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**SUSTAINABILITY AND OPTIMAL
USE OF HEALTH INFORMATION
SYSTEMS: AN ACTION RESEARCH
STUDY ON IMPLEMENTATION OF
AN INTEGRATED DISTRICT-BASED
HEALTH INFORMATION SYSTEM IN
ETHIOPIA.**

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Sustainability and Optimal Use of Health Information Systems: an
Action Research Study on Implementation of an Integrated
District-Based Health Information System in Ethiopia

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Abstract

This study investigated the factors contributing to unsustainable health information systems and low level of use. Approaches to development and implementation of an integrated district-based health information system focusing on sustainability and use as well as the challenges are studied. This action research was carried out in Tigray Region, Ethiopia, at all levels of the health structure in two pilot districts: Hintalo-Wajirat and Wukro.

The intervention was undertaken using an action research approach with an interpretive case study. Interviews with observations of the information management activities at Region, district and facility levels, and document analysis were the chosen methods of data collection. The empirical findings were analyzed in relation to the existing knowledge in the relevant domain area and concepts from structuration theory.

The researchers found that centralization, fragmented structure and the low capacity of the health information system were the root causes of its very limited contribution to the performance of the Region's health system. The introduction of an integrated district-based health information system was the action proposed by the researchers to change the situation and put into action. The initial phases of the implementation of the redefined routine data flow and introduction of DHIS in order to create a unified health information system and facilitate decentralization were undertaken during the period of the research. The pilot implementation process is still ongoing in the Region under the technical assistance and follow-up from the Health Information System Project (HISP) in Ethiopia. We believe that this intervention is believed to contribute to the realization of optimal usability and sustainability of the Region's health information system.

Key words: Health Information Systems, Sustainability, Information use, Integration, Decentralization, Action research, Developing countries.

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1 Introduction

The ultimate goal of any health information system, in addition to providing quality information to the health managers, is to encourage use of information for improved decision-making at all levels. However, the accomplishment of this goal is determined by factors involved in the development and implementation as well as maintenance of the system. Consequently, this action research study mainly focused on the design, development and implementation of a sustainable health information system aiming for enhanced use in Ethiopia, Tigray Region. The research and software implementation addressed the integration of the parallel data flows and decentralization of the health information system to the district level, in order to facilitate change in local level use of health information and to motivate improvement in the quality of data collection. The empirical data for this study was obtained from a fieldwork carried out in Tigray Regional Health Bureau and two districts selected for the pilot implementation.

The chapter is organized in seven sections. The first section gives an overview of information systems in developing countries. The common problems encountered in the development and implementation process as well as the value of sustainable health information systems in relation to addressing these problems are presented. The second section focuses on the problems of sustaining health information systems in developing countries, in general, and the basic problems of the current health information systems which are affecting the service delivery at the periphery level in Ethiopia. This section also introduces the main problems of health information systems in Tigray Region, the empirical site of this study. Sections 1.3 – 1.6 briefly discuss the research domains, motivations, the main objectives of the research and the scope of the study in order to give the full image of the thesis.

1.1. Background

The development of an appropriate information system and its effective implementation should be viewed as a critical element of the success of many modern organizations (Walsham and Waema, 1994). Information systems have vital significance to organizations in different sectors regarding financial, administrative, and other related aspects, whilst the benefits vary depending on the type of information technology and the way that specific information systems have been developed and implemented (Ibid.). The introduction of appropriate information systems in developing countries is seen as a way to accelerate the socio-economic development. However, getting the process to work is not an easy task. Walsham, Symons and Waema (1988) stated that "...the problem of information system development and use are often more severe in developing countries in terms of factors such as the current state of knowledge, availability of suitable equipment and infrastructure, lack of financial resources, shortages of technically competent personnel and constraints imposed by the social and political context" (p. 190).

Information technologies are expected to play a key role in the developmental benefits. As Wilson (2000) suggests that the use of information technology is one of the most promising means of improving the quality, timeliness, clarity, use and presentation of relevant information for health care management. However, in developing countries, it is well known that using information technology for such developmental benefits is difficult for a variety of complex reasons. Lack of adequate infrastructure, ineffective training to cope with the technology and lack of awareness to use information technology for effective decisions are among them. "It is widely recognized that communication and information systems are essential infrastructures for economical and social development. However, there is a lack of conventional wired infrastructure to fulfill the tremendous demand for communication and information services in many developing countries" (Nichol and Jarke, 1998, p.1).

The health care service delivery in most developing countries is characterized by poor quality and inequity. The gap between the actual delivery and the demand for the service is widening because the resource allocated to the sector are limited in spite of the poor living

conditions of the community and high population pressure. In order to deal with this problem, in 1978 the WHO Alma Ata declaration wrote up a global vision called “Health for All” aimed at strengthening primary health care for equitable health service in all developing countries (WHO, 1978). In these countries primary health care is adopted and used as an overall strategy. However the principles are still facing significant challenges and the impact of the policies on the equity and access to care and health status is limited. The Alma Ata objectives are still far from being realized.

In order to address these problems, increasing the efficiency and effectiveness of existing facilities and resources is important. This can be facilitated with well informed decision-making and resource management supported by effective information systems. Health information systems are used for generating information for rational decision-making at each level of the health system, from local up to national level (Lippeveld, 2001; Skobba, 2003).

However, other than the development and implementation of health information systems, making adequate use and sustaining them are also challenges in many developing countries due to several reasons. In order to tackle these problems, the WHO Regional Office for Africa has identified as a priority the need to strengthen the health information system in the countries of the Region and to find the mechanisms to sustain them.

Sustainability reflects the tendency of an information system to continue functioning over time regardless of certain changes in the organization. Since development of information systems should be an ongoing process and needs to be reviewed and updated as circumstances change and lessons are learned. This study looks at the potential sustainability of an information system in relation to its potential for optimum use to serve its purposes in the health system not only its survival in an organization over time.

The key factors influencing sustainability may vary between countries, such as their level of economic development, the role of the donors funding in the economy, the government’s ability to meet recurrent cost-financing requirements, the available human capital, and the

nature of political and administrative decision-making systems (Young and Hampshire, 2000). “Donor funding and top-down approaches generally fail to bring sustainable benefits that hinder the system in relation to end users ownership and commitment” (Young and Hampshire, 2000, p. 4).

As a factor of sustainability and information use, this study particularly addresses the fragmentation of data flows within a health system. The process of implementing sustainable health information systems can facilitate the integration of poorly coordinated work processes to minimize redundant operations horizontally among departments (Monteiro, 2003).

This study also dealt with decentralization of health information to the district level. It is assumed that decentralization is “a spatial aspect in that authority and responsibility are moved to organizations in different physical locations, from the center to the local level” (Brinkerhoff and Leighton 2002, p. 2). The implementation of district-based health information system aiming at collection of quality data at facility level and increase in health workers motivation, improved efficiency of resource utilization, increased service delivery effectiveness through adaptation to local conditions and targeting to local needs (Brinkerhoff and Leighton, 2002).

Thus, considering all the advantages of sustainable and useable health information systems in developing countries, this study investigates the actual status of health information systems in Ethiopia, Tigray Region to identify the factors contributing to the unsustainability and low level information use, as a basis for determining how to intervene to address the problems. This action research is a continuation of similar action research interventions which have been undertaken by the Health Information System Project (HISP) in other developing countries.

1.2. Research problem and research questions

Designing and implementing sustainable and usable health information systems in developing countries is a difficult task for challenging reasons of political, social, cultural and administrative nature. The governments of developing countries have tried to restructure their existing health information systems under the pressure from donor agencies. However, such systems were unable to be sustained (Kimaro and Nhampossa, 2004). The key reasons for this unsustainability are difficulties of adapting software from one country to another; training and retaining technical staff; infrastructure issues (uneven power supplies, poor communication facilities); and funding mechanisms that do not support on-going maintenance and system enhancements (Walsham, Symons, and Waema, 1988; Wilson, Sapirie and Lippeveld, 2002). Other causes for the ineffective attempts and problems of sustainability of the health information systems in developing countries are problems of shaping and adapting the systems to a given context, cultivating local learning processes, and institutionalizing routines of use that persist over time (Braa, Monteiro and Sahay, 2004).

In Ethiopia, there is a need for a well-structured, sustainable and usable health information system at the local level, where the basic data collection is conducted. Considering the structured health information systems' benefits to improve the quality of the data disseminated to the higher levels of the structure and external users as well as the potential to increase the use of information at local level rather than collecting data only for reporting purpose.

The current health information system has certain gaps in coverage, particularly for drug-related and financial management indicators. Lack of timeliness and completeness of reporting from Regions remains a weakness of the health information system and such delays contribute to the failure at all levels to use data as the basis for informed decision-making in planning and management. In addition, parallel reporting mechanisms persist, with programmatic and donor-supported initiatives resulting in multiple reporting formats and an increased administrative workload (Tigray Health Profile, 2003; MoH, 2002).

Different reports confirm this problem. The World Health Organization (WHO) reported on the assessment of Reproductive Health Needs in Ethiopia that "...in none of the areas visited could it be said that adequate health information system were in place. In some Regions, health administrators were able to provide estimates of antenatal care coverage, infant mortality, and demographic indicators..." (WHO, 1999, p.18). The consequences of inadequate data go far beyond the inability to determine accurately the gravity of any particular health risk. They also limit the ability to determine what progress, if any, is being made to confront those risks (Ibid.).

The use of computers in managing the health information is at its very early stages. It is mostly limited to using general purpose software for data processing at the Regional and to some extent zonal levels, but not at the health districts. Thus manually collected paper-based data must flow from the local health facility to the Regional Health Bureau with an insignificant use at the district level.

Accordingly, in Tigray Region, the researchers' pilot study area, the health information system is suffering from fragmented structuring which had a tremendous impact on its usability. Centralization of the information management at the Regional level is another characteristic of the Region's health information system. This means, the data collection is only for reporting purposes and there are no established procedures encouraging local level data processing or use. Thus, the decentralization of the system to the districts as well as the implementation of an integrated system is vital in order to meet the goals of the Bureau. These goals were declared in the Region's annual health profile, as follows:-

- Improving quality of health care services,
- Increasing health services coverage and utilization,
- Implementing best health management practices and
- Reducing morbidity and mortality (Tigray Health Profile, 2003).

Therefore, this action research has investigated the present status of health information system in the Region and proposed and undertaken actions which were believed to address the Region's identified problems. The study is guided by two broad research questions:-

- What are the challenges and opportunities for implementing integrated district-based health information system in the context?
- What strategies and approaches need to be employed for the development and implementation of integrated district-based health information system, aiming at increasing the possibility of optimum use and sustainability in the context?

To respond to the overall research questions, we need to know:-

- What is the current status of the information support in Tigray Region health system?
- What are the potential factors limiting sustainability and use of the health information system in the Region?

1.3. Research domain

This research is carried out in the domain of information systems applied to benefit the health system. Its main focus is the design, development and implementation of an information system in the public health sector. Contemporary concepts in relation to district-based health information systems and system integration are also considered.

1.4. Motivation

This research was mainly motivated by the researchers' involvement with the ongoing international action research, the Health Information System Project (HISP), as part of expanding the network in other developing countries to Ethiopia. We believe the objectives of HISP can largely benefit the realization of the goals of primary health care in the national health system in Ethiopia.

Although the researchers had studied information science, they did not have any health related background previously. However, they developed the interest in working in the area by the wide coverage of the application of information systems in the health sector during their stay in the International Master Program in Informatics. This research will help in

creating knowledge on the proper employment of information systems enabling contributions to the achievement of the core goal of the health system in the country, improved services.

1.5. Objectives

The study mainly aimed at investigating the existing health information system in Tigray Region and improving the system by implementing an integrated district-based health information system. Moving towards achieving the main objective of the study, the following specific objectives were met:

- Identifying the potential factors limiting sustainability and usability of the health information system in the Region
- Identifying mechanisms for implementing a usable and sustainable health information system through an action research approach
- Identifying challenges of implementing a health information system at the district level.
- Contributing to the existing knowledge about implementation and adaptation of information systems in Ethiopia and in developing countries at large.

1.6. Scope of the study

This study focuses on the integration and decentralization of health information systems in Tigray Region, emphasizing on the quality of data and information use at district level. The investigation of existing health information system is concentrated on the data flow within the health structure and the types of reporting formats. The assessment was conducted only in governmental health institutions which are the most common health service providers in the region. The fieldwork was confined to the Regional bureau and two selected districts for the investigation of the actual status and initial implementation of an integrated district based health information system.

1.7. Organization of the thesis

This thesis is structured as follows: - Chapter 1:- presents background, problem area and research questions, research domains, motivations, objectives, scope of the study and organization of the thesis. Chapter 2:- discusses the related literature and theoretical perspectives. Chapter 3:- provides the research methodology, research approaches and sources of the data. Chapter 4:- presents the research settings and context to show the countries' historical and existing situation, including an overall description of the selected Region and the two pilot districts. The first four chapters provide the readers with background information adequate for understanding the main findings from the empirical research, the analysis and conclusions drawn in this thesis. Chapter 5:- describes the findings of existing health information systems in Tigray Region and the initial intervention under-taken to solve the identified problems. Chapter 6:- provides an analysis of major findings in relation to key concepts from structuration theory and in relation to the research literature. Chapter 7:- provides discussions of the researchers' reflections on the research findings, conclusions, and contributions of the study towards the main problem area. At the end of the thesis, we provide references cited in the thesis and appendices of additional documents.

2 Literature Review and Theoretical Perspectives

Review of related literature and use of concepts from theories is vital to understand and develop new knowledge. The purpose of this chapter is to establish the significance of the study as well as provide an outline of a standard for comparing the results of the study with previous findings and share existing knowledge in the research domain with the reader. The chapter presents review of related literature aiming at drawing the linkage between the study and the existing knowledge in the domain and drawing the theoretical framework in which the study is analyzed.

The chapter is organized in six parts. The first part includes the theoretical basis of information systems in organizations, in order to describe the system and the environment or the context in which it is operating. The second part introduces health information systems and their objectives as well as presents the common reasons hindering health information systems from meeting these objectives in general and specifically in developing countries. The third part focuses on information use and sustainability in developing countries, as context of the research, by organizing the major challenges in to four sub-sections. In the fourth section, the introduction of district-based health information systems and their assumed advantages for the health system is made, as part of the actions proposed by this research. Review of concepts from structuration theory as analytical tools for the contents and process of change in the restructuring effort is presented in the last two sections.

2.1. Information systems in organizations

Information systems can be defined as an information technology orientated solutions to organizational and management challenges. Information systems, as they are described in literature, are networks of information flows or files which are needed for relevant action in organizations, either computerized or paper based. Lippeveld (2001) cited Hurtubise (1984) for the definition of an information system; “a system that provides specific information

support to the decision-making process at each level of an organization” (Lippeveld, 2001, p.3).

The ultimate purpose of information systems is to enable the management and use of information for decision, to ensure efficiency, profitability and growth of the organization (Ciborra, 1985). Information systems help organizations to improve their ability to make rational decisions and as a result increase productivity and quality of products. In addition, information systems allow organizations to remain competitive and maintain better communication with collaborating organizations and clients (Zwass, 1997).

Computerized information systems are believed to benefit organizations over paper-based information systems by:

- processing and analyzing large amounts of data quickly
- producing a wide variety of reports from a single data set
- reducing duplication of work
- improving data quality through for example automatic validation during data entry
- improving analysis and presentation, which facilitates interpretation and use.

Literature confirmed that computer based information systems have potential advantages to support decision-making, planning, budgeting and other activities. Vlahos, Ferratt and Knoepfle (2004) studied a case on the use of computer based information systems by German managers. They approved that the German managers’ are relatively heavy users of computer based information systems. “The greatest task technology fit occurred for resource allocation, evaluating alternatives, identifying problems, and making short term decisions” (2004, p. 763). Similar study conducted in Australian large organizations also confirmed this fact. The most noticeable advantage of information systems and information technology were “process efficiency and satisfying information needs. Cost saving was perceived to be a further benefit with improved systems applications, productivity, and business needs” (Lin and Pervan, 2003, p. 18).

Health information systems as applications of information systems in the health area and as part of the integration of information technology in the health sector are the sources of decision for the health management. Health information systems are described as sets of components and procedures organized with the objective of generating information which will improve health care management decisions at all levels of the health system (WHO, 2000). They consist sets of tools and procedures that a health program uses to collect, process, transmit, and use data for monitoring, evaluation and control (Kuhn and Guise, 2001; Wilson et al., 2001).

Health information systems, as stated in several literature, facilitate the integration of health service (Alvarez, 2004; Heywood and Magaqa, 1998), focusing on primary health care (Braa and Nermunkh, 1997; Heywood and Magaqa, 1998). In particular they are essential for monitoring the health situation: the performance of promotive, preventive and curative health services and activities as well as the availability and utilization of health resources (WHO, 2000).

Health information systems generate information supporting for decision-making at each level of the health system (Lippeveld, 2001; Skobba, 2003), and are consist of mechanisms and procedures for acquiring and analyzing data useful for:

- All levels of health planners and managers for the planning, programming, budgeting, monitoring, assessment and coordination of health programs and services.
- Health care personnel, health research workers and educators in support of their respective activities.
- Socioeconomic planners and the general public outside the health sector for intersectoral information linkage.
- National policy-makers for evidence-based policy formulation (WHO, 2000, p. 1).

The ultimate objective of health information systems, as stated by Sauerborn and Lippeveld (2000, p.3.) is not only “to gain information” but “to improve action”. They have a

powerful potential to improve the functioning of health care organizations, however, that potential can only be realized if they are successfully developed and implemented.

The next section presents the common problems hindering effective use of health information systems, generally as well as specifically in developing countries.

2.2. Health information systems: why do they fail?

Avgerou and Walsham pointed out that “successful examples of computerization can be found” and yet the probability of failures is very high and “... frustrating stories of systems which failed to fulfill their initial promise are more frequent” (Avgerou and Walsham, 2000, p.1). As a result, according to Lippeveld,

Routine health information systems in most countries, industrialized as well as third world countries are woefully inadequate to provide the necessary information support to individual care and public health activities. In fact, poor use of information for evidence-based decision-making is probably one of the main causes of the current lack of linkages between individual care and public health system (Lippeveld, 2001, p.13).

Most past investigations into failure of health information systems has tended to be “normative” focusing on

a set of managerial prescriptions which, taken as a whole, constitute the ideal way to implement an information system. Despite these normative principles, many organizations and health care institutions find their attempts to make use of computer-based information system fraught with difficulty” (Paré and Elam, 1998, p. 332, quoted in Heeks, Mundy and Salazar, 1999, p. 3).

Other than the technical part, Heeks, Mundy and Salazar pointed out that health information systems often fail due to “reality gap” between the systems and the existing situation in the organizations. They said this can occur in either of the following cases:

- When health care information systems derived from hard rational models of organization meet a different behavioral reality.
- When health care information systems derived from private sector are transferred to public sector health care organizations.

- When health care information systems derived from one country are transferred to another country, especially from an industrialized to a developing country (Heeks, Mundy, and Salazar, 1999, p. 16).

In general, despite reports of many examples of the use of information technology to deliver benefits to the health system, there is considerable evidence that the implementation of health information systems can be hazardous. Thus, consideration of the organizational environment in relation to technical, social and organizational factors is very necessary for the implementation of sustainable and usable health information systems.

Coming down to the context of this study, in the following sub-section, the situation of health information systems in developing countries, focusing on the potential problems resulting in failure to sustain and utilize them, is presented.

2.2.1. Health information systems in developing countries

The health care service delivery in developing countries is characterized by poor quality and inequity. The delivery of health services to the communities is a truly complex task (Braa, Monteiro and Sahay, 2004). The 1978 World Health Organization Alma Ata declaration stated that “ the existing gross inequality in the health status of the people particularly between developed and developing countries as well as within countries is politically, socially and economically unacceptable” (WHO,1978, p. 1).

The declaration wrote up a worldwide vision of access and equity of health services in developing countries under the slogan “health for all by year 2000”. In order to tackle the problems of primary health care, the declaration emphasized that:

all governments should formulate national policies, strategies and plans of action to launch and sustain primary health care as part of a comprehensive national health system and in coordination with other sectors. To this end, it will be necessary to exercise political will, to mobilize the country's resources and to use available external resources rationally (WHO, 1978, p. 2).

As part of dealing with service delivery problems developing countries are facing, increasing the efficiency and effectiveness of existing facilities and resources is important. This can be facilitated with well informed decision-making and resource management supported by effective information systems.

The introduction of information technology is aimed at helping to manage scarce resources, increase efficiencies and reduce workload. Thus, information and communication technologies and related systems can have potentially significant advantage to aid the economic growth and provide other developmental benefits to developing countries (Avgerou and Walsham, 2000). However, a variety of factors retard the realization of such benefits (Kimaro and Nhampossa, 2004). As Sahay and Avgerou argue there are two interrelated problems.

First, many organizations have difficulties in nurturing and cultivating complex technology projects over the long periods of time that are typically required. Second, the resulting ICT-based system may have little impact on the organizational weaknesses they were intended to alleviate (2002, p. 73).

WHO and other international agencies, government authorities, and researchers widely recognized that, the strengthening of health information systems significantly contributes to enhancement of effective primary health care services (Braa, Monteiro and Sahay, 2004; Lippeveld, 2001; WHO/AFRO, 2004). However, there are still obstacles hindering the countries from benefiting them.

Information system developments in developing countries are widely constrained by the lack of conventional wired infrastructures to fulfill the tremendous demand for communication and information services in addition to financial, political and regulatory problems (Nichol and Jarke, 1998). Some of the reasons include: 'lack of linkages' between individual care and public health system, 'centralized information system management' and 'lack of infrastructure' (Lippeveld, 2001; Yahya, 1993).

Moreover, there are also other factors contributing to the inadequacy of health information systems in developing countries. Sauerborn and Lippeveld summarize five reasons for this:

- Irrelevance of the information gathered (...data that are needed are frequently not collected.).
- Poor quality of data (...data requirements are frequently chosen without taking into account the technical skills of the health workers collecting the data.).
- Duplication and waste among parallel health information systems (...health workers are drowned in a multitude of reports to be completed every month).
- Lack of timely reporting and feedback (Outdated information, even if of high quality, is of low value. Delays in data transmission and lack of feedback at the district level are often caused by the presence of strong vertical programs).
- Poor use of information (...information use was found to be especially weak at the district...due to the centralization of many health systems and, hence, health information system) (Sauerborn and Lippeveld, 2000, p. 3-5).

2.3. Challenges of sustainability and optimal use of health information systems in developing countries

In this case, sustainability refers to the tendency of an information system to continue functioning over time adequately serving its purpose regardless of certain changes in the organization. Sustainability is a major issue in the implementation process. However designing and implementing sustainable health information systems in developing countries is a difficult task because of, among other things, “government bureaucracies”. There are other reasons why the implemented health information systems fail to be sustained in developing countries. Lippeveld and Sapirie summarized some of them as:

- The folly of pursuing the grand design: the managers and system designers are too ambitious
- Health information system restructuring for central-level data accumulation: the systems have been designed to provide epidemiological and statistical data to the central administration and programs in the ministry of health
- Forms review and revision without confirming the service information needs
- Information needs based on detailed decisions or long lists of data elements

- Mistaking computerization for health information system restructuring
- Donor-driven health information system restructuring (Lippeveld and Sapirie, 2000, p. 246-247).

Most of the time, systems implemented in developing countries with limited knowledge of the organizational environment such as the actual work practices and capacity, and need of the end users as well as less flexibility to adapt institutional changes. Kimaro and Nhampossa (2004) argue that most developing countries are dependant on short term financial and technical donor assistance for the introduction as well as operation of the information systems. Even if the donor input for restructuring the existing health information systems is vital in developing countries, this support comes with challenges for sustainability. The systems developed and implemented by donor assistance mostly are with a top-down approach and they usually fail to institutionalize and build local capacity which can sustain the system. Lippeveld and Sapirie argue that “without mobilizing national support, such projects ultimately cannot be sustained and may actually damage the existing routine health information system” (Lippeveld and Sapirie, 2000, p. 247). Moreover, Williamson and Stoops contend that “an identified threat to sustainability at district level is the influence by the failure of top and middle management to support strengthening of a district-based information system. This support includes the allocation of human and financial resource” (Williamson and Stoops, 2001, p. 113).

There are also problems related to technology transfer. As argued by Baark and Heeks (1998), it has long been identified as a key issue within the development process, with the realization that transfer is “problematic”. Technology transfer needs both technical and managerial skills in order to operate the technology transferred from the west to developing countries. Odera-Straub mentioned an instance: a case in Zambia in which computing equipment remained unused due to lack of necessary system development skills within the recipient organization (Odedra- Straub, 1992, quoted in Baark and Heeks, 1998, p. 3). Various efforts on transfer of information technology have been carried out, and many failures have been reported due to lack of consideration of the local context, social and

cultural conditions, (Kaasbøll and Nhampossa, 2002; Avgerou and Walsham, 2000; Sahay and Avgerou, 2002).

Poor information technology infrastructures in developing countries, which do not support day to day health care services, also contribute to unsustainability (Sahay, 2001; Kimaro and Nhampossa, 2004). As Sahay argues:

This extremely poor infrastructure in terms of communication, patient care and human resources serves as a serious bottleneck to attempts at reform since people are working everyday in Herculean circumstances with little incentives, resources or time to try and embrace new technologies and approaches. Attempts at reform are confronted with the classic “chicken and egg” problem in that the infrastructure required to introduce the technology is non-existent or weak (Sahay, 2001, p. 1).

Lack of continuous training and heavy workload also contributes to the failure to sustain. Experience from Mozambique showed that the Ministry of Health in Mozambique (MISAU) has been given training during nationwide implementation of SIS software for data entry and generation of reports. “Since 1992, when training was carried out along with the implementation of SIS, there has been no further training. As a result, there is inadequacy of skill and human capacity to support SIS functions” (Kimaro and Nhampossa, 2004, p. 10).

Gladwin, Dixon and Wilson (2003) in their report of investigation of implementation of a new health information system in Uganda, they described the health information system in Uganda as centralized focusing on morbidity and mortality reporting until the Ministry of Health implemented a health information system targeting use at local levels. Referring to a review of researches and reports on health information systems in developing countries, they noted that many of the problems indicate the need for “Information that could inform various aspects of operational managers’ policy implementation, monitoring evaluation and planning role, rather than contribute to profiling mortality and morbidity status for national use..... (Gladwin, Dixon and Wilson, 2003, p. 215).

