw data. It also presented attempts done to enhance the validity of the findings, ethical considerations and limitations of the study. In the next chapter the focus is on presenting background information about the research setting and research context in which this study is conducted.
4

RESEARCH SETTING and BACKGROUND

4.1 Background about Ethiopia

GEOGRAPHY AND CLIMATE

Ethiopia is a country which is situated in Eastern Africa between 3 and 15° north latitude and 33 and 48° east longitude with an area of 1,127, 127 sq. KM. Ethiopia is now land locked country after the de jure independence of Eritrea on 24th may, 1993 (World fact book, 2007). Bounded on the North East by Eritrea and Djibouti, on the East and Southeast by Somalia, on the Southeast by Kenya and on the West and North West by Sudan, Ethiopia is Africa’s oldest independent country which has never been colonised2 (A map of the country can be seen in Figure 4-1).

Its topographic features range from peaks as high as 4, 620 m above see level at Ras Dashen to 125 m below sea level in Afar( Denkel depression) with most of the country categorized as highland which lies above 1,500 meters above sea level (FMoH HSDP-III, 2006). There are three broad ecological zones that follow the topography of the country. The “Kola” or hot lowlands are found below approximately 1000 m, the “Weyna dega” between 1000-1500 m, and the “Dega” or cool temperate highlands between 1500 and 3000 m above sea level (FMoH HSDP- III, 2006). Mean annual temperature varies from 10-16 °c in the “Dega”, 16-29 °c in the “Weyna dega” and 23-33 °c in “Kolla”. Distribution of rainfall varies according to geographical locations; the highlands receive more rain than the lowlands with annual rainfall of 500mm to over 2000mm for highlands and 300mm to 700mm to lowlands (MoH HSDP- III, 2006).

ADMINISTRATIVE STRUCTURE

The new constitution which was established in 1994 created federal government structure which is composed of nine national regional states namely: Tigray, Afar, Amhara, Oromia, Somali, Benshangul Gumuz, Southern Nations Nationalities and peoples, Gambella and Harari and two city administrations called Addis Ababa and Dire Dawa (See Figure 4.1 below). Following the new governmental structure and as a

2 http://news.bbc.co.uk/2/hi/africa/country_profiles/1072164.stm
consequence of the decentralization policy power and responsibility were transferred to these regional governments (WHO, 2004). Accordingly, responsibilities of health care provision and management were also shared with regional states.

Figure 4-1 Map of Ethiopia.

The National Regional states and City Administrations are further divided into 611 districts (Woredas) and 15,000 Kebeles (which is the lowest administrative boundary in the hierarchy) organized under peasant associations in rural areas and urban dwellers associations in towns (FMoH HSDP-III, 2006).
Research Setting and Background

DEMOGRAPHY AND POPULATION

Ethiopia has a population of 75,067,000 and is the second most populous country in sub-Saharan Africa (FMoH, 2006) following Nigeria. According to World fact book (2007) estimation, annual population growth rate is 2.27% which means that the population is growing by 2 million people per annum. More than 85% of the population lives in rural areas which makes Ethiopia one of the least urbanized countries of the world (FMoH HSDP- III, 2006).

Although there is big discrepancy across regions, the national average for population density is 57 per sq. km. Higher densities are found in the highland areas, mostly above 1,500 meters above sea level. On the average 50% of the land area in the country represents sparsely populated areas with nomadic and semi-nomadic pastoral people living in arid plains or in a semi-desert environment (FMoH HSDP- III, 2006).

The structure of the population is characterised by 45% under the age of 15 years and 51.1% of the population is between the ages of 15 and 59 years, and only 4.6% is aged 60 years and above. Total fertility rate for the country is high about 5.9 children per woman (Demographic parameters of the country can be seen in Table 4-1). But fertility rate significantly varies between urban and rural areas which is higher in rural areas; and it also varies across administrative regions for example, 6.4 births per mother in Oromia and 1.9 births per mother in Addis Ababa (FMoH HSDP- III, 2006).

Table 4-1 Demographic Parameters of Ethiopia.

<table>
<thead>
<tr>
<th>Major demographic parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude birth rate</td>
<td>37.39</td>
</tr>
<tr>
<td>Per 1000</td>
<td></td>
</tr>
<tr>
<td>Crude death rate</td>
<td>14.63</td>
</tr>
<tr>
<td>Per 1000</td>
<td></td>
</tr>
<tr>
<td>Total fertility rate</td>
<td>5.1</td>
</tr>
<tr>
<td>Per woman</td>
<td></td>
</tr>
<tr>
<td>Infant mortality rate</td>
<td>81.99</td>
</tr>
<tr>
<td>Per 1000</td>
<td></td>
</tr>
<tr>
<td>Life expectancy</td>
<td></td>
</tr>
<tr>
<td>Per population</td>
<td>49.23</td>
</tr>
<tr>
<td></td>
<td>48.06</td>
</tr>
<tr>
<td></td>
<td>Per male</td>
</tr>
<tr>
<td></td>
<td>50.44</td>
</tr>
<tr>
<td></td>
<td>Per female</td>
</tr>
</tbody>
</table>

(Source: World fact Book, 2007.)

SOCIO-ECONOMIC PROFILE

Ethiopia is one of the least developed countries in the world with low per capita income of 100 USD. Poverty is pervasive with 47% of the population estimated to live below the poverty line (HSDP III, 2005). In 2006, the structure of the economy (in percentage of GDP) was: agriculture accounts for about 46.7% and employees about 80

Evaluating challenges and opportunities for sustainability of computer-based health information system in Ethiopia: case study from Addis Ababa
% of the labour force in the country, industry account for about 12.9% and employees around 8% of the total labour force and services 40.4%. The agricultural based economy is highly dependent on coffee exports, for example, in 2006 the country earned $350 million from this sector. Although the agricultural sector is the backbone of the countries’ economy, it could not bring significant change and the required development because of dependency on traditional way of farming and poor cultivation practices as well as due to its dependency on rain water which is vulnerable to frequent drought. National income of the country is very low and so is the expenditure in public health (World Bank, 2004). For example, 30% of total GDP is spent on the public sector and only 5% of this budget goes to the health sector. For example, in 2006, public health expenditure was only 1.5% of the total GDP. Until 2002, the public expenditure almost remained the same except for the year 1999 which dropped to 1.1% due to the war with Eritrea (Ibid) (See Figure 4-2).

**Figure 4-2 Public Health Expenditure as of 1990/91-2001/02 Gregorian calendar.**

**HEALTH STATUS AND ASSOCIATED PROBLEMS**

The health status in Ethiopia is extremely poor with very low life expectancy for example; currently the average life expectancy is only 49 years (World Bank Report, 2004). Major killer diseases are Tuberculosis (TB), respiratory illness, malaria, gastrointestinal infection, meningitis and HIV/AIDS. Poverty, malnutrition, low levels of education, high fertility, limited sanitation and inadequate health services are some of the factors that contribute for the existing poor health status in the country (Ibid).
According to the MoH health indicators report of 2006, ten disease that cause death in the year 2006 in Ethiopia is depicted in Figure 4-3.

Figure 4-3 Top Ten Leading Causes of Death as of 2006.  
(Source: From health and health related indicators 2006, Addis Ababa)

Health service coverage is also very limited compared to the total population of the country. For example, currently, in Ethiopia there are 138 hospitals of which 86 are administered by ministry of health and 52 by Non Governmental Organisations (NGOs), private sector and others. There are 635 health centres of which 620 are administered by Ministry of health (MoH) and 15 by others. There are also 1,206 health stations and 5,955 health posts all over the country (MoH, 2006). With regard to human resources for the health service provision, currently there are only 2,115 doctors and 17,845 nurses for more than 75 million people all over the country (FMOH, 2006).

TECHNOLOGICAL INFRASTRUCTURE INDICATORS

The introduction of telecommunication service in Ethiopia dates back to 1894. However, expansion of fixed telephone lines nation wide and adoption of new telecommunication innovation is pitifully lagging behind and is putting Ethiopia at the bottom of the list of global Information and Communication Technology (ICT) diffusion. Despite recent efforts of privatization in various sectors of the country, the telecommunication service remains at the hand of the government. The Ethiopian Telecommunication Corporation (ETC) is the only fixed and mobile telephone services, fax, telegraph and telex services, internet service and data network service.
provider. It is widely believed that government policy on monopolizing the telecom service provision is one great impediment for expansion and evolution of telecommunication infrastructure in the country.

On the study conducted to track ICT penetration in education, health and public sectors (such as federal ministries and regional bureaus) in Ethiopia, Mulat and Tadesse (2002) indicated that as of 2002, telephone service was only satisfying 65% of the demand of the country. In addition, the authors noted that ICT penetration in the health sector is very low compared to other sectors which they incorporated in their study (i.e. education and public sector). Furthermore, they indicated that penetration and usage of ICTs in government owned health and education institutions is extremely low compared to privately owned institutions or NGOs. Mulat and Tadesse (2002) also point out that regional towns are less advantaged than Addis Ababa (the capital city) in terms of ICT diffusion and usage.

4.2 Addis Ababa

Addis Ababa is the capital city of Ethiopia. It was founded by emperor Menilik II and his wife Taitu in 1887. It is situated at 09.02° North latitude and 38.42° East longitude. The king initially settled in “Entoto”, a mountainous area which is located in the northern part of Addis Ababa, due to its strategic location since it stood on an easily defensible plateau. At the time of its establishment there were 50,000 households, most of them were soldiers and their families. It is possible to say that it was like military camp with small number of houses made up of tents. Soon after establishment, some fine buildings like churches and Menilik’s palace started to emerge. Since then Addis Ababa became seat of governments and centre for economic, social and cultural activities of the country. The name Addis Ababa literally means “new flower” and is coined by Queen Taitu. Addis Ababa is now the biggest and semi-metropolitan city with an area of 450 square KM. Until very recently there was no urban planning and the architecture of the city varies from tall building, elegant villas functional bungalows, flat fashionable hotels, conference halls and the theatres to traditional homes of wattle and daub, surrounded by cattle, sheep, goats and chickens. Addis has two major seasons in the year. The dry season called “Bega”, prevails from October through may and the rainy season “kiremt” takes place between the months of June to September. Addis is seat of the Federal government, United Nations Economic Commission for Africa since 1988 and Organization of African Union (OAU) and latter African Union (AU) since 1963.

3 http://www.addisbabacity.gov.et/History.htm
4 http://www.tourismethiopia.org/pages/addis.asp
POPULATION

Currently, according to central statistics authority report of July, 2006, total population of the city is about 2,973,000 with 1,428,000 male and 1,545,000 female.

SOCIO-ECONOMIC PROFILE

The economy of the city is dependent on large and small industries, commercial activities, farming in rural areas as well as informal agriculture in the city (World Bank, 1998). Comparatively, being the capital, Addis has better infrastructure like highways, roads, airport, water supply, electric power and telecommunications than other cities. At the present time, projects for road construction are appearing at different parts of the city. The first Ring road in the country is constructed in Addis; other roads like China-Ethiopia road, Gotera-Kirkos road and Adowa road are constructed and other projects like building complex interchange road around Gotera are currently undergoing construction. Regarding the electricity supply there is continuous interruption of power. However, when it is compared to other cities in the country which obtain power supply on a shift basis, one can say that Addis has better infrastructure in this regard. Similar to the electric power, telecommunication services primarily focus on urban areas of the country and Addis being the capital city is more beneficiary every time new technology is introduced.

Administratively, there is three-tier government system in Addis Ababa city Administration (AACA). City-level represents the mayor of the city; sub-city administration refers to sub-cities and the kebele administration (which is the lowest administrative boundary in the hierarchy). Addis is divided into ten sub-cities and each sub-city has an average about ten kebeles. The following map depicts the kebele, sub-city and city boundary.

http://www.addisababacity.gov.et/Map_addis.htm
Figure 4- 4 Map of Addis Ababa.  
(Source: Addis Ababa city administration)

**HEALTH STATUS AND SERVICES**

As the result of the decentralisation policy introduced in 1992 in the country, public health services in Addis are provided by Addis Ababa Health Bureau (AAHB). The health bureau is an autonomous institution which has a mandate to organize,
coordinate, regulate, deliver and manage public health care services in the city. Currently, in Addis Ababa there are about 29 hospitals of which 5 are administered by the AAHB, and 24 are owned by either NGOs or the private sector. There are 29 health centres of which 24 are managed by AAHB and 5 by others. There are also 8 health stations and 36 health posts in the city as of 2006 (FMoH, 2006).

Majority of the population in Addis gets health services from primary health care units (such as clinics and health centres) with reasonable accessibility and affordability (Addis Ababa City Administration Health Bureau, 2002). The total number of health professionals actively working in the various health institutions of the region as of 2006 are 240 Medical Doctors, 652 Nurses, and 92 health assistants (FMoH, 2006).

### 4.3 Health Information System Program

Health Information System Program (HISP) is a research project under which this study is conducted. HISP is an extensive South-South-North network with a focus on information systems for public health care (Braa, 2007). It was founded in South Africa by researchers from Norway and university of Western Cape (Braa et al., 2004). The primary goal of HISP is to design, implement sustainable health information system following a participatory approach to support local management of health care delivery and its further spread within and across developing countries. Accordingly, HISP has carried out country wide implementation of sustainable and scalable health information system in South Africa and is currently operating in Mozambique, India, Tanzania (including Zanzibar), Ethiopia, Malawi, Botswana, Nigeria, Namibia, Zambia and Vietnam, with the objective of HIS design, development and implementation of computer-based health information system, including improved use of information and development of human and organisational resources (Braa and Hedberg, 2002; Braa et al., 2004; Braa et al, 2007b). HISP seeks to address existing problems of health service delivery in poor countries by strengthening health information systems according to local needs (Braa et al., 2004).

As part of its integrated effort to achieve its objectives, this research project has developed a data based application called District Health Information System (DHIS) software. The first version of the software is DHIS 1.3 which relies on MS office for its core modules. New developments are continuously incorporated in to the software and the most recent version of the software is DHIS 2.0. DHIS 2.0 is an open source and web enabled software which can be accessed through the internet. Java programming language was used to develop the software. It is platform independent and can run on windows as well as Linux and Mac operating systems. Currently the user interface can support several languages including English, Vietnamese, Hindi, Gujarati, Amharic and Norwegian.

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6 [http://www.hisp.info/confluence/display/DHIS2/DHIS+2+Features](http://www.hisp.info/confluence/display/DHIS2/DHIS+2+Features)
HISP initiated health information system research and development in Ethiopia in early 2003, as a result of collaboration between the Department of Informatics University of Oslo and the Department of Information Science Addis Ababa University. HISP is now taking part in the process of health information system reform in five regional states namely; Addis Ababa, Tigray, Oromia, Amhara and Benishangul Gumuz.

As a partial fulfilment of the requirements for the degree of masters from University of Oslo as well as to practice scientific writing and reporting, I enrolled to HISP network, which is an ongoing full fledged research project participating in design and implementation of sustainable information system in public health care areas in several countries worldwide.

Accordingly, I situated my study under this wide network and I specifically conducted my study in HISP-Addis Addis Ababa project which is one part of the global- HISP network.

At the beginning, the implementation process of the DHIS software was initiated at Addis Ababa health bureau. In 2004, the HISP-Ethiopia team developed a DHIS software prototype and demonstrated to health workers and managers at regional health bureau to show the functionalities of the software and to gain organisational and managerial commitment to support its successful implementation. Following the demonstration, HISP-Ethiopia was asked and backed by the high level leadership of the former head of the bureau to make city-wide implementation of DHIS software (Braa et al, 2007a). The process of implementing the software in all sub-city health offices, all hospitals and almost all health centres were undertaken during the period of 2004-2005 (Ibid). Standardisation of fragmented and redundant data elements was one of the important aspects of the health information system restructuring process (Woldeyohannes and Molla, 2005). Soon after the implementation of the new system, in July 2005 assessment was performed on the annum data reporting processes and it was pronounced as useful health information system (Braa et al, 2007b).

Currently, DHIS version 1.3 is running at different levels of the Addis Ababa health bureau. The following is screenshot of the software taken from one of the sub-city health offices during the empirical phase of this study.
In this chapter, I presented the geographical facts, administrative structure, and socio-economic profile of Ethiopia. Besides, the chapter outlines health-status and associated problems and technological infrastructure indicators of the country. Since this study was conducted at Addis Ababa city (the capital); demographic facts, socio-economic profile and health status of the city was also presented. Furthermore, description of HISP; about its initiation, major goals, current international status as well as its current status in Ethiopia is also provided. The next chapter presents key empirical investigations and findings of the study.
5

EMPIRICAL INVESTIGATIONS AND FINDINGS

This chapter reports the empirical results and findings of the case study which is conducted at different levels of the administration structure of the Addis Ababa Regional Health Bureau. The chapter is organized into three major sections. The chapter begins by presenting research results of the assessment conducted at sub-city health offices. Under each section of this chapter, issues related with human resource, information processes, infrastructure and managerial support for the computer-based health information system are presented. In the following section there is a focus in presenting research results from the study in sub-city health offices. Similar to sub-city health offices, in the following section research findings from hospitals are presented. The third and final section of this chapter describes the empirical results of the study conducted at health centers. The chapter will conclude with a brief summary of the key research findings and serve as a background to the analysis and discussion chapter, which follows.
5.1 Assessment conducted in sub-city health offices

In the current structure of the Addis Ababa City Administration (AACA), there are ten sub-city administrations which are hierarchically accountable to AACA and are responsible for managing and coordinating the social, economic and health status of the population living in each respective sub-city. Sub-city Health Offices (SHOs) are an integral part within the sub-city administration which are responsible for the well being (health) of the population living within the sub-city (See Table 5-1. for detail about the population size in each sub-city administrations). So, the focus of this section will be on Health Management Information System (HMIS) related activities within the SHOs. Therefore, the following sub-sections present the empirical investigation conducted by the researcher with respect to human resource, information process, infrastructure and managerial support.

Tabel 5- 1 The Ten Sub-cities, Population size and Kebeles.

<table>
<thead>
<tr>
<th>Sub cities</th>
<th>population</th>
<th>Kebeles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addis ketema</td>
<td>320,389</td>
<td>9</td>
</tr>
<tr>
<td>Akaki</td>
<td>182,502</td>
<td>8</td>
</tr>
<tr>
<td>Arada</td>
<td>303,810</td>
<td>10</td>
</tr>
<tr>
<td>Bole</td>
<td>298,000</td>
<td>11</td>
</tr>
<tr>
<td>Gullele</td>
<td>333,998</td>
<td>10</td>
</tr>
<tr>
<td>Kirkos</td>
<td>318,508</td>
<td>11</td>
</tr>
<tr>
<td>Kolfe</td>
<td>261,235</td>
<td>10</td>
</tr>
<tr>
<td>Lideta</td>
<td>296,073</td>
<td>9</td>
</tr>
<tr>
<td>Nifas silk</td>
<td>304,550</td>
<td>10</td>
</tr>
<tr>
<td>Yeka</td>
<td>304,550</td>
<td>11</td>
</tr>
</tbody>
</table>

(Source: From Addis Ababa city administration official website7)

HUMAN RESOURCE

♦ Formal Posts

In all SHOs, there is budget for the position “information desk expert” responsible for performing HIS related activities. Information desk experts also have an office in order to perform their day to day duties. There is uniform allocation of staff in all SHOs i.e. one staff for the position. However, at the time of this research, trained health information workers who were working in four SHOs were not in their job for various reasons such as resignation, taking long vacations and staff transfer to other positions.

with in the SHO. All the interviewees who were working as “information desk expert” have a background in health sciences and most of them are public nurses (See Table 5-2). Even though, there is budget to recruit full-time HIS workers in each sub-city, there are four sub-cities which did not yet assign full time HIS staff. My investigation regarding issues related with human resources also revealed a case where data reporting to the next higher level is quit for the last four months due to lack of assigned manpower that works on DHIS software. The manager of this SHO described the situation as follows:

*During the implementation process of DHIS in 2004, there were two staff members who received training on DHIS software. One is health care provider responsible for the task and the other was family health expert. The family health expert passed away before four months and almost at the same time, the one who was responsible for the task leaves the organization. Unfortunately, the position is now vacant. Hence we are using the hard copy format to send reports to the higher level (Manager, Nov, 2006).*

I further asked the respondent the reasons for not recruiting staff for such long time when there is a budget for the position. Replying to this question the respondent stated that:

*No one is happy to work with this salary, even employees who are working in the health centers. In case if we find someone for the position, they will lose their interest because there is no scheme for promotion. Due to all these reasons it is not possible to recruit new staff and to retain staff. We are trying to recruit staff as much as we can, we are trying to assess some one who has skill on computer basics as well as background on health sciences.*

This reason seems rationalization for me because this SHO is the exceptional case for not assigning staff for long time. Other three sub-cities who did not yet recruit full-time HIS worker are trying to address such problems by temporarily assigning staff members who have other responsibilities in the SHOs. According to my investigation, the newly assigned staff members are usually nominated based on the skills and background they have on computer basics. Most of them did not receive formal training on DHIS software, but they are performing the job based on their own efforts and on-the-job training given to them by the HISP Addis facilitator. For example, one of the newly assigned staff who is trying to perform the task with out getting formal training stated that:

*Here I am working as my second job. My profession is pharmacy. I am working here because the girl that was responsible for the sub city information desk position is in leave for long time. I have been assigned to perform the job because I have knowledge in computer operation and software programming. To carry out the task it is important to get training, I have not get formal training in this regard, I am working based on the manual I read and based on some orientation from HISP- facilitator. (working as information desk expert Nov, 2006)*
These problems may show the existing high HIS staff turnover and lack of properly skilled HIS personnel in the specified sub-city health offices.

♦ Training

As to Lippeveld et al (2000), well trained staff is necessary if not sufficient condition to produce valid, reliable and useful information. Majority of the respondents in SHOs indicated that they have received training which was provided by HISP-Ethiopia in collaboration with the regional health bureau. But all stated that they did not receive further training for more than one year. Besides, most of the previously trained staff members who are working as information desk experts feel that they do not have adequate knowledge and skills to operate DHIS software effectively. As one of the respondents stated:

*I can work on data entry efficiently but I need more training to generate HIV reports on governmental health centers for example (Information desk expert, Oct. 2006).*

Lack of such skills may affect the level of information use since managers in this and similar conditions might not obtain the information they need in a timely manner. Training is critical to perform data entry, data processing, data presentation and report generation activities. However, as to the result of this study, one case has been identified where staff member is working the task mainly by his own personal efforts. Furthermore, in this specific case it is identified that even standard report generation was not properly accomplished due to lack of training about the software in use. He described the problems faced so far as:

*To work the task it is important to get training....If I had detailed knowledge in the software, I could have performed the task more efficiently. For example to fill data elements in to the software, I spent considerable time in the manual. This week we opened three new clinics, to enter the name of these clinics in to the system, I am still struggling to get ideas from the manual and I am spending much time on this... another problem is generating reports up on managers request. If they ask for annual report I could not generate and I end up generating monthly report since I am working by trial and error (working as information desk expert, Nov. 2006).*

The respondent also stated that section heads in the SHO, prefer and usually request reports from DHIS software. However, since the assigned manpower is not capable of generating standard reports as required, section heads are forced to use the competitor system i.e. the paper-based report (since data reporting from health facilities is done both in soft copy and in paper-based form).

On the other hand, some health information workers who took training on DHIS software feel that the training they have received so far is adequate. They also described that there are DHIS software functionalities such as pivot table which they
are not yet familiar with by mentioning reasons such as lack of hands on exercise and lack of computer. One amongst these respondents said:

"...I think the training given is adequate, although I can not perform all the functionalities due to lack of computer to practice (information desk expert, 2006)."

### Table 5-2 Qualification of HIS Staff in Ten Sub-cities.

<table>
<thead>
<tr>
<th>Sub-city</th>
<th>Qualification</th>
<th>Received training by HISP</th>
<th>Fulltime/additional job</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addis ketema</td>
<td>Nurse</td>
<td>No</td>
<td>Additional</td>
<td>Less than 1 year</td>
</tr>
<tr>
<td>Akaki</td>
<td>Nurse</td>
<td>Yes</td>
<td>Additional</td>
<td>2 years</td>
</tr>
<tr>
<td>Arada</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bole</td>
<td>Public nurse</td>
<td>Yes</td>
<td>Full time</td>
<td>3 years</td>
</tr>
<tr>
<td>Gullele</td>
<td>Public nurse</td>
<td>Yes</td>
<td>Full time</td>
<td>3 years</td>
</tr>
<tr>
<td>Kirkos</td>
<td>Pharmacist</td>
<td>No</td>
<td>Additional</td>
<td>Less than 1 year</td>
</tr>
<tr>
<td>Kolfe</td>
<td>Public nurse</td>
<td>Yes</td>
<td>Full time</td>
<td>3 years</td>
</tr>
<tr>
<td>Lideta</td>
<td>Public nurse</td>
<td>Yes</td>
<td>Full time</td>
<td>3 years</td>
</tr>
<tr>
<td>Nifas silk</td>
<td>Public nurse</td>
<td>Yes</td>
<td>Full time</td>
<td>3 years</td>
</tr>
<tr>
<td>Yeka</td>
<td>Public nurse</td>
<td>Yes</td>
<td>Full time</td>
<td>3 years</td>
</tr>
</tbody>
</table>


#### Availability of substitutes

During the implementation of DHIS in Addis Ababa, strategies were designed by HISP- Ethiopia team and the Addis Ababa health bureau to make the information system work smoothly. The strategy devised was to give training for at least two personnel from each SHOs so that to ensure the HIS work is done smoothly. Even though, training was given for two staff members in most sub-cities, this study have shown that in all SHOs, there are no substitutes with the required skills to perform data management tasks using DHIS software specifically during the absence of the
permanently assigned staff. The following interview excerpt is taken from one of the respondents who explained the existing lack of substitutes:

Most of the times I can not take my annual leave. Sometimes if I am off they will call me and I will be forced to come back and prepare monthly reports (information desk expert, October 2006).

As to the investigation of this study, this problem exists in all SHOs and respondents indicated information work is usually discontinued in case they are absent for various reasons.

With the intent to know about why those staff members who already received training hesitate to work in case of absences, I asked the respondents for more explanation. According to the respondents, staff turn-over, lack of sense of responsibility and lack of practices after the training were described as the main reasons. One of the respondents explained this problem as follows:

....of course some one has taken training with me but due to lack of practices she can not perform the job efficiently and in my absence there is no one to perform the task (information desk expert, Oct. 2006).

Another respondent explained her feeling about why the staff member who supposed to substitute her could not able to perform the job as follows:

....there is a feeling that the job is only my own responsibility (information desk expert, Nov. 2006).

Respondents of the study from SHOs were asked for recommendations to solve the problem of inadequate human resource for the smooth performance of the job. Most of them recommend if the training is given to more than two or three personnel from one SHO so that the job will not be discontinued due to lack of human resource. As one of the respondents put it:

I recommend if training is given to all these staff members around so that one of them can do the job incase I am not here at my job (information desk expert, Nov. 2006).

DATA CAPTURE, ANALYSIS, REPORTING, TRANSMISSION AND USE

♦ Data capture and analysis

Among the ten SHOs, nine of them have computers with DHIS software for data storage, processing and retrieval. The data received from health facilities includes reports on delivery, family planning, monthly IDSR report, NRC, syndromic SDI case report, IMCI, antenatal, children vaccination, VCT, measles, and postnatal. Besides, health departments in all sub-cities receive reports from private health facilities and
NGOs for example, reports on family health and control of communicable diseases (CDC). After receiving monthly reports from health facilities which are located within the sub-city, data is entered into DHIS database by the health information worker in each respective SHOs and thus data is captured electronically at this level. As the interviews with the respondents revealed, it is specified in their job description that prior to preparing the data for analysis purposes, information workers at Sub-city level are responsible for checking and correcting errors from the reports received from health facilities. Accordingly, health information workers at SHOs carry out this activity every month when they obtain the reports from the health facilities. In this process, however, respondents indicated that they usually receive incomplete, inaccurate and exaggerated data recordings from the reports. The major cause for the inaccurate data recording from the reports from lower levels as to the respondents is mainly due to data collectors’ lack of background in health sciences. For example, information desk expert in one of the sub-cities complained about this problem as follows:

*Data collectors at lower levels are Para-medicals. So they do not have the knowledge to track errors and check the accuracy of the data they are reporting. They do not understand the actual meaning of the figures since they do not have health care background. I recommend if the positions are taken by people with health care background so that they can correct possible errors on the spot (information desk expert, Oct. 2006)*.

In the same way, most respondents confirmed presence of inaccurate data from the reports received from health facilities. One of the respondents explained his experience by saying the following:

*... they [data collectors at health facilities] fill women disease in men field and sometimes there are diseases applicable only to adults, but in some reports we find this data recorded in the child field (Information desk expert, October 2006)*.