The restructuring also involved integration of the system “by having one data source and set of forms in the health facility so that all existing health program and general administrative information would be brought together, instead of having parallel and duplicate information” (Gladwin, Dixon and Wilson, 2003 p. 216).

They also reported that the implementation process was highly affected by the hierarchy of power, lack of prior organizational changes such as decentralization of managerial responsibilities and lack of skill.

In the next four sub-sections the above mentioned and other problems of health information systems in developing countries are summarized and as the same time the four interrelated concepts widely used in system development and implementation in relation to ensuring sustainability and increase information use are introduced. This study also contributes to the future knowledge on the sustainability and optimal use of health information systems by practicing the major categories presented below.

2.3.1. Lack of user participation in systems design

The centralized procedures practiced in most developing countries constrained end user participation in the system design, employing top-down implementation as the dominant approach for systems development and implementation.

Participatory design is an approach to systems development which encourages involvement of the potential or current users of the system in the design and decision-making process. Parties which are going to be affected by the introduction of a new system in an organization participate either directly or indirectly. Using participatory approach to designing a system enables designers understand the organization and easier integration of the system to be developed.

Bjerknes and Bratteteig (1995) discussed participatory design of systems development, as it allows an increase in knowledge, work place democracy and a reduction in the resistance to change. This approach to organizational development which is characterized as user oriented than management oriented, emphasized on the work place democracy that is

participation of parties who would be affected by decisions (the system in the case of system development) either directly or through representatives. This is mostly implemented through the Collective Resource approach, which aims at obtaining knowledge and the right to have a say in decisions through Collective Resource such as trade unions. Trade unions were part of the existing power structure established to empower the workers so that they can influence the new technologies introduced at different levels. The strategy for increasing productivity was increasing the democratic values of individual employees at their work place.

The participatory design approach was introduced in systems development projects implemented in the Scandinavian countries in 1970's aimed at increasing user participation; most of them were user oriented system developments tailored for specific organizations (Bjerknes & Bratteteig, 1995). The trade unions believed researchers should be supporting the workers, so the projects aimed at introducing alternative technology to increase productivity, create a better work environment while protecting the workers' job security. The second generation of these projects focused on organizations not on a certain group of workers. They involved automating works in an organization, developing systems for organizations by integrating all the sub systems. This time the workers are not only influencing the decision, but they are participating in the system design process.

The user participation process, in this case, aims at involving future users of a computer based system in decisions during system development. User participation is also central to successful implementation of the system. Butler and Fitzgerald (1997) said the participative approach to systems development is founded on the belief that the development process is heavily influenced by social, political, and economic factors, rather than technical ones. Lippeveld and Sapirie (2000) also note that participation of key actors in the process and fostering of their understanding and ultimate support during system development is critical. Participation of the end user contributes to developing sustainable system (Bjerknes and Bratteteig 1995; Haga, 2001). The absence of the user participation, capability and motivation, coupled with an inflexible system design, makes it difficult for the system to

evolve over time and for institutional changes to be incrementally adapted (Kimaro and Nahmpossa, 2004).

Study from Mozambique indicated the significance of participation in the effort of adaptation of DHIS in to Mozambican context. Even though participating users and prototyping encountered a number of challenges at all levels, it was enabled through discussions held in HISP organized meetings, seminars, workshops and training sessions with health workers, top and middle managers and doctors (Nhampossa, Kaasbøll, & Braa, 2004).

Shrestha and Bodart (2000) argue determination of information needs of an organization through ‘consensus building’ among users as is the way of achieving overall improvement of the management of health services. They provided a participatory guideline for defining action oriented information requirements and essential indicators. They described the participatory process employed to define the national indicators for Cameroon in 1991 as: the methodology used was functional analysis at all levels to identify the information need and it resulted in 255 indicators after going on for two years. There was a need to use objective selection criteria because it was hard to convince the program directors to reduce the number of indicators related to their program. Though inefficient, they attributed the process for helping with creating sense of ownership among the stakeholders.

Prototyping of a newly designed system is a common strategy of enabling user participation. Budde et al. (1991) defined prototyping as “an approach to provide a communication basis for discussions among groups involved in the development process, especially between users and developers” (1991, p. 7).

In systems development process, the end users usually find it difficult to specify their requirements. It is difficult for them to predict how the system will work, how the system will affect the working environment, and how it easily interacts with other systems. Therefore to reduce the users’ uncertainty about these issues, careful requirement analysis would be necessary, which is possible if the system prototype is made available (Sommerville, 2001).

Software development approaches incorporating participatory prototyping have gained respectability as they have proved to be able to dynamically respond to changes in user requirements, reduce the amount of rework required, and help control the risk of incomplete requirements (Floyd, 1984, quoted in Budde et al, 1991). Braa and Hedberg (2002) emphasized that formal prototyping is crucial for the system development process referring to their experience of standardizing DHIS in South Africa.

2.3.2. Lack of standards

Mintzberg (1989) asserts that the division of labor in order to perform different tasks and coordination of those tasks is an essence of organizational structure. He describes standardization as a coordinating mechanism which enables organizations to coordinate the work done at different levels and parts of the structure, horizontally or vertically, despite the time and space of the work. According to Mintzberg, organizations can standardize the work processes, the outputs of the work, the skills of the workers and the norm of an organization. In information system, as it is put by Information Technology Group (2001), standards are specifications that are agreed to by a consensus process, and which may exist at local, national or international levels [and] it is essential to adopt standards to enable sharing of data across boundaries, both between internal system modules and in the wider care environment.

Lippeveld and Sapirie argue that standardization is the primary process of health information system restructuring “the selection of indicators should be done through a consensus building process involving health services managers at various levels and district staff”(2000, p. 248).

The standardization of health information system primarily involves identifying the essential data set that is relevant and useful to calculate indicators that measure the performance of the health system, defining each data element and indicator in the set so that there will be a common understanding and comparability between horizontal levels and developing data collection and integration formats.

Lack of consensus regarding the information needed between the end users of the data and the information producers is among the most prevalent problems in health information systems in developing countries.

Braa and Hedberg (2002) describe standards and standardization as a key issue in the development of HISP in South Africa. Because standardized health information system was taken as a means to achieve equity of health service provision nationally which was the major goal. Standardization of the data collection was important to maintain a lower structure based health information system as part of the national systems and coordination of all levels of the structure. They illustrate the process of developing new standards for the health data in HISP South Africa, as a gradual, bottom up and incremental process because local health information system is part of the higher level and interacts with the different levels using standardized data collection procedures, it is difficult to maintain localized information systems and also to coordinate with the national level. Standardization of the practices can involve scaling up of local interventions as a basis for institutionalization and sustainability. Standardization enables integration of data from horizontal levels of the health structure and achieving consistency of the work practices in data collection, integration and analysis, which leads to the institutionalization of the system, and to ensure its sustainability.

2.3.3. Weak institutionalization

The term institutionalization as defined by Avgerou “is the process through which a social order or pattern becomes accepted as a social ‘fact’ ” (Avgerou, 2000, p. 236). Institutionalization is the process of integrating an information system in to the organization’s structure so that it can be part of the daily activity. As Kimaro and Nhampossa argue, “Institutionalization is about making steady and gradual changes in people’s beliefs” (2004, p.4). The process of making a new system part of the organization’s routine involves creating roles, responsibilities and allocating budget.

Change is a relatively slow process. Even with a positive attitude, people who are affected by the change will take time to understand it, to learn skills and to internalize the use of the new system as a part of their every day routines (Information Technology Group, 2001).

Introduction of a new technology or change in technology is expected to bring changes in an organization. According to Wegerich (2001), institutional change involves changes in the architecture (the agencies and their relationship), rules, processes and norms that make up an institution.

However, Wegerich (2001) says changing the environment in an organization is more difficult than the technical part of implementing a new information system. The need for change may arise from different parts of an institution which have different degree of flexibility resulting in varying cost of change. The degree of flexibility or “adaptive capacity” varies from one institution to another. Some institutions are easier to change than the others. Changes in an organization can be constrained by the existing practices, path dependency and resistance from stakeholders who strive to protect their interest. He also added changes need to consider the institutional environment in order to be implemented efficiently and sustained: for example, willingness of the actors to implement change which can be influenced by the cost of the change, existing norms, conventions, benefits from the change and their power to influence. Otherwise good systems might end up “technical successes but organizational failures” (Keen, 1981, p.24).

Effective implementation relies on incremental change, small-scale projects and face to face facilitation. Keen (1981) describes that a strategy for successful implementation requires both “the conceptual and empirical work on implementation. Information systems development is an intensely political as well as technical process and that organizational mechanisms are needed that provides managers with authority and resources for negotiation” (1981, p. 24). He concludes that the strategy for the implementation of successful information systems must recognize and deal with “the politics of data and the likelihood, even legitimacy, of counter implementation” (Ibid.).

In a meeting report by WHO, observation from experiences presented by different countries was stated as “most efforts have been directed at developing techniques and improving reporting systems. What has been relatively neglected is examination of the processes by which these approaches can be incorporated within districts health systems” (WHO, 1989, P.15).

Processes of institutionalization and sustainability are closely linked. Sustainability of information systems depends on its integration into the organizational complexities and routine work practices through institutionalization. However, such process takes time and demands a continuous learning. In order to develop gradual changes in user’s understanding and to enable the new system to become a normal way of doing things, user participation is required. Such changes need to be carried out incrementally, enabling users to learn from previous changes and to incorporate new changes that emerge over time (Kimaro and Nhampossa, 2004).

2.3.4. Unsuccessful scaling up of local implementations

The term scalability is defined as “the ability of the current work practice to cope with a growing workload” (Bergqvist, and Dahlberg 1998, p. 10). In the context of information systems scale then could refer to the scope and size of an information system for making the system accessible to more users or increasing its functionalities.

Sustainability of a newly introduced health information system is also determined by a number of factors involved in the implementation like the success of the standardization process and its potential to be scaled up out of the intervention locality. Scalability of a locally implemented system in to a broader context influences the sustainability of a system, which usually constrained by the uneven distribution of resources and infrastructure in developing countries. Scalability as noted by Braa, Monteiro and sahay (2004) is a prerequisite for sustainability.

Braa, Monteiro and Sahay (2004) conducted a study on the sustainable health information systems in developing countries on the perspectives of action research. They assessed

number of developing countries of HISP nodes. They mainly investigated the problem of sustainability. This study confirmed that “local success is not sufficient to be sustainable; it also has to have scale”. They called this problem “all or nothing” (2004, p. 340).

2.4. District-based health information systems: advantages

District health system is defined by WHO Global Programme Committee as:

a more or less self-contained segment of the national system comprising a well-defined population, living within a clearly delineated administrative and geographical area, whether urban or rural. It includes all institutions and individuals providing health care in the district, whether governmental, social security, non-governmental, private, or traditional. A district health system, therefore, consists of a large variety of interrelated elements that contribute to health in homes, schools, work places, and communities, through the health and other related sectors. It includes self-care and all health care workers and facilities, up to and including the hospital at the first referral level and the appropriate laboratory, other diagnostic, and logistic support services.... (WHO, 1986, In, WHO, 1988a).

Strengthening of district health system is considered to be crucial for addressing the 1978 WHO Alma-Ata declaration, “health for all by the year 2000”. Participants of an interregional meeting on strengthening district health systems, in order to support primary health care, in Harare in 1987, pointed the significance of district health systems in their declaration as:

Effective intensification of primary health care depends on comprehensive action based in well organized district health system, as called for by the 1986 World Health Assembly. With increasing concern to ensure equity and the sustainability of the impact of accelerated programmes on primary health problems, we are convinced that the district provides the best opportunities for identifying the underserved and for integrating all health interventions needed to improve the health of the entire population (WHO, 1987, p. 26).

In a report of the WHO interregional meeting on strengthening information support for management of district health systems held in Indonesia in October 1989, it is stated that the idea of district health systems is aimed at providing a local support to the primary health care, required by the existing poor management of the health care (WHO, 1989). The key element in improving the weak management is availability of quality information to guide

the actions of the health managers. Success of this effort depends on adequate decentralization, which in turn facilitated by strong support of district health information systems. Districts need to be given more authority, so that they practice using information for local action, which motivates the district level health workers to demand better quality data (WHO, 1988a; Heywood and Magaqa, 1998).

Strengthening district health system without effective information systems may lead the health system to retardation. The efficient management of a health system requires an information system based on local needs and designed to produce data relevant to the district. A good information system at the local level can be used for “assessment of local health needs, health service implementation planning, controlling key resources, and monitoring and evaluating programmes (WHO, 1994, p. 40).

Even if there is a tendency that obtaining information to be seen as an end, the ultimate aim of district health information systems as stated by Williamson and Stoops “is to use locally generated information to improve coverage and quality of health services” (2001, p.101). In most developing countries, health information systems at the district level either computerized or paper based, serve merely as a mechanism for reporting routine raw data up through the health structure.

Information is a means for better decision in health management and planning. However, most of the time, even the available information is not in use,

Information use was found to be especially weak at the district, health centre, and community levels because of the centralization of many health systems and, hence, health information system. This raises serious concern, given the current effort to decentralize decision-making and build capacity at the district level (Sauerborn and Lippeveld, 2000, p. 5).

Information use was one of the points of discussion at the Harare meeting. It was stated that “Information should be used for feedback to workers, managers and policy-makers to assure needed changes in the implementation of primary health care. These again need to be monitored and evaluated involving the communities as much as possible” (WHO, 1987, p. 9). It is difficult to say the data collected by a system is useful in the absence of an active

information use culture as “the physical and mental acts involved in incorporating the information found in to the person’s existing knowledge base” (Wilson, T.D., 2000, p. 50).

It is generally believed that, particularly, health centre staff spend too much time and effort filling in reports requested by higher levels. Instead “health centers should first and foremost collect information that is needed by them and the community in order to set priorities and make decisions. They should then provide the information needed by their district health authority, which in turn feeds the higher levels” (WHO, 1994, p. 41).

Thus, there is a need to shift from such practices to local analysis of data and use of information so that it contributes to the local improvement of health care services. District-based health information systems are believed to facilitate the necessary change in information usability, information use culture and as a result improve quality of data¹ collected. “Analysis and use of information at district level is necessary in order to improve health management and services, but it is also necessary in order to improve data quality at all levels. Data needs to be used and controlled at the entry point in order to ensure quality” (Braa et al., 2001, p.19).

The main issue raised in the 1987 meeting in Harare was the strengthening of district health information systems, as well organized and decentralized information systems are helpful to collect quality data and to facilitate the use of information for local decision for supporting health planning, management and evaluation of health systems (WHO, 1987). District health information systems have the potential advantage of facilitating the collection and use of routine as well as non-routine data at the periphery level. Lippeveld

¹ Quality of data can be described as its ‘fitness’ for a specific use and it is measured in terms of certain attributes: completeness, which indicates the extent to which all the relevant data is recorded, accuracy whether all the data are correctly recorded, consistency if there is any uniformity in the way the data has been recorded, timeliness if the data is recorded or obtained on time and reliability of the source of the data (Tayi and Ballou, 1998).

suggests that “Decentralization of information management towards the district level is an effective strategy to improve the use of routine information. The district level is also the most appropriate level to link routine and non routine data collection”(2001, p. 13).

Availability of data of appropriate quality, aggregated at the right level, and produced in a timely manner are among Lippeveld’s (2001) suggestions to improve the level of information use.

2.5. Organizational change

According to Wegerich (2001) the main reason for change is the acquisition of new information about the actors and their interaction and technology, which triggers the need for new practices and change in structure. Change can be initiated by the demand of powerful stakeholders either individuals or collective actions, they can induce change if they are not satisfied with the existing system. Change can also be caused from outside of the institution for example advance in knowledge in specific discipline.

The change in organizations in relation to information system needs human, organizational and technological factors which cannot be easily separated (Walsham, 1993; Keen, 1981; Walsham, Symons and Waema, 1988). Walsham (1993) says the introduction of systems involves significant change to the way people are expected to work and interact, which takes place within the organizational context and culture. He added “the wider socio-economic context of the organization is very important in the change process” (1993, p. 52).

Walsham (1993) underlined the need to focus on the process of change involved when understanding organizational change associated with the introduction of information systems, as opposed to the technological deterministic perspectives that solely on the content of change.

2.6. Theory of Structuration

This section aimed at introducing theory of structuration and establishes its significance to analyze the case material.

Structuration theory is developed by Anthony Giddens, a British Sociologist, to explain and integrate human actors and structure. Structure, system and duality of structure are the core concepts of structuration theory. Systems “are reproduced relations between actors or collectives, organized as regular social practices” (p. 25). Anthony Giddens (1984) argues that human practices are recursive that is; through their activities individuals create both their consciousness and the structural conditions that make their activities possible.

Giddens defined structuration as the ways in which social systems are produced and reproduced (1984). Structuration theory is described as “the structuring of social relations across time and space, in virtue of the duality of structure” (Giddens, 1984, p. 376). Another more elaborated definition was given by Orlikowski (1992) as she describes structuration as “a social process that involves the reciprocal interaction of human actors and structural features of organizations. The theory of structuration recognizes that human actions are enabled and constrained by structures, yet, these structures are the result of previous actions” (Orlikowski, 1992, p. 404).

Orlikowski (1992) explained the concept of “duality of structure” as follows. Structure is a paradigm of the structural properties of the social system, which mediate human action. The rules and resources used by human actors are the properties of the structure. Implicit and explicit knowledge of the human agencies enable them to regularly act in their “day to day social encounters” (1992, p. 404) creating patterns of actions. This gradually establish institutionalized standards and form “structural properties of organizations” (1992, p. 404). The continuous use of these standardized properties, which is the structure, evolves in to reinforcing itself.

Structure

Giddens (1984) defined structure as “rules and resources recursively involved in institutions” (p. 24). This rules and resources are at the same time the means of

reproduction (the duality of structure) (p. 19). Signification, domination and legitimation are the three structural dimensions of social systems.

Signification is Accumulation of shared meaning or interpretative scheme communications draw on. *Domination* is Exercise of power through authoritative and allocative resources which human actors use to interact; transformative capacity of actors. It is also “the condition of existence of codes of signification” (p. 31). *Legitimation* is composed of organizational conventions or rules governing patterns of conduct in an organization, it is a “legal institutions” (p. 31).

Modalities

The modalities of structuration serve to clarify the main dimensions of the duality of structure “actors draw upon the modalities of structuration in the reproduction of system interaction, by the same token reconstituting their structural properties” (p. 28). Interpretative schemes are the modes of typification incorporated within actors’ stock of knowledge, applied reflexively in the sustaining of communication” (p. 29).

Interaction

The very identification of acts or of aspects of interaction implies the interlacing of meaning, normative elements and power. Communication as a general element of interaction is a more inclusive concept than communicative intent.

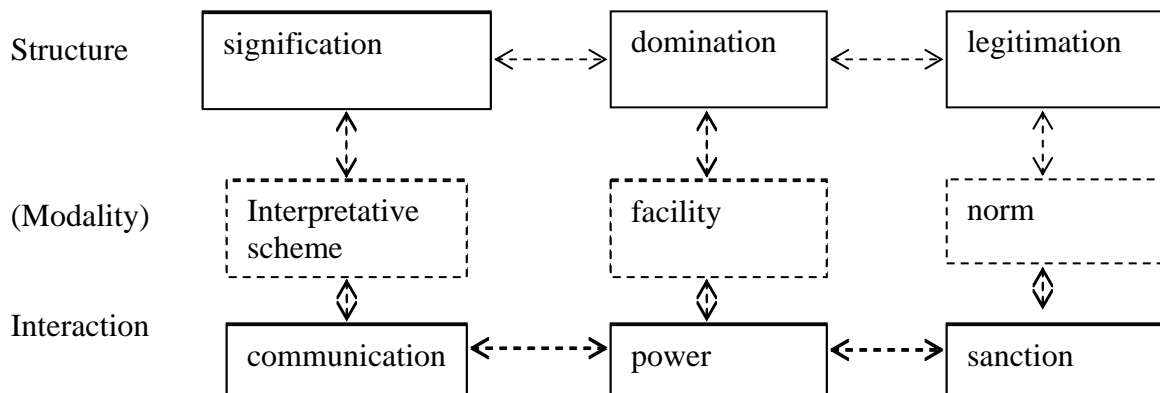


Figure 2-1: The dimensions of duality of structure

(Source: Giddens’s 1984, p. 29)

Walsham (1993) says structuration theory aimed at resolving the debates between social theories, due to their difference in point of emphasis “One of the principal aims of the theory is to resolve the debate between those social theories which place their emphasis at the level of human agents and human action, and alternative theories which focus on the structure of social systems” (1993, p. 60).

Walsham added the main contribution of structuration theory is not in its conception of either action or structure but in its understanding of the two levels through the “duality of structure” and its use of modalities as a linkage device (Walsham, 1993).

2.6.1. Structuration theory in information systems

Orlikowski (1992) suggests that even if structuration theory is not adapted to technology, it is necessary to look at technology from the structuration point of view as technology is one of the structural properties. Since it is the same as the creation of structures, she calls the process involved in creating and using technology by human action the ‘duality of technology’. She also argues that technology is “interpretively flexible”, (1992, p. 422) which implies its interaction with organizations is dependant on the human actors and the context of its development and use.

While adapting it to the technology domain, Orlikowski (1992) also used concepts of structuration to analyze the changes caused by the introduction of new productivity tools in a software development company (Beta). Flynn and Hussain (2001) used structuration theory in order to explain the information system development and use in a UK public National Health Service organization. They mainly focused on the intended and unintended consequences of information use and actions to shape structures. They also aimed at establishing a valid analytical use of concepts drawn from the theory of structuration for the information system researchers and developing middle level theories. The reflected on the validity of the theory as it allowed them to “clearly see an outline ‘architecture’ of [their] project, within the framework of the duality of structure” (p.10). Braa and Hedberg (2002) also used the theory in their analysis of the DHIS implementation process in South Africa.

Similarly, the employment of structuration theory for the analysis of this case is motivated by the sole purpose of this action research intervention. It is the recreation of structures enabling the management of an effective health information system. Therefore it appeared reasonable to study the process leading to the realization of this structure. Concepts from structuration theory are believed to assist the analysis in identifying the institutional properties of the Region's health system enabling and constraining the implementation of the ongoing intervention (opportunities and challenges). Moreover, to examine the nature of the organizational changes and their intended and unintended effects ultimately aiming at identifying the factors of sustainability and use of the information system.

This chapter presented the knowledge we based ourselves on to analyze the empirical material, next we discuss the methodologies and approaches we used to carry out the empirical study.

3 Research Methodology

Research methodology moves from the underlying philosophical assumptions to research design and data collection. The choice of research approach influences the way in which the researcher collects data (Myers, 1997). Our research is informed by strategies of qualitative inquiry, action research and interpretive case study to investigate the situation of the existing health information systems thoroughly and identify mechanisms for intervention to address the problems.

This chapter is organized in five sections. The first section provides a brief introduction of the philosophical assumptions of qualitative and quantitative research approaches and knowledge claims used for this study. The second section describes the methods, sources of the data and forms of documentation from the fieldwork. The third section briefly describes the mode of limitations faced and ethical issues considered during the research are presented at the end of the chapter.

3.1. Research Approaches

This section begins with a brief discussion of qualitative and quantitative inquiries before providing a description of the approaches and methods used in this study. The approaches of action research and interpretive case study in an information systems context and reflections for this study are discussed.

Qualitative inquiry is the process of understanding a social or human problem based on building a complex, holistic picture, formed mainly with words, reporting detailed views of informants, and conducted in natural settings (Creswell, 1994; Myers, 1997; Silverman, 2000; Strauss and Corbin, 1998). It is important to understand the philosophical assumptions because they provide direction for the design of the research study (Creswell, 1994). The qualitative method of this study is directed by the philosophical assumptions underpinning the social constructivism of knowledge. Derived mainly from Mannheim, Berger, Luckmann, Lincoln, and Guba (Creswell, 1994; 2003), the assumption is that

knowledge is constructed by the individuals involved in the situation. They develop *subjective* meanings of their experiences (Creswell, 1994; 2003; Myers, 1997; Silverman, 2000) through processes of interaction among individuals. A focus of the research is on the specific contexts in which people live and work in order to understand their historical and cultural settings (Creswell, 1994). Qualitative researchers tend to use open-ended interviews so that participants can express their views (Creswell, 2003). To understand and explain the social and cultural phenomena, researchers use qualitative material from interviews, observation, documents, records and films (Strauss and Corbin 1998; Myers, 1997). These methods can be used to “familiarize oneself with a setting before the serious sampling and counting begins” (Silverman, 2000, p. 9).

The field of information systems needs to understand social, environmental, political, managerial and organizational issues. It is a research domain that looks at the impact of information technology on organizations and people (Myers, 1997; Silverman, 1998). Accordingly, qualitative methods were chosen to undertake the understanding of organizational, social and cultural aspects of the research settings in Tigray Region Health Bureau and the two pilot districts Hintalo-Wajirat and Wukro. Qualitative method provided detailed data for the researchers as insiders (Myers, 1997) in the course of a discussion with the management, unit heads, and health workers. It was a means to understand the situation of health facilities.

Quantitative research is another form of inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers and for analyzed with statistical procedures. Quantitative methods are well accepted in the social sciences including survey methods, laboratory experiments, and numerical methods such as mathematical modeling (Myers, 1997; Creswell, 1994; 2003). Quantitative research approach are termed traditional, the positivist, the experimental, or the empiricist paradigm established by Comte, Mill, Durkheim, Newton, and Locke (Creswell, 1994; 2003). The identifying assumption is that reality is *objective* (Silverman, 2000). Something can be measured objectively by using a questionnaire or an instrument. Unlike qualitative research, quantitative research can give a solution for a specific problem without direct

contact with the people. It is based upon the relationship among variables and poses this in terms of questions or hypotheses (Myers, 1997; Silverman, 2000; Creswell, 2003). Therefore it is sensible to make one's choice of research methodologies according to the interest and research domain of the researcher. Each method has its place if used appropriately and rigorously (Silverman, 2000).

The research approaches followed in this study reflect constructivist knowledge claims. The approaches of action research and interpretive case study were used. Key theoretical concepts of the approaches and the activities in the research are presented subsequently.

3.1.1. Action Research

A research methodology based on action research used by different researchers (see Braa and Hedberg, 2002; Braa, Monteiro and Sahay, 2004; Kimaro and Nhampossa, 2004) in a global research and development project called the Health Information System Program (HISP). HISP is a large-scale action research initiative that operates as a global network within the health care sector in a number of developing countries. Thus action research was chosen for this research as one approach because the research was conducted as part of the HISP initiatives in Ethiopia, Tigray Region.