♦ **Work load**

Staff members who are working HIS related activities as their second job also indicated that it is not possible to make data entry for all the data received from the health facilities within the sub-city due to the work load they have. One of the respondents said the following responding if he can manage to send complete data to the regional health bureau:

*I am not able to make data entry to all these reports due to the work load I have (working as information desk expert Nov, 2006)*

Due to this, incomplete data will be sent to the next higher level.
Data reporting and transmission

The process of data transmission is one important element in HIS activities which is performed to ensure timely delivery of information to higher level managers. This study emphasized vertical data transmission between different levels of the health care system, i.e. data transfer between health facilities to sub-cities and sub-cities to the Regional Health Bureau (RHB). Among 24 health centers, 17 health centers use DHIS software and send reports using diskette as a medium. Information workers in these health centers are also required to send reports in paper format because some departments such as family planning request report in hard copy (See Fig. 5-6). On the other hand, those facilities with non-computerized HIS prepare and send reports to the SHO in paper-based forms (See Fig 5-1). At sub-city level, all reports received from all health facilities are more or less captured electronically and all sub-cities send reports to the regional level electronically using diskette. Even though, information desk experts send report to planning and program department in the RHB which is responsible to transfer the reports to department managers within the bureau, department managers at the regional health bureau usually ask to their respective department in SHOs to send reports in paper format directly to them. In such situations departments within the SHO request reports from the health information desk and they send the print out to their respective departments at the higher level (RHB). According to respondents this is mainly due to lack of data transmission across departments at the regional health bureau. The following excerpt is taken from the discussion with one of the respondents:

When we were using DHIS software we deliver the report to planning and program division. That division supposed to distribute reports to each department in the region. I think there are problems there, other departments at regional bureau request to respective department at our office to send reports in hard copy format while we send soft copy report to the HMIS unit in the regional bureau (sub-city health office manager, Dec.2006).

Information desk experts in SHOs are also responsible for providing reports to specific health programs and services such as health services, family health, CDC, and HIV/AIDS units within the SHO.

Similarly, even though there is report submission schedule to trigger timely reporting (See Table 5-3), all most all respondents at sub-city level revealed that they do not usually get reports from lower levels such as health centers as the specified time in the schedule. According to the respondents, most of the problems that cause late delivery of reports are mainly associated with lack of skilled and assigned manpower and lack of transportation facilities:

I am not getting reports as the time set in the schedule between 20th -25th day of the month. This is because there is shortage of manpower especially in the health centers where DHIS is installed. The staffs who are doing the job now are working
as delegates. They have other full-time job and are not well trained to prepare and send reports timely (health information desk expert, Oct. 2006).

Such problems in data transmission might result in late reporting or failure to reporting at all which seriously affects the timeliness and availability of information for decision-making purposes.

**Table 5-3 Data Reporting Timeline at Different Levels.**

<table>
<thead>
<tr>
<th>Health units</th>
<th>Next higher level</th>
<th>Submission date to the next higher level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health centers</td>
<td>Sub-cities</td>
<td>20th of each month – 25th of each month</td>
</tr>
<tr>
<td>Hospitals</td>
<td>Regional bureau</td>
<td>25th of each month – 30th of each month</td>
</tr>
<tr>
<td>Sub-cities</td>
<td>Regional bureau</td>
<td>25th of each month – 30th of each month</td>
</tr>
</tbody>
</table>

(Source: Field visit, Addis Ababa, from Oct. 2006 to January 2007)
Information presentation

DHIS software has the potential to support visually enhanced information presentation using tables, graphs and charts. In all SHOs information is presented to managers, NGOs and other information users using tables only. Most respondents indicated that they know DHIS software has a functionality (pivot table) to support multiple ways of information presentation but do not use it mainly due to lack of adequate training and lack of practices.
♦ Use of reports produced by DHIS software

This study also identified use of reports produced from DHIS software by asking respondents on the frequency of report requests from managers at different departments in SHOs. According to the respondents, routine reports are usually maintained monthly, quarterly, semi-annually and annually. All indicated that managers in their respective sub-cities request and obtain reports monthly, quarterly, semi-annually, annually and whenever the need arises. Quarterly reports are usually generated every three months for the review meeting held with in the sub-city administration to discuss the overall performance of the SHO. Non governmental organizations who are interested to work with the SHOs and other people sent from the RHB are also users of the information generated from DHIS software. As to the respondents, managers in different departments in their respective sub-cities use the information produced for planning, evaluation, human resource performance, and drug selection purposes. As one of the respondents explained:

The management use reports to see this year’s performance of the sub-city and to plan for next year. For example, they use it to know this year’s drug consumption and base their next year plan from the fact in the report. Our sub-city also uses the report to design budget for the next year based on the data we got from reports of this year. Another example is vaccination under one year polio and measles. The same things for out patient to know what amount of patients are treated by one doctor in OPD[Out Patient Department]. Unless we use the data of this year it will be difficult for us to plan and even if we plan, the plan will not be efficient in practice. For example, there will be over or under estimation for human resource allocation. If it is over we will have wastage of human resource and if it is under there will be pressure of work on doctors (information desk expert, Nov. 2006).

Other respondent indicated:

Yes, they are asking reports on VCT, surveillance and family health. They use reports for planning purpose (Information desk expert, Nov. 2006).

♦ How DHIS software is perceived?

As per the interviews and frequent on-site observations conducted with the system users in the SHOs, users indicated that DHIS software liberate them from manual data processing and analysis, eliminate problems of missing paper records, minimizes error compared to the manual system and offers multiple types of reports. They also acknowledge it has good storage and retrieval capacity and enable them to retrieve last years’ report easily and rapidly. One of the interviewees pointed out the importance of DHIS software as follows:

It saves time of calculation. Previously in the manual system I took me four to five days to prepare report. But now if I get access to computer I can finish it with in ten minutes. The other benefit is I can retrieve the information I need timely. Previously the document might not be found or I can miss it, but if it is stored in
the computer any time I can retrieve reliable data (Information desk expert, Oct. 2006).

One respondent also described her perception on the usefulness of DHIS software in supporting her task as follows:

Previously, preparing reports even at health post level takes four to five days and here in the sub-city it took us four to five days and reports were usually sent to the region very late around 8th day of the month. Since we start to use DHIS, it saved our time and I can generate the information whenever I need. For example, if I want to generate report based on the last two years’ data, I can generate easily with out spending much time and I can get accurate data. If NGOs want to work in this sub-city and if they ask me to bring top ten or top twenty diseases in the sub-city, I can generate it easily with out consuming much time. When we buy drugs, our drug expert could also get data from us on last years’ disease with in the sub-city. If there was no DHIS I would spend lots of days to produce the required reports. Besides, since it is cumbersome I may not generate accurate data (information desk expert, Nov. 2006).

It is a well known phenomenon that decision-makers need information to make realistic and informed decisions. One of the respondents indicated that the sub-city is using manual information processing due to lack of human resource with a capacity to operate DHIS software and explained problems in obtaining the information required in a timely manner. As he explained:

There is a problem here, for example when I was in Kolfe sub- city, if I want quarterly report for specific program I get the report with in five minutes from DHIS database. But now if I ask report it requires lots of human resource and even it is not possible to get the report within two or three days. When we were using DHIS software, it full-filled our information need by delivering report for example on VCT, family health, other reports about the sub city health issues, quarterly and annually in a timely manner. For example last time I requested quarterly report on VCT, it took long time since it is done manually. DHIS software delivers reliable data and you can get report with in short period of time (sub-city health office manager, Dec. 2006).

On the other hand, respondents also indicated that there are new reporting forms and additional data elements such as adolescent reproductive health and PMTCT report form (See appendix F) that are not included in DHIS software and are expected to be reported together with the existing standardized reporting forms by the Addis Ababa health bureau and ministry of health (MoH). Since these new data elements are not included in DHIS software, reports of these data elements are transferred to the regional health bureau in a paper format (See Fig.5-1). One of the HIS staff in one SHO said the following:

We have new forms, for example, there is form called adolescent reproductive health (18-24). If someone with in this age takes service in antenatal, the data will be captured in antenatal report and the same data will be recorded in adolescent
reproductive health report form. For me, being professional I am watching inappropriate way of data reporting, data collected in this way does not represent the actual phenomena. There must be a pressure to health managers at regional bureau. There are also other new elements in PMTCT. In DHIS we have nine items, but now it is becoming sixteen items. So I think these conditions must be resolved (information desk expert, Oct. 2006).

**INFRASTRUCTURE**

Computer-based health information systems require infrastructures such as computers, access to internet, telephone and electricity in order to support HIS related tasks more effectively. Accordingly, the study found that nine out of ten sub-cities have Pentium 4 Dell working computers with printers dedicated for the health information work (See Table5-4). However, at the time of my visit to SHOs, some printers were out of order mainly due to minor problems such as several printing queues. Besides, in one sub-city there is no computer for dedicated for health information activities and the health information worker perform the task by sharing computer with the secretary. Respondent in this sub-city said:

……….even here we have shortage of computers. I am using computer once in a month to prepare reports. Even, I can not use it for the whole day because we share the same computer with the secretary (information desk expert Nov. 2006).

Regarding essential communication technologies such as telephones, five SHOs have direct telephone line dedicated for the health information activity which means they have full access to communicate with health information workers at various levels while the rest five health information workers in SHOs use telephone line dedicated for the task of other departments within the SHOs. Similarly, respondents were asked if they have access to internet in order to send reports to the RHB electronically. Among all ten SHOs, this research identified only one case where the SHO is networked and has access to internet for information sharing and communication activities (See Table 5-4) for the details of existing technological infrastructures.

Even though electric power supply in the case of Addis Ababa is not regular, all sub-cities have 24 hours access to electricity.
Table 5-4 Distribution of Technological Infrastructures at each Sub-city.

<table>
<thead>
<tr>
<th>Sub-cities</th>
<th>Existing Infrastructures</th>
<th>Internet access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Computer</td>
<td>Dedicated for the task</td>
</tr>
<tr>
<td>Addis ketema</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Akaki</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Arada</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Bole</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Gullele</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Kirkos</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Kolfe</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Lideta</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Nifas silk</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
<tr>
<td>Yeka</td>
<td>1(Dell Pentium 4)</td>
<td>Yes</td>
</tr>
</tbody>
</table>


♦ Availability of technical manpower

In all visited SHOs in fact in all sub-city administrations, there is no technical manpower that is responsible to provide support whenever there is hardware or software failure. As to the result of the study, in case of technical failure on the software, SHOs ask and get support only from HISP-Addis facilitator from the RHB. However, since there is one facilitator to support all SHOs, all hospitals and health centers for all their software-related problems, information workers in SHOs complain about getting the needed technical support as required in a timely manner. As to the interview with the HISP-Addis Ababa facilitator concerning this issue, indicated that this problem is truly observable phenomena and said that the problem is further aggravated due to the existing lack of cooperation in providing transportation facilities in the regional health bureau even if there are failures in more than three places at a time. Concerning hardware maintenances, most SHOs indicated that they use commercial vendors. It is also indicated that getting such services from commercial vendors is problematic since it takes long time due to the existing government bureaucracy.

MANAGERIAL SUPPORT

♦ Availability of HIS supplies

In all visited sub-cities, respondents indicated that there is no shortage of supplies such as standard reporting formats and diskettes to perform health information activities. However, in some SHOs it is identified that there is lack of data transmission tools such as memory sticks. This problem is specifically indicated by respondents who encountered difficulty of transmitting data effectively. This is to say that when reports...
are sent to the RHB using diskette as a medium, HMIS team at RHB face challenges to open the diskettes and ask information workers at respective SHOs to resend report properly for the second or third time. In most cases respondents indicated that they face such problems associated with diskette failures and claim that they did not receive the required attention from their superiors. As one of the respondents put it:

*Most of the times, HMIS team in RHB ask me to send report again using diskette, by mentioning that they could not open it. To avoid such problems, I asked management to purchase memory stick but I did not get any response yet* (Information desk expert, 2006).

Lack of the required resource for data transmission may also adversely affect the timeliness of the information produced.

On the other hand, similar problems are alleviated in some SHOs where managers are willing to provide support and purchased memory-stick for more effective data transmission.

♦ **Feedback and supervision**

According to Shrestha and Bodart (2000), regular supervision and feedback from HMIS team is an important incentive for staff to report quality data. All respondents indicated that they sometimes receive feedback on the reports they send through telephone. Aside from this kind of feedbacks, this study has identified that there is no regular and written or positive feedback from the higher level. As one of the respondents indicated:

*I do not get feedback on written form or on regular basis; they tell me to correct errors when I go to the regional bureau or through telephone* (information desk expert Dec. 2006).

One among the respondents also revealed that, the health unit did not get positive or negative feedback from higher level about reports even if the data is not reported for long time. As he put it:

*………………for the last four months we did not send softcopy and sometimes we do not send hard copy to the regional bureau. No one from regional bureau gives us feedback about this issue, except family planning department* (sub-city manager, Dec. 2006).

With regard to feedback and supervision to the lower levels i.e. health facilities, most respondents indicated that they usually correct exaggerated errors by themselves mainly by informed guess work (i.e. based on their observation of the last two or three months data) or find the accurate data through telephone. In principle, there is permanent schedule for visiting and supervising health facilities’ HIS performance
every three months. However, all respondents indicated that in practice it is not usually applied at the specified time. One of the respondents said:

“We have permanent schedule to visit health facilities every three months in order to check the information work, but usually this is not applicable due to work over load” (information desk expert, 2006).

The respondent in a sub-city with networked office environment indicated that top managers are always willing to provide the required support in order to facilitate HIS activities. He described this issue as follows:

*The managers in our sub-city give financial support to this department. This month we established internet connection and our office is networked. I am planning to send next months’ report through e-mail (information desk expert, Oct. 2006).*

This kind of support to the HIS contributes to the timeliness of reports which are sent to the higher level and can also facilitate information use by department managers with in the SHO.
5.2 Assessment conducted on Hospitals

Hospitals are health facilities that provide general and specialized medical services to the public. In this study, five hospitals which are currently administrated by the Addis Ababa regional health bureau were included. All the five visited hospitals are tertiary level referral hospitals which provide pediatrics, surgery, intensive care, ophthalmology, oncology, ultrasound, X-ray and so many other services. Hospitals are important places because information which is relevant for decision making at different levels of the health care system evolves from the data which is also originated in hospitals following patients’ visit to hospitals. Therefore, the assessment made on the existing HISs in hospitals addresses issues related to human resource, infrastructure, information processing and managerial support.

HUMAN RESOURCE

♦ Formal posts

In each hospital there is a unit responsible for data management activities. This unit has budget for one “statistician” position. Most managers in the hospitals have assigned human resource for this task. There are also other cases where the position is vacant (mainly due to taking long leave or staff transfer) and as a result, in these cases, reports are not sent to the higher level for several months. As one of the interviewees explained:

*We did not receive reports from Zewditu hospital for the last three or so months because the statistician in charge of the information system activities is in maternity leave (HISP-Addis Ababa facilitator, Dec. 2006).*

There is also another similar case where there is no staff to perform HIS activities because managers re-assign the staff member who was responsible to work on His was transferred to other department in the hospital. As the interviewee put it:

*Following the resignation of the head of accounting section, I have been transferred from my previous position [working as statistician] to work here temporarily as head of accounting department for similar salary I had (ex-statistician, Dec. 2006).*

In this specific case, data reporting for the month prior to my visit was not done because the person who was working as statistician is now working in the accounting department in the hospital.

All staff members who work on HIS related activities in five hospitals do not have background from health science. For the detailed information about their educational background See Table 5-5.
Training

As per the adequacy of the training received on computer basics and DHIS software, most of the respondents feel that they have adequate training to work on the software. They also indicated that they have not received training for more than a year and recommend for further refresher trainings to perform the job effectively. On the other hand, I have interviewed a staff who is assigned to the position for less than a week and said that she did not get any kind of training to perform the job: As she explained:

*I start to work in this position before three days. I was working in different position and I do not know much about the job. I am trying to understand the job by my own effort and with the assistance of the statistician in Yekatit 12 hospital (Hospital statistician Dec, 2006).*

The respondent also indicated that she is trying to understand the various paper-based report forms by her own efforts and by contacting colleague from other hospital. This case may clearly shows the trend of human resource for HIS-related activities without any kind of training even preliminary orientation on how to fill data on paper-based forms.

As it is depicted in the table below, all staff members who work as statistician do not have background on health sciences.

**Tabel 5- 5 Qualification of Statisticians in Hospitals.**

<table>
<thead>
<tr>
<th>Hospitals</th>
<th>Qualification</th>
<th>Received training</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghandi memorial</td>
<td>Accounting diploma</td>
<td>Yes</td>
<td>4 and 1/2</td>
</tr>
<tr>
<td>Menilik</td>
<td>High school diploma</td>
<td>No</td>
<td>Less than one week</td>
</tr>
<tr>
<td>Ras Desta Damtew memorial</td>
<td>Statistician + diploma on marketing</td>
<td>Yes</td>
<td>10 years</td>
</tr>
<tr>
<td>Yekatit 12</td>
<td>Diploma on statistics</td>
<td>Yes</td>
<td>19 years</td>
</tr>
<tr>
<td>Zewditu memorial</td>
<td>High school and diploma on statistics</td>
<td>Yes</td>
<td>14 years</td>
</tr>
</tbody>
</table>

(Source: Field visit, Addis Ababa in November 2006)
Availability of substitutes

To assess the availability of adequate human resource (in terms of number with the required training), I interviewed respondents and I found out that only one person is responsible to perform the data processing and reporting in each hospital which is similar with the case in SHOs. All respondents stated that one person is not adequate to perform the task especially when they are not available at work for various reasons. For example one of the respondents said:

...if I want to take annual leave during the report preparation period the director tells me to postpone my leave and I am forced to take leave after the report preparation. We are using such techniques to solve this problem, no other solution (statistician, Nov. 2006).

Respondents were also further asked if additional person from their respective hospitals took training on DHIS software. The following transcript is taken from the discussion with the participants:

- No there was no one who took training with me (Hospital statistician, Nov. 2006).
- Yes, she took two days training on DHIS software but she is transferred to regional bureau (Hospital statistician, Dec. 2006)
- We have been told to come up with some one to take training and I randomly select from one of my friends and took him there...he has another responsibility and task, so he is not working on DHIS (Hospital statistician Dec. 2006).

Work load

Respondents especially statisticians in hospitals with several departments feel that they have work load. They also stated that the probability of recording wrong data is high due to the work load they experience.

DATA CAPTURE, ANALYSIS, REPORTING, TRANSMISSION AND USE

Data capture and analysis

Data is captured by health workers while performing their day to day activities. In hospitals, data collection tools such as patient card, hand drawn tally sheets and reporting forms are used as a tool for collecting data. Statisticians are responsible for collecting reports from each department in the hospitals Tally sheets are used to organize and summarize the data obtained from different departments and at the end of each month the summarized data is entered in to DHIS database. In this process, however, statisticians indicated that they face problems such as incomplete or lack of reporting and unreadable forms from the health service departments. Specifically health professionals who code data to the reporting forms do not usually fill ICD codes.
and respondents indicated that this is usually a common problem for them. One of the statisticians stated that some times she sends empty reports to the RHB because she could not obtain data from clinical and outpatient departments. As she recalled:

*I am always quarrelling with health workers; there are departments who are not willing to fill the form by giving excuse such as we do not have adequate health worker to fill the data. As a result I send incomplete reports to RHB. I am always reporting this situation to the planning and program department in the health bureau but I did not get any feedback so far (statistician, May 2007).*

Furthermore, in this case, the respondent also indicated that the responsibility of filling data to the reporting forms is in principle the task of the doctors but, in practice it is collected by nurses. However, timely data reporting by nurses is becoming increasingly problematic. As the respondent put it:

*The nurses were better for data collection. They were usually filling the forms whenever they are free. In present times they are starting to complain and nurses in some departments are not willing to report data (Hospital statistician, May 2007).*

As to my observation as well as from the interviews, illegible data is usually received from departments within the hospital. For example, the following reporting forms are collected randomly from dozens of reports in one hospital that shows illegible and incomplete data reporting:
Respondent in this hospital also explained issues such as lack of cooperation from health workers to fill data is becoming a problem for their effort on collecting data properly. She explained the situation in the following way:

Evaluating challenges and opportunities for sustainability of computer-based health information system in Ethiopia: case study from Addis Ababa
Besides, respondents stated that health workers usually do not fill ICD codes and as result statisticians fill it by themselves if they are familiar with the diagnosis. Respondents also indicate that they report incomplete data to RHB in cases when they obtain diagnosis which they are not familiar with. Problems of filling ICD codes seem more severe in places where there is no experienced or trained HIS staff. The following two forms depict incomplete data recordings:
Empirical Investigations and Findings

Figure 5-3 Incomplete Data Recording 1.

Evaluating challenges and opportunities for sustainability of computer-based health information system in Ethiopia: case study from Addis Ababa
Required data is not filled

Figure 5-4 Incomplete Data Reporting 2.

Evaluating challenges and opportunities for sustainability of computer-based health information system in Ethiopia: case study from Addis Ababa
♦ Data reporting and transmission

Concerning to timely data transmission to the regional health bureau, all statisticians confirmed that they are aware of the existing timetable for data reporting (See Table 5-3). As to the results obtained in this regard, most of the respondents report monthly data to regional health bureau within the demanded timetable. However, there are cases where data is not reported at the time required due to work overload. Data is reported from hospitals to the regional health bureau using diskette as a medium of data transmission (See Fig. 5-5).
Figure 5- 5 Data Flow from Hospitals to Regional Health Bureau.
(Source: Drawn from the empirical data collected from Oct, 2006-Dec. 2006)

♦ Information presentation

Presenting information using graphs and charts help decision makers to quickly see facts from the reports. DHIS software can offer multiple ways of information presentation using graphs and charts. According to the respondents and my observation, most hospital statisticians use standard reports using tables for information presentation purposes. Unlike all the other research sites visited, in one hospital the statistician was using pivot table for report generation and I have seen reports he
generated in table, graph and chart formats (See appendix C, D, and E ). He explained how he prepares the reports in different ways as follows:

“Yes, I will show you how I present information. My room is full of charts, I am using pivot table, you can manipulate the data by taking to excel you can make the graph you want; you can compare what is the performance with the plan. Once, managers see unexpected results when I present report using graphs. I can present reports to compare the performance of several years using one report. Pivot table offers additional advantage which is not seen in standard reports and it allows further data analysis” (ex-statistician, Dec. 2006).

♦ Use of reports produced by DHIS

Statisticians indicated that, managers request and obtain information required for evaluation and planning purposes from reports generated from DHIS software routinely on monthly, quarterly and annual basis. Besides, respondents indicated that NGOs are also users of the report generated from DHIS software. One of the respondents said the following on the frequency and purpose of use of reports by the managers in a hospital:

They need monthly, quarterly and annually... each department head deliver plan every New Year and they need reports to compare the plan with last year’s performance (Hospital statistician, Nov. 2006).

With regard to information use, this research has also identified a case where frequency of report request from statistics department is becoming lower due to assignment of new medical director. In response to my question, the respondent said:

The medical director is new and he is not asking for reports but previously we were asked to prepare monthly and quarterly reports for meeting purposes within the hospital (Hospital statistician, Dec. 2006).

On the other hand, I have found out a case where the medical director is taking the leading role in valuing quality data and using information from DHIS software frequently for decision-making purposes. The respondent in this hospital said the following concerning request of reports from the management:

Yes the medical director has awareness about the value of information. He always would like to get reports from 25th to 30th. For example, today, he requested me to generate last year’s quarterly report in order to compare it with this year quarterly report (Hospital Statistician, Nov. 2006).

As to the respondent, top managers within the departments in the hospital and the medical director request report in a timely manner to use it in the monthly meeting within the hospital to monitor and evaluate health service performances of the hospital.
How DHIS software is perceived?

Respondents were asked to explain what they perceive about the usefulness of DHIS software in supporting their day to day activities. All respondents indicated that the software saves time and effort which they were spending while preparing reports manually. One of the respondents put it as follows:

*DHIS makes our job easier previously, we were selecting from dozens of registers, convert it to a form and summarize and compile. For example, now I am not working annual or semi-annual reports manually. If I feed daily the appropriate data to the software, I can get reliable annual, semi-annual or monthly data with in five minutes. The only problem we are facing now is the departments are not giving us complete and appropriate data (Hospital statistician, Dec. 2006).*

Similar to this, the other respondent said:

*...monthly, quarterly or annual data can be calculated with in two or three minutes. It gave us such possibilities and I can get any kind of report with in two or three minutes (ex-statistician, 2006).*

All respondents feel that DHIS software supports them to be productive in their job. One respondent also recommended to have networked communication with the RHB in order to avoid problems such as lack of transportation facilities for data transmission purposes.

INFRASTRUCTURE

Based on my observation and interviews, four hospitals have Pentium 4 computers with printers dedicated to the information work. In one case there is no computer in the statistics department and the statistician use medical director’s computer for health data management and processing activities. Concerning essential communication technologies such as telephone and internet, among five statistics offices in all hospitals, there is only one office which has direct access to telephone the rest others do not have direct access to telephone and they use telephones which are dedicated for other tasks in the hospital in order to communicate with health information workers at various levels. Similarly, all statistics offices do not have access to internet. Table 5-6 depicts distribution of technological infrastructure in the hospitals.
Tabel 5-6 Distribution of Technological Infrastructures in Hospitals.

<table>
<thead>
<tr>
<th>Hospitals</th>
<th>Existing Infrastructures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Computer</td>
</tr>
<tr>
<td>Ghandi memorial</td>
<td>-</td>
</tr>
<tr>
<td>Menilik</td>
<td>One Dell Pentium 4</td>
</tr>
<tr>
<td>Rasdesta Damtew memorial</td>
<td>One Dell Pentium 4</td>
</tr>
<tr>
<td>Yekatit 12</td>
<td>One Dell Pentium 4</td>
</tr>
<tr>
<td>Zewditu memorial</td>
<td>One Dell Pentium 4</td>
</tr>
</tbody>
</table>

(Source: Field visit, Addis Ababa, from Nov 2006 to Dec 2006)

♦ Availability of technical manpower

In all visited hospitals, there is no technical manpower that is response-able to provide immediate support whenever there is hardware or software failure. Similar to SHOs, technical support for software failure is obtained from HISP-Addis facilitator. However, since there is only one facilitator assisting all the SHOs, hospitals and health centers, information workers in these places complain about getting the required support in a timely manner. As is the case in the SHOs, hospitals also use commercial vendors for hardware maintenance.

MANAGERIAL SUPPORT

♦ Availability of HIS supplies

As to the interviews with the hospital statisticians, there is no shortage of HIS supplies such as tally sheet, reporting forms, diskettes and stationeries such as paper, pens, pencils and staplers.

♦ Feedback and Supervision

This study also attempt to study if there is supervision and feedback mechanisms from HMIS team at RHB to lower levels such as hospitals. As to the result of the interviews, it was identified that HMIS team from regional bureau conduct annual supervision to assess the overall HIS activities at hospitals. Apart from the annual supervision, all respondents indicated that there is no frequent or regular feedback or follow-up from the higher levels. One of the respondents confirmed this fact and said the following:
There is no feedback for example, last month I sent inaccurate data about cholera, but no body traced the problem rather it was me who gave them the correct figure when I recognized that I sent the wrong data (Hospital statistician, 2006).

This could be a good example of lack of timely and appropriate feedback to lower level HIS staff even when inaccurate data is reported.

The statisticians also complained about lack of positive feedback that motivates them to perform the job with good morale. One of the statisticians recalled her experience as follows:

Once in a meeting before two years, I have been told that our hospital is performing well but, afterwards I got neither written acknowledgment on our good performance nor financial incentives (Hospital statistician, 2006).

♦ Defining roles and responsibilities

Presence of managerial support is usually seen as critical factor for the well functioning of information systems in general and health information systems in particular. This study also investigated one case where the medical director of one hospital defined roles and responsibilities for the health professionals who collect and code data which is relevant for managerial purposes. According to the statistician in this hospital, problems of data quality and late reporting are minimized after the medical director assigned roles and responsibilities to trigger proper data collection and reporting. However, in other hospitals visited by the researcher, such definition of roles and responsibilities was not identified which may have a negative impact on the quality of the data collected and reported.
5.3 Assessment conducted in Health centers

Health centers are integral part of the public health care system of the AARHB which are established to provide both preventive and curative out-patient care to the public. Similar to hospitals, health centers are also important places where data that is useful for improving management of the health care system is generated. This data is generated following patients/clients visit to the health center. As it was done for SHOs and hospitals, issues related with availability of human resource for HIS activities; data input, analysis, transmission, information use and perceived benefits of DHIS; availability of infrastructure and managerial support were investigated in health centers and it is presented as follows.

**HUMAN RESOURCE**

♦ **Formal posts**

All health centers have a budget for one full-time health information worker who is in charge of HIS related activities. In all visited health centers human resource is assigned to perform HIS activities such as data collection, processing and reporting.

♦ **Training**

Training can play a useful role for health information workers to function more effectively in data collecting, processing and reporting activities. Statisticians in visited health centers who are using DHIS software for data processing and reporting purposes indicated that they have received trainings on computer basics and DHIS software which was given by HISP-Ethiopia in collaboration with Addis Ababa City Government Health Bureau in 2004 and received refreshment training at the beginning of 2006. Furthermore, statisticians in these health centers also mentioned that the training given mainly focused on how to enter data and how to export data using DHIS software. However, most statisticians feel that the skill they currently have is not sufficient for performing the job effectively. The following excerpts are taken from the interviews I made with health center statisticians in this regard:

♦ *I think the training is not enough, what we have learned is on how to enter data and how to export it. Aside from that we do not know how to solve minor problems. For example, if a computer stuck I search the solution by common sense and doing this I may succeed in solving the problem and at other times I may not.....If I had adequate training I will not call HISP-Addis Ababa facilitator every time I face minor problems.*

♦ *I start to use computer for the first time when DHIS was installed and it is sometimes difficult for me to generate reports.*

♦ *I took training two times but computer knowledge is forgettable...may be this is because I use the software only once in a month to prepare reports.*
I can not use the software to generate graphs, I can make graphs manually. May be it is related with my capacity [skill]

As it is indicated in the study results of the SHOs, it is also confirmed from the result of the study at hospital level that almost all staffs who are currently working as “statistician” do not have background on health sciences (See Table 5-7).