The HISP team working in Tigray Region consisted of five persons. Two Ethiopian master students (the authors of this thesis), one Ethiopian PhD student, one Norwegian Masters student and one assistant from college of Computer Science who is in charge of offering technical support. We took active part in all aspects of the project. We shared all assignments such as training, defining data elements, defining indicators, software development, reporting formats customization, reporting format revision, and development of data flow models. We had both formal and informal meetings.

Since the health information system implementation was part of the HISP initiative, the HISP methodology on the development and implementation of district-based health information systems was the leading method during the study. Experiences of the program

from other developing countries as published by the program members, and participatory action research, as a main approach, were largely used in the research.

Action research, which is introduced by Kurt Lewin and later the Tavistock institute (see Greenwood and Levin, 1998) is one qualitative research approach. It is used to analyze the social situation by introducing change. In this, change process effects are studied (Baskerville and Wood-Harper, 1996; Baskerville, 1999). It can be thought of as a two stage process consisting of the diagnostic and the therapeutic stages (Blum, 1955, in Baskerville and Wood-Harper, 1996, p. 237). Action research is the process in which a group of people aim to influence or change the focus of their research through the improvement of a practice, the improvement of the understanding of the practice by its practitioners and the improvement of the situation in which the practice takes place (Baskerville, 1999).

Susman and Evered describe (see Baskerville and Wood-Harper, 1996, p. 237) five phases of action research as an “ideal” exemplar of the original formulation of action research. These phases were used for this study, for the assessment and the assumed intervention process to solve the identified problems. The original meanings of the phases and their reflection on the study are succinctly presented here.

Diagnosing. Diagnosing corresponds to the identification of the primary problems that are the underlying causes of the organization’s desire for change (Baskerville and Wood-Harper, 1996, p. 238). The researchers diagnosed the problem of the existing health information system of Tigray Regional State Health Bureau and the two pilot districts. On doing that the researchers visited the two pilot districts in addition to the Region Health Bureau and consulted different documents, research papers and reporting formats. Discussion with the management team was also the first step taken by the researchers as a HISP team to identify the primary problems which affected the organization’s ambition for change.

Action plan. An action plan specifies organizational actions that should relieve or improve these primary problems. The plan establishes the target for change and the approach to change (Baskerville and Wood-Harper, 1996, p. 238). After investigating the major problems, the HISP team has delivered the project proposal and activity plan. The plan included statement of the problem, proposal for addressing the problem, on implementation plan and description of final deliverables. More to the point, specific mechanisms on the particular activities, resources required from the Regional Health Bureau, resources provided by HISP-Ethiopia and the time frame for action were clearly stated on the proposal. The proposal was delivered for all members of management team and unit heads in advance before the meeting with the management team. The proposed plan was accepted by the management team to implement district health information system in two pilot districts and at the Region Bureau level, including DHIS software installation.

Action taking: The action taking phase then implements the planed action (Baskerville and Wood-Harper, 1996, p. 238). Based on the approved plan by the Regional Health Bureau, the action started with the establishment of a working group comprising representatives from concerned departments. The established working group was assigned to work on the preparation of a minimum data set for the bureau, indicators and minimum set of reports which are required for local analysis and should be routinely generated. The HISP team worked with the working group on both assignments. The HISP team has provided the minimum data set and reporting formats which have been established by Addis Ababa City Administration as a point of departure for the selection of minimum data set and reports.

In order to develop working software, customization of the DHIS software to the Region's requirements was among the actions taken. This action has been started by defining the data set and designing the reporting formats approved by the working group. The process has been continued during the training of both the Regional and district level staff, using the trainings as means of identifying more requirements.

The researchers have participated in training health workers at the Regional, district and facility levels. All the training materials were provided by the HISP team. HISP-Ethiopia

has recruited one support staff person to provide training to trainers nominated by the bureau and to assist them through the implementation process.

The researchers had continual meetings with the management team on the steps and procedures of the implementation. The researchers delivered the integrated data flow model and presented for the top management on how to integrate the health information system throughout the Region.

Post implementation evaluation: researchers and practitioners undertake the evaluation of the outcomes (Baskerville and Wood-Harper, 1996, p. 238). In our case, the evaluation could not be done on time because of slow progress of the implementation process and time constraint.

3.1.2. Interpretive Case study

We used interpretive case study approach as a tool to explore in depth the conditions of the participants and to understand the context of the settings.

A case study approach is used “to explore in depth a program, an event, an activity, a process, or one or more individuals” (Creswell, 2003, p. 15). It offers a possibility of an in-depth understanding of a particular case or development project. Interpretive case study, as argued by Walsham, can make a “valuable contribution to both information system theory and practice... since human interpretations concerning computer based information systems are of central importance to the practice of information systems” (1995, p. 80). Interpretative methods of research in information systems are 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.

Walsham (1995) proposes that using interpretative approaches in case studies can give implications for specific domains and rich insights. As our approach of research has been interpretative, using qualitative methods, and reviewing literature on similar case studies the researchers have found it reasonable to offer some relative generalizations based on

their findings. The analysis of findings is primarily based on their interpretation of the data.

Case studies are performed before implementing a large scale investigation. Their basic function is to help identify questions and select types of measurement prior to the main investigation (Walsham, 1995). Therefore, the researchers' main intention to use a case study approach was to identify the possible challenges and opportunities for the implementation of district-based health information systems in the two pilot districts to make the system scalable for the remaining districts.

3.2. Research Methods

Interviews, participant and non-participant observations, and document analysis were used to collect relevant data. A brief account of data sources is presented below.

3.2.1. Methods and Sources of Data

Interviews

Interviews offer researchers the chance to explore topics in-depth and to gain appreciation of the context of the phenomena. Researchers enabled to explore the respondents' perceptions. The interview guide was of a semi-structured type where the researchers had an opportunity to raise questions based on the interviewees' answers. In addition, each respondent was asked to elaborate questions which seemed unclear and/or inconsistent. The interview guide is provided as Appendix B.

Prior appointments were made with the health workers at the Region, district and facility level before we went to conduct the interview. The arrangement was made by the Regional level HMIS head and district heads for district and facility health workers. The researchers had an intention to know the problems of both the decision-makers and the data collectors. Therefore, we conducted interviews both with top management and lower level health workers.

Individual and group interviews were conducted within departments at the Region, district and facilities. We decided to use group interview due to shortage of time the health workers

can give, since our fieldwork was at the end of the budget year when every staff member was busy with making annual reports. We had a group interview with different sections of disease prevention and control department at the Region level: Maternal and Child Health (MCH), Epidemiology, HIV/AIDS and TB/Leprosy sections and with experts at the district level. Experts represented each program in the departments (see diagram 4.1 for the programs at district level). In the remaining departments at the Regional level such as Malaria and Vector Borne Diseases, Planning and Program and Health Services, we had individual interviews (see table 3.1 for the number of interviewees). We had long and constructive discussions in the group interviews. The discussions were open and free and provided us with detailed and positive inputs.

Individual interviews were conducted with the Bureau Head and the Deputy Head to understand the major problems of fragmentation², information use, sustainability and scalability of the existing health information systems at the Region, district and facility levels. We had a discussion with one of HMIS unit staff members about the initiation and establishment of the HMIS at the Region and about the software they are using.

Individual interviews were also conducted with the heads of the two pilot districts. Different health workers in health facilities were interviewed to understand the ways they collect, store, retrieve, use and report data and to know their suggestion about how to improve the current procedures. Interviewees at the district and facility levels responded to the questions by providing more explanations about the different forms, registry books, and tally sheets they are using.

During interviews, we were not able to use tape recorders because people were not comfortable with such devices. Instead, notes were carefully taken. However, we were allowed to use a photo camera to take pictures of some data collection tools, and staff in training and meetings for the selection of standard data elements and indicators.

² independent parallel data flows from the facility up to the Region

Unit/persons level	Level			
	Region	District	Facility	
			Hospital	Clinic
Heads	2	2		
Disease prevention department	6	8		
Malaria department	1	2		
HMIS unit	3			
Health Service Department		6		
Nurses			2	2
Statisticians		2	1	
Total	12	20	3	2

Table 3-1: Number of Interviewees

Observations

The researchers used observation methods to get impressions about the health workers' surroundings and their activities. Both participant and non-participant observation were used. The way health workers presented, interpreted, analyzed and reported data were observed. The observations and interactions mainly took place within the working environment of the health workers. In addition, the researchers had a chance to observe the situation of the software (Epi Info TM) used by the Regional Health Bureau as an information system application tool.

The researchers participated in different meetings and discussions with the top management, technical team, and district health office heads and experts. In those meetings and discussions, the researchers took notes as participant observers in addition to solving technical problems related to the functioning of computers and suggesting theoretical principles for the integration and usability of the health information system.

Document Analysis

The researchers consulted different types of documents to understand the context of the Region. Documents were collected within the annual profile of the Region (Tigray health

profile, 2002; 2003), the guidelines of reporting formats prepared by Tigray Region, guidelines and user manual prepared by Southern Region, a list of different forms and reports at each level, registry and tally sheets at facility level, reports of the Ministry of Health sector development program, different research papers published by the Region and by individual researchers, and the brochures of the Ministry of Health.

Documents like the health sector development program, the Regional health profile and other research papers provided us detailed understanding and background information about the research settings on social, political, economic, infrastructure of the Region and districts. We used the other documents to assess the existing situation of the health information systems of the Region, to identify the possible problems of redundancy of data collection, usability and data quality.

3.2.2. Fieldwork Documentation

Most of the time, the researchers took notes during interviews and/or observation. While one of us led the interview, the other one observed and took notes. Notes taken were then word processed as soon as possible. Before typing notes were checked against the research questions formulated, as this is the main duty of the researchers during fieldwork.

3.3. Data Analysis

The collected data were summarized and analyzed according to themes. The research questions guided theme development and provided the framework for analysis. The data analysis was performed continuously as the study went on. The findings were analyzed using concepts from structuration theory and existing knowledge in the relevant domain areas.

3.4. Limitations related to research methods

Several factors may have affected our research. As we mention above, we could not use the tape recorder during interviews, discussions and meetings. It was thus difficult to remember all the details while taking notes.

Another problem was related to the number and type of the research sites which were selected by the management team as pilot districts. It was not possible for the researchers to visit the other districts, as to do so required an official letter or call from the Regional level. Thus generalization from this research may be limited as we only have empirical experience from two out of the thirty five districts.

There were two ongoing general limitations in the Region related to the research settings in the health sector. The first was a high rate of staff turnover, especially at the management level, which demanded from the researchers a substantial amount of time and effort in introducing the same objectives and plans. We faced different persons in almost every site visit we made. The more critical problem faced by the researchers was shortage of staff's time, especially during the first phase of the study. Health workers were busy writing annual reports to their next higher level as it was an end of the budget year. It was thus not possible to follow the already developed work schedule.

3.5. Ethical Issues

Ethical standards were maintained during the research period.

- The researchers obtained support from the Tigray Regional State Health Bureau, especially from the top management.
- Official permission from the Bureau was given (see Appendix A for the ethical clearance letters).
- The purposes of the project and study were clearly communicated to the concerned body.
- Names of the health workers were not mentioned in the reporting of the results.
- The team respected the rules and regulations of the Bureau.
- Others' research and contributions to this work are fully acknowledged.

4 Research settings and Context

In this chapter, the settings of the research are described. Since this research was done under the Health Information System Program (HISP), the pilot Regions have been chosen by the HISP team. Among nine Regions and two city administrations in the country Tigray, Addis Ababa, Oromiya, Amhara and Benshangul-Gumuz were selected. Tigray Region was the research setting for this study to implement the integrated district-based health information system including the District Health Information Software (DHIS). In choosing the sites, the following reasons were considered:

- The study was an action research project that required an official agreement and cooperation. The Tigray Regional State Health Bureau demonstrated interest in the project prior to other Regions.
- The Region has relatively better infrastructure at district level, so it was believed there would be fewer problems for the implementation of the DHIS software.
- It is relatively possible to find people in the pilot districts who have basic computer skills, therefore it was considered to be easier to give training and with a greater likelihood that staff could use the system immediately after the implementation, so that the post-implementation evaluation could be possible within the time frame of the study.
- There was a software initiative in the Region since 2003; it could be easy for the lower level staff to cope up the new introduced DHIS software at district level.
- There was no integrated health information system previously implemented in the Region,

4.1. Research Settings

Of the thirty-five districts in the State, two districts, Hintalo-Wajirat and Wukro were chosen as pilot sites by the Tigray Regional State Health Bureau management team. Such

selection was justified in terms of transport accessibility, better infrastructure and the districts' experience in using computerized systems (Epi Info™).

In the following sections, a brief introduction about Ethiopia, the Tigray Regional State and the two pilot districts is presented. This may situate the study in its socio-economic and cultural context.

4.1.1. Background Information about Ethiopia

Ethiopia is situated in the Horn of Africa between 3 and 15 degrees north latitude and 33 and 48 degrees east longitude (MoH, 2002; The World Factbook, 2004). The total area of the country is approximately 1,127,127 square kilometers. Ethiopia shares borders with Djibouti, Eritrea, Sudan, Kenya and Somalia. Unique among African countries, the ancient Ethiopian monarchy maintained its freedom from colonial rule, with the exception of the Italian occupation from 1936-1941. Ethiopia is the oldest independent country in Africa, and one of the oldest in the world (ibid.). The three main colors of her flag (Green, Yellow and Red) were often adopted by other African countries upon independence (The World Factbook, 2004). Currently Ethiopia has a Federal Democratic Republic government with nine ethnically-based Regions³ and two city administrations. Each Region has its own parliament and is responsible for legislative and administrative functions except for foreign affairs and defense.

Geographical feature

Ethiopia is a country with great geographical diversity, with topographic features ranging from the highest peak at Ras Dashen (4,500m above sea level), to the Afar Depression (110m below sea level). More than half of the country lies above 1,500 meters. There are broadly three climatic zones: the hot lowland (kola), the Weyna Dega and cool temperature highlands (Dega). Mean annual temperature ranges from 10-16⁰c in the Dega, 16-29⁰c in the Weyna Dega and 23-33⁰c in the kola. In general, the highlands receive more rain than the lowlands. In addition, the irregularity of rainfall is a characteristic of climates in

³ Region is similar to a State in some other countries

Ethiopia and the country is prone to recurrent droughts and famines (The World Factbook, 2004; MoH, 2002). Due to this diverse topography and climatic conditions, the epidemiology of malaria, problem of malnutrition, maternal and infant mortality are more variables and unstable than in any other country in Africa because of the inaccessibility of road and communication infrastructures.

Demography

The total population of Ethiopia was about 67,851,281 by July 2004 as estimated from the 1994 census (The World Factbook, 2004). Of the total 49.8% and 50.2% are females and males respectively. The average population density is 52.2 per square km, with great variation among Regions. Population densities are highest in the highland Regions and lowest in the eastern and southern lowlands. Most of the districts along the borders of the country have densities of less than 10 persons per square km. Higher densities are found in the highland areas, mostly above the 1,500m contour line. 23.2% of the population is concentrated on 9% of the land area. The settlement pattern of the population and its density greatly affect the provision of health care including the accessibility and utilization of existing health care facilities.

In Ethiopia the age structure of the population is typical of many developing countries, with *0-14 years*: 44.7% (male 15,189,921; female 15,109,870) *15-64 years*: 52.5% (male 17,857,758; female 17,767,411) *65 years and over*: 2.8% (male 855,103; female 1,071,218) and the population growth rate is 1.89% (The World Factbook, 2004). The main religions are Orthodox Christian and Muslim. Many languages are spoken in the country including Amharic, Tigrigna, Oromigna, Guragigna, and Somaligna. English is the major foreign language taught in schools (Ibid.).

Economy

Almost 80% of the population economy is based on agriculture. The agricultural sector suffers from frequent droughts and poor cultivation practices. These problems of drought and under nourishment place further pressure on the health services of the country. Under Ethiopia's land tenure system, the government owns all land and provides long-term leases

to the tenants; the system continues to hamper growth in the industrial sector as entrepreneurs are unable to use land as collateral for loans. Coffee is critical to the Ethiopian economy with exports of some \$156 million in 2002 (MoH, 2002; The World Factbook, 2004). Widespread poverty along with the generally low income levels of the population, low education levels, inadequate access to water and sanitation facilities, a high rate of migration, and poor access to health services contribute to the high burden of ill health in the country. This situation is further aggravated by high population growth (MoH, 2002).

Health Status

A combination of rapid population growth, poor economic performance and low educational levels has constrained Ethiopia's socio-economic development and impacted on health status in particular. Ethiopia has an extremely poor health status relative to other low-income countries. The major health problems that account for about 60-80% of the registered morbidity of the country are due to infectious, communicable diseases and nutritional problems (MoH, 2002; Awala, 2003; The World Factbook, 2004). Health-service providers in all sites attributed the high incidence of diseases to poverty, hunger, and poor sanitation. Dirty contaminated water results in a high incidence of diarrhea. The health system is underdeveloped and only able to provide health service to about half of the population. Population coverage in terms of health workers remains poor (see table 4.1 for the distribution of health workers for the population).

Health Workers	Number	Ratio
Doctors	1366	1:47,836
Nurses of all types	7723	1:8461
Health assistants	7386	1:8847
Technicians of all types	1753	1:37,276
Pharmacists	85	1:768,753
Sanitarians (Environmental Health Specialists)	920	1:71,026

Table 4-1: Health workers per population ratio, EFY 1993

(Source: MoH, 2002)

The overall level of health service coverage is estimated to be approximately 45 percent. The actual coverage estimates for the individual programs are very low (MoH, 2002). The major reason for the poor coverage of health services in Ethiopia is the limited physical access of the population to health facilities, as illustrated by the facility to population ratio on table 4.2.

TYPE OF HEALTH FACILITIES	NUMBER	POPULATION RATIO
Hospitals	110	1 : 594,036
Health Centers	382	1 : 171,057
*Clinics	3,463	1 : 18,869
Health Posts	1,023	1 : 63,875
Hospital Beds	10,736	1: 6,086

Table 4-2: Health Facility to Population Ratio

(Source: MoH, 2002)

*Note: The category “clinics” includes both government health stations and private clinics

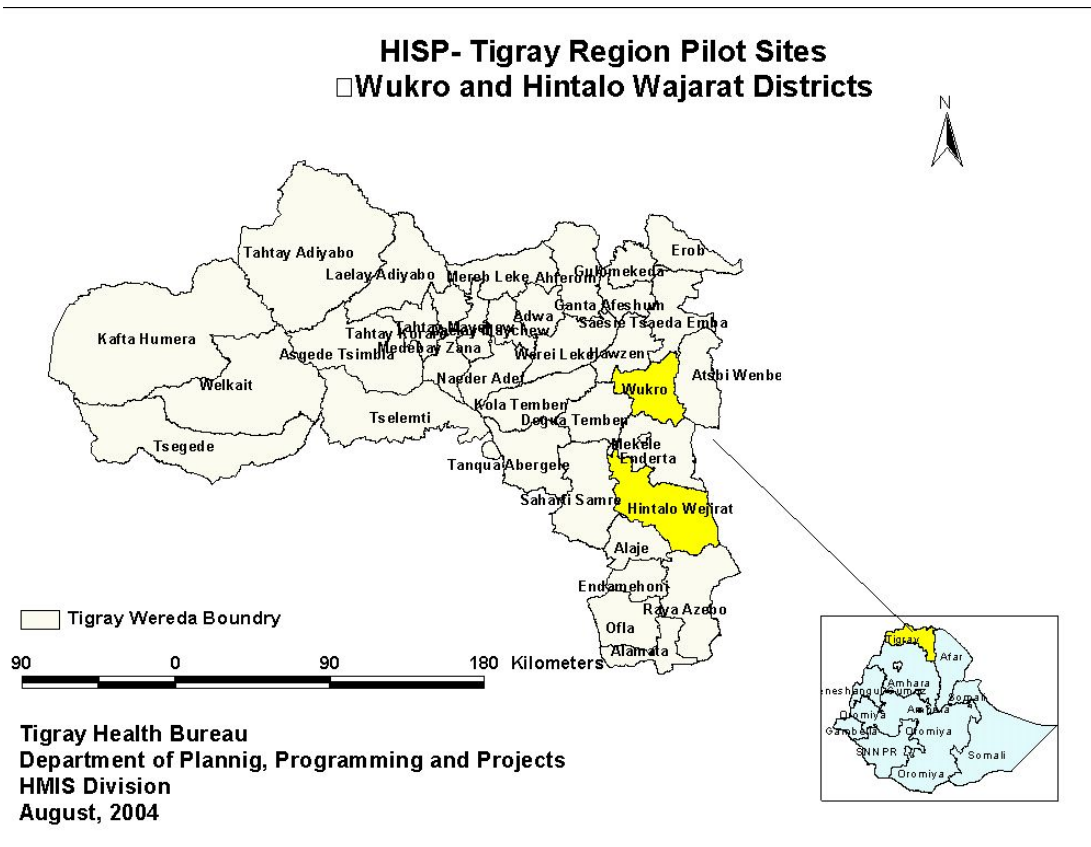
Generally, responsibility of health policy and regulation is of the Federal Ministry of Health in Addis Ababa, while responsibility for management of health service delivery falls to the respective Regional Health Bureau.

Health Management Information Systems (HMIS)

HMIS in Ethiopia have a poor status. At the national level, the HMIS has been established for receiving summarized data from all the Regional Health Bureaus each quarter of the year. At the end of each year, the report is issued in a Ministry of Health (MoH) publication which includes health and health related indicators (MoH, 2002; Awala, 2003). The major concerns regarding the current HMIS in Ethiopia refer to certain gaps in coverage, particularly drug-related and financial management indicators. Lack of timeliness and completeness of reporting remains a weakness of the HMIS, and such delays contribute to the failure (at all levels) to use data as the basis for informed decision-making in planning and management. In addition, parallel reporting mechanisms persist, with program-based and donor-supported initiatives resulting in multiple reporting formats and an increased administrative workload (Tigray Health Profile, 2003; MoH, 2002; WHO, 1999).

4.1.2. Tigray Regional State Health Bureau***Geographical features***

Tigray is the northern most national, Regional State of Ethiopia and it is located between latitude 12⁰ and 15⁰ north. The Region is divided into northern, western and southern lowlands (700-1500 meters above sea levels) and central highlands (1500-3000meters above sea levels). The Region covers 54,572.6 square kilometers. Tigray is bounded on the north by Eritrea, south by Amhara Regional State, on the east by Afar Regional State and on the west by Sudan (Tigray Health Profile, 2003; Awala, 2003).



Map 4-1: Map of Ethiopia, Tigray Regional State and the selected two districts

Demography

The Tigray population in the 1994 census was 3.16 million and the growth rate was estimated at 3% per year. The 2003 projected population size was 4,006,000 of which 51% were females. 85% of the population is rural and engaged in subsistence agriculture (Tigray Health Profile, 2003; MoH, 2002).

Socio-Economic Profile

Agriculture is the major economic activity and the main means of subsistence for most of the population in Tigray Region. It is based on plough cultivation of mainly cereal crops, which until recently depended almost entirely on rainfall. The main rainy season is from May to September with most rain falling in June and July. In south eastern Tigray,

additional rain falls during January and February providing sufficient moisture for a second harvest. Mean annual temperature is 18⁰c (Awala, 2003).

The Region's socio-economic and health problems are immense and highly interrelated. Development without healthy people is unthinkable; the health sector is considered as the integral target of development by the Regional government. Since 1991 General Census, there has been an upgrading of general health services through rehabilitation and construction of health facilities, training and deployment of health personnel, and expansion of primary health care. As a significant proportion of the population still live beyond the catchments areas of even peripheral health institutions, community-based volunteer health workers continue to play an important part in delivery of primary health care services (Tigray Health Profile, 2003).

Health Status

Communicable diseases and nutritional problems are major health problems of the Region and account for the majority of all health problems. Malaria, tuberculosis (TB), acute respiratory tract infection (ARI), diarrhea and HIV/AIDS are among the top ten disease burdens in the Region (Tigray Health Profile, 2003). Tigray Region health services are provided predominantly by the government. There are some institutions owned privately and by non-governmental organizations (NGOs).

In general Tigray Regional State has thirty five districts. The two pilot districts are presented as follows.

4.1.2.1. Hintalo-Wajirat District

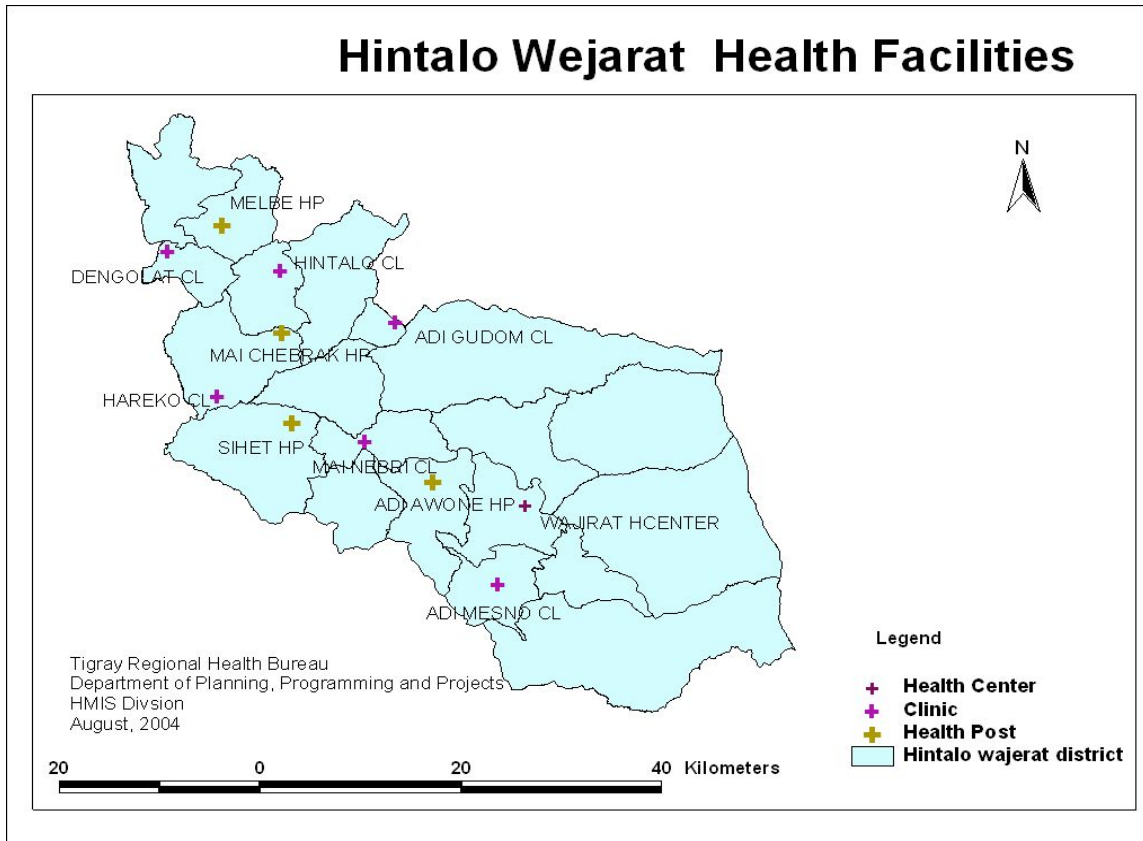
Hintalo-Wajirat is located in north Ethiopia at 746 kilometers from Addis Ababa and is approximately 37 kilometers south of Mekelle. Hintalo-Wajirat is geographically characterized by flat cultivable land bounded by a mountainous forest area, with some mountainous area and few cultivable plateau lands and very few highlands with small patches of ragged hilly areas and low rainfall. Some of the kebeles in Hintalo-Wajirat district have no access to roads, so it is difficult to visit the villages particularly during the rainy season (Ruth, Zemenfeskidus and Teklay, 2004).