**Tabel 5-7 Qualification of HIS staff in health centers.**

<table>
<thead>
<tr>
<th>Health center</th>
<th>Qualification</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lideta</td>
<td>Health extension worker</td>
<td>3 years</td>
</tr>
<tr>
<td>Woreda 7</td>
<td>12th grade</td>
<td>20 years</td>
</tr>
<tr>
<td>Akaki</td>
<td>Certificate IT</td>
<td>5 years</td>
</tr>
<tr>
<td>Addis Ketema</td>
<td>Diploma accounting</td>
<td>3 years</td>
</tr>
<tr>
<td>Selam</td>
<td>12th grade</td>
<td>4 year</td>
</tr>
<tr>
<td>Kuture 1</td>
<td>12th grade</td>
<td>10 years</td>
</tr>
<tr>
<td>Woreda 17</td>
<td>12th grade + 1 year IT</td>
<td>2 years</td>
</tr>
<tr>
<td>Beletschachew</td>
<td>Certificate in accounting</td>
<td>5 years</td>
</tr>
<tr>
<td>Kazanchis</td>
<td>12th grade</td>
<td>20 years</td>
</tr>
</tbody>
</table>

(Source: From interview transcripts taken from Dec 2006 to May 2007)

Availability of substitutes

As it is stated in the literature, adequate HIS staff is required to perform HIS activities properly and to repair possible breakdown in reporting data to the next higher level. As to the result of my investigation in this regard, in most health centers data processing and management activities is highly dependent on the availability of the permanently assigned staff. One of the respondents described this condition as:

> Here I am the only person to do the task. Even if I am sick I must come back and prepare the monthly report, otherwise reports will not be sent (Health center statistician, Mar. 2007).

I further investigated if the training on DHIS software is given to other members within the health centers. Unlike in the SHOs, in most of the health centers the training was given to one person. However, there are also cases where training is given to more than one person. In most of these cases, trained staffs who were supposed to substitute the permanent staff are not available in the health centre for simple reasons such as staff resignation or staff transfer to higher levels as a result of promotion. Further investigations on adequacy of staff also revealed two peculiar cases where health professional who took training on the software work the job with good motivation in case of absences and whenever the need arises. According to the interview result, in these particular cases, health professionals who are working in the place of the statisticians are mainly motivated by personal interests.
There are also respondents who described the existing lack of adequate manpower as lack of recognition from managers. As one of the respondents explained:

*...managers do not recognize the task of data management as a professional work that requires due attention. If I am not here no body will perform data collection and reporting (Health center statistician, May 2007)*

Lack of adequate manpower to perform HIS related activities appears to be common phenomena even in contexts where DHIS software is not installed and used. I have also visited some health center where data processing and reporting is done manually. For example, in one health center the person responsible for this task was in her last months of pregnancy and there was no staff readily available to substitute her or someone who get on the job-training to perform the job when she takes for at least six months of maternity leave.

♦ **Lack of motivation**

Designing and implementing incentive structures to motivate workers is considered as one important component to retain experienced staffs and to reduce staff turnover in organizations. However, as per my interview results, there is no such scheme to HIS staffs who are working at all levels of the health structure. Particularly, statisticians in the visited health centers complained that they do not have incentive structures and feel that this condition is influencing their motivation of doing their job in a productive manner. One amongst the participants explained:

*The salary we have is really discouraging us not to work at our best. It is not enough we got only 450 birr [which is approximately 50 USD per month]. We have three steps lower than the statistician position in hospitals while the job is almost similar.......they [top managers] must consider this we are collecting the data that they really need (Health center statistician, Dec. 2006).*

And another respondent indicated that the task to be performed is continuously growing but the salary they got remains almost the same. As she put it:

*The salary is insignificant but we receive more to do tasks from the regional bureau......ministry of health did not give due attention to this job (Health center statistician, Mar. 2007).*

**DATA CAPTURE, ANALYSIS, REPORTING, TRANSMISSION AND USE**

♦ **Data capture and analysis**

Data is initially captured in the health centers by health service workers upon patients visit. Data about a patient or group of patients is captured in paper format (patient card) in the health centers. Other tools for data collection and coding purposes include hand drawn tally sheets and standard reporting forms. Since all health centers share almost
identical standardized reporting forms, the process of data collection and processing is somehow similar. At the end of each month i.e. at the time of report preparation, statisticians give standard reporting forms to each section (such as MCH, family planning, IMCI) in the health center to obtain the required data. Statisticians are also required to collect morbidity and mortality data from Out Patient Department (OPD) on daily basis or on every other day. After they collect the required data from OPD and other sections within the health center, the statisticians organize the data using hand drawn tally sheets and feed it into DHIS database. However, during data processing respondents indicated that they face problems of incomplete recordings of facts such as missing or wrong ICD codes received from the units within the health center. The following data quality problems are mentioned by the respondents:

- Health professionals do not know the ICD code.
- Here in this health unit non of the doctors feel ICD code
- I sometimes get wrong ICD code for example, ICD code more than 170
- There are diagnoses such as HIV/AIDS which are not supported by WHO ICD codes list.

Accordingly, respondents indicated that they are coping up with these somehow problematic situations by filling or correcting the ICD code to the diseases that they are familiar with or by referring WHO list of ICD codes. On the contrary, if the diagnosis is not available in WHO list of ICD codes or if it is not well known by the statisticians, incomplete data will be reported to the SHOs.

- Data reporting and transmission

The role that data transmission and reporting can play is to ensure that the required information is delivered to the right users in a timely manner. As it is stated in the other two cases, to facilitate the timeliness of information transmission among the levels of the health care system, there is HMIS guideline i.e. a schedule which details specific time for data reporting among the different levels (See Table 5-3). In the visited health centers, statisticians are aware of until which date they are supposed to send reports to their respective sub-city health offices. However, this study investigated cases where data is not reported to higher level at the time specified due to reasons such as workload on health professionals who fill and code the data and shortage of manpower to fill data in to the paper-based standard reporting forms. On the other hand, there are cases where statisticians send report to their SHOs within the time frame. In these cases, respondents mentioned that they send reports on timely manner due to reasons such as consistent feedback obtained from HIS staff in SHOs and availability of trained staff who can substitute them in case of their absences. All respondents also mentioned that monthly reports are checked for possible errors and is signed by the medical director of the health centers prior to sending the data to the higher levels i.e. SHOs.

Data from health centers is also reported to respective SHO in the form of both soft (using diskette as a medium) and hard (using paper as a medium) copy (See Fig. 5-6).
Figure 5-6 Data Flow from Health Centers to Sub-city health offices
(Source: Drawn from the empirical data collected from Nov, 2006-May 2007)

♦ Use of reports produced by DHIS software

Local use of information is discussed in the literature as an approach for solving local problems more quickly, for improving local health care service and ultimately improving the health status of the community. I have asked statisticians in the visited health centers if they get request for reports by managers for local use within the health centers. Most respondents indicated that there is no monthly request from section heads and managers such as medical directors and head nurses, rather they are asked to prepare quarterly, bi-yearly and annual reports for meetings held to evaluate health services provided by the health centers. One of the respondents noted:
NGOs working in health sector and interested to work together with health centers are also users of reports produced using DHIS software, specifically reports on Voluntary Counseling Testing (VCT) and Prevention of Mother-To-Child Transmission (PMTCT).

♦ How DHIS is perceived by users?

In response to the question of perceived usefulness of DHIS software in supporting their job, system users indicated that prior to the implementation of the software; manual data processing was laborious and tiresome. As to the respondents, the software enabled them to prepare monthly, quarterly, or yearly reports very quickly and traces unintentional recordings of wrong data. One of the respondents said the following:

You can see your report any time; you can finish your work quickly. I can generate annual report very easily within two minutes. When I was working in the manual system it took me two to three days to produce annual reports (Health centre statistician, Dec. 2006).

Another respondent pointed out:

DHIS helps me to finish my job very quickly, besides it stops me if I enter wrong data. For example if I enter one ICD code twice it will give me error message immediately (Health center statistician, May 2007).

In the same way, another respondent indicated:

it makes our job easier, prior to DHIS, I was collecting data from each department, it was tiresome, now, I can finish preparing monthly report within in two and three hours even that it is because we share the same computer with the secretary [who handles clerical work for the medical director] (Health center statistician, Mar. 2007).

In addition, system users indicated that there are new data elements (such as adolescent reproductive health and PMTCT (See Appendix F) that are not supported by DHIS software. As per the respondents, collecting these specific data elements from the paper forms manually is time consuming.

Furthermore, respondents from hospitals also indicated that they need DHIS software to support them and liberate them from making tallying.
INFRASTRUCTURE

As to my observation and interview with the respondents, among ten health centers, seven health centers have computers dedicated for statistical purposes. Where as in three health centers statisticians are using computers which are dedicated for secretarial purposes. In all visited health centers there is no e-mail access and direct telephone line (See Table 5-8 for detailed infrastructural distribution in the visited health centers)

Tabel 5-8 Distribution of Technological Infrastructures in Health Centers.

<table>
<thead>
<tr>
<th>Health centers</th>
<th>Existing infrastructures</th>
<th>Computer</th>
<th>Dedicated for the task</th>
<th>Telephone</th>
<th>Internet access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lideta</td>
<td></td>
<td>1Dell Pentium 4</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Woreda 7</td>
<td></td>
<td>&quot;</td>
<td>No</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Akaki</td>
<td></td>
<td>&quot;</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Addis Ketema</td>
<td></td>
<td>&quot;</td>
<td>No</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Beletschachew</td>
<td></td>
<td>&quot;</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Selam</td>
<td></td>
<td>&quot;</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Kutre 1</td>
<td></td>
<td>&quot;</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Woreda 17</td>
<td></td>
<td>&quot;</td>
<td>*</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Kazanchis</td>
<td></td>
<td>&quot;</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Beletschachew</td>
<td></td>
<td>&quot;</td>
<td>No</td>
<td>✓</td>
<td>No</td>
</tr>
</tbody>
</table>

* Computer is purchased for statistical purposes, but DHIS software is not installed.

(Source: Field notes taken from Dec 2006 to May 2007)

♦ Availability of technical manpower

In all visited health centers, there is no technical manpower that is response-able to provide support whenever there is hardware or software failure. Similar to the other two cases i.e. the sub-city and hospital, in case of problems in the software the respondents indicated that they contact HISP-Addis facilitator to get support. However, since there is only one facilitator to support all SHOs, hospitals and health centers, information workers in these places expressed complaints regarding getting the support timely.
MANAGERIAL SUPPORT

♦ Availability of HIS supplies

As to the interviews with the health center statisticians, there is no shortage of HIS supplies such as tally sheet, standard reporting formats, diskettes and stationeries. As I have learned from the results of the study in SHOs, statisticians in the health centers did not mention the importance of flash memory for data transmission.

♦ Feedback and Supervision

As it is described in the literature, supervisory visits to health centers and providing feedback on the data reported is seen as important, in fact cost-effective activity to improve data quality at different levels. Accordingly, as to the interview results with responsible staff in SHOs, health information staffs at higher levels i.e. at sub-city health offices are required to make supervisory visit to health facilities with the objective to check data quality and to assess HIS performances. However, all statisticians in the visited health centers confirmed that there are no supervisory visits from higher levels. One statistician described this situation as:

No supervision, previously they were coming every year or every six month but not now (Health centre statistician, May 2007).

Concerning to the availability of formal feedback on the data reported to SHOs, most statisticians in the health centers mentioned that they rarely obtain feedback from HIS staff in SHOs through telephone for example, when there are errors or empty recordings in the sent reports. Apart from this most respondents do not obtain formal, regular or rewarding feedback on the data they report.

On the other hand, there were also cases where HIS staffs in SHOs give consistent follow up and feedback to the health centers in order to ensure the accuracy and quality of data. One of the statisticians in these health centers stated the following:

Yes, every month, the HIS staff from the sub-city take reports by himself and he ask me if there is problem, check tally sheets and discuss together if there are problems (Health centre statistician, Dec. 2006).

And another respondent indicated that there is review meeting every month at the sub-city level and she participate in that meeting and describe any problems faced during data collection. As she explained:

Yes, we participate in the review meeting every three months and we will discuss problems we faced during the meeting. In addition, when I bring report to the sub-city, [the HIS staff] will check data elements or empty fields and I will make corrections there (Health centre statistician, May 2007).
As it is stated in the above excerpt, making statisticians to participate in the review meetings enable them to express any problems faced while data collection and may enhance the awareness they have towards the value of information for managing health service provision.

5.4 Summary

This section presents summary of the key findings of the case study research which was conducted in SHOs, hospitals and health centers of the AARHB. The summary is categorized into four main pillars of this study (i.e. human resource, information, infrastructural and managerial support related issues).

1. Human resource related

   ♦ Sub-city level

After the agreement reached between HISP-Ethiopia and AARHB on the importance of integrated data sets and on timely, relevant, and accurate information for management decision making purposes at all levels in 2004 (Braa et al, 2007b), resources were mobilized for the institutionalization of the new computer-based health information system. Accordingly, budget for recruiting health information worker at various levels was allocated. However, at the time of this research, information system workers who got training on DHIS software were not in their job for various reasons including resignation, taking long vacations and staff transfer to other positions within the SHOs. To tackle this problem, there are some sub-cities who attempted to fill the positions by assigning new staff members with other additional responsibilities in the SHO. However, those newly assigned staff does not receive formal training on the software which impedes their effectiveness in properly operating the software for data processing purposes. Lack of sufficient training on the software was identified as a major problem both for the newly assigned health information workers as well as others who already took the training given by HISP-Ethiopia. All of the existing health information workers of SHOs, have a background from health sciences and most of them are public nurses.

   ♦ Hospital level

Similar to the case in SHO, there are also cases in hospitals where the position for information worker is vacant due to staff transfer to other positions within the hospital or staff taking long vacations. However, unlike to the SHOs, most respondents in hospitals pointed out that the training given about the software is adequate to perform their day to day activities effectively. In addition, all health information workers do not have background in health sciences.
Unlike SHOs and hospitals, in all visited health centers human resource is assigned to the statistician position and most of them have received formal training on DHIS software. However, most of the statisticians feel that the skill and knowledge they currently have about the software is not sufficient to carry out the job effectively. Similar to the statisticians in hospitals all but one of the statisticians in the visited health centers does not have background on health sciences. The most interesting and specific issue to health centers is that motivationally, all statisticians in the visited health centers expressed their complaints about the existing lack of recognition and incentive structures.