The population of Hintalo-Wajirat is 143,270 of which 70,202 are male and 73,068 are female. The age distribution of the population is characterized by a high proportion (48%) of youth below the age of 15 years.

The economic situation of the district is mostly dependent on agriculture. Mixed farming, crops and livestock are the economic bases of the majority of the population in the district.

On the distribution of the health facilities, there is no hospital or health centre in the district. There are 4 health posts and 8 clinics which are serving 143, 270 people. There are clinics and health posts under construction and most of them will start work by 1997 Ethiopian fiscal year (map 4.2 shows the location of health facilities in the district).

In Hintalo-Wajirat district, there is no statistician in the position. They have the budget and the post but they could not recruit someone due to the shortage of educated manpower in the district. There is one pharmacist who is in charge of both statistics and pharmacy work (see the organogram of the district health office on diagram 4.1).



Map 4-2: Map of Hintalo-Wajirat district showing the location of health facilities.

Health Structure at District level

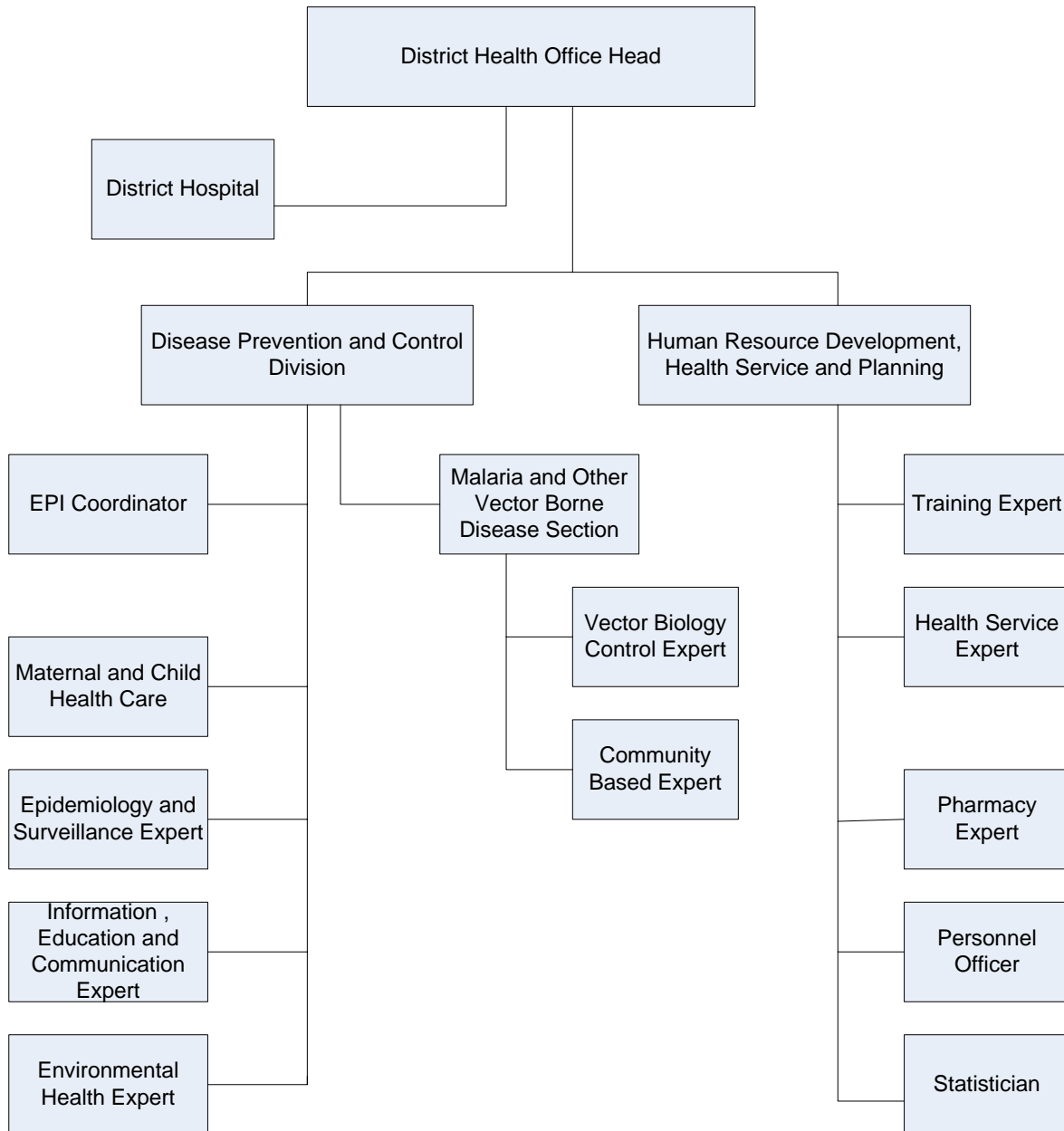


Diagram 4-1: Organogram District Health Office

(Source: Tigray Health Profile, 2003, p. 2).

4.1.2.2. Wukro district

Wukro district is located in north Ethiopia at 825 kilometers from Addis Ababa and is 45 kilometers north of Mekelle. The district is administratively subdivided into 15 rural and 4 urban kebeles (Awala, 2003).

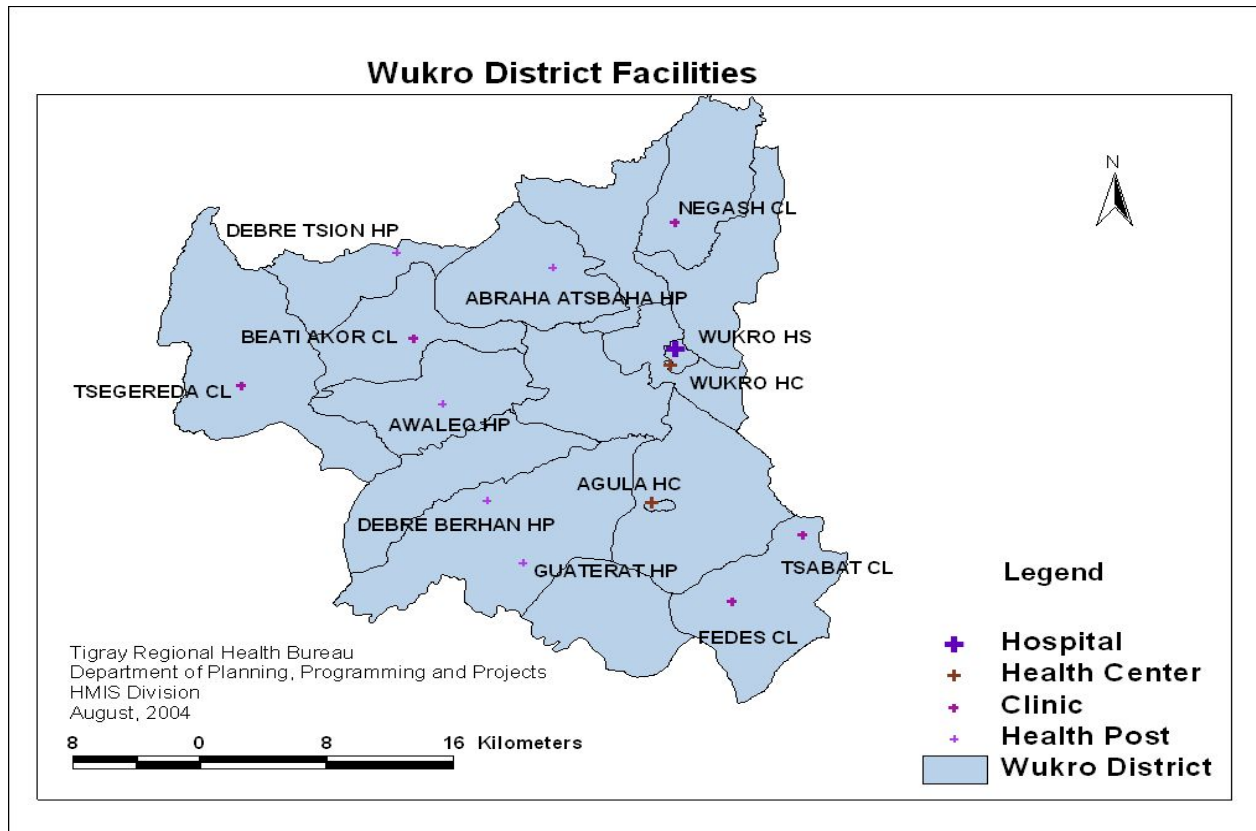
According to the 1994 census, the population of Wukro was estimated to be 108,386 of which 23 percent live in the two urban settings (Wukro and Aguale). The age distribution of the population is characterized by a high proportion (46%) of youth below the age of 15 years. Children under five years of age constitute 18 percent of the population.

The language of the people is Tigrigna, which is one of the Semitic languages. It is related to the national language Amharic and is the third most widely spoken language in Ethiopia. The main religion of the district is Ethiopian Orthodox Christianity. The main means of income for Wukro people is farming. The majority of the houses in the rural areas are made from stone and mud with traditional wood and earth roofing, almost all with no or rather small windows. About 61 percent of the households, with average of five persons, share a single room (Awala, 2003).

Most of the rural villages have access to health facilities within 10 kilometers or two hours walking distance. Although they are not adequate, there are some cars, which provide transportation service to some of the villages for a reasonable price. There is an ambulance owned by the district Red Cross Office placed for emergency referral to the Regional hospital in Mekelle. Two towns and two villages have access to telephone service.

There is one statistician who is responsible to collect all the data from facilities and enter the morbidity and mortality data by using Epi Info™.

The Wukro district has one hospital, two health centers, five clinics and five health posts (see Map 4.3 for the location of health facilities).



Map 4-3: Map of Wukro district showing the location of health facilities.

4.2. Health Information System Program (HISP) Context

HISP started in South Africa after the dawn fall of apartheid in 1994 when the time the African National Congress (ANC) government launched the Reconstruction and Development Program (Braa and Hedberg, 2002). The team known as the Reconstruction and Development Program Strategic Management aimed at the reconstruction of health sector in all provinces. Several projects were initiated and HISP was one of them. HISP was initiated by researchers from Norway and the Universities of Western Cape and Cape Town with its motivation drawn from “Scandinavian action research” (Braa and Hedberg, 2002). HISP was based at the two Cape Town Universities and received funding from Norwegian Agency for Development Co-operation (NORAD) for the period of 1996-1998 (Braa, Monteiro and Sahay, 2004).

The aim of HISP was primarily to empower the new and emerging local health management structures and health workers through improved and locally based information system. HISP is a large-scale action research initiative that operates as a global network within the health care sector across a number of developing countries including South Africa, Mozambique, India, Tanzania, Cuba, Malawi and Ethiopia. It is a grassroots program addressing the concerns of the national health system with a bottom-up approach, with all its efforts concentrated at district levels. The major issues included in the goals of the program are:

- ❖ Health information system design, development, and implementation;
- ❖ Organizational and human resources development; and
- ❖ Developing theoretical and practical knowledge about the challenges of implementing health information system in developing countries, with a focus on issues of scalability and sustainability (Braa, Monteiro and Sahay, 2004, p. 343).

HISP in South Africa aimed its first pilot phase from 1996 – 1998 developing district health information system to support the emerging decentralized administrative structures in three pilot districts in Cape Town., emphasizing prototyping and local use and analyzing of data. In 1997, the first essential data set was implemented in all local government health facilities in the Cape Metropole including HISP pilot district and in the whole of Western Cape (Braa and Hedberg, 2002). In 1998, the first version of District Health Information Software (DHIS) was developed and used in Western Cape to capture and analyze data at all levels.

In 1999, based on achievements of the pilot phase, the department of health in South Africa adopted the strategies, processes, and software developed in the pilot districts as the national standard. The politics of apartheid were deeply inscribed into the old health information systems; the process to change the systems has been complicated because of centralized systems, organizational structure and intimately linked to the wider political, social and health sector changes (Braa and Hedberg, 2002). In 2000, HISP was rollout in different provinces in the country. In 2001, HISP rollout continued in all provinces and districts in South Africa. Training and education has been the major process of HISP. A

HISP training manual has been created, updated and circulated continuously for the use of other HISP nodes (Braa, Monteiro and Sahay, 2004). Today in almost all provinces of South Africa, HISP has installed DHIS which is accepted at the national level.

In Mozambique, HISP started in January 1999, funded by NUFU, and by the collaboration of the University of Eduardo Mondlane and Ministry of Health in the aim of implementing health information system in three pilot districts. The database which was used and acknowledged by the Ministry of Health was useless and out of date and was in need of replacement. HISP faced the dilemma of gaining stronger political support by showing success on the ground, which is difficult to achieve in the absence of Ministry of Health instruction to the districts and provinces. The key problems identified from the three selected pilot districts were related to poor reporting and data management systems at district and provincial level, absence of feedback of information, and no involvement of district level. Another problem was that many data elements, what they had before, were making the information useless at health facility and district level (Braa, Monteiro and Sahay, 2004).

The solution taken for the above mentioned problems was to focus on provincial and district level; develop sound routine data collection and reporting and use based on the existing data element and adapt software called DHIS. HISP has developed a computer based district health information system, within the South African context. In the collaboration basis, the DHIS is being translated from the South African context to the Mozambican context. In this case, DHIS is treated not as information systems, but as a tool which can be referred to during the design and development process of Mozambican DHIS. DHIS was customized according to Mozambique context and translated into Portuguese language (Braa, Monteiro and Sahay, 2004). In Mozambique, an analysis of the ICT use at district and province level shows that there are few people with skills in ICT, but that people get help and support through informal networks, such as people working with computers in education and, administration, etc. (Braa et al., 2001). Besides, the IT infrastructure is weak; the big challenge is in finding appropriate strategies to facilitate the installation of appropriate technologies. The strategy applied to solve this problem is to make computer available in the province head quarter so that staff

from districts without computers could come and enter their data at the province head quarter (Braa, Monteiro and Sahay, 2004).

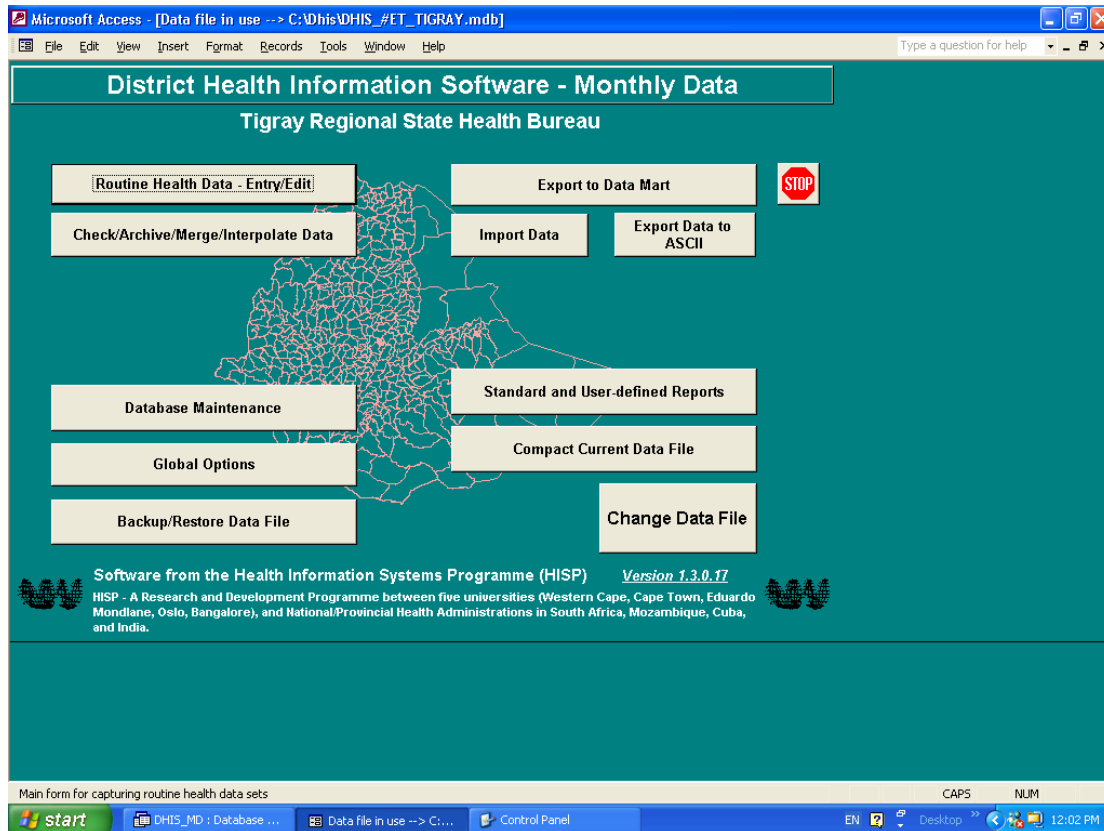
Because of lack of human resources, the development of educational capacity has been a key focus of HISP. “An integrated Masters program in health informatics has been established through the collaboration of University of Eduardo Mondlane (UEM), University of Western cape and the University of Oslo” (Braa, Monteiro and Sahay, 2004, p 352). HISP has conducted a number of trainings, workshops and onsite sessions in the three provinces and students in the master’s program are taking part in the action research. The strategy is to develop the UEM master’s into an institutional base for a continuous education and training scheme in support of the national health information systems development. HISP has also the pilot project in India, Malawi, Mongolia, Cuba, Tanzania and Ethiopia.

The initiation of HISP in Ethiopia is as a result of the collaboration of the Department of Informatics, University of Oslo and the Department of Information Science, Addis Ababa University. HISP is currently working under the Federal Ministry of Health with different Regions. As a pilot sites, Addis Ababa, Tigray, Oromyia, Amhara, and Benishanguel-Gumuz, are selected. The implementation process was started at Addis Ababa by customizing the DHIS software on the local context. Currently the DHIS has installed to all sub-cities and health facilities in Addis Ababa. The pilot implementation also started to other Regions. The ongoing process of implementation organizes by head of the Department of Information Science, Addis Ababa University and supported by facilitator hired for the pilot Regions.

4.2.1. District Health Information Software (DHIS)

The District Health Information Software was and continues to be, developed by the Health Information Systems Program (HISP) team in accordance with the principles supported by the “Free and Open Source Software” philosophy, and is therefore freely available to anyone who wishes to use it, as long as it is not abused for commercial purposes. It is open software can be freely probed, customized and modified. It is flexible software that allows the entry of routine anonymous service delivery data from health

care facilities so that it can be converted into indicators to monitor service delivery. It is now used in the public sector primary health care facilities throughout South Africa and other HISP pilot sites (HISP, 2004).

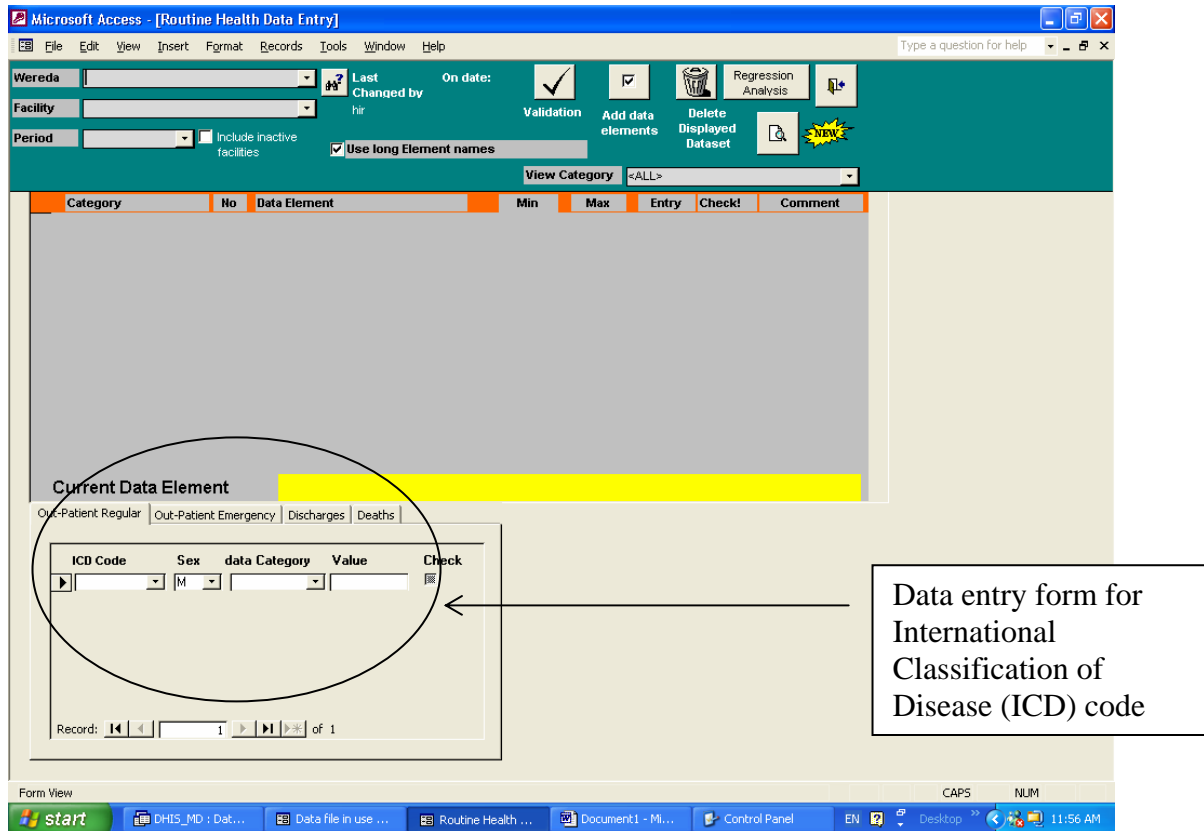


Picture 4-1: The main display of the DHIS in Tigray Region, Ethiopia, Version 1.3.0.17, August 2004

The DHIS supports not only routine monthly or quarterly data, but also the capture and analysis of semi-permanent data (population estimates, equipment, infrastructure, number of personnel, services provided per facility) and survey/audit data. This stems from the premise that not all information needs to be collected on a routine basis – some can be collected annually or six-monthly through regular surveys, and some semi-permanent data can be updated whenever changes are occurring.

The adoption of the DHIS software in a new country requires adjustments and add-ons to satisfy the needs of the local health authorities. Thus DHIS is being customized according

to Ethiopian context. The customization was begun in the research and development reported here, and is ongoing.



Picture 4-2: The screen shots show the features added and/ customized by HISP-Ethiopia. The monthly routine data entry screen, version 1.3.0.17, August 2004.

Its high degree of user definability has led to it being translated into other languages for use in those countries. Currently supported languages include Spanish (Cuba), Portuguese (Mozambique, Angola), Mongolian, Russian, and Chinese. Efforts are underway to complete the translation into Swahili (Tanzania), Telugu (Andra Pradesh, India), Kannada (Karnataka, India), and Norwegian.

The DHIS software was first developed in 1998 and despite many new releases and continuous improvements that have kept it functioning and quite successful throughout these years; there is now a need for a complete revitalization of the software. The architecture of this existing version cannot be web-enabled. Furthermore, the DHIS is based on the Microsoft Access platform and thereby require expensive Microsoft licenses in order to be deployed. The Department of Informatics at the University of Oslo plays a

central role in coordinating a recently established global systems development project targeted at developing a new version of the software, the DHIS 2.0. The DHIS 2.0 development team consists of HISP developers from India, South Africa, Ethiopia, Vietnam, Oslo and possibly other HISP nodes (Titlestad, 2004).

Therefore, both the country, Regional and district and these software research and development settings and contexts supported the researchers on both diagnosing (problem identification) and therapeutic (action intervention) process of the study. In the next chapter we presented detail descriptions of the case findings.

5 Empirical Study and Findings

This action research study was conducted at two levels of the health structure in Tigray Region: at the Regional and district levels. At the Regional Health Bureau (RHB), the focus was on five departments directly involved with the processing and use of routine health data. At the district level, we studied two pilot districts recommended by the RHB management team. The findings from these field sites are presented jointly. In the two pilot districts, we observed similarities in work practice, level of infrastructure, manpower, status of computerization and distance from the Region's capital. In order to make the differences easily identifiable, the sources of most of the findings and their locations are stated.

In this chapter, the researchers describe their findings from the fieldwork carried out at the Regional Health Bureau (RHB), two District Health Offices (DHO) and the health facilities.

The chapter is organized in two parts. The first describes the existing health information system at all levels of the Tigray Region health structure. This description includes the functionalities of the system and the major problems encountered during the assessment, which are potentially affecting the sustainability and usability of a health information system. The second section describes action research interventions towards data flow restructuring, and the implementation of district-based health information system.

5.1. Assessment of the Existing System

Undertaking an in-depth assessment in order to determine the performance of an existing health information system and propose alternatives to strengthen the system is the foundational task for health information system development. During the course of the assessment, the researchers observed the workplace, interviewed the staff at the health facilities, district and Regional levels and analyzed documents. In the next sections, results of the assessment are presented.

5.1.1. Routine Health Information Management in Tigray Health System

In this section, the existing situation of the Tigray Region health information system is described in terms of its main functionalities: the main activities performed within the system. The source of this qualitative data is the assessment carried out at the Regional bureau and two pilot districts chosen for the district-based health information system implementation.

Health Management Information System (HMIS)

The HMIS unit in Tigray Region is established under the department of Planning, Programming and Projects in 2001. The Regional bureau structured in 1995 right after the country declared federal system. Before that until the establishment of HMIS there was one statistician in planning and programs department who collect only annual report from the district health offices. The districts were not sending routine monthly data until the establishment of HMIS. This time, the unit has seven full time staff responsible for entering the data that come from the districts in paper and prepare yearly health profile; all the staff has basic computer skills.

The work practices in relation to data collection, data capture and storage, information use and analysis, data quality evaluation, reporting and transmission as well as the existing situation of basic infrastructure supporting the system are presented subsequently.

5.1.1.1. Data Collection

The basic routine health data collection in Tigray Region was done at two levels, at the health facilities and at the community levels.

At the health facilities, health posts, clinics, health centers, and hospitals, the health workers responsible for providing the health services collect data while giving the services using different registry books and tally sheets. See picture 5.1- 5.5 for sample registry book pages and tally sheets. According to the head nurse at the Adi Gudem health clinic (Hintalo-Wajirat district), the facilities are facing shortage of registry books

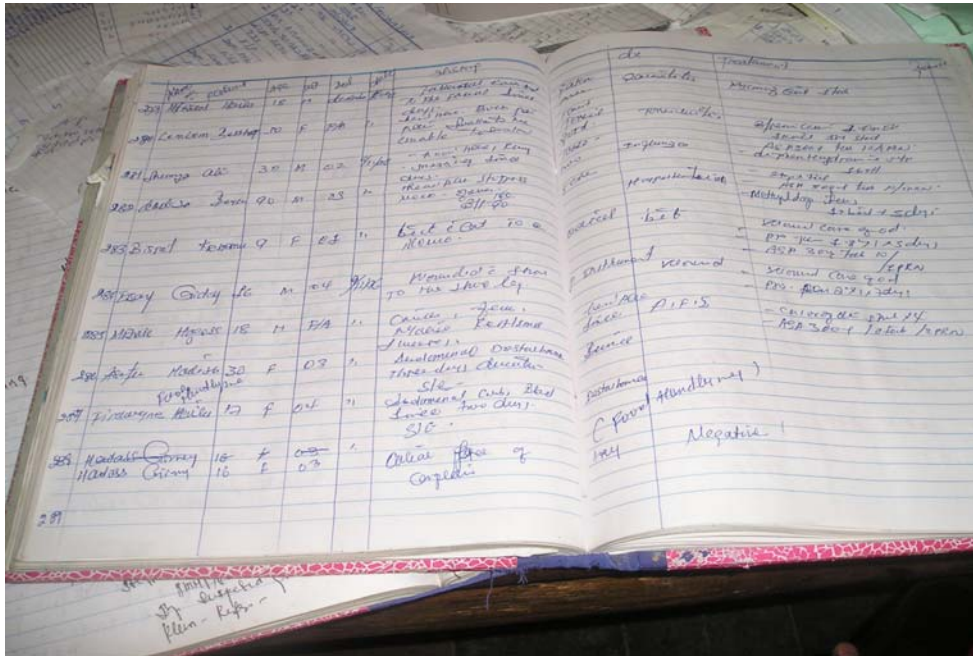
because the RHB is not providing them regularly. They buy log books from the market and draw the formats by pen, as shown in picture 1. During our meeting with the district staff in Hintalo-Wajirat, we mentioned to them that there is a feature in DHIS that can help them with producing some of the data collection tools, and they can easily design and print them from the system instead of working by hand. However, they told us that even if there is a new heavy duty laser jet printer acquired by donation at the district office, it is always a problem to get paper and cartridges. They could not believe they will be able to make use of the help that we recommended.

At the community level, data from the outreach services are collected by the Traditional Birth Attendants (TBA)⁴ and the Community Health Workers (CHW)⁴. They report the deliveries, family planning services, environmental health data, the treatment they provide as well as epidemic cases, using the reporting forms they get either from the district health office (DHO) or the nearby health facilities. They deliver the monthly and weekly routine reports and the case-based reports mainly to the district health office and to the health facilities.

Based on our observations and interviews with the facility heads, except for the hospitals, at the health centers, clinics and health posts they do not have a staff specifically hired to do the summary of data from the registries and the tally sheets into reporting formats and send the reports. Therefore, the heads of the facilities have to do the job in addition to their duties, which adds to their already heavy workload. Other than the case-based reports, which should be sent immediately to the district, and other non-routine reports, the facilities are expected to send the routine monthly reports to their respective districts on the 5th day of every month.

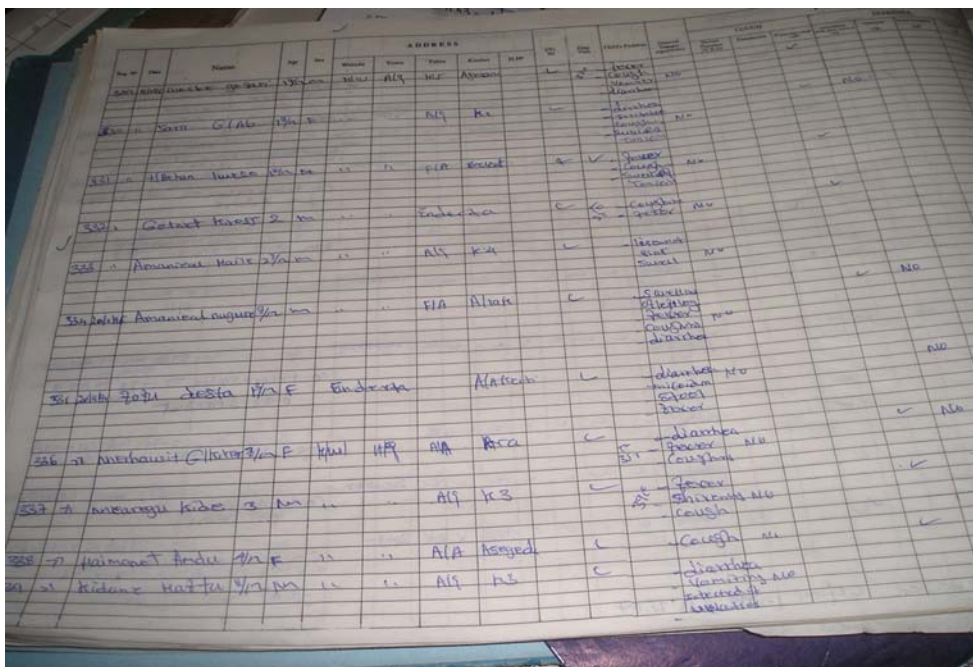
⁴ Volunteers recruited out of the rural community and trained by the district health office.

Major Routine data collection tools at the health facility level picture 5.1 - 5.5.



Picture 5-1: A manually formed registry book used in adult outpatients

(Source: Field visit at Adi Gudem Clinic, Hintalo-Wajirat District)



Picture 5-2: A registry book used in Child outpatients

(Source: Field visit at Adi Gudem Clinic, Hintalo-Wajirat District)

Picture 5-3: A manually formed Antenatal and postnatal registry used in Maternal and Child Health care

(Source: Field visit at Adi Gudem Clinic, Hintalo-Wajirat District)

Picture 5-4: Records of Family Planning services.

(Source: Field visit at Adi Gudem Clinic, Hintalo-Wajirat District)

Picture 5-5: Treatment records for Children under 5, using a manually produced copy of the regular format

(Source: Field visit at Adi Gudem Clinic, Hintalo-Wajirat District)

The scarce numbers of health workers at the facilities which are expected to serve a large population size and the resulting hectic work environment, as well as the inadequacy of data collection tools appear to be the main problems the health information system is facing at the data collection level.

5.1.1.2. Data Capture and Storage

Out of the thirty five, thirty three of the districts in the Region have personal computers. One of the visited hospitals in Wukro district also has a computer, which is not used most of the time due to lack of skill and some times lack of maintenance for hardware and software failures. By the time we visited the hospital, the computer wasn't working due to some failure and they were planning to send it to the Region for maintenance.

At the health facility and district levels the data management is purely paper-based. The health workers at the facilities and the Experts⁵ at the district health offices spend most of their working hours processing paper-based data. The computers at the districts are usually also used for other office routines, mainly word processing. The bureau made an effort to computerize the health information system using a MS-DOS based software called Epi Info™ provided by the Center for Disease Control and prevention (CDC), which has some statistical analysis features. Epi Info™ is developed primarily for analysis of epidemiological survey data. Data entry is done through questionnaires designed by the users. It is not database management software. Only the mortality (death) and morbidity (illness) data received from the districts are entered by the HMIS staff at the Region in Epi Info™. Departments at the Regional level enter their own selected data into Epi Info™ by facility level and keep the rest in Excel files aggregated. They also use Excel spreadsheets for data processing. The bureau tried to implement this system at the districts to enable them to enter their own morbidity and mortality data and send the soft copy to the Region. However, it is not still successful in most of the districts for different reasons, including shortage of successive training on the system as well as on basic computer skills, and the very frequent transfers of personnel from the districts. Since there is no permanently assigned staff for the position, staff are always preoccupied with other tasks and they are not able to use the system.

Health workers at both the health facilities and district levels usually store their data on paper, in files. According to the Hintalo-Wajirat District Health Office Head, poor filing is a big problem. The data are not well documented, and so retrieval of stored data is difficult, especially when a member of staff who originally documented the data had left the District Office. There was no proper software provided to capture all their data. Besides, as we have been told by an HMIS expert at the Region, even to enter the mortality and morbidity data into the Epi Info™ questionnaire they had been provided, most of the districts did not have staff with computer skill continuously. The statistician at the Wukro hospital told us that there are no motivating work practices:

⁵ The title Expert is conventionally used in the Region for professional staff working in the offices, other than the heads.

We are not using the data we enter into the computer for reporting purpose. We use it for storing data as a backup, which is not still totally updated, because we are asked to submit the soft copy along with the hard copy reports prepared manually, we prefer to prepare only the manual reports (Statistician, Wukro District Hospital, August 2004).

The computerization is limited only to the mortality and morbidity data, which are expected to be sent to the HMIS unit and the health service department both on paper and in soft copy. Since the computer system was not uniformly working in all the districts, it was not possible to integrate the data at the upper level. The HMIS unit expert said that is why they ask for both the soft copy and the paper data. He also said that they do not import the soft copy data they received from the districts into their database at the Region; rather they entered it themselves from the hard copy, because they did not trust the quality of the soft copy data coming from the districts.

We are still testing their capacity; the softcopy reports are not regular and timely (HMIS Head, Tigray RHB, August 2004)

It looks like that the data the districts enter in to the software are of no significance at any level.

In sum, the computerization process at the districts is not in a noticeable state of progress since its initiation in 2003. At the Regional bureau, the computers are in relatively better use, even if they are in a stand-alone state; and consequently, data are stored fragmentally in terms of location as well as diversity of formats.

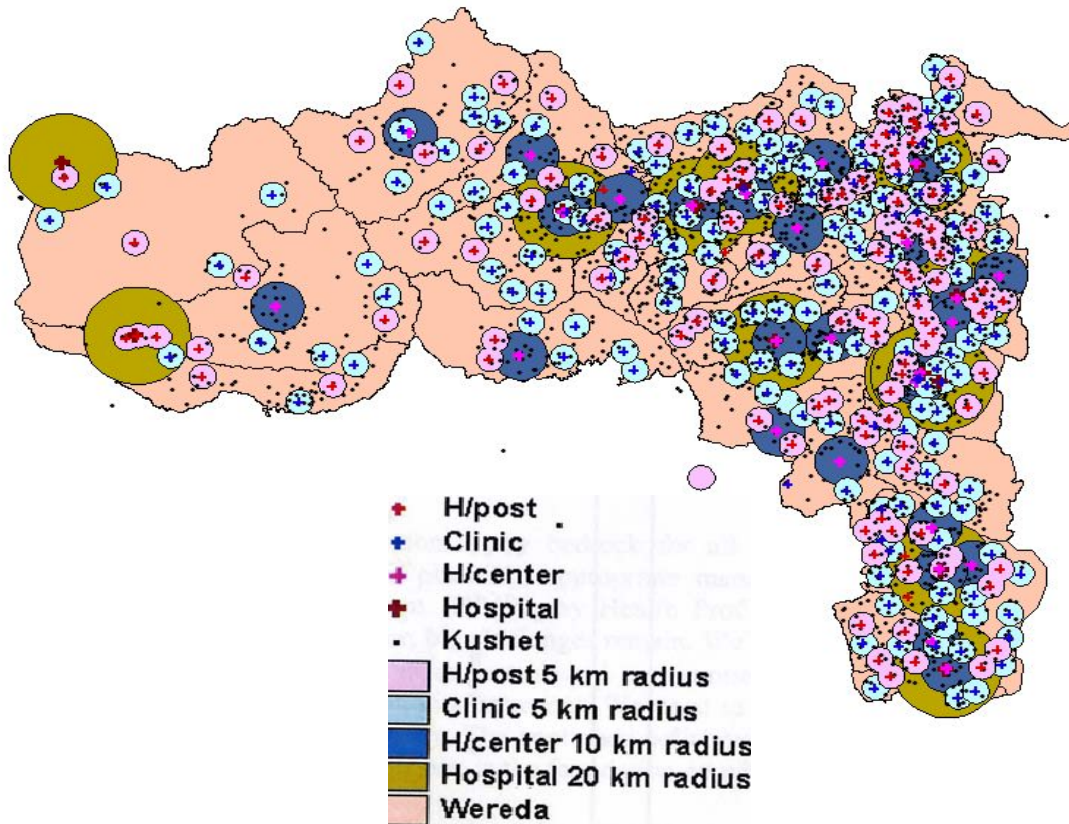
5.1.1.3. Data Analysis and Information Use at the Region and Districts

Preparation of the Region's annual health profile is the major data analysis made in the bureau. The HMIS unit prepares the profile at the end of every fiscal year; it contains the Region's health data (specially the morbidity and mortality data), indicators and analysis. Tabular presentation of summarized data and use of maps are significant.

The HMIS unit implemented a Geographic Information System (GIS), mostly used at the Regional level. Maps, as aids of geographical analysis and data interpretation, are

produced in the HMIS Unit using Arc View 3.3 software. The Region, districts, and the sub districts boundary files, and road files are entered in the database. The GIS initiation was taken by the Malaria and Other Vector Born Disease Department to make a Regional-wide project for mapping villages, institutions, water resource development projects and meteorological stations. The HMIS unit collaborated in this field mapping, and in developing the computerized database. During mapping, the Tigray Health Bureau team collected detailed village information, including population, altitude, walking time to nearest institution, and type and number of community health workers in the village. Almost all facilities are geo referenced. The statisticians at the districts are trained in using GPS (Geographic Positioning System) and they collect the data when new facilities are constructed. Then the data will be entered in to the database by HMIS at the Region. However, the facilities have problems with keeping the trained personnel. The HMIS unit head said they are trying to give continuous trainings to keep the maps up-to-date.

This database had provided important information for the profile. Visualizing distribution of services and diseases helps with planning and with assessment of service provision (Tigray Health Profile, 2002; 2003). The maps produced by the system are widely used in assessment reports, surveys and other writings presented by the staff. We presented one map as an instance; Map 5.1 clearly shows the catchment's areas of the facilities.

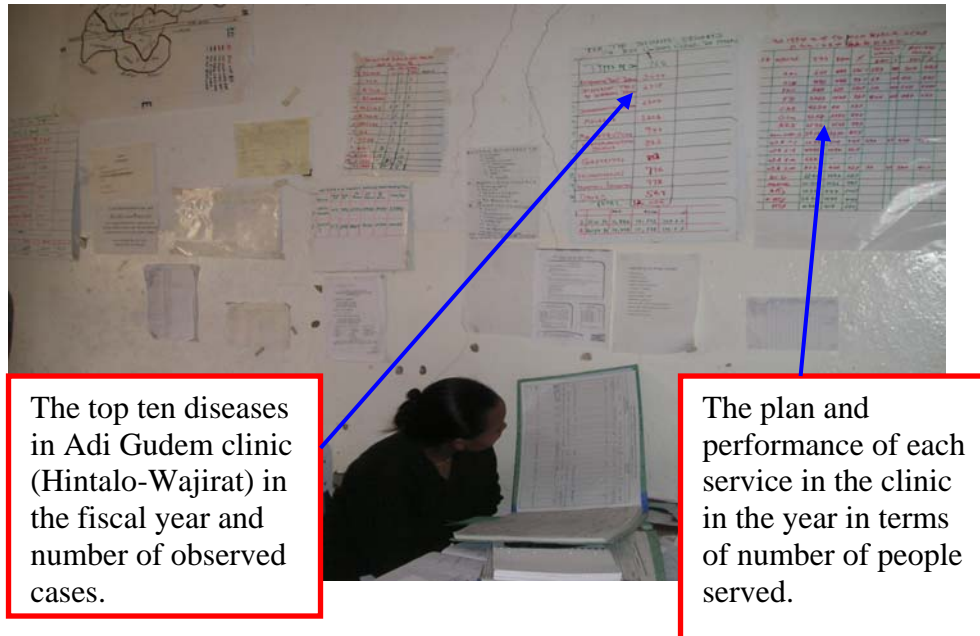


Map 5-1: Shows the catchment's areas of the health institution in the district.

At the Regional level, other than the limited Epi Info™ functionalities, the departments use MS-Excel spreadsheets for tabular and graphical presentation. With regard to data analysis at the districts and health facility level, we observed some data analyzed by the health workers posted on the walls in the facilities. About the way they analyze the data, a staff member said:

We do not use computer for analyzing the malaria data because we do not have computer basic skills. We do the analysis manually. For example we spread DDT at the village by our community workers then we make the analysis manually to check the coverage, follow the performance, and prepare a plan (Malaria Expert, Wukro District, August 2004).

The following picture shows the current data about the top ten diseases in Hintalo-Wajirat district and the comparison between the plan and the performance of the departments in the fiscal year posted on the wall in order to inform the staff.



Picture 5-6: Data analysis and information use at Adi Gudem clinic (Hintalo-Wajirat)

(Source: field visit, Tigray, August, 2004)

According to both the Wukro and Hintalo-Wajirat DHO Heads, the government has dedicated a certain amount of decision-making authority to the districts. They can use the data they are collecting for decisions such as allocating budget and medicine to the facilities, to identify the top ten diseases in the district and plan interventions, to evaluate their performance compared to their plans, to follow-up resource consumption. However, the health service expert at Hintalo-Wajirat district told us they allocate medicine and other resources based on the facilities' request; they don't use the routine data reported to estimate their demand. The same was true between the districts and the Region. We asked what practical uses of data they had come across in the districts, and they told us that they used the reports to identify epidemic situations and to evaluate the facilities' performance.

In divisions at Regional level, for instance Epidemiology, data collection aims are quite different from the HMIS. They use the collected data for urgent intervention by individual cases but HMIS collects summarized monthly and weekly data for planning and management purposes. According to the Planning and Programs Department Head of the RHB, in general, the use of information for local level decision-making was limited. We asked him if there were any efforts made by the RHB to improve this situation and he told us that the problem was recognized by the RHB as well as the government and they had been encouraging the district level personnel to use the data they collected to some extent. He mentioned as an example of the governments effort to give training to the managers and civil servants at the district level on “Management by Objectives: Evidence-based strategic planning”. He said the trainings were meant to build the capacity of the personnel in how to improve their information use, resulting in improved decisions. After the training they had been provided software designed to help them with planning and performance evaluation activities. During our observation at the HMIS unit, we could see the software installed in the computers. However, we did not observe its use, and one of the Experts told us that it was not being used actively as it used to be right after the training.

5.1.1.4. Data Quality Evaluation

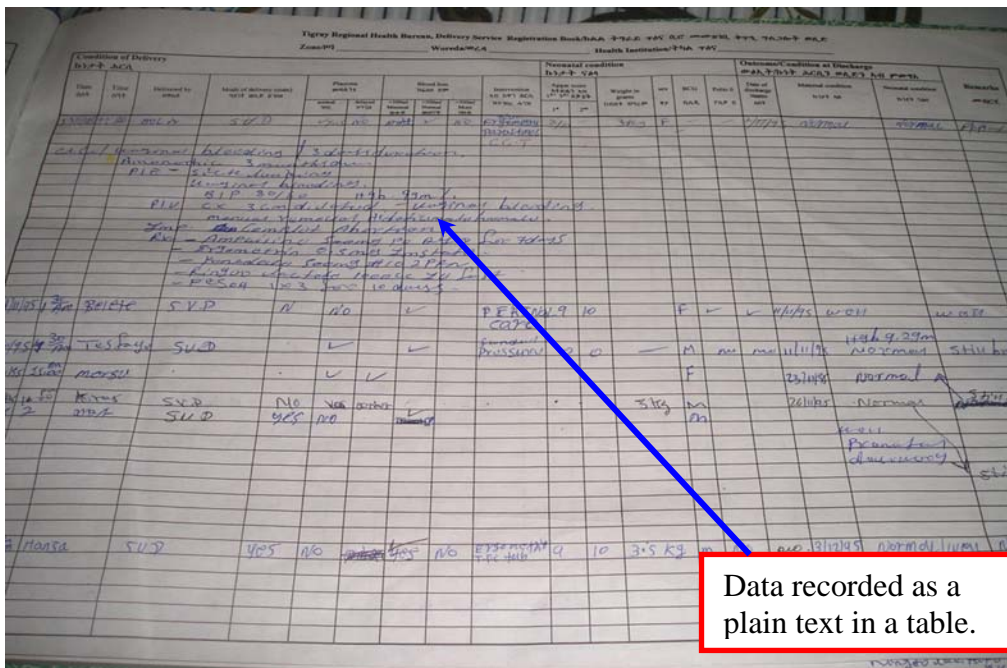
At the RHB, there was an effort to establish a mechanism for checking the quality of data which was collected from each district, comparing the aggregated excel data and disaggregated data from Epi Info™ with the paper-based data sent by the districts. The officials grade the districts based on the quality of the data and send the feedback with the indicators comparing their last and current performance. As a mechanism to ensure the quality of the data coming from the districts and creating accountability, the Region required the District Health Office Head to sign on each report confirming the quality.

According to the Hintalo-Wajirat District Health Office Head, the district personnel conduct supervision in the facilities quarterly, which includes communicating the results of the evaluation of the quality of data they sent to the district, such as its completeness and timeliness. Even if we could not get any documentation of the process to check for its

usefulness, the head nurse at the district clinic told us that it helped them to correct their errors.

To help the reports reach the district office on time, experts going for supervision, sometimes bring some data back with them. In addition, they randomly check the data coming from the community workers on site. They cross-checked the summary reports and the tally sheets on which the data were primarily collected at the facilities.

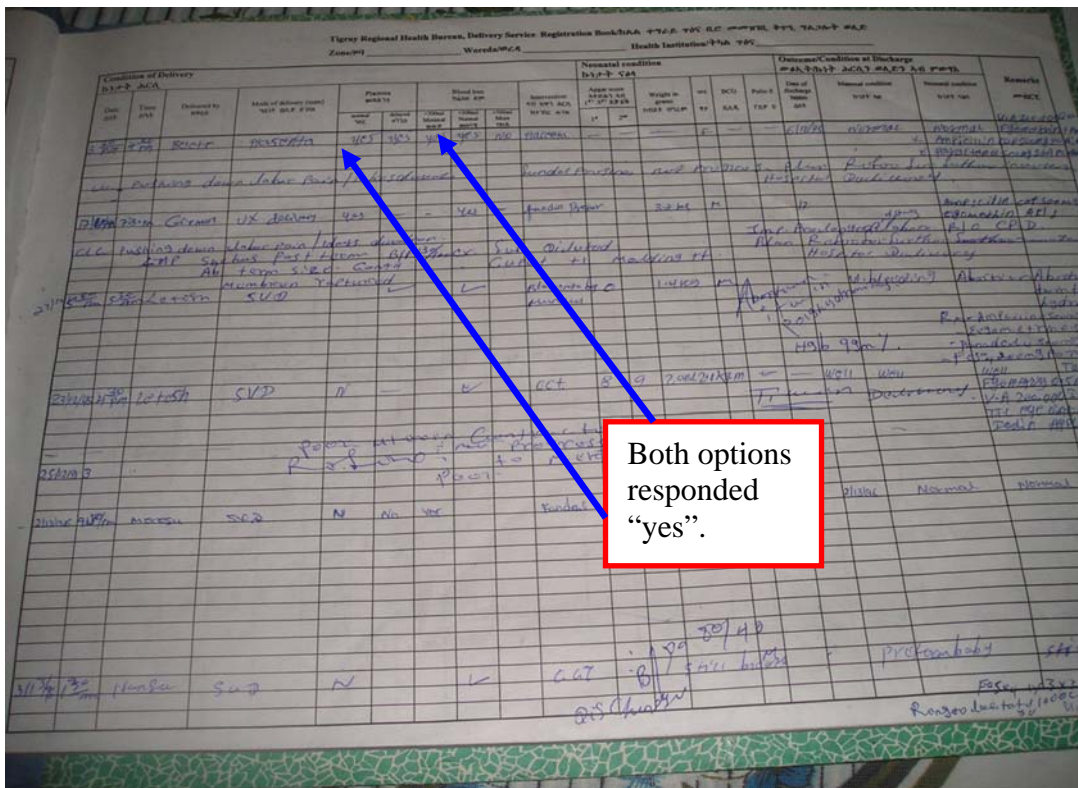
During our field visit, we could notice significant quality problems in the registry books at the health facilities. Samples are shown in the following two pictures. In the registry page indicated in pictures 5.7, instead of filling the data in their respective fields in the table, they were written down as a text. We came across many pages written like this in the registry books. It is clear that this creates a problem during report preparation. Since most of the report forms are filled in by counting occurrences in the fields in the registry columns, these kinds of recordings either lack the necessary data or they made it difficult and time-taking to locate specific data even if they were there. Looking at the forms, we got the impression that they are also most likely to be omitted.



Picture 5-7: Mother and Child Health Registry book showing problems in quality of recording
 (Source: Field visit, Tigray, August 2004)

We asked the head nurse at the Hintalo-Wajirat clinic if they had taken any kind of precautions to prevent this problem and she told us that they very often face the problems and they believed that orientation on how to fill in the forms was necessary for health workers. However they did not do that usually when new health workers came to the Clinic, most of them were new graduates from school. She also said, especially when they were busy with high number of patients and during emergency cases, they focus on treating patients rather than filling in the forms. Sometimes they recorded the data afterwards. Columns filled with ambiguous data as it is shown in Picture5-8 are also observed. Even if we have been trying to be careful so that they would not misunderstand our visit, we asked the nurse what they did when they come across such records. She responded:

We ask the health worker who filled the form to correct it; usually they are not more than two. If it is a recent case and they remember it we can correct it (Head Nurse, Hintalo-Wajirat Clinic, August, 2004).