2. Information related

Sub-city level

Data is reported to the regional health bureau electronically using diskette and using paper to data elements which are not supported by the software. Health information workers in all SHOs pointed out that they usually receive incomplete, inaccurate and exaggerated data recordings in the reports received from health facilities within the sub-cities. The main cause for receiving poor quality data from health facilities mainly emanates from data collectors’ lack of background in health sciences. Even though, DHIS software has functionality to present information in visually enhanced ways i.e. in the form of graphs and charts, all information workers in the SHOs present information in table form only. It is also identified that reports produced by DHIS software is used in all SHOs for planning, evaluation, human resource performance and for drug selection purposes. Concerning about end users’ perception about DHIS software, it was identified that DHIS software liberate information workers from manual data processing and analysis, eliminate problems of missing paper records, minimizes error and improves accuracy compared to the manual system and offers multiple types of reports very quickly. The respondents also acknowledge that the system has good storage and retrieval capacity and enable them to retrieve last years’ report easily and rapidly.

Hospital level

Data reporting to regional health bureau is done electronically using diskette as a medium. Problems of data quality are also identified in most hospitals from the data collected through observations and interviews. These are incomplete, illegible, and lack of timely reporting of data from departments within the hospitals to the statistics unit in the hospitals. Some of the reasons for this poor quality data are lack of cooperation among health care professionals to fill data properly and lack of understanding about the value of data among health care professionals. On the other hand, this research also identified a special case where medical director took the leading role in valuing data...
Empirical Investigations and Findings

quality and assigned roles and responsibilities for health professionals who collect data in order to reinforce them to record accurate and complete data, and to send reports in timely manner. This evidence is reflected and observed in the words of the interviewee in that specific hospital. By doing this, problems of data quality and late reporting are minimized. Concerning ways of information presentation in hospitals, most statisticians present information in table forms. But, unlike other levels i.e. SHOs, health centers and other hospitals, a statistician in one hospital present information in visually enhanced way in the form of graphs and charts so that to support managers to see facts more quickly as compared to presenting information in table or other forms. It is also identified that information generated from the software is used by the managers in hospitals for planning and evaluation purposes. Concerning the perception about the usefulness of DHIS software in supporting their tasks, respondents who use DHIS software stated that it helps them to finish the task very quickly, makes the task easier, and enable them to retrieve annual, semi-annual and monthly reports very quickly and at any time.

♦ Health center level

Data is reported to SHOs both electronically using diskette as a medium and manually using papers. Data quality problems were also identified at the visited health centers. Specifically incomplete and inaccurate and untimely data recordings and reporting were repeatedly explained by most respondents. Unlike the results from SHOs and hospitals, in health centers information produced from DHIS software is used for quarterly meetings held in the higher level i.e. SHOs for the purpose of evaluating the performance of the health centers. With regard to the perception about the software in use, end users indicated that the software enables them to finish their task more quickly, saves their time and minimizes error by tracing unintentional recordings of wrong data.

3. Infrastructural issues

♦ Sub-city level

Almost all sub-cities have a computer with a printer dedicated for health information work with software to manage information processing. All sub-city health offices reported to have direct telephone lines. On the other hand, almost all sub-city health offices do not have access to internet. Related with infrastructural issues, this research also identified shortage of technical manpower that can provide immediate support for both software and hardware failures.

♦ Hospital level

Similar to SHOs, almost all hospitals have a computer with a printer dedicated for health information work with software to manage information processing. All hospitals do not have access to internet and almost all do not have full telephone access. Similar
to SHOs, there is also shortage of technical manpower that can provide support on hardware and software failures in a timely manner.

♦ Health center level

As it is in the other two cases i.e. in SHOs and hospitals, majority of the visited health centers have a computer with a printer dedicated for the task of health information processing. All health centers do not have access to internet and full access to telephone line. Similar to the other cases, in health centers here also, there is shortage of technical human resource that can provide support in case of software or hardware failures.

4. Managerial support

♦ Sub-city level

At sub-city level there is no shortage of HIS supplies such as reporting forms and other stationeries. However shortage of data transmission tools such as memory stick was identified from the study conducted in SHOs. Other type of managerial support for HIS activities that this study gave focus is provision of feedback and supervision. As to the results, there is no feedback on the data reported and no supervision to regulate the effective performance of HIS activities from responsible bodies at regional health bureau.

♦ Hospital level

Similar to the SHOs, there is no shortage of HIS supplies such as tally sheet, reporting forms, diskettes and stationeries such as paper, pens, pencils and staplers. As is the case in SHOs, hospitals also do not receive regular feedback on the data reported and there are no frequent supervisory visits from HMIS team at regional bureau.

♦ Health center level

At health centers there is no shortage of tally sheet, standard reporting formats, diskettes and stationeries. Similar to the other research sites in most visited health centers there is no formal or regular feedback on the data reported and supervision is not available at all.

The next chapter highlights the analysis and discussion of the research findings presented in this chapter.
6

ANALYSIS AND DISCUSSION

This chapter presents the answers to the research questions specified in chapter one, based on the empirical investigations and findings reported in the previous chapter (Chapter 5). Moreover the chapter provides discussion of the research findings by using the literatures reviewed in chapter two. Accordingly, the chapter is structured into two broad sections which are further divided into sub-sections. Section 6.1 presents the challenges and opportunities for sustainability of the computer-based health information system with respect to human resource, technological infrastructure and managerial support. Section 6.2 presents the discussion of the findings. Specifically, the discussion part focuses on data quality and information use which are the central issues in studying the performance of health information systems in developing countries.

6.1 Challenges and Opportunities for Sustainability of the Computer-based Health Information System in Addis Ababa

As it is indicated in chapter 2 (literature review), definition of sustainability which I have chosen for this study is the descriptive definition contributed by Bare (2002) as “…a rational and dynamic continuation of a set of activities or processes that produce desired products and services over long periods of time”. In the context of health information system, the desired product is good quality data (accurate, relevant, complete, timely, legible etc) and continuous use of information (LaFond and Field 2003). Thus, drawing up on the above definition of sustainability and based on other literatures reviewed (for example Braa et al 2004; Korepela, 1998), I conceptualized sustainability of health information systems as effective continuation of activities and processes (such as proper data collection, processing and reporting) within computer-based health information system to produce good quality data and to facilitate information use over time. Therefore, based on this perspective of sustainability and based on my assessment and empirical findings of the existing computer-based health information system at different levels (sub-cities, hospitals and health centers of the AAHB), the following two sub-sections present the analysis of the challenges that impede the sustainability and opportunities that enhance the sustainability and long term viability of the computer-based health information system which is embedded at Addis Ababa health bureau.
CHALLENGES FOR SUSTAINABILITY

This section presents the challenges that threaten sustainability of the existing computer-based health information system with respect to human resource, technological infrastructure and managerial support

**Human resource related challenges**

Human resource is one of the crucial prerequisites for any health information system to function. Deployment of skilled and adequate human resource at all levels of the health care is not only the significant step for the improvement of health information systems but also one important factor that highly contributes to the sustainability of health information systems (WHO, 2006 and Lippeveld and Sauerborn, 2000 pp 27). Therefore, human resource related challenges for sustainability of the existing computer-based health information system within Addis Ababa health bureau are presented as follows.

- Professional career/educational background

In its simplest form, educational background can be described as knowledge gained in school or through training. Educational background of health information workers may have an influence on the task they accomplish in their work environment. Within the domain of this study, this means that health information workers who have background from health sciences have better knowledge and insight about the meanings of the health data that they collect due to their background and knowledge acquired through schooling or training. For this reason, it is possible for them to fill data more accurately and to identify and correct possible errors from the data which in turn can help in collecting and reporting better quality data.

However, in the case of this study, as it can be seen from the research findings, health information workers especially at hospitals and health centers do not have background on health sciences. Rather most of them are high school graduates and have diploma on accounting and IT related field (Details can be seen in chapter 5). This lack of background on health sciences among information workers in hospitals and health centers is exerting its own negative impact on the level of quality of information produced. For example, health information workers at sub-city health offices (who all have background in health sciences and most of them are public nurses) complained that they usually receive inaccurate data from health centers on different reporting forms. This includes codification of adult disease in to children’s data entry field due to statisticians’ lack of background on basic data elements in different health programs and services.
It is practically difficult to recruit well trained health practitioners as “health information workers” at all hospitals and health centers because of the existing shortage of health practitioners in Ethiopia. However, in order to curb this problem, it is possible to hire health extension workers (HEWs) (who provide curative and preventive health services in rural community) with the existing salary scale for statisticians at health centers as it is observed in one of the visited health centers (See Table 5-7) as they have better know how on health related issues compared with statisticians who do not have background from health sciences. Thus, recruiting staff with background on health sciences helps to improve the quality of the data collected and reported to higher levels. However, the recruitment must be supplemented with intensive and continuous training on computer basics and on functionalities of the software since the process of acquainting health information workers with the necessary skills requires long time and continuous efforts (Cibulskis and Hiawalyer, 2002). This combined with their knowledge of the domain area will obviously contribute for the production of good quality data. And as the quality of the data generated from health information system improved, managers will rely on the information system and will be encouraged to use the data generated in their day to day activities and this will definitely contribute to the sustainability of computer-based health information system which is embedded at different levels of the Addis Ababa health bureau (Setzer and Stoops, 2003).

♦ Lack of proper skill and training to utilize the software

Training (capacity building) can be thought of as one effective approach to make health information workers learn basic skills that allow them to carry out HIS related tasks effectively using various types of data collection and processing artifacts. Availability of skilled personnel with a capacity to collect, process, and report data is one most important element of health information systems to ensure production of good quality data (Kleinau, 2000 and Shrestha and Bodart 2000). Similarly, Cibulskis and Hiawalyer (2002) also argue that availability of skilled personnel (with appropriate skills on statistics, epidemiology and computing) is crucial factor that governs sustainability of health information systems. On the other hand, Azubuike and Ehiri (1999) clearly point out that lack of personnel with sufficient skill for managing health information is greatest impediment for success and continuity of health information systems particularly in developing countries. Similarly, result of this study illustrates that health information workers especially at sub-city health offices and health centers do not have sufficient skill that allow them to accomplish their task effectively using DHIS software. For example, one of the basic functions that DHIS software provides is a feature that allows information workers to present health data in various forms such as graphs and charts. However, in spite of an initial training and one additional refresher training to users at different levels by HISP team members in Addis Ababa on basic functionalities of the software, all information workers in sub-city health offices, almost all statisticians in hospitals and all statisticians in visited health centers were not
proficient in the advanced data analysis functionalities and in presenting information in graphical forms.

Lack of proper skills had obviously affected and is affecting the type and quality of information produced and delivered to managers at different levels. For example, health information worker in one sub-city health office indicated that he is not able to deliver standard reports despite managers within the sub-city prefer and ask reports from DHIS software, since he does not have the necessary skill to generate even standard reports due to lack of formal training on the software. As it is described in the research findings section, managers in similar situations are forced to use the manual system which is currently running in parallel with the computerized system. Therefore, such inability or limited use of the existing functionalities of the software mainly due to lack of skill and training will inevitably negatively influence managers attitude towards the system and would have an impact on future usability and sustainability of the computer-based health information system.

This problem is mainly attributed to lack of intensive and continuous capacity building efforts by both the regional health bureau and HISP-Ethiopia to empower users with necessary skills so that they could master all functionalities of the system. Besides, users lack of self initiated motivation to explore and use all the functionalities (as one hospital ex-statistician did) through hands on exercise and practice is also another impediment for the limited usage of the software at different levels of the Addis Ababa health system hierarchy.

♦ Lack of substitutes to replace permanent HIS staff

Substitutes in this study refers to staff member/s with other responsibility in a particular health unit and who are supposed to replace and perform the information work in case when the staff member in charge of the health information system is not available for various reasons. Kleinau (2000), indicated that availability of two staff members for information work especially at district levels ensures that data reporting and transmission is performed smoothly incase one of them are absent from their work. Similarly, as it was pointed out in the findings section, during the implementation of DHIS software in Addis Ababa health bureau, such strategies were designed by HISP-Ethiopia and the Addis Ababa regional health bureau to ensure the continuity of HIS work, i.e. training was given for two staff members (one full-time HIS worker and another staff member with other responsibility) in all ten sub-cities, some hospitals and some health centers.

However, the result of this study illustrates that, in all sub-cities, all hospitals as well as in most of the visited health centers, the additional staff members who took training on DHIS software are not actually substituting when the need arises, This means that they are not working with data capture, analysis and reporting tasks in the absence of the regular health information staff. The main causes for substitutes not to perform the
information work whenever the need arises is mainly due to lack of sense of responsibility and lack of hands-on exercise and practice. In this study, lack of substitutes is therefore imposing its own impact on the timeliness of the data reported as well as on effectiveness of data transmission. For example, most subjects of the study revealed their experience that data transmission to the next higher level is usually ceased in case of their absences whereas there is relatively better data transmission at some health centers where substitutes are working the health information work. Therefore, if reports are not sent to higher levels at the required time due to absence of regular staffs, managers would start to question the reliability of the system and would easily shift to the paper-based system which is done by existing staff with no technical background and training. This is therefore, a risk for sustainability of the system which requires proper attention from all stake holders.

As some of the subjects included in this study recommended, it is crucial to offer regular training on the software for two to three people from each health unit in order to minimize this problem. However, assigning substitutes for long period of time in the position is not recommended since it creates workload to them and this in turn has influence on the quality of the data collected. For example, the pharmacist who is also working as health information worker in one sub-city indicated that he does not report complete data due to the work load he experience. Additional and important point here in selecting substitutes for training is to make the selection process better grounded locally. This means that candidates for the training should be given responsibility and should explicitly know the purpose why they are selected for, prior to the training to minimize problems of negligence (lack of sense of responsibility) among substitutes as it is observed in this study.

- Poor technical support

Availability of technical support staff to deal with technical failures (both hardware and software) is another crucial human resource related issue to ensure the sustainability of computer-based information systems. Allocation of human resource for provision of technical support in the context of computer-based information systems in a given organization may refer to assignment of staff member/s with required technical skill to support software (such as computer applications for data management) or hardware failures (such as computer and printer equipments). Wilson (2000) and Lippeveld (2001) discuss availability of competent technical staff for maintaining technological infrastructures as one essential factor that facilitates adequate usage of computer-based health information systems. However, in this study, although HISP has assigned one technical facilitator to handle all technical problems raised from the different places where the software is implemented, the researcher had noticed that the current number is insufficient to provide support to all 10 sub-city health offices, all 5 hospitals and more than 17 health centers where the software is deployed. This problem is further exacerbated by the existing lack of transportation facilities provided by the Addis Ababa health bureau. As a result of this, many HIS workers at different levels have
complained on frequent system failure (both hardware and software) and lack of prompt technical support. Thus, to make the system more usable and to ensure its future sustainability, the issue of technical support should be given due emphasis both by the regional health bureau and HISP mainly by assigning adequate technically competent staffs.