Picture 5-8: Mother and Child Health registry book showing recording errors

(Source: Field visit, Tigray, August 2004)

The concerned parties at all levels did not seem to give the necessary attention to these problems at the basic data collection level. Therefore, they remained as a threat to the accuracy of the information produced by the system cumulatively.

5.1.1.5. Reporting and Transmission

The health facilities prepare the respective reports to be sent to each Expert representing the departments at the district level. They also send all the reports to the Health Service Expert. Under normal circumstances, the districts accept reports from facilities until the fifth day of the month and expected to reach the Region until the tenth day of each month. The districts also send quarterly reports to the Region. In addition, there were case based and urgent reports required during epidemics. During an epidemic, they used telephone communication or they sent member of the staff to deliver the reports in person to ensure it reaches on time. The district office also compiled a report to be sent to the district administration indicating the plan and achievement of each department. Diagram 5.1 shows the regular reporting flow and data transmission in the Region's health system.

The experts at the District Health Office representing the departments at the Regional level send their reports to their respective departments. Experts also send the summary report to the District Health Officer for the annual plan and budget preparation, for the district administration and for other NGO's request. The statistician or another staff assigned to cover the statistician's place in the district sends the morbidity and mortality data to the Health Management Information System (HMIS) unit at the RHB. At the district level, even if there was a position and budget reserved in the health structure for information management personnel as a Medium Professional 10⁶, in most of the districts the position was vacant and the work was given to other staff as an additional assignment.

The departments at the Region report to their respective departments at the Federal level monthly and quarterly. The HMIS unit receives summarized data from the departments

⁶ A standard rank of jobs used by the Civil Service Commission for positions requiring a two years college education.

based on a request for the purpose of Regional yearly profile preparation. There was no established regular reporting system that enabled the HMIS unit to get hold of the Regional health data. According to the head of IDSR and surveillance at the Regional level, there was a probability of data difference received by HMIS and their department because most of the time there were cases which were reported by symptoms before and tested negative later. Since the reports for the same period are usually sent with a time difference to different departments, such cases can make discrepancy in the values. The only time when this can be noticed is when the HMIS unit prepares the Annual profile and requests total of the data for each month from the departments, especially the mortality and morbidity data sent to the HMIS unit and to the disease prevention department. Some times they do not match. Both the HMIS unit head and the disease prevention head confirmed this; however we could not get samples of such data because they did not keep records. We asked their opinion why this could happen and they told us some possibilities. It might be because of the difference between the reporting times data from the next period might be included in the current report when the report is compiled late. Personal errors when compiled by different facility and district staff are also the other possible reason.

The Head of HIV and STI Division said,

We do not want the HMIS unit to handle our data, because we know it would be difficult for us to get it on time and since they do not have the capacity we do not trust the quality” (HIV and STI Division Head, Tigray RHB, August 2004).

He also emphasized the need for an integrated information management system unit with better capacity. Each department at the Region had its own information management system, which did not communicate with the others. Redundant data collection and reporting due to lack of integrated information system were the major problems mentioned almost by every staff we interviewed.

The districts get feedback for the data they sent to the Region in the form of yearly profile. However, during our interview with the district personnel in charge of the routine reporting, they emphasized the need for feedback and told us they were supposed to get some kind of feed back from the Region more often than they currently did.

5.1.1.6. Infrastructure

The role of the availability of basic infrastructure is vital in sustaining an information system. Tigray Region has succeeded in facilitating access to computers and the Internet for almost all the district health offices. Thirty district health offices have connection through dial-up to the Internet and email since 2003 however majority of the districts have problems with slow connection and no supervision from the Region HMIS unit if there is some problem on the internet. According to the pharmacist who was also serving as the HMIS personnel in Hintalo-Wajirat district, the districts were provided with internet service to enable them to send their soft copy data through e-mail. There was only one internet service account for the Region as well as all the districts; therefore if the district wanted to connect a new computer or if someone accidentally deleted the password, they should bring their computer to the Region to get the user name and the password saved on their computer. The HMIS Unit Head said this was to prevent misuse of the account, since the budget allocated for internet services was very limited.

Fulltime electric power was available only in the districts closer to the towns, which were very few, the others get limited hours of electricity per day. Most of the health facilities did not have a telephone line; therefore members of the staff have gone to the district health offices in person and report epidemics.

The HMIS Unit Head told us that most of these problems would be solved in a short time, because as soon as the Ethiopian telecommunication corporation finished the ongoing establishment of broadband connection services to connect all the districts with the Wide Area Network. He also told us that their proposal to connect all the computers at the Regional bureau with Local Area Network was also approved by the Bureau Head. However, he could not give us any time plan as to when they plan to implement the proposal.

5.1.2. Problems of Sustainability and Optimal Use of Health Information System in Tigray Region

Sustainability in this context is used to refer to the possibility of a system to be actively maintained in an organization and usability is the level at which the products of an information system are practically employed for decision-making in an organization.

We identified a number of problems in Tigray Region, which potentially influence the sustainability of health information system and also the quality and usefulness of the information obtained from the system. In this section, the major factors contributing to the un-sustainability and limited usability of the health information system and their effects on the information management as well as the overall performance of the health system are presented.

5.1.2.1. Fragmented data flows

By integration we refer to the coordination between the departments in the Region with respect to the data collection, transmission and storage. Lack of integration of the data flow in the departments is the most noticeable problem, which affects the quality as well as use of information produced by the health information system. The need for integration is highly recognized by the bureau staff. The Bureau Head believed that the collaboration between departments, the Region and districts is “the foundation on which the health service grows” Tigray Health Profile (2003, p.3). The fragmentation at the Regional level is directly reflected at the district and facility levels. Diagram 5.1 shows a model of the existing data flow with in the Region’s health system in order to facilitate understanding.

The fragmentation data flow in Tigray Region resulted in the following major problems.

Redundant data collection - Since the facilities are expected to respond to report requests from all experts representing the departments and services at the district level exclusively, they spend much time filling different reporting forms with the same data elements in addition to their routine work. According to the Hintalo-Wajirat District Health Office Head,

For example, the Health Service Department receives malaria data in the mortality and morbidity report, and the Malaria Department also receives malaria data on the same data elements for the same period with different values more often (DHO Head, Hintalo-Wajirat, September 2004).

Based on our observation at the bureau, we could notice that the data elements reported to the health service department were also sent to the Maternal and Child Health, Environmental Health, Epidemiology and Health Education.

There is no means to cross-check and correct the inconsistency in values, because the data go from the facility up to the Ministry of Health and to the external users in parallel. This affects the quality and reliability of the information obtained from the system, resulting in a failure to serve its purpose. Samples of different reporting formats with the same data elements are shown in the following pictures 5.9, and 5.10.

During our meeting with the Wukro Clinic Health Workers and District Experts, they strongly emphasized that filling in these forms was time consuming.

I report the mortality and morbidity data to the health service and the HMIS Unit with different forms; I think it is possible to merge the forms (Health Service Expert, Wukro DHO, September, 2004).

We asked the statistician at Wukro District Health Office his opinion about the health workers' complaints and he said he agrees with them. He also showed us the forms he thinks contained redundant data elements including the examples shown here.

HEALTH INSTITUTION MONTHLY MCH REPORT MCH
 ናይ ጥዕና ትካላት ክንክን ጥዕና ቤተ ሰብ ወርሓዊ ሪፖርት ፎርም
 woreda-----; Health Institution ጥዕና ትካል----- 199-----
 Reporting period/ወርሓት ሪፖርት from ክብ----- To ለስካብ-----

S.N	Activities ስራሕቲ;	In Health Institutions እብ ጥዕና ትካላት					By TBAs/CBRH እናብ ጥዕና መሓውር		TOTAL ጠቓላላ ድምር
		Hospital ሆስፒታል	H/C ጥ/ጣብያ	Clinic ክሊኒክ	H/post ጥ/ኪላ	Sub Total ድምር	ፋና ጥዕና	ሰነተ-ዋ ልዶ	
1	Antenatal Service ክንክን ጥኑባት First Visit ንመጀመርያ ጊዜ ዝተመርመራ Revisits 2ተ ጊዜ ንክብሉ ንላዕልን ዝተመርመራ								
2	Delivery Service ወለድ ግልጋሎት Normal Deliveries(SVD) ንቡር ሕርሲ Abnormal/Instrumental deliveries (forceps, vacuum, Breach, etc) ዘይንቡር/ብመርኦ ዝወለደ Caeserean Section ብመጥባሕት ዝወለደ Total Number of Births ጠቓላላ ባዝሒ ዝወለደ Mothers died during delivery እብ ሕርሲ ንጥታ Birth Weight less >2.5 kg ክብደት ትሕት 2.5ኪ Babies died during delivery እብ ሕርሲ ዝሞቱ ቆልዑ								
3	Postnatal Service ክንክን ድሕሪ ሕርሲ First Visit (seen only within First 42 Days) ንመጀመርያ ጊዜ እብ 42 መዓልቲ ውሳኔ ዝተርከቦ Revisits 2 ጊዜ ክብሉ ንላዕልን ዝተመርመራ								
4	Abortion ምንግል ጥንሲ Total Number of Spontaneous Abortions ባዕሉ ዝተነፀለ ጥንሲ Total Number of Induced Abortions ብሰብ ብገለ ዝተነፀለ ጥንሲ								
5	Family Planning (FP) ምጣኑ ስድራ New ሓደሻቲ Pills ክኒን Depo Provera ብመርፍኒ ዝወገብ Condom ኮንዶም Norplant ኖርፕላንት (ትሕት ቆርቦት ዝኣቲ) Sterilization:-a) Tubal Ligation ብመጥባሕት ዝግፀዎ b) Vasectomy ብመጥባሕት ዝግፀዎ IUCD ሱፕ Others ካሊእ Total ድምር Revisit ድንገምቲ (2-11 ወርሓ) Pills ክኒን Depo Provera ብመርፍኒ ዝወገብ Condom ኮንዶም Others ካሊእ Total ድምር Continua 1 ን1 ዓመት ወይ ክብሉ ንላዕል ዝወለደ Pills ክኒን Depo Provera ብመርፍኒ ዝወገብ Condom ኮንዶም Others ካሊእ Total ድምር								

Data elements collected in form below as well

Picture 5-9: Health facility reporting format for MCH services, showing redundant reporting data elements reported in other formats as well,
 (Source: Field visit, Tigray Region, October, 2004)

MONTHLY HOSPITAL AND HEALTH CENTER ACTIVITY REPORT PAGE 1

Name of Health Institution W-H-C Woreda WUBKRO
 Month Jan Year 1996 Name & Signature of reporter T. Blot

1. Health Education

SUBJECT	PLACE	No. OF SESSIONS	TOTAL NUMBER OF Attendants

2. M.C.H (Note:- Include MCH new diagnosis in morbidity Report)

TYPE OF ACTIVITY	PLACE			Total
	At the Health Institution	At Far Filed	At Home	
ANTENATAL	First Visit	39		
	Second Visit	31		
	Third visit & More	107		
	Total	177		
DELIVERIES ATTENDED	Normal	2	22	
	Abnormal			
	Total		22	
NEO NATAL	Normal Birth Weight			
	Low Birth Weight			
	Still Birth			
POST NATAL	First Visit	2		
	Second Visit	2		
	Third visit & More			
	Total	4		
GROWTH MONITORING	Over 80%	627		
	70-80%	632		
	Less than 70%	22		
STATUS	First			
	Repeat			
	Total	22		
CHILD EXAMINATION WITH OUT BODY WEIGHT				
FAMILY PLANNING	First Visit	58	22	
	Repeat Visit	15	99	
	Continuing Acceptors	72		
	First Visit			
	Repeat Visit			
	Continuing Acceptors			
	First Visit	2	7	
	Repeat Visit		28	
	Continuing Acceptors			
	First Visit	129	2	
	Repeat Visit	100		
	Continuing Acceptors	71		
Total	First Visit			
Repeat Visit				
Continuing Acceptors				
Attendants	Continuing Acceptors			

Data elements included in the above form

Picture 5-10: Health facility reporting format for health services, showing redundant reporting data elements reported in other formats as well,

(Source: Field visit, Tigray Region, October, 2004)

Picture 5.9 and 5.10 are different forms with repeated data elements reported for two separate departments. The form in picture 5.9 includes antenatal (first and revisit), delivery service, postnatal, family planning, and, growth monitoring to be reported to Maternal and Child Health (MCH) department. The other form on picture 5.10 repeated all the data elements of the MCH form to be reported to Health Service department. This specific form has three pages with repeated data elements of different departments of Malaria, Environmental Health, and HMIS.

The HMIS unit Head was asked to comment on the issue, and he said,

We recognized the problem already. However in order to avoid the redundancy in the forms, first we need to have a unified information system, which we could not realize (HMIS Unit Head, Tigray Health Bureau, October 2004).

Excessive number of data elements and indicators - The fragmentation system results in a large amount of data elements and indicator sets containing many non-useful and redundant data elements and indicators. The redundancies are difficult to identify because there was not one complete list of data elements and indicators used at all levels. Most of the staff we interviewed strongly complained that the amount of data they collect and report is more than what can be used and the need to identify a unified useful data set for the Region's health information system. The Bureau Head called this problem "a big challenge", and said,

We need to critically assess what information we are collecting to make sure it is important and action- oriented (Tigray Health Profile 2003, p.3).

Our observation and analysis of selected data collection and reporting formats also confirmed this fact.

Difficult cross-services analysis - Less possibility of analysis decreases the usability of the data. Data for different services and departments are stored separately, in multiple formats making it difficult to analyze and compare data. For example, if a user wants to compare the data for fully vaccinated children under one year with infant deaths, the two

data sets are located independently in two different departments, the Maternal and Child Health and Health Services Departments.

Fragmented use of resources - The departments' independently processing their respective data, obviously increases the need for resources involved: reporting papers, transportation, computers, labor and time spent on compiling reports. Departments gaining relatively higher funds, for example the Malaria Department, have their own HMIS personnel at the Regional level and better computer facilities. Joining these resources could result in one strong unit in the bureau.

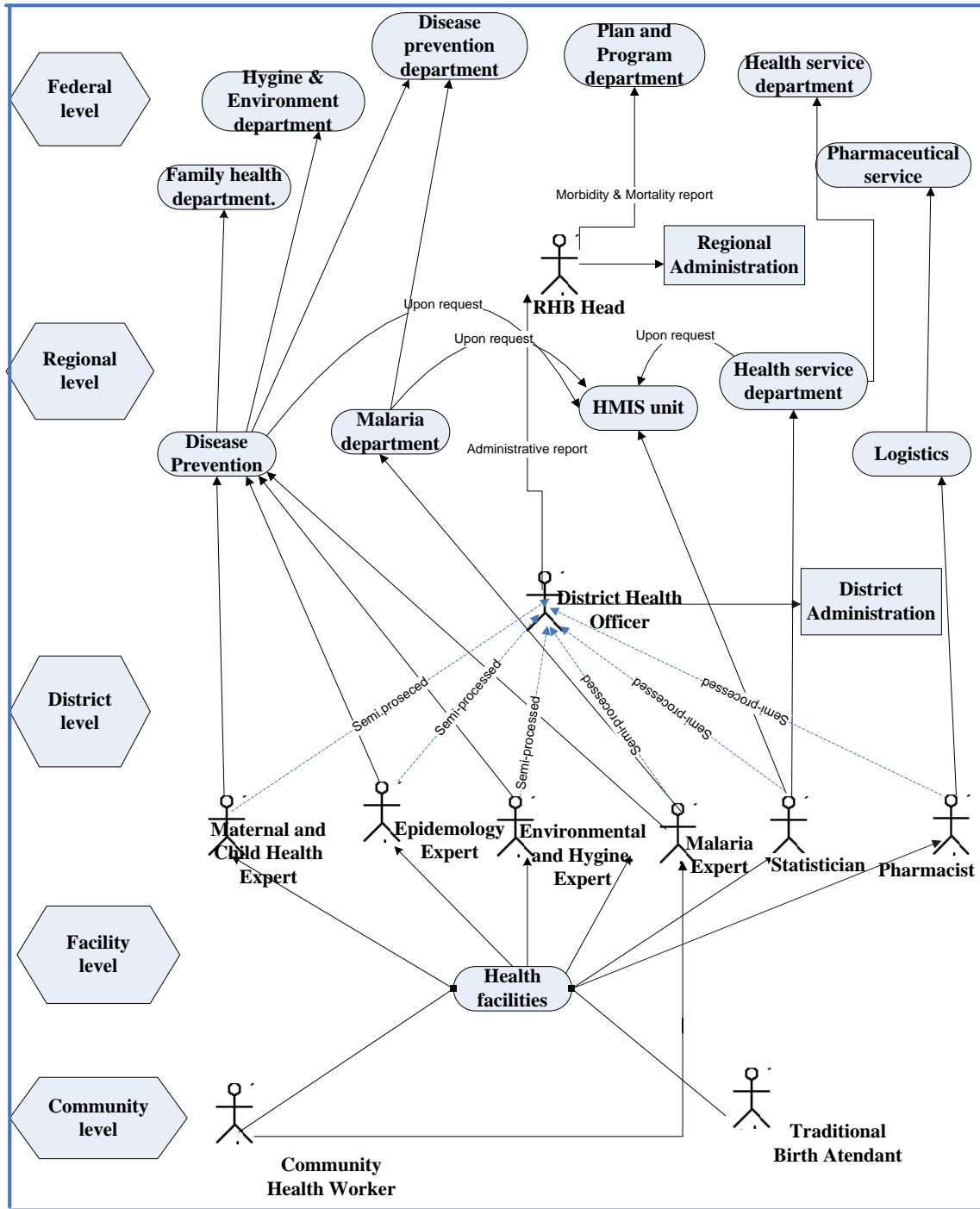


Diagram 5-1: Model of the existing Data flow within the health structure drawn from the situation analysis

(Source: Field visit, Tigray Region, August-September, 2004)

5.1.2.2 Centralized information processing

In Tigray Region, the purpose of data collection at the local levels is merely for reporting raw data from facilities to the districts and from districts to the Region. There is no established body at the districts responsible for processing the raw data and make it available for local use. The experts at the districts pass the data to their respective departments in the Region. This doesn't create an environment promoting information use at local levels.

5.1.2.3. High Staff Turnover and Low Capacity

We observed high staff turnover and very frequent transfers of personnel within the health sector, which significantly influences the sustainability of any system introduced. When a trained and experienced member of staff, who has been working on the information management, leaves the office, most of the time there would not be anyone to take over immediately; the office then continues at a lower capacity.

The information management capacity of the Tigray Regional Health Bureau and the districts is described as low by most of the staff we interviewed. The Bureau Head confirmed: "We need to strengthen Regional and district capacity for information management" (Tigray Health Profile, 2003, p. 3). However there are no significant measures being taken in this regard so the problems are expanded.

5.1.2.4. Lack of Continuing Training

Continuous training is as necessary for current staff as for new recruits. Lack of training was one of the reasons frequently mentioned by the district staff for the under-use of the computerized system. The districts expect the trainings to be provided by the Region, both on basic computer skills as well as on the information management software. Mostly, they do not have the budget to get trainings by themselves, for example by hiring private trainers, unless they could find donations from external funding such as through NGOs.

5.1.2.5. Challenges to scale systems up to Regional standard

The Tigray Region Health Bureau have attempted since 2003 to implement the Epi Info™ software at the district level for mortality and morbidity data to start with. However, there are only few districts that have continued to enter the data into the system, with some interruptions in between.

When a system is used only in pilot areas for a long time, it most likely becomes difficult to sustain. This is the case in Tigray Region. The pilot users are expected to send reports both in soft copy and hard copy, to enable their integration at the higher levels. This practice has continued for about two years, therefore they are not getting their work load simplified, rather doubled. This discourages them to use the computerized system. The statistician we interviewed at Wukro district hospital, one of the districts where Epi Info™ has been piloted, emphasized this point.

According to our sources, the Region and district staff, the main reasons for the failure to scale up the computerization are:

Lack of basic infrastructure: Infrastructures including roads, telephone and electricity are not evenly distributed amongst the districts in the Region. This hinders the computerization process from going at a similar pace in all the districts. For the remote districts, it is difficult to contact the Region for material or technical assistance in case of technical problems. This discourages them from continuing to use the computers.

Unavailability of skilled manpower: At the remotest districts, it is relatively difficult to find people with basic computer skills to manage the system locally.

In general, remarkable achievements have been made in the past two years while a lot more needs to be accomplished towards a dependable and sustainable health information system. Some of the achievements done by HMIS are the production of Regional health profile of two consecutive years. All districts, health facilities, villages, roads, water resource development projects, are geo-referenced. This allows the inclusion of geographic related information in systems development initiatives. It is possible, for example, to influence the progress of health surveillance, environmental health

assessment and allocation of health resources based on the needs of specific geographic areas.

Regarding software in the Region, Epi Info™, Arc View, and MS Office applications are in use to capture routine monthly health reports collected from the health facilities and for the Geographical Information System. All the districts have computers and Internet connection. Mostly, districts use Epi Info™ to enter only morbidity and mortality data. The other reports are paper-based, since the computerization is still at its pilot phase. Basic training on computer basics and Epi Info™ was conducted for staff of district health offices and some health facilities. However, most of the districts are not using the software to enter the data because there is no continuous training. The staff at districts are not motivated to use the software.

The inadequacy of the health information system in Tigray Region has several causes. The main problems which are going to be addressed by this action research are listed in the next section, as points of departure to the presentation of the intervention carried out.

5.2. Action Research Interventions

We conducted this phase of the research as part of the HISP team working in Tigray Region, which consisted of four researchers. In addition, the software customization was carried out in collaboration with HISP Ethiopia team working in other Regions of the country.

Based on the investigation undertaken, the main problems needed to be addressed and basic requirements of the health system were identified. A summary of the problems and requirements which were used as points of departure is presented as follows.

- ✚ A tendency of centralization of information management at the Region level,
- ✚ Requirement for collecting excessive reports from the health facilities,
- ✚ Absence of standard data set and indicators,
- ✚ Lack of coordination in data collection and reporting among the departments,
- ✚ Lack of continuous training, and,

- ✚ Lack of established procedures and awareness that enable practical uses of data being collected as well as using computers for data processing.

In order to solve these problems, it was required to:

- ✚ To define minimum standard data sets, indicators and reporting requirements (both routine and analytical) which can be used at the different levels of the health structure,
- ✚ To introduce a flexible software which can incorporate the data for all services and departments, usable at the district level and expected to support the integration process,
- ✚ To identify different training requirements,
- ✚ To rationalize procedures and establish policy for streamlining information flows within and across levels in the systems, and,
- ✚ To establish structures to support institutionalization and sustainability of the system.

Implementation of an integrated (a unified system in which the routine data passes up through the HMIS unit and distributed to the other departments) system based at the district level was the proposed action by the HISP team towards tackling the above problems. The decision had taken by the management team to implement at the Regional and at the two selected pilot districts.

In this section, the process of action taken by the researchers in order to identify more challenges affecting sustainability and optimal use of health information systems and to solve the existing problems related to the health information in Tigray Region are described. Mechanisms employed to lay the foundation and establish the basis for a sustainable and relatively usable health information system in the Region's health system, are also presented.

5.2.1. Plan and proposal for action

The preparation of the plan and proposal for how to solve the problems and meet the requirements identified by the committee was the second step taken by the HISP team.

We used the problems discussed above as a point of departure for developing a plan for action. The proposal consisted of:

- ✚ Specific mechanisms suggested to address the above mentioned problems,
- ✚ Resources required from the RHB,
- ✚ Resources provided by HISP-Ethiopia, and,
- ✚ Timeframe for action.

In the first meeting with the management team, a brief introduction of the HISP initiative in other developing countries and its current status in Ethiopia was given by the HISP team. The proposal was presented to the management team along with the demonstration of the DHIS software to be implemented. The management fully accepted the plan and decided to start a pilot implementation at the bureau level and at the two selected districts namely Hintalo-Wajirat and Wukro.

Since the research was done under the HISP framework, the HISP implementation phases were followed. Besides, the assessments undertaken revealed that most of the problems identified require the involvement of all the departments in the bureau. The experts need to be sure that the work practices of their respective departments are considered in the solutions. Based on our discussions with the HMIS unit, the influence of the departments on the information system is significant. We could find out there were initiatives meant to change the system by the unit itself and assisted by donors, which were not supported by the departments and failed to succeed. The most appropriate example here is the effort to unify the information system; the HMIS staff prepared the formats by themselves and distributed to the departments for comments. This did not work at the time. (Mentioned again in section 5.2.3) Therefore, the formation of a team consisting of representatives of the departments was proposed as a prerequisite for proceeding to the proposed actions.

5.2.2. Process of establishing participatory team

At the end of the meeting, the RHB Head established a technical committee composed of representative experts from all departments in the RHB and led by the Head of the Planning and Programs Department. The committee was mainly given the assignment to

standardize a minimum data set for the bureau in collaboration with the researchers and was expected to report its progress regularly to the management team. We participated in five meetings for thirteen hours held by the committee, in which there were discussions on the problems the bureau has been facing regarding information management at all levels.

5.2.3. Process of establishing data standards (Minimum dataset)

Among the problems of the Region's health information system identified, redundancy of reporting forms as well as too many data elements and indicators were the major ones which needed timely action for the application of data for decisions and for action.

Experts from all departments strongly agreed on the idea that there was more data being collected than the bureau could use. There were many data elements which nobody knows why they are being collected. According to the Plan and Programs Head there were about 250 reporting formats, containing more than 3600 data elements, currently in use. The forms were developed and distributed by the departments in the bureau, special programs and donors. He showed us a very thick file containing hundreds of data collection and reporting formats currently being used in the bureau, which was gathered for the purpose of preparing a unified list of data elements planned previously. We asked why they could not realize their plan, and the Planning and Programs Head said,

We could not complete the plan because the staff were busy with immediate daily routines so they did not get a break to do it (Planning and Programs Head, Tigray RHB, August, 2004).

The HMIS Unit Head also said,

We suggested the need to reduce the data elements to the bureau and it was accepted, however after we started doing our part none of the other departments have given it any attention. They always had other priorities. That is why we could not go any further (HMIS Unit Head, Tigray RHB, August 2004).

Therefore, preparation of a use-oriented minimum data set to be implemented with the new system at the district level was proposed by the HISP team, accepted by the management and put into action during the next weeks.

The technical team in its first meeting, agreed on the procedures, on how to go about the preparation of one list including all the data elements currently being used in all departments and selecting the most important data elements. To help define a minimum data set for the bureau, and the revision of the reporting formats, experience from implementation of HISP in other developing countries and in Ethiopia, Addis Ababa City Administration was recommended as an input to the committee’s next course of action. The standardization process was started by giving out an empty format to each member so that they list the forms currently in use in their department, to create an inventory of the forms used for reporting as well as for local use. Then, the list of data elements and indicators obtained from Addis Ababa city administration was given to them so that they could use it as a starting list to identify the data elements in their forms.

Department	Existing forms for data collection	Existing reports (routine and analyzed)

Table 5-1: Format used for creating inventory of existing forms and reports

In consecutive meetings, the team members brought together their lists and cross-checked for redundancies, which they removed from the other lists except one. After they came up with one long list free of repetition, they evaluated each data element in the list for its usefulness. Most of the data elements considered to be not useful were removed from the list.

One of the department heads recommended that they should not remove data elements contained in the report forms they send to the Ministry of Health, even if they know they are not useful. He said,

We do not have to touch their forms, there are data elements I do not know why they make us collect and there are also others which I never saw filled. However, we have to provide them with what they want. Let us keep all the data elements in the forms from the Federal Ministry of Health (Maternal and Child Health expert, Tigray RHB. September 2004).

Gradually the others also agreed with his idea and decided to do so. This constraint forced them to keep more data elements in the list and restricted the realization of the minimum data set. However they could cut the list from 3600 down to 1092.



Picture 5-11: Minimum data set preparation at Tigray Regional Health Bureau: technical team. August 26, 2004.

As a factor indicating the usefulness of data elements, considering the contribution of each data element to the calculation of important indicators was suggested by the HISP team. The same process was followed in order to identify the list of important indicators which can be used at all levels of the health system, as the data elements.

There were debates between the committee members on issues including,

- If they have to list only the basic data elements or include the calculated ones,
- If they have to include data elements from reports of all frequencies,
- How they should treat data elements appeared in different departments' lists but with different age groups,
- Whether they need to include the data elements from the drug logistics department since they were too many and not routinely reported.

We forwarded our opinion and finally they reached at a consensus that since the calculated fields can be designed in the reports where they are needed, there is no need to include them in the list. They agreed to include data elements from reports of all frequencies, because the factor here should be whether the data are useful or not, it should not be how often they need to report them.

In relation to the age groups, they agreed on taking the data elements with the narrower age groups, it is possible to aggregate the data into wider age groups whenever they are needed. From the drug logistics department, considering the importance for decision, only the top 35 medicines were included in the data elements list.

As to integrating the reporting formats from the facility level, members of the team from HMIS recommended using the draft guideline previously organized (mentioned earlier) by the HMIS unit, which included reporting formats, as a starting material. The guideline was meant to integrate the reporting flow and reduce the redundancy of data elements in the reports. It was distributed to the department heads by the HMIS unit for their comments in August 2004. However, the implementation was hindered because it was not given the support needed from the management or the departments.

Among the challenges faced during the standardization process, the most significant were the repeated replacement of the committee members and the constraint to the minimum data set in relation to maintaining the data elements from the Ministry of Health.

5.2.4. Redefining Data Flow

The fragmented (independent parallel data flows from the facility up to the Region) routine health data flow and its centralization (the raw data passing up to the Region and almost no processing or use is done at the local levels) at the Regional departments in the Region was found to be the root cause for the redundantly collected data, multiplicity of data elements, and limited usability of the data collected.

We recommended to the RHB that the data flow needs to be restructured, as shown in diagram 5.2. In the recommended flow, which shows only the regular routine data flow but not surveys or disseminations based on internal and/or external users' requests, the district HMIS Expert will be in charge of collecting the raw routine data concerning all services from facilities, and the internal and/or external transmission within and from the district level and to the Regional HMIS unit periodically. The HMIS unit at the Region also disseminates the data to users in and out of the health system. The experts at the districts and Regional level can process the raw data they get from HMIS in any way that suits their purposes.

The redefinition of the data flow was intended to bring changes and help address some of the problems of the existing system; meant to achieve the following benefits:

- ✚ It would decentralize the health information management to the districts, increasing information use at the lower level. Basing the computerization at the districts and providing the necessary training to the district personnel, can increase the possibility of the districts benefiting from the computerization of the health data.
- ✚ It would integrate the parallel data flows into one unified system and as a result avoid the duplicate reporting and reduce the workload at the facilities as well as contribute to an improved data quality.

The recommendation was supported by the bureau management; especially the HMIS unit shared our vision. We then proceeded to the pilot implementation for the two pilot districts and at Regional bureau level.

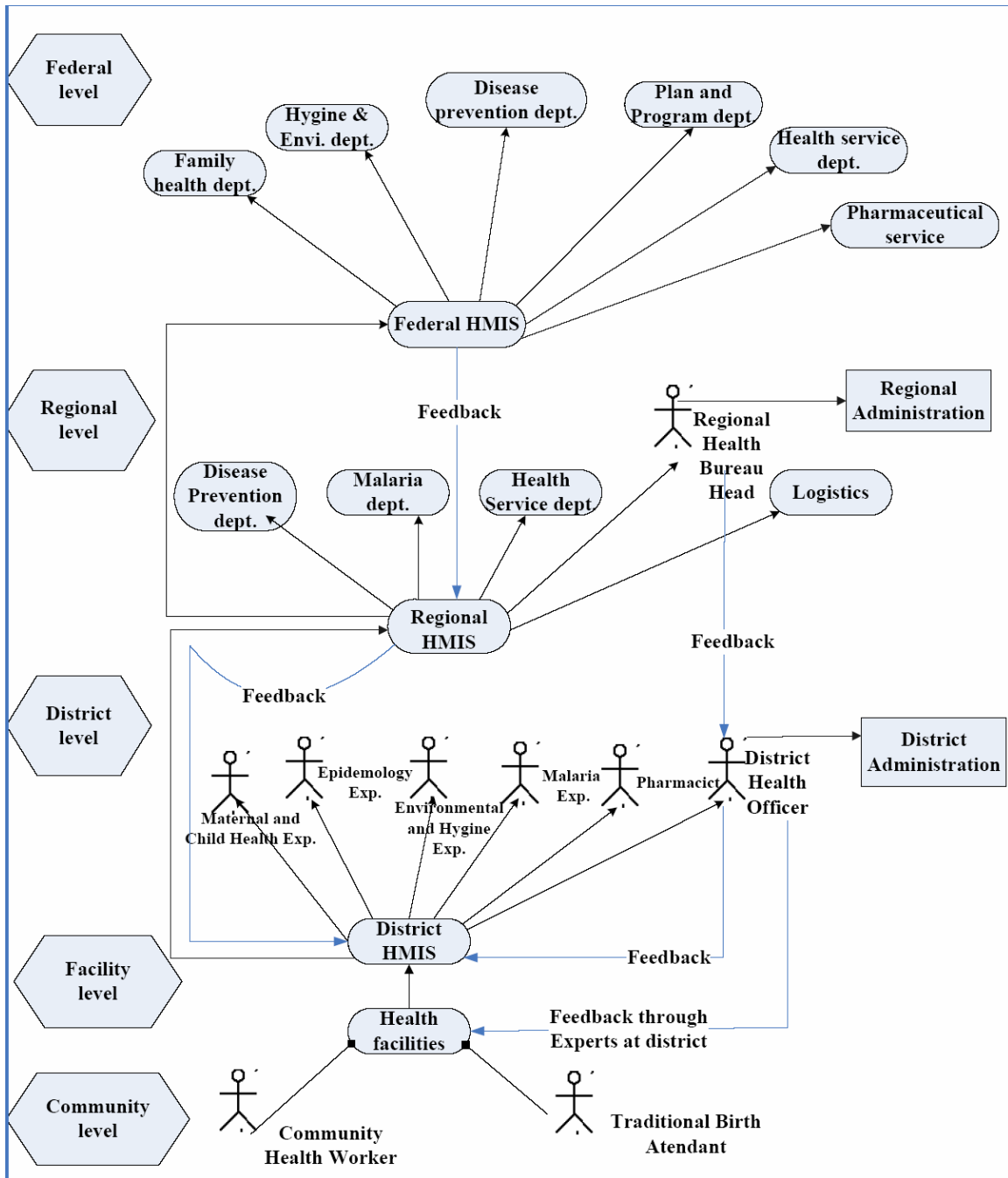


Diagram 5-2: A model of the integrated data flow recommended by the researchers

(Source: Tigray Region, 2004)

5.2.5. Software development and adaptation

Development of software to support the restructuring as well as the implementation of the district-based health information system was done mainly by adapting the already existing DHIS software, provided by the Health Information System Project (HISP), into the context of the research setting. To begin the adaptation to the Tigray Region's context, we used the customization of the DHIS already done for the Addis Ababa City Administration of Ethiopia. The system development was carried out by the research and development team that consisted of four researchers and one technical support staff from HISP-Ethiopia.

The activities involved in the process of adapting the software are presented as follows.

5.2.5.1. Prototyping

In order to implement a new district-based health information system in the Region, we had to introduce software that can support the new integrated system. The team was planning on implementing the District-based Health Information Software (DHIS); therefore in one of the meetings with the management team, there was a presentation of the prototype of the software. We used the database we brought from Addis Ababa Region to present the system for the first time.

During the discussion held after the presentation, several questions related to the advantages of the DHIS were raised by the bureau management team and possible answers were given by the HISP-Ethiopia team. The questions raised by the participants are summarized as follows:

- ✚ How flexible is the software to accommodate the changing situation, for example, for new data elements and structures as well as change in frequency of reporting?
- ✚ How simple is the software to be managed by district personnel, where computer literacy is limited?
- ✚ How flexible is the software to be adapted to the local needs and perhaps to local languages?

- ✚ How time-saving is the software during data entry and report production?
- ✚ What security and data cleaning features does the software have?
- ✚ Does the software support collecting data at the community level?

The HISP-Ethiopia team has given the appropriate answers for the questions by consulting other researchers in the HISP team, as: As the DHIS software is open source aiming at customization for local requirements, it is flexible to accommodate changes and easy to use based on low technology. We introduced the data validation features the software had. These were the answers to the relatively easier questions. However, the questions about the frequency of reporting, translation of the interface in to local language, weather it is time-saving or not, security features and community level data entry were challenging to answer. Because the DHIS has only monthly data module and it is platform dependant and the Ethiopic script is not supported by the Microsoft windows on which the DHIS runs, it has no security features and support for community level data entry. We could not answer some of their questions at the spot. However, we promised to do more customization to make data entry time-saving and the rest of the problems would be solved with further development by the international HISP team.

After the presentation, the management team decided to carry out pilot implementation of the software and the new integrated district-based health information system in two districts and at the Regional bureau level.

5.2.5.2. Customization

The DHIS should be customized so that it serves the identified requirements of the Region. As a point of departure for the customization of the DHIS to the Tigray Region requirements, we used the customization already done for the Addis Ababa City Administration Health Bureau. In the software we obtained from the Addis Ababa team, the Monthly Data module was customized by modifying the interface to enable the entry of mortality and morbidity data by ICD (International Classification of Diseases), the routine and semi-permanent⁷ data elements, and the indicators were defined. In the

⁷ Data which are not collected routinely, Example demographic data.

Report Generator module, reports were developed. There was also a brief manual prepared for training. We could use these modifications in our case.

However, there were additional requirements specific to Tigray Region which required additional customization, as described below.

- ✚ The Tigray Region health structure has two levels, the Regional level and the district level, unlike the other Regions which have three levels. Therefore, the organizational unit needed to be redefined and the interface labels to be changed accordingly.
- ✚ In Tigray Region, two types of disease codes are used: ICD which are detailed and used in the health centers and hospitals, and clinic codes which contain counting numbers 1 up to 48 and are used only in the clinics and health posts. Since they wanted both to be included in the mortality and morbidity data entry window, adding the clinic indexes in addition to the ICD codes was necessary.
- ✚ A requirement for the disease codes to be sorted in an ascending order and the entry window to be changed to the same order as that on the paper form, to enable faster data entry.
- ✚ The interface for the Report Generator module needed to be redesigned. Due to the difference in the structure, the reports needed to be reorganized.
- ✚ Additional standard reports were required to be developed or modified. The departments wanted all their reporting formats to be generated from the system as they are in the paper form, especially the reports they have to send to the Ministry of Health.
- ✚ One of the requirements from the HMIS unit was that if it was possible to convert the data they already have in Epi Info™ in the DHIS database to avoid re-entry. Therefore, the team had to work on converting the data.
- ✚ More validation features than already available in the software were also required, such as rejecting entries of the wrong sex or age group, especially for the mortality and morbidity data entry. For example, accidental entry of abortion data for male as it was said by the HMIS staff member.

- ✚ There were requirements concerning security that the design of the forms and the source codes was accessible by all users and vulnerable to be accidentally deleted or changed. There was a concern expressed by the HMIS unit that problems in the source code might not be located and fixed easily especially if it happened when technical assistance is not available, since the bureau did not have personnel with programming skills. Password for the users was also another requirement.
- ✚ A requirement for the software to be compatible with the Windows 2000 operating system the bureau is currently using at the Region and at the districts as a standard. This issue was raised because we asked them to upgrade the system to Windows XP so that we could run the customization on the monthly data entry interface, which was developed using Windows XP platform.
- ✚ A requirement for changing the date in to Ethiopian calendar as the reports come from the districts based on the Ethiopian calendar.
- ✚ A requirement for the system to calculate the estimate total population for the coming years based on the given population entered once at the beginning.
- ✚ Because they have a GIS working on Arc view, they required us to demonstrate the GIS functionality of the DHIS, and if it was possible to import their shape files into DHIS and link the maps with the database.
- ✚ A detailed manual for the DHIS was also required and we had to edit the draft manual included in the DHIS software package and provide them along with the brief manual from Addis Ababa.

The HISP team customized the software based on the requirements of the Region and the district staff. The following were completed during the customization:-

- ✚ Data element definition. Both the routine and semi-permanent data elements identified for the minimum dataset were defined in the system prior to the data entry. We collected the data elements from the technical team and categorized them according to the services using them.
- ✚ Indicator definition. The selected indicators were also defined in order to prepare the system for data entry.

- ✚ Organizational unit definition. The Region, all the districts and the health facilities within the Region are defined in the system.
- ✚ Designing standard reports and pivot table templates. Reports which are expected to be regularly generated from the system were designed. The reporting requirements were collected from all the departments using routine health data reports.
- ✚ Modifying data entry interfaces. Modifications in the user interface were required due to factors, such as speed, user friendliness and ease of use.

5.2.6. Capacity-building

Low capacity for managing information at both the Regional and district levels is one of the major problems of sustaining a strong health information system in the Region. In order to address this, most importantly for developing skilled personnel, organizing training sessions was very important. Undertaking capacity-building and skills enhancement was a prerequisite for effective implementation of a new integrated system.

The HISP team has given training to Regional and district level staff. For two weeks, from October 2 to 18, 2004. The training was basically on the DHIS software which was going to be used for the implementation of the integrated system. In addition to the software training, there were discussions on how to implement the new report flow structure which helps them to simplify their data collection process and on the reporting flow within the health structure. The training was provided for HMIS and Malaria Department staff at the Regional level and for statisticians and experts at the district level. The training manual for Tigray Region was also provided.



Picture 5-12: Health Staff in DHIS training session at Regional Health Bureau. (October, 2004)

The HISP team recruited one full time facilitator for the Region, to give continuous training for the two pilot districts and the bureau staff. There is also a plan to give basic computer training for Experts at district level as a prerequisite for the software training.

During the training sessions, the trainees were able to propose some improvements, which are indicated in the customization section, in the software to make it more user friendly.



Picture 5-13: DHIS training at Wukro district Health Office (October, 2004)

5.2.7. The Implementation Process

Before starting the implementation of the integrated system, we had a discussion with the management team including the bureau heads on how to proceed to the implementation strategies. We demonstrated the existing and the recommended integrated reporting flow from the facilities to national level and explained the advantages. In addition, there was also a discussion about reporting formats from facilities to districts, where the redundancies typically occur. The HMIS unit has carried out revisions of reporting formats and compiled it as a draft guideline for the Region. Therefore, the management team decided to use these reporting formats as a point of departure for the integrated system and the HMIS unit was given the responsibility to implement the system with the support of the HISP team. To begin with the implementation phase, the HMIS unit decided to distribute the revised formats to be used for reporting from facilities to the districts. The facilities can send the reports to the statistician, representing the HMIS at the district level, using the integrated formats instead of sending them to the experts separately. The following are some of the strategies agreed by the HISP team and the management team,

Reporting formats - New reporting formats containing all the data elements for all departments, especially for the facilities should be developed. In this case, the already revised formats for the purpose of HMIS guidelines preparation was recommended to be used as the starting material.

Software - The DHIS will be implemented at the district level for the two pilot districts and at Regional level for all the departments.

Data entry - Data will be entered into the DHIS by the district statistician.

Reporting - A soft copy of the data entered by the districts' HMIS will be sent to the Regional HMIS and to the departments for analysis and local use purposes. At the Regional level, the HMIS unit receives the soft copy and distributes it to the departments.

Restructuring - There is a need to restructure the reporting flow accordingly, and this is to be implemented in the pilot districts.

Responsibility - The HMIS unit is given full responsibility for the implementation.

Capacity-building - In order to upgrade the capacity of the unit so that it can handle the new assignment, the management team agreed to do immediate recruiting.

Concerning the implementation of the integrated data flow, the management team agreed to perform certain essential activities prior to the implementation.

Convincing the departments in the bureau to gain their support for the plan was one major task to be carried out. Since the departments are strongly accustomed to working independently and data are believed to be the properties of departments responsible for the respective services, resistance from the departments is inevitable. As the HMIS Unit Head said,

The departments link their ownership of the data and their parallel Relationship with the higher level with the funds they get, therefore I do not think they would accept the idea of a unified system easily (HMIS Unit Head, Tigray RHB, October 2004).

In order to gain the departments' support, we made a demonstration of the database and the reporting functionalities. The HMIS unit also presented their plan of connecting all the computers in the bureau through a Local Area Network. They explained the possibility that all users can access the database from their offices and they can generate reports in any way they want once the data is entered into the database. After the presentation, we asked the management team for their reaction and generally they seemed positive about the idea. However, one of the department heads told us that he still has his reservations about the capacity of the HMIS unit to handle the job. He said,

They do not have a computer specialist. They are all health workers with little computer training. I doubt if they can manage it (Department Head, Tigray RHB, October 2004).

We tried to explain the bureau's plan for enhancing capacity in the unit in the near future and the management team decided to have another meeting to discuss the matter further.

Introducing the idea to the districts, in order to familiarize the district personnel with the recommended data flow, we used our field research for the situation assessment as well

as the DHIS training sessions. We asked for their opinions and we got the impression that they agree as long as their superiors at the Regional level accepted it. The HMIS Expert at Wukro district expressed his fear that there might be more workload for him. We made it clear to him that since the data elements as well as the reports coming from the facilities will be reduced, there will not be as much workload as he anticipates. Even if we made our effort, the management team agreed that the HMIS unit along with the HISP technical support staff should make one more visit to the two districts and talk with them.

Unifying the collection and reporting formats is decided to be taken care of by the HMIS unit. The unit can use the forms in the guidelines by revising them once more to include new requirements and delete data elements which are removed from the data set.

On-site short trainings to the health workers and distributing the new formats were also necessary. Since there will be a major change in the work practice at the facilities, they need an introductory training. These trainings were assigned to be held by a staff member from the HMIS unit and the technical support staff from HISP, sometime prior to the implementation.

The plan for implementation was discussed thoroughly with the management team. The responsibility to undertake the implementation was given to the HMIS Unit and regularly reporting the progress to the management is also part of the assignment.

5.2.8. Challenges Encountered

During our overall stay at the Region, we faced significant challenges. Some of them are pointed below:

Resistance from some of the staff: Some members of staff at the bureau level were not fully interested in having a new system, even if they believe the existing system to have many problems. During the interviews we had, they said that they think the Bureau needs to reform the overall information system. They mentioned the fragmented system as a major problem which should be tackled as soon as possible. According to the HMIS unit Head, they already recognized the problem and prepared a guideline for implementation

of a new system and distributed to the department heads, however, they still did not get any reply or permission to go ahead until the HISP team intervened. Even if they were convinced that our proposals are useful for the bureau, it was difficult to get their full cooperation. Through time, this problem could be partially solved after several individual discussions with members of staff. Some of the staff from HMIS were also not interested to accept the system even if they believed the introduced system is much better than the existing one. Resistance from HMIS would be a potential difficulty for the slow movement of the implementation process.

Shortage of staff time: Most of the time, the Regional as well as the district staff are occupied by meetings, fieldwork, and other immediate routine activities in the office. Therefore it was difficult for them to schedule meetings with us and be fully committed to the assignments of the technical committee. Based on our request, the bureau heads arranged a meeting with the staff and discussed the importance of the work we were about to do, how much the bureau can benefit from it and the time limit we are working in. This meeting helped to convince the staff to accommodate the work in their busy schedule.

Expectations for the Ministry's approval: The staff at the Region are accustomed to a centralized practice for a long time. Even if the Region is entitled to make its own decisions to some extent, most of the time they expect orders or approvals from the Ministry of Health. Due to the Ministry's very slow reactions, this usually takes a longer time. Their hesitation to decide was one major obstacle for us to be on our schedule.

Frequent staff transfers. There was a frequent transfer of personnel both at the Regional and district level, so the team had to meet different people at the same post through the research period. During our stay for four months about ten members of staff among the heads and the technical team members left the bureau. In order to avoid the problem of redundant introduction and explanations, we convinced the officials leaving the bureau to introduce the project's aim and the status of the process as well as to handover the documents we presented to the newcomers. As to the information system staff, assigning

a continuous trainer would solve the problem for the present. The technical support staff from HISP-Ethiopia will assist the Region with trainings for the coming one year. However, in the long run, we agreed with the management that a staff member should train the newly transferred or recruited personnel, who are going to replace him/her, before leaving the bureau.

When we went back to the Region for our last visit after two months, we found out that in general the restructuring as well as the DHIS implementation process had slowed down. Based on the discussion with the HMIS Unit, the responsible body for the implementation, the main reasons hindering the process were summarized as follows.

The Ministry of Health notified the Region that they are sending to the Regions a new set of nationally standardized data collection formats with less number of data elements and may be new data elements added any time soon. If the Region is to duplicate and transmit the new formats developed by the HMIS unit and the HISP team before that, they believed the cost for duplication of formats and training would be doubled. Therefore they decided to wait for the formats to come from the Ministry Of Health before they start implementation. However, the Ministry did not send the forms until our latest contact with the unit, in January 2005.

Due to the established parallel programs and very low integrated practices between departments, it took them a long time to convince the departments to support the plan to integrate the Bureau's several independent information flows into one system. The departments had reservations regarding the capacity of the HMIS unit to manage their data; accurately and timely. They have limited knowledge of databases; and thinking of data as the departments' property is one big obstacle. Finally, they agreed on trying both the old and the new flows in the pilot districts.

The Bureau and department heads were away from their offices participating in continuous meetings during the period. The frequent transfer of personnel from

departments, which needed introducing the issue to new people, was also mentioned among the reasons for the slow progress.

Based on our last contact with the HMIS unit, the HMIS unit and the departments agreed to send the new format to the facilities in the pilot districts, without waiting for the Ministry's input, so that they can fill them in along with the old formats. The districts will enter the data with the new formats into DHIS and send the soft copy to the Regional HMIS to be used as a prototype, while the old formats will go in the usual way to the departments.

Summary

This chapter presented account of the fieldwork carried out at the Regional bureau and two pilot districts for the district-based health information system implementation. The findings indicated that the basic routine health data collection in Tigray Region was done at two levels, at the health facilities and at the community levels. At the health facilities, health posts, clinics, health centers, and hospitals, the health workers responsible for providing the health services collect data while giving the services using different registry books and tally sheets. The health facilities prepare the respective reports to be sent to each Expert representing the departments at the district level. There was no established regular reporting system that enabled the HMIS unit to get hold of the Regional health data.

At the health facility and district levels the data management is purely paper-based. Only the mortality (death) and morbidity (illness) data received from the districts are entered by the HMIS staff at the Region in Epi Info™. Departments at the Regional level enter their own selected data into Epi Info™ by facility level and aggregated data in Excel files. Documentation of data is problematic at all levels. In addition to the fragmentation at both levels, at the districts, the papers are not well kept and at the Region due to multiple storage formats. Therefore, retrieval of stored data is difficult.

Preparation of the Region's annual health profile is the major data analysis made in the bureau. The HMIS unit implemented a Geographic Information System (GIS), mostly used at the Regional level. Analysis and information use at the districts is at a very low level.

Lack of integration of the data flow in the departments is the most noticeable problem, which affects the quality as well as use of information produced by the health information system resulting in redundant data collection, and excessive number of data elements and indicators. In Tigray Region, the purpose of data collection at the local levels is merely for reporting raw data from facilities to the districts and from districts to the Region. Low capacity for managing information at both the Regional and district levels is also one of the major problems of sustaining a strong health information system in the Region.

Introduction of flexible software which can incorporate the data for all services and departments, usable at the district level and expected to support the integration process, was the action taken by the HISP team towards tackling the above problems. The development was done by adapting the already existing DHIS software, provided by the Health Information System Project (HISP), into the context of the research setting. A process of standardizing data was undertaken through participatory approach. Preparation of minimum data set and standard reporting formats, trainings are also carried out as part of the action. The chapter presented the detail of the activities involved in each of the actions.

We gained a great deal of practical knowledge during the course of these actions. Thus, in the next chapter, we analyzed our learning from the research using the existing knowledge in literature and concepts from structuration theory.

6 Analysis

This chapter presents our understandings of the findings of the study in relation to concepts and knowledge in the relevant research domains. The analysis also employs the concept of ‘the duality of structures’ and other key concepts from structuration theory, to analyze the case and to discuss its implications.

The chapter is organized in three sections. Section 6.1 presents analysis of key findings from the case study in Tigray Region. Section 6.2 helps understanding of application of concepts from structuration theory for the design and implementation of an integrated health information system. In this section, the issues and challenges of decentralization, standardization, institutionalization and scaling-up are also discussed. In section 6.3, user participation is discussed as a main strategy for the changes introduced by the system.