- Poor incentive mechanisms

Sapirie (2001) argue that designing incentive structures to motivate information workers to collect and record data is central task in the implementation and use of health information systems. Similarly Azubuike and Ehiri (1999) indicated that poor incentive mechanisms such as poor wage and poor working conditions have significant influence on the motivation of health information workers in collecting and recording data accurately and in complete manner. Furthermore, Sapire (2001) discuss poor payment in developing countries as one factor for resignation and frequent transfer of computer literate health information workers. Similarly, in this study, poor payment is exerting negative influence on the good performance of the computer-based health information system in Addis Ababa health bureau. For example HIS workers at lower levels especially at health centers are less motivated towards their job and were eager to express their feelings on the low level salary they earn per month during interview sessions. Similarly at higher level of the hierarchy especially at sub-city health offices there is frequent staff turnover of skilled and experienced HIS workers due to low level salary they earn and lack of scheme for promotion.

- Lack of perception about the link between information and management decision and action

Having knowledge about the link between information and management among managers and HIS employees at various levels within the health care system hierarchy may trigger positive contributions from different directions towards the good performance of a particular health information system. For example, Azubuike and Ehiri (1999) stated that lack of understanding about data collection and information use among health managers and other HIS personnel results in negligence on generation and use of accurate and complete data. Such examples from the empirical findings which are related with poor insight about the link between information and managerial decision and action are presented as follows.

In this study, it was identified that some managers and HIS staffs at different levels of AAHB do not have the right perception about the link between quality information and managerial action. This is observed among managers on the level of attention they give towards recruiting and assigning appropriate staff for health information system posts. For example, after the institutionalization of the new health information system at AAHB in 2004, formal posts were created and budget was allocated for recruiting human resource for health information system related activities in SHOs, hospitals and health centers. However, after two and half years, the findings from the empirical data
Analysis and discussion

indicated that there were cases where managers empowered to recruit full-time staff did not recruit and assign HIS staff for months. For example, the position in one SHO remains vacant for more than four months following the resignation of previous HIS staff. There is also another similar case where health care managers in one hospital transferred the HIS staff to work in another department within the hospital without assigning staff for the health information work. These are compelling evidences of the existing lack of perception on the importance of health data for health care system in general and for day to day managerial activities in particular. This lack of proper attention to health information system positions by managers at different levels make it difficult to recruit and assign staff which in turn affects the usability of the system and which ultimately poses a challenge on sustainability of the computerized health information system.

There are also other similar cases from this study which magnify the existing perception among managers of not considering information work as a business that yields positive result which requires human resource for its proper functioning. For example, HIS staff in one hospital takes leave for more than five months and there has not been any effort from managers to fill the position. In this specific case data transmission was terminated for more than three months prior to my visit. Another noticeable case related with this is that of manager’s attitude towards the type of skill and experience required to effectively perform HIS tasks. For example, in one hospital new HIS staff was assigned to the position without any knowledge, experience, training, even without preliminary orientation or in other words, without any know how on how to fill data on paper-based formats. Therefore, these may possibly be considered as additional evidences that display the existing lack of perception about the value of information among managers across different levels.

There is also lack of proper perception about the value of information among health practitioners who participate in data collection activities. For example, some health professionals (such as doctors and nurses) in hospitals report incomplete, illegible data (for example See Figures 5-2, 5-3 and 5-4) to statisticians. In one case I have been informed that some clinical departments in one particular hospital even refused to compile and send the data to the statistician at all. Similar problems of inaccurate and incomplete recordings of data by health practitioners in some visited health centers were also identified in this research. As to the evidences obtained from the study in this regard, this type of poor cooperation and negligence for proper collection of routine health data by health practitioners themselves is a good indication of lack of perception about the link between information and improved health service delivery and management.

In summary, these issues will have a negative impact on the completeness and quality of the information generated from the software and of course on the systems future usability as a tool to support managerial decision and action at different levels.
Technological infrastructure

ICTs can be conceptualized as a medium that have a potential to turn health information systems in to powerful management tool for health sector by radically improving the availability, dissemination and use of health data (Shrestha et al, 2000; WHO, 2006; Raghavendra and Sahay, 2005; Walsham and Sahay, 2006; and Stansfield et al, 2006). Challenges for sustainability of the system which are related to technological infrastructure are presented in the following two points.

♦ Software related (DHIS)

_Emergence of new reporting format and data elements which are not included in the software_

Braa et al (2007b) have point out that lack of shared standards for data collection can be considered as collection of the same data through different systems many times which ultimately results in poor quality data and poor use of information. Likewise, in this study, there is an overlapping information flow in the existing computer-based health information system in Addis Ababa health bureau. This means that new reporting forms and additional data elements which are not supported by the existing software are continuously emerging and there is reporting of the same data two times. For example, data about a patient who make antenatal visit is normally kept in antenatal standardized reporting form, whereas the same data is again collected in a new reporting format called adolescent reproductive health between the age of 18-24, which is not integrated and included within the existing routine health information system. Besides, there are new data elements being added on PMTCT reporting format. As respondents indicated, DHIS incorporates only nine data elements on PMTCT reporting form, but currently there are more than six new data items which are not incorporated in to the integrated reporting format. This addition of new data elements forced information workers to use a separate reporting form to send reports to higher levels which in turn brought additional work load on HIS workers at all levels. In such conditions, as Braa et al (2007b) clearly stated and as some of the subjects of this study indicated, data which is collected through two or more different channels can not measure or reflect the actual happenings to health care managers at higher levels and will exert negative influence on the future usability of the information generated in this way.

♦ Hardware

_Lack of internet connectivity_

In the context of health information systems, Shrestha and Bodart (2000) stated that internet technology has the potential to speedup health data transmission in a more effective way than any former data transmission mechanisms such as postal mail. In spite of the growing recognition of the importance of modern communication
infrastructure for health data transmission, in Ethiopia, this infrastructure is yet in its infancy. Although Addis Ababa is the capital city of Ethiopia and even if it is usually assumed that it has relatively better technological infrastructure compared to other regional states, in this study, as it can be seen from the research findings it was identified that except in one case none of the health units at various levels of the hierarchy had access to internet and therefore could not send reports as e-mail attachments to higher levels. Thus, even though this is not a critical element for sustainability of health information system, availability of internet access for data transmission to the central levels will obviously make the health information system more effective by facilitating availability of timely information for managerial action.

Organizational/managerial support

Organizational/managerial support and commitment can be conceptualized as provision of needed resources such as human resource, HIS supplies, computer technology, establishing organizational rules such as defining staff responsibilities and creating data quality assurance mechanisms in order to sustain the usability and functionality of a particular health information system (Lippeveld and Sauerborn, 2000 and Keleinau, 2000). Challenges which are related to organizational and managerial issues are presented as follows.

♦ Top-level commitment

Commitment from top management is one crucial factor that facilitates successful implementation and sustainability of health information systems (Lippeveld and Sapiere, 2000). In this study, it was noted that there was a strong political commitment from the top management when DHIS software was initially introduced to the health care units at AAHB. However, after the resignation of the former head of the regional bureau, most respondents included in this study indicated that DHIS software is not getting the attention and commitment from the new management as it was enjoying previously. This lack of commitment among managers at Addis Ababa health bureau is exerting its huge negative influence on the overall performance of the existing HIS in various ways. For example, there are no follow-up mechanisms on proper data transmission and delivery of routine reports even when reports are not sent to the bureau for more than four months; most of subjects included in the study have the feeling that the software is not properly handled by top managers at the regional level, there is very limited commitment from the bureau in providing transportation facility to HISP-Addis Ababa facilitator whenever there are technical problems at sub-city health offices, hospitals and health centers. Thus, if the existing lack of political commitment persist, in the long run this will be the most serious and critical threat to sustainability of the existing health information system.

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Creating data quality assurance mechanisms such as providing supervision support and providing reporting feedback are important incentive structures for HIS staffs to encourage them to collect and report quality data (Shrestha and Bodart 2000). According to the authors, providing supervision support and providing feedback on data errors from higher level HIS staff to staffs at lower level of the hierarchy is one necessary condition to improve production of good quality data. On the other hand, LaFond and Field, 2003 stated that failure to provide regular feedback on data errors and supervision on assessing the operation of health information system is deterrence to health information workers to report good quality data. Likewise, from the data obtained during the empirical phase of this study, it was discovered that there is no provision of regular positive or negative feedback on the quality of data from higher level health information staff to HIS staff at lower levels. Therefore, this lack of feedback from higher level health information workers on the quality of the data reported from lower levels is one impediment to the commitment and motivation of health information workers towards collecting and reporting good quality data.

On the other hand, at higher level of the hierarchy for example at sub-city health offices, there is permanent schedule (every three months) to make supervisory visits in health centers in order to assess the operation and performance of the health information system. However, from the findings of this study, this is not executed practically on regular basis mainly due to lack of frequent follow-up from HMIS staffs at AAHB and partly due to work load health information workers experience.

OPPORTUNITIES FOR SUSTAINABILITY

This study have also attempted to key out some positive aspects and opportunities that need to be maintained and maximized in order to ensure the long term viability and usability of the system. This section will present opportunities identified from the research findings which are related to human resource, technological infrastructure and managerial/organizational issues. Similar to the previous presentation, this sub-section of the chapter is structured into three sections each of which will present the analysis of the theme of that section.

Human resource related

Health information workers in most sub-city health offices have background from health sciences and most of them are public nurses (See Table 5-2). Their background helps them to understand the meanings in health data and to correct possible errors as it is revealed from the interview transcripts. Therefore, the availability of HIS worker with health science background across sub-city health offices can be considered as an
opportunity since it is one of the ingredients of skilled health information worker (Cibulskis and Hiawalyer, 2002).

**Technological related**

- **Software**

*Perceived usefulness of DHIS software*

From information systems literature, user satisfaction towards using new information system is usually seen as one factor to measure the success of information systems. For example, Sapirie (2001) argue that user satisfaction on the usefulness of the system in supporting their task is one factor that can measure the success and sustainability of health information systems. Similarly, this study also investigated end users’ perception towards the usefulness of DHIS software in supporting their work. As a result, subjects of this study at sub-city health offices, hospitals and visited health centers indicated that they have a positive attitude towards the software. Specifically, most of them revealed that DHIS software makes their task easier by liberating them from routine manual data processing, eliminate problems of missing paper reports, offers multiple types of reports, enables them to generate reports more quickly than the manual system and minimizes error by tracing unintentional recordings of wrong data through data validation rules which is embedded in the software. Thus, this is one opportunity for sustainability of the existing routine computer-based health information system that needs to be maximized.

*Usability of the software*

Usage of the output of the software such as use of routine reports by managers at various levels of the health system hierarchy can be conceptualized as an achievement of one of the objectives for implementing health information systems within the health care system. Sapirie (2001) clearly stated that frequent request of data from policy makers and program managers for the purpose of evaluation and planning is one factor that can assess the success and sustainability of newly implemented health information systems. In the same way, in this study, most health care managers especially at sub-city health offices and hospitals request and get data routinely on monthly, quarterly, and annual basis and they use it for evaluating and for planning purposes. For example, managers at sub-city health offices consult a drug consumption report which is generated from DHIS software to plan and decide on the kind of medicine that is required and that should be available.

- **Hardware**

Essentially, computer hardware/equipments are artifacts that are necessary to run software applications and are integral components of ICTs. Kimaro and Nhampossa
(2005) discuss about the significant role played by technological infrastructure such as computer equipments in realizing the potential of ICTs. Similarly, in this study all sub-city health offices, almost all hospitals and most visited health centers have state-of-the-art working computers with software for managing health data and working printers for data communication. Even though, putting a computer box in health units will not promote sustainability of HIS by itself, it is one important input for successful health information system restructuring that allows users to carry out data collection, analysis and reporting tasks more efficiently (Lippeveld, 2000). Besides, it was identified that telecommunication facilities such as telephone lines are more or less available in all sub-city health offices, all hospitals and all health centers. However, the distribution of direct telephone access is not uniform across levels i.e. at sub-city health offices there is full access to telephone for HIS activities whereas at hospitals and health centers full access to telephones is somehow limited (See Table 5-6 on hospitals and Table 5-8 on health centers).

As it is indicated above, access to computers and telephone services at all levels of the AAHB is a great opportunity that should be maintained and maximized to enhance sustainability of the computer-based health information system.

Organizational / managerial commitment

♦ HIS supplies

Sapirie (2000) emphasized the significance of managerial support in providing HIS supplies such as reporting forms, diskettes and other supplies which are useful for proper data collection and transmission. Similarly, as the result of this study there is no shortage of HIS supplies such as tally sheets, standard reporting forms, other report forms, diskettes and stationeries such as pen and pencil at sub-city, hospital and at all visited health centers in Addis Ababa health bureau.

However, most information workers in sub-city health offices indicated shortage of memory stick for the purpose of effective data transmission since they continuously encounter floppy disk failures. Thus a simple way to increase sustainability of the system would be to provide memory sticks as storage and transmission solution.

♦ Defining roles and responsibilities

Defining roles and responsibilities for health care staffs who are involved in HIS activities is one important function of health care managers to facilitate proper data collection and reporting (LaFond and Field, 2003; Lippeveld and Sauerborn, 2000 and Kleinau, 2000). Similarly, in this study, the research finding in this regard identify one exemplary case where medical director of a hospital defined clear roles and responsibilities for health practitioners who are actively participating in data collection activities and as a result, problems related to poor quality data and late reporting were
significantly minimized and awareness of information for managerial action is enhanced.

- Interaction between HIS workers and decision-makers

Regular meeting among HIS workers and decision-makers at district/sub-city level is considered as one strategy to foster understanding about the implication of information for decision making purposes among health information workers and to have common understanding among HIS workers and decision makers (Sauerborn, 2000). Similarly, the study in this regard revealed a practical case where statisticians from health centers and HIS staff in sub-city health office participate in review meeting with health care managers which is held every three months. In the meeting health information workers discuss the problems they face in performing their task and solutions will be generated from the meeting in collaborative manner.
6.2 Discussion

Sustainability of useful information systems in organizations is an important condition that has great consequence on organizational efficiency. However, sustainability of information systems especially in the social, economic, organizational and technical setting of developing countries is continuously reported as a challenging task. For example, Braa et al (2004) discussed design and development of sustainable health information system across developing countries as a challenging task which includes making an information system work, in practice, overtime and in a local setting.

According to LaFond and Field (2003), useful information system is a system that produces good quality data and that facilitates information use. As to the authors, good performance and sustainability of such useful system emanates from the synergetic improvement of three major dimensions of the information system itself namely: human resource related factors, technological infrastructure factors and managerial/organizational factors.

Several and different factors influence the sustainability of useful information systems. For example Korpela et al (1998) point out the challenge of making information systems in developing countries sustainable and indicated factors such as lack of long term financial support and other resources as a threat to sustainability of well designed and useful information systems. On the other hand, Heeks (2002); Cibulskis and Hiawalyer (2002) and Lippeveld and Sauerborn, (2000) argue that lack or resignation of skilled and well trained human resource as one factor that highly influence sustainability of information systems. Technological infrastructure is also discussed as additional factor that influence sustainability of information systems. For example Kimaro and Nhampossa (2005) and Yusof et al (2006) stated the significant role of technical infrastructure in realizing the potentials of health information systems in developing countries. A guideline for the development of HIS prepared by WHO (1993) also explicitly stated the importance of managerial support in making good health information system to be operational and sustainable.

Based on the perspectives taken from relevant literatures, this study attempted to analyze the influence of human, technological and managerial/organizational factors on sustainability of health information system in general and in the Ethiopian public health care system in particular. In addition, I have studied the aspects related to data quality and information use as seen in the conceptual model (Figure 6-1). Data quality and information use (which is the ultimate objective for implementing health information systems) along with other three factors is presented in the conceptual model as a condition that highly influence the sustainability of health information systems.
Accordingly, as it was presented in the previous section of this chapter, human resource, infrastructural and organizational/managerial related issues significantly influence the sustainability and usability of the computer-based health information system which is currently embedded at Addis Ababa health bureau. However, through this empirical study, I argue that these three factors influence the sustainability of health information systems indirectly and directly (See Figure 6-1).

Figure 6-1 Conceptual Model of Direct and Indirect Factors for Sustainability.

As it is depicted in Figure 6-1, each of the factors are classified as direct critical factors for sustainability and indirect factors which affect data quality and information use and which in turn affects sustainability overtime. Therefore, the discussion in this section revolves around on: how human resource, infrastructure, and managerial/organizational related issues directly influence sustainability and how they also indirectly influence the performance and long term viability of the system.
DIRECT CRITICAL FACTORS FOR SUSTAINABILITY OF HIS

Direct critical factors are factors that exert huge direct influence on the existence and performance of the health information systems. For example, from human resource dimension, lack of technical personnel (in case of systems’ failure) is one critical factor that directly terminates full usability of the system (Heeks, 2002 and Lippeveld, 2001). Similarly, in this study as it is presented in the analysis section, there is lack of adequate technical personnel and this can be considered as one human resource related factor that exert huge direct influence on the existence of the computer-based health information system which exists at health centers, hospitals and sub-city health offices.

From infrastructure dimension, availability of well functioning and sufficient technological infrastructure plays a significant role to ensure the existence and usability of computer-based health information systems (Kimaro and Nhampossa, 2005). For example, from the case in this study, availability of well functioning and sufficient computers and printers at all sub-city health offices, all hospitals and most health centers can be thought of as one critical factor that supports the existence and proper functioning of the computer-based health information system embedded at Addis Ababa regional health bureau.

From this study there are also critical factors from managerial support dimension that directly influence sustainability of the health information system. For example, the political commitment and support for the new computer-based system from top managers at Addis Ababa health bureau during the initial period of the implementation of DHIS software, influenced positively for the system to be operational at all levels of the public health care system. However, the current low level motivation and commitment by the new team of the top level management at the regional health bureau is one critical factor that threatens the system’s maintainability, usability and long term viability of the system.

INDIRECT FACTORS FOR SUSTAINABILITY OF HIS

On the other hand, the indirect factors affect the sustainability of the computer-based health information system in indirect way. That is, these factors do not only make the computer-based system to terminate operation immediately. As it can be seen from the conceptual model, these factors affect sustainability first by influencing data quality and information use and then the usefulness and sustainability of the system. According to Setzer and Stoops (2003), as health information systems produce good quality data, data users will develop trust on the information system and will be motivated to use information for various decisions and vice versa.
Shrestha and Bodart (2000), argue that data quality is multidimensional and is affected by several sources. Similarly LaFond and Field (2003) point out that data quality and information use is affected by human resource related, infrastructural and managerial/organizational factors which exists within the health information system. Similarly, this study attempted to understand the impact of these three factors on data quality and information use and on sustainability of the computer-based health information system in Addis Ababa health bureau. The following three paragraphs present a discussion on each of these three factors (i.e. human resource, infrastructural and managerial issues) by presenting one example from the study.

From human resource dimension, there is lack of substitutes especially at sub-city health office level which results in poor quality data (i.e. incomplete and late or obsolete data). As Setzer and Stoops (2003) explicitly stated, in the long run, this condition might minimize the usability of the system by making it less reliable and creating less trust and towards the system among health care managers on the information produced in this way and this can be considered as one indirect factor that threatens sustainability of the health information system in the long run.

Fragmentation of integrated and comprehensive health information system is reported as a condition that paves way to the production of poor quality data by creating parallel and overlapping information flow and a condition that creates unnecessary job burden to health information workers (Braa et al, 2007b; Chilundo and Aanestad, 2003). Similarly, from the Infrastructure dimension, new reporting forms and additional data elements are emerging in the existing integrated health information system. As it is underlined by Braa et al, 2007b and Chilundo and Aanestad, 2003 this study contends that, the emergence of new reporting forms and additional data elements is one important factor which is paving a way to the production of poor quality data and is creating unwelcome job burden to health information workers at different levels of Addis Ababa health bureau. Thus, this condition can be conceptualized as one indirect factor that affect sustainability of the computer-based health information system, in the long run by affecting the quality of the data generated from the system.

From managerial dimension, there are indirect factors that affect data quality and information use. For example, providing support and incentive structures such as creating data quality assurance mechanisms is one important task of managers to encourage health information system staff to collect and report quality data (Shresta and Bodart, 2000 and LaFond and Field, 2003). However, in this study, top managers did not yet create data quality assurance mechanisms which are essential for the production of good quality data and information use. Thus, this factor can be viewed as one indirect factor that threatens future viability and sustainability of the computer-based health information system at Addis Ababa health bureau.

The following table depicts some examples of direct and indirect factors that are extracted from the empirical data of this study.
Factors for sustainability | Examples of contributing factors from the study
--- | ---
Direct | Top-level commitment, Technical support, presence of skill and adequate training to utilize the software, perceived usefulness of DHIS software, usability of the software, availability and sufficiency of computers, printers and other equipments, availability of HIS supplies.
Indirect | Professional career/educational background, lack of substitutes to replace permanent HIS staff, emergence of new reporting format and data elements which are not included in the software, access to internet connectivity, creating data quality assurance mechanisms, defining roles and responsibilities, interaction between HIS workers and decision makers, availability of incentive mechanisms, proper perception about the link between information and management decision and action.

Tabel 6-1 Examples of Direct and Indirect Factors affecting sustainability of HIS.

6.3 Summary

This chapter focused on highlighting the analysis and discussion of the empirical study. It demonstrated the factors that have impact on sustainability of the computer-based health information system at Addis Ababa health bureau using literatures drawn from the information systems field. Most of the findings resulted from the analysis conform to the existing literature on information systems. New conceptual model that helps to understand the impact of the context-specific factors on sustainability of a given information system is also provided. The next chapter will present concluding remarks, contribution and research areas for future work.
7

CONCLUSIONS

This chapter highlights the main conclusions from the empirical study, analysis and discussion. The research questions guiding this study were: 1. What conditions are influencing the sustainability of the health information system? 2. How do these conditions affect its’ sustainability? 3. How should the identified problems be solved?

Accordingly, challenges and opportunities that have influence on sustainability of the computer-based health information system at Addis Ababa health bureau have been identified. As this study suggest, and as it is indicated in other research studies from the information systems literature, sustainability of health information systems in developing countries cannot be viewed as a phenomenon which is influenced by one specific factor. Rather, it is influenced by multiple contextual factors. This study has identified multiple factors which can influence sustainability of the computer-based health information system. Identified factors are categorized into three broad groups; human resource, infrastructural and managerial/organizational. Following the analysis, possible solutions to address the identified problems have been described. Identifying the context-specific factors that exert influence on sustainability of the system is valuable for the organization where the system exist and information systems stakeholders to manage the risk that threatens sustainability of the system which is currently used as a source of information for managerial action at Addis Ababa health bureau.

As has been said in the discussion part, multi-dimensional factors which emanates from the context of an information system itself affect its’ sustainability both directly and indirectly. From each of the three main categories identified from this study namely: human resource, infrastructure and managerial/organizational issues, there are factors that are crucial and which exert huge influence for the sustainability and long term viability of computer-based health information systems. These direct critical factors are essential elements needed to prolong the existence of the computer-based health information system such as availability of skilled human resource and availability of technical support during system failure. On the other hand, there are factors from each of the three main categories that threaten the sustainability of given computer system in indirect way. These indirect factors have impact on the systems’ sustainability first by influencing the process of production and use of good quality data. This means that, the indirect factors impede/promote the production of good quality data and use of good quality data by data users. For example, from this study, lack of follow-up on the quality of data reported is one of the major impediments identified for production of good quality data. Such and other similar factors have impact on sustainability and long term viability of a given information system because as system users (for example
specific for this study health care managers) obtain good quality data, the more they put trust on the information system and the more they use information generated from the system, and vice versa.

This study also made some important contributions to knowledge and practice. Knowledge yielded through this study contributes to the scanty literature on sustainability of health information systems in developing countries in general and in the context of the Ethiopian public health care in particular. And this will benefit to the research community interested on sustainability of health information systems in developing countries. In addition, the study also attempt to explicate as to how the different factors situated in the context of the information system affect its sustainability and develop conceptual model. This conceptual model can also be viewed as new contribution to the information systems literature. Furthermore, this conceptual model provides potential contribution to practice by serving as a base for designing action plans that prioritize the multiple challenges which surrounds the health information system in Addis Ababa health bureau.

This study did not cover exhaustively all the challenges for sustainability of the health information system in Addis Ababa health bureau. Rather this study unfold several problems areas that needed further research to provide new knowledge and full understanding on the topic of interest, i.e. sustainability of health information systems in developing countries. Based on the impression obtained from the empirical study, the present author proposes the following areas for future work:

♦ Revision of data elements that have relevance to managerial task: the existing integrated system is facing challenge of fragmentation due to the emergence of new data elements.

♦ Data quality: this study conducted preliminary step on the quality of data produced from the computer-based health information system. Systematized detailed investigation on the quality of the data produced from the computer-based system is another relevant research area because it is revealed from the interview results that some health care managers are becoming skeptic to use reports due to the inconsistency they see between the report generated from the computer system and reports maintained through manual system.

♦ Political commitment: Due to limitation of time and resource, this study did not include the political dimension of the computer-based health information system. This area is also proposed for future work since it is critical t area to sustainability of health information systems particularly in the context of developing countries.
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APPENDICES
Appendix A: Ethical Clearance from University of Oslo

UNIVERSITY OF OSLO

To Whom It May Concern

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Norway

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FACULTY OF MATHEMATICS AND NATURAL SCIENCES

Request for Master thesis studies – Sofia Lulsegd Abhha

Sofia Lulsegd Abhha is currently a student in the International Master of Science in Information Systems programme at the Department of Informatics, University of Oslo. In this programme, the students have to collect data for their research through fieldwork in organizations that use information technology. The method of data collection might include interviews, observations, questionnaires and reading of documents.

The University of Oslo requests that the student will be allowed to carry out such studies after agreement concerning time schedule, privacy and other issues has been settled.

Best regards

Jens Kaasbøll

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Professor

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Head of International Master Programme in Information Systems
Appendix B: Ethical Clearance from AAU to work in SNNP

ADDIS ABABA UNIVERSITY
FACULTY OF INFORMATICS
DEPARTMENT OF INFORMATION SCIENCE

Appendices
Appendix C: Line Graph representing Born Alive against Veand IUFD at Different Points of a Given Time Period (prepared by HIS worker in Ghandi hospital).
Appendix D: Bar Graph Comparing Major and Minor Operations in a Given Period of Time (prepared by HIS worker in Ghandi hospital).


- Major Operation
- Minor
Appendix F: Additional Data Elements in PMTCT Reporting Format

Ministry of Health
Health Facility PMTCT report for the month of ---------19 ---------EFY

<table>
<thead>
<tr>
<th>Region</th>
<th>Addis Ababa City administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-City</td>
<td>KIRKOS</td>
</tr>
<tr>
<td>Name of health facility</td>
<td></td>
</tr>
<tr>
<td>Type of health facility</td>
<td></td>
</tr>
<tr>
<td>Reporting month:</td>
<td></td>
</tr>
<tr>
<td>From: (day/month/year)</td>
<td>DD MM YY</td>
</tr>
<tr>
<td>To: (day/month/year)</td>
<td>DD MM YY</td>
</tr>
</tbody>
</table>

1. Number of ANC clients in the last month
   - New: [ ]
   - Revisit: [ ]
   - Total: [ ]

2. Number of ANC clients pre-test counseled in the last month
   - New: [ ]
   - Revisit: [ ]
   - Total: [ ]

3. Number of pregnant women who received testing for HIV in the last month
   - New: [ ]
   - Revisit: [ ]
   - Total: [ ]

4. Number of pregnant women who received their test result and post-test counseling in the last month
   - New: [ ]
   - Revisit: [ ]
   - Total: [ ]

5. Total number of pregnant women who tested HIV positive in the last month

6. Total number of pregnant women who tested HIV negative in the last month

7. Total number of pregnant women who received NVP in the last month

8. Total number of babies who received NVP in the last month

9. Total number of HIV positive pregnant women who received counseling on infant feeding options the last month

10. Total number of infants born from HIV positive mother receiving Co-TMX prophylaxis in IMCI care in the last month

11. Total number of HIV positive pregnant women who received referral to or provision of long-term care and support in the last month

12. Total number of male partners tested in the last month

13. Total number of infants born from HIV positive mother tested negative (age 18 month or above) in the last month

14. Total number of infants born from HIV positive mother tested negative (age 18 month or above) in the last month

Comments: (explain unusual results, challenges, lessons learnt, next steps etc)

Completed by: ________________________________ Signature: ___________ Date: __/__/____

Checked by: ________________________________ (Dr.) Signature: ___________ Date: __/__/____
Appendix G: Interview Guide

1. How do you collect data?
2. How and when do you report data to the next higher level?
3. Have you worked in HISs before DHIS software was installed Y/N?
4. If yes how do you compare the existing systems with the one you were working on?
5. Have you got adequate training on DHIS software?
6. How many staff members took training in your institution?
7. Have you request for reports from managers, NGOs…who are the users of the report generated from DHIS software?
8. For what purpose are users using the information generated from the software?
9. How do you present reports?
10. Do you get feedback on the data you reported to higher level, how and when?
11. Do you give feedback to data reported from lower levels?
12. Do you have computer for HIS activities, internet access and telephone?
13. Is there anyone who can work incase you are not available in your position and what are your recommendations to overcome this problem?
14. Are there any incentive and promotion schemes to the HIS worker position?
15. How do you feel about the quality of the data you obtain from lower levels (lower levels) / departments? What problems do you face while collecting data from lower levels/departments?
16. Do you send reports at the time required?
17. Do you get report from lower levels/departments in a timely manner? If yes what are the causes?
18. By training, what is your qualification and how long have you been working here?
19. Problems faced while using DHIS software?
20. Do you have shortage of materials needed to perform your day to day activity?
21. Is there a unit for maintaining hardware and software failures? If No, what other mechanisms are devised to deal with this and similar problems.