6.1. Analysis of key findings from the Case study

In order to understand the overall situation of the health information system in the Tigray region, the key findings from the assessment are discussed in relation to concepts and knowledge from research literature. We discuss three attributes of the health information system in the Region: fragmentation, centralization and the low capacity of the health information system, as key findings of the study.

Attribute 1: Fragmented information activities (data collection, transmission and storage) among the departments in the health structure

A health information system should generate information useful for all components of the health structure aiming at improving the performance of the overall health system. The interaction between the components or the subsystems is often emphasized as the basic characteristic of a good system and as an apparently key contributor to its efficiency. As Rice and Anderson (1994) write (quoted by Shrestha and Bodart 2000), a successful information system should support the interdependence of activities in the health system.

An information system should enable interaction in order to share resources. However, in Tigray Region the existing practice involves independent health information systems supporting different functions of the health system. Our findings indicate that the health workers and the district experts spend a considerable amount of time collecting and reporting redundant and overlapping information to these independent systems.

Duplication among parallel health information systems is discussed by Sauerborn and Lippeveld (2000) as one of the consequences of fragmented information systems. Referring to an assessment made in 2002, Braa, Monteiro and Sahay (2004) describe how the Cuban health information system is fragmented and linked to vertical health programs, and how overlaps result from a lack of standards. They also argue that the health information system in Cuba involves large use of inappropriate independent computer applications worsening the fragmentation. The case in Tigray matches this description. During our stay in the Region, several contacts we had with the staff gave us the impression that the common understanding of information systems equates health information systems with using computers to process data for reporting without a practice of active use of data for local decision making. Multiple stand-alone software applications are in use. Data are stored fragmented physically as well as in different formats.

Donor-supported vertical programs are repeatedly mentioned as main contributors of lack of integration in the health systems in many developing countries (Gladwin, Dixon and Wilson, 2003; Kimaro and Nhampossa, 2004). Our findings in Tigray Region confirmed this point. The staff believed that data collected from the services belong to the respective departments. This is because they mainly consider the data as the means of presenting their performances to the donors in order to secure funding.

The fragmented structure of the health information systems is identified by Braa, Monteiro and Sahay (2004) as the main obstacle for health information systems in developing countries, hindering them from contributing to the improvement of the health service delivery. Lippeveld and Sauerborn (2000) also confirm that the inefficiency of the

health information systems in many developing countries emanates from their structural weaknesses and lack of integration in the overall health system. They suggest that, the efficiency and sustainability of health information systems is dependant on “their organization in to a well designed management structure” (p. 30). Based on our findings, the case in Tigray Region confirms this. Even if there is a relatively wide use of computers in the data management, especially at the Regional level, the structural and organizational problems are very serious and the system is running at its minimum efficiency. Sauerborn and Lippeveld (2000) suggest that, in order to eliminate this duplication and solve the related problems, the development of a unified system is a requirement because “it permits the development of a health information system in support of the health services system in its entirety, rather than fragmented systems in support of separate disease oriented vertical programmes” (Lippeveld and Sauerborn, 2000, p.30).

Attribute 2: Centralization of the information management towards the Regional level

There is a tendency of centralization of information management at the Regional level. The strong legacy of the centralized management which has been practiced in the Region as well as in the country for a long time is still in place. Even if there is delegation of power to the districts as part of implementation of the current government policy, in practical terms the resources and the responsibilities are still in the hands of the Regional Bureau.

Concerning the health information system, based on our observations, we could hypothesize two possible reasons as to why the previous effort to decentralize the computerization of the health information system to the districts was almost discontinued. One reason is lack of local empowerment in terms of skilled manpower; a second reason is the use of inappropriate software. Districts are underutilizing their resources, especially computers, due to lack of skill. This practice contributes to the minimum use of information for local decisions. “In order to make the information process efficient, a health information system management structure is required to ensure that resources are

used in such a way that the information process produces high quality information in a timely fashion” (Lippeveld and Sauerborn, 2000, p.17). As one of the reasons constraining the local use of information, Gladwin, Dixon and Wilson (2003) point to the lack of decentralization of responsibilities, resources and the necessary organizational restructuring to enable decisions at local levels.

Attribute 3: Low level of information use at the district and facility levels

Sauerborn (2000) states that in developing countries, the incidence of information-based decision-making is low in the health sector. Sauerborn adds that developing countries have additional problems in relation to making optimum use of health information systems. He described these problems broadly as lack of provision of information meeting the management’s requirements in a way it can be easily accessed and problems related with the way data are communicated in the health system. This is confirmed by our findings in Tigray Region, where the health information system serves as a mechanism of reporting routine raw data up through the health structure. This is mainly due to the lack of established structural and procedural arrangements to reinforce local level information processing and use. Considering the low level of information use, there is a need to shift from such practices to local analysis of data and use of information so that it contributes to the local improvement of health care services.

Based on our findings, lack of reliability on the quality of the data is mentioned as a problem that leads to less than optimal use by the region staff. Sauerborn (2000) argues that an increase in the level of information use can also motivate concern for data quality at local levels. Braa et al. (2001) add to this point, writing that: “Analysis and use of information at district level is necessary in order to improve health management services, but it is also necessary in order to improve data quality at all levels. Data need to be used and controlled at the entry point in order to ensure quality” (Braa et al., 2001, p. 19). Therefore, the low level of information use at local levels has its effect on the quality of data reported up through the structure.

Recognizing the prevailing structural problem, several developing countries are restructuring their health information systems aiming at increasing the information support they provide to the local health management in addition to the reporting purposes at regional and national levels. (Gladwin, Dixon and Wilson, 2003; Sauerborn, 2000).

In our study, after having learned about these problems from the diagnosis phase, interventions aiming at addressing the above problems related to the health information system were made in the action taking phase of the research. Definition of minimum standard data sets, indicators and the reporting requirements (both routine and analytical) which can be used at the different levels of the health structure was carried out. In order to establish structures supporting institutionalization and sustainability of the system, redefinition of the information flows within and across levels in the systems was proposed (see Diagram 5-2 and discussion 5.2.4). The introduction of flexible district-based software that can incorporate the data at all levels and for all services and departments, usable at the district level and expected to support the integration process was also initiated.

6.2. Analysis with key concepts from structuration theory

Action research involves change in all components of the health information system, both in the information process and the system management structure consisting of the resources and organizational rules. The changes are aimed at the re-creation of the structure (the routines that need re-creation). The system development consisted of redefining the data flow to enable coordination among the sub-systems, and redesigning the DHIS software. The introduced system is composed of new rules and norms, enabling and constraining the daily interactions in the bureau, and knowledge which is expected to change the existing structures. For example, knowledge about the use of shared database is introduced.

In this section we make use of structuration theory to analyze the case. The existing structures framing the interactions (the routines) and reinforced by them are discussed

here. In this section we will apply key concepts from structuration theory to the case; particularly signification, domination and legitimation. Table 6.1 presents a simplified overview of the relations between the interactions of the staff, the mediating institutional properties and the resulting structures. It is based on Giddens' idea of dimensions of duality with which we aim to assist understanding the existing structures in the health system.

<i>Structure</i>	<i>Signification</i>	<i>Domination</i>	<i>Legitimation</i>
<i>Modality</i>	<p><i>Interpretative Scheme</i></p> <p>Definitions of data elements Reporting formats EPI infoTM and MS Excel Documentation media Definitions of indicators Characteristics of quality data</p>	<p><i>Facility</i></p> <p>Administrative structure Funding Skills Technology Data flow</p>	<p><i>Norms</i></p> <p>Reporting deadlines Accurate recording during service delivery Data aggregation methods</p>
<i>Interaction</i>	<p><i>Communication</i></p> <p>Data collection Reporting Data entry Storage Analysis Feedback</p>	<p><i>Power</i></p> <p>Budget allocation Hardware and software maintenance Introduction of new procedures Distribution of data collection tools</p>	<p><i>Sanction</i></p> <p>Timely reporting Quality of data</p>

Table 6-1: Interactions and structures making up the health information system in Tigray Region, drawing on structuration theory
(Source: Situation assessment by researchers)

Structures of signification

Interactions in the system are mediated by shared meanings (the interpretative scheme) that are built-up through time reinforcing the structures of signification.

At the health facilities, while providing health care services, the health workers record data on each case using the registry books and the tally sheets. The interaction is mediated by their common knowledge on how to do the recording and by the definitions of the data elements. During reporting their knowledge about the reporting formats mediates their action. They enter the data by drawing on their common understanding of the software in use, either EPI infoTM or MS Excel. The shared meaning of the indicators used in the bureau enables the analysis of data. The staff at the departments use the common knowledge about characteristics of quality data to evaluate and give feedbacks on data quality.

The interpretative scheme among the staff reaffirmed the idea that data belong to the departments administering the source service and the sole purpose of data collection is for reporting to the superiors without questioning. Therefore, the reporting to the higher levels involves fragmentation resulted in redundancy. This maintained a structure of signification constraining an effective interaction between components of the health structure and enabling the continuation of fragmented independent systems with less usability in the bureau. The resulting fragmented storage of data both in terms of location as well as formats constrained use and analysis.

Structures of domination

By structures of domination we refer to the structures reinforced by the exercise of power mainly through resource allocation. The structure of domination in Tigray Region health system coincides with the administrative hierarchy. It also involves donors, since they bring a vast amount of resource into the system. Resources, including information system personnel, are centralized at the Region. The amount of resource mobilized by the facility and district levels is insignificant. The local level management operates with very little decision-making power and low capacity. Even if there is an effort going on to strengthen

the districts, it is still incomplete. The computers given to the districts are under-utilized, due to lack of skill, lack of maintenance and operational costs such as cartridges and paper. In addition, the fact that all the work is centralized at the Region made the district HMIS almost non-existent.

Power is practiced through the budget and material allocation, the data flow, skill and access to technology and skills. The districts have to rely on the Region for any type of technical assistance, hardware or software maintenance.

Structures of legitimation

Interactions in the system are guided by rules and norms, creating structures of legitimation, which the staff draw on for approval of their actions as legitimate. There are some rules in the system guiding the staff's actions in relation to the information management. These include requirements from facility heads to report the routine data using all the forms in use. Routine data reports are expected to reach the district on the 5th day of each month and reach the Region office on the 10th day. The districts are expected to enter their mortality and morbidity data into the computer system and send the soft copy to the HMIS at the Region.

Proper reporting, in addition to the deadlines, is guided by use of the right data aggregation methods. A health worker makes sure he/she records every case he/she treats at their work place to ensure that data are properly collected. This norm when properly practiced can help collecting quality data. However, we observed that its practicality sometimes has a problem due to lack of proper orientation.

6.2.1. Decentralization of the health information system and integrating multiple data flows

The present structure of domination constrained the creation of a demand-driven environment for information use at local level. In other words, since the decisions to be made by the districts are too limited, practical application of information use is not motivated. Reciprocally, the decentralization which needs to be realized in the region can

be strengthened and reinforced by local level information support. The system introduced by this research is composed of suggestions of practices requiring decentralization of resources which affects the bureau's structures of domination.

Implementation of an information system based at the district level, benefits the health system largely by facilitating change in local level information use and motivating improvement in the quality of data collection. The effort to decentralize resources and decision-making power has been going on in the region since the country adopted the WHO focus on primary health care as a national policy, as other developing countries have. Decentralizing the information system to the district level, as a supporting tool, is also part of this effort. However, according to our findings the process is still at its early stage.

Decentralization of an information system to the operational level allows for keeping the data available at the minimum level of aggregation at all levels, to enable the users to analyze the data at the level and type of aggregation that suits their purposes, for example, facility level analysis. In Tigray Region, the departments at the regional bureau receive facility level disaggregated data only for selected services. Most of the paper-based data they receive are aggregated at the district level. This obviously limits the usability of the data.

The findings indicate that, at this time, the regional HMIS enters the data from all the districts. Decentralization of data entry reduces the burden for the region staff. Compared to the redundant paper-based reports they create presently, use of computer-based information systems will be easier and less time consuming for the district staff as well.

The previous decentralization efforts by the bureau, even if they were not able to achieve the intended objectives significantly, have brought some light to the darkness. At this time, computers are known to the district staff as information management tools and are in place in each district. A slight progress in computer literacy is observable and the uses of storage devices such as floppy diskettes have been introduced. In some of the districts,

use of all-purpose software such as word processors and spreadsheets is growing. Internet connections are being made possible. Having these as foundations, through this action research, the implementation of a district-based health information system was initiated by employing mechanisms intended to increase its success.

The system development was guided by the bureau's needs. In other words, the system designers had to consider the needs of users in the bureau, which consequently enabled and constrained the system development and implementation in relation to the organization's properties. Activities performed during the design phase included embedding data and system standards and the resource requirements and setting rules which recreate the structure of legitimation, such as change in the reporting channels. The inscription of quality and use facilitating tools such as validation rules and standard and user-defined report templates was also carried out.

Trainings given to the staff and communications during meetings are instances of the developers changing the structures of signification to accommodate the introduced system.

The fragmented data flows in the departments largely constrained a coordinated interaction. The actions taken to unify the data flows were intended to establish the information system as a mediator of coordination in the health system. Lack of standards created a disorganized situation. Standards can be products as well as reinforcing structures of the integration. The practice of the standardized interactions along with an enabling structural change can facilitate system integration. Standardizing the data and the information activities was also carried out in this action research study.

6.2.2. Standardization: shaping the structural properties

Sustainability of a newly introduced health information system is determined by a number of factors involved in the development and implementation such as the success of the standardization process (Shrestha and Bodart, 2003). Standardization enables integration of data from horizontal levels of the health structure and contributes to

achieving consistency of the work practices in all components of the information process. It facilitates the institutionalization of the system potentially leading to its sustainability.

The standardization process in this research was undertaken based on the assumption of bringing consensus regarding the information needed between the end users of the data and the information producers. It was meant to increase the relevance of the data collected and the information produced and thereby improve the use of the system. Standardization can thus enable the production of information that can be easily integrated into the daily routines in the health system. Participatory approach was taken towards realizing the standards.

The standardization we introduced through this research mainly involved the minimum dataset preparation, redefining the existing reporting procedures and customizing the database software to the user requirements.

We found that excessive data elements are being collected. Services and departments collect data from facilities through their respective representatives at the district level, using their own different formats. Altogether, these formats include a large number of data elements, among which most appear redundantly, since the departments could require similar data elements for different purposes. The data collected from the health facilities are excessive in relation to the small number of data elements that can be of any use. There were neither standard data sets nor standard indicators in the bureau.

The identification of the essential data set that is relevant and useful to calculate indicators that measure the performance of the health system was carried out, defining each data element in the routine data set and every indicator so that a common understanding and comparability between horizontal levels is possible. Similarly, in order to standardize the fragmented health information system in South Africa, the development of minimum data sets and the supporting DHIS application was done (Braa, Monteiro and Sahay, 2004). As part of experiences gained from other DHIS

implementations in the HISP network (HISP methodology) this approach was also adapted to our case, in Tigray region, Ethiopia.

Lack of good documentation at the district health offices and the fragmented storage of the computerized data at the region were among the problems of data management identified in the region. Standardizing the data format was needed. Currently data in the region are stored in separate locations in at least three formats: paper format, EPI info text files, and Excel files. The DHIS software was introduced in order to enable a use of standard format and a unified database. Using a database system at the districts can solve the problem in relation to data storage and keep the data easily accessible and available to all users through time.

The action was expected to lay the foundation of a procedure enabling coordination among the main actors of the health system in the region. Standardizing the dataset needed identification of the bureau's information requirement. The process largely required the involvement of the future users of the system, under the assumption of their contribution to its success. We employed a participatory team approach for the identification of the minimum dataset and requirements for software development. Since the data has been under the control of the departments for a long time, any intervention intending to change the information system needs to involve the departments. The very significant influence they had makes their support decisive for success. During our meetings with the technical team, we got the impression that there was a need to reduce the number of data elements that needed to be initiated among the staff. However, they are still constrained by the lack of similar measures at the federal level. The process mainly focused on eliminating redundancies and coming up with one list of data elements to be used in the bureau. Due to the need to maintain the national and donor reporting requirements, elimination of un-useful data elements was limited to the data elements which are not included in the reports to national level or to the major donors.

6.2.3. Institutionalization

Institutionalization, as the internalization of the introduced change by the staff and integration of the procedures involved in the daily work practice of the health system has, a direct relationship with the use and sustainability of a health information system. It is the result of reinforced structures mediating the interactions of the staff.

Low capacity at the district level can describe the situation in Tigray Region. The findings indicate that it is difficult for the staff to satisfactorily perform the information system management activities as an additional assignment, since the statistician post is vacant in most of the districts. This fact is expected to result in a slow progress of the implementation of the proposed actions as well as their institutionalization. Williamson and Stoops recommend “formal appointment of information officers at the district level” and the development of data handling structures as a key strategy to deal with a similar problem faced in the implementation of DHIS in South Africa. Developing formal job descriptions should also be considered in our case in order to facilitate the institutionalization process. “Organizational change in job function and responsibility is needed in order to institutionalize the streamlining of the systems and processes created to implement, maintain and sustain a DHIS” (Williamson and Stoops, 2001, p. 113).

In order to institutionalize change in an organization, the operational staff should get full support from the management. Change in some organizational practices and structures as well as the necessary recruitment of dedicated information systems personnel and allocation of resources, which are the basis for a successful and sustainable implementation of a new information system need to be facilitated and supported by the administrators.

Discontinuation of external financial and technical assistance without building local capacity to maintain the system and integrating the running cost of the system into the organization’s regular budgetary system are stated as causes of failure to sustain health

information systems in developing countries (Braa, Monteiro and Sahay 2004; Lippeveld and Sauerborn, 2000; Kimaro and Nhampossa, 2004). Confirming this point, Lippeveld and Sauerborn (2002) point to an experience from a health information system restructuring initiative in Pakistan in 1991, which was progressing well until it was discontinued due to the termination of the financial and technical support from USAID.

The possibility of the intervention in Tigray Region facing the same problems was reduced considering the mechanisms we employed to prevent them. In each step of the action, except for the technical detail work on the soft ware, we made sure the bureau HMIS staff were the major actors and we limited our involvement to acting as external supporters. The technical assistant assigned by the HISP is working on creating the local capacity. Moreover, since the intervention is part of the national as well as international HISP network, the necessary assistance will be available for a longer period of time, making it possible to fully institutionalize the system. Regarding finance, there was very little involvement of external financing, other than the payment for the technical assistant, so this does not leave a significant gap after withdrawal.

6.2.4. Scaling up: a potential challenge

The success in spreading local interventions and experiences gained to a broader area is stated as a prerequisite for sustainability of a system by Braa, Monteiro and Sahay (2004). They explain, “local success is not sufficient to be sustainable; it also has to have scale” (2004, p. 340).

The findings of the study indicated that the region’s previous efforts to decentralize the health information system to the districts could not be scaled up beyond the pilot sites. Moreover, they were not successfully implemented to benefit the pilot users, nor did they prove their usefulness to the managers. This was believed to be mainly because the preliminary actions taken before the implementation in order to create enabling organizational situations were not adequate, especially the establishment of enabling organizational structures and procedures.

However, local success does not always ensure scalability, as Braa, Monteiro and Sahay (2004) argue: “systems do not succeed in being scaled up despite local successes.” Other administrative or political factors interfering in the implementation process can be expected. Braa, Tilestad and Sæbø (2004) described the extension of the scope of the interventions as a key challenge to the continuity of the implementation process in their presentation of the experience of HISP’s intervention effort in the locally-based information system development effort in Cuba. A similar situation like the centralized practice they faced in Cuba is still prevailing in Ethiopia with prospects of very slow change.

Uneven distribution of resources and infrastructure in the region, as it was experienced in a DHIS implementation attempt in Mozambique (Braa, Monteiro and Sahay, 2004), might have an enormous influence on the systems success in being scaled up.

On the contrary, the very similar existing work practice in all districts in the Tigray region can be mentioned as a facilitating factor for implementing standardized procedures and scaling actions from one district to the other. There are almost no local variations in the way that data are collected and transmitted, nor in the formats used and organizational structures between the districts. If a system could work in one district and scaled up to the others, the contextual difference to be faced in relation to routine practices can be less challenging. Here, we can bring in the structure of domination as an advantage which enables circulation of uniform rules and shared meanings, for example- through trainings given to the personnel from all the districts at the same time.

6.3. User participation

Participation of the key stakeholders in the design process is among the strategies of making an action sustainable. Braa, Monteiro and Sahay (2004) described the DHIS implementation effort in South Africa as a successful application of user participation, Lippeveld (2000) reported that the user participation process benefited the health information system restructuring in Pakistan, despite limitations due to other factors involved.

Participation of the end users in the identification of the data to be collected and the useful indicators helped to develop ownership of the system among the users as well as maintaining relevance of data elements and indicators. Thus, user participation is believed to enable system designers to inscribe the needs and the organizational variables into the system and gives the chance to the users to think about their expectations from the system, which permit a better use of the system after implementation. Lippeveld (2000) infers that there will be a strong tendency to use information as long as the system was designed by being agreed upon from the inside rather than imposed by outsiders.

Confirming a point made by Gregory (2003), participatory action research as the main research approach for the case study, motivated the use of participatory design. In addition, the developer team was composed of researchers with information science background, with limited previous knowledge of the health area or the functions involved. It was not easy for the team members to understand the medical terms used. The unfamiliarity of the responsibilities of the actors at all levels of the health structure was also another challenge. Undertaking the standardization process was unthinkable without the full support and involvement of the staff, which helped us overcome the problems and address the gaps in our knowledge and understanding of users' practices.

Participatory prototyping (Bjerknes and Bratteteig, 1995) of the DHIS facilitated the representative participation of the end users in the system design, in addition to the meetings and discussions held during the standardization process and the DHIS training sessions. The requirements of the users identified through the participatory process were the inputs to the customization of the DHIS software to the local context.

Through such a participatory approach, users contributed in shaping the system which is going to frame their interaction. They addressed their expectations and requirements to the developers through different media.

The interpretative flexibility, the degree of user involvement and control on their interaction with the system, was meant to be maintained during use of DHIS. This is possible because DHIS is open source software which was developed in the context of developing countries and aimed at enabling local level customization. The technology choice is meant to allow user level designing, such as development of standard reports, end user defined reports, data elements and definition of indicators. The flexibility inherent in the open source software as a tool encourages the design of new modules and improving the existing ones for a better outcome by the users, which will in turn change the way the users interact.

Lippeveld (2000) states the high staff turn-over that occurred during the restructuring in Pakistan was an obstacle for the realization of the benefits of participatory action during the implementation. Similarly, we faced a problem with members of the staff who have been involved in the preliminary actions leaving the bureau and being replaced by new people requiring explanation.

The action is at its early stage at the time of writing this thesis, therefore limiting our ability to witness the practical benefits of user participation in information use or sustainability. However, in this early DHIS implementation we were able to base the system under implementation on adequate organizational knowledge and to create a relatively better sense of ownership among staff.

7 Discussion and Conclusions

This thesis presented an action research study on the development and implementation of a health information system focusing on the possibility of local level implementation and use. The factors of future potential sustainability are derived from the study of the present situation research setting the region and health districts in Tigray, Ethiopia. The chapter is organized in four sections. Section 7.1 presents responses to the research questions from the empirical findings and analysis in relation with concepts of structuration theory. Section 7.2 presents our conclusions. Section 7.3 presents the major contributions of the study, in terms of, contributions to knowledge in the information systems research community, and the theoretical, methodological, and practical contributions from the study and software development. In the last section 7.4, we suggest areas for further study.

7.1. Discussion

In this section, we summarize the main findings of the study whilst responding to the research questions. The research questions were:

- What is the current status of the information support in Tigray Region Health System?
- What are the potential factors limiting sustainability and use of the health information systems in the Region?
- What strategies and approaches need to be employed for the development and implementation of an integrated district based health information system, aiming at increasing the possibility of optimal use and sustainability in the context?
- What are the challenges and opportunities for implementing integrated district-based health information systems in the context?

The first two questions are related to the existing situation of the system. The next two research questions focus on factors for the success of development and implementation and maintenance of health information systems in contexts similar to the research

settings, either within Ethiopia or other developing countries. The responses to these questions are based on interpretations of the potentials perceived during the first phase of DHIS the implementation, rather than being based on actual experiences since it was not possible to go through all the phases of the action research due to time constraints. The early actions we were able to accomplish were mainly focused on creating ‘framing structures’ to enable the changes.

The discussion is organized by the research questions.

What is the current status of the information support in Tigray Region health system?

Key findings from the empirical study and analysis indicated that the status of the information support in Tigray Region has problems that are hindering it from attaining its ultimate goal of improving the health care service in terms of quality as well coverage. (see section 1.2) We looked at the prevailing low level of information use for decision-making at all levels of the system mainly as a result of fragmentation and the lack of enabling structures (fragmentation) that can facilitate change in the information use culture. The centralized nature of the system reinforces a practice that promotes the idea that data are for reporting rather than for use at local level. In addition, the low capacity of the existing health information system in all aspects at the local level limits the achievement of the practical benefits of information.

The Tigray Region health information system has come a long way in the last thirteen years of the Bureau’s history, during the last four years the HMIS has grown from a one-person desk into a unit. The establishment of HMIS as a unit in 2001 was initiated by a foreign researcher who has been working with the bureau in relation to health information systems. It now has Regional and district staff (statisticians), with more than ten computers at the Region (only in the HMIS unit) and at least one computer in most of the districts. The data collection expanded from annual summarized reports to monthly facility-level routine data. Use of technology such as the internet and GIS is encouraging.

However there is still a long way to go. The unit plays a mixed role; as an inside tool for the department to which it belongs and as the Bureau's overall information management body. The unit is organized under the planning and programs department and its functions remain attached to the planning purposes, i.e., the data collected by the unit is only for the use of the department of planning.

The existing data flow confirms that the HMIS is entitled to collect only the data for planning purposes. However, it is still authorized to compile the bureau's annual profile; even if it has to get the data from multiple "HMISs" in the other departments like any other external user. Moreover, the HMIS unit represents the bureau at any events that concern the health information. Even if there is a gradual change towards achieving a strong health information system, there is a lot to be done to facilitate the process.

What are the potential factors limiting sustainability and use of the health information system in the Region?

Study of the situation in the Region's health system indicated two types of factors which have an impact on sustaining the health information system serving its purpose in the health system, namely, organizational factors and administrative factors.

Organizational factors. These are different day to day happenings in the health system. Multiple unsustained interventions by different stakeholders, especially donors, occur often in different departments. During our discussions about previous efforts with the staff, we found out that there were initiatives aiming at improving the information provision in specific departments and services, such as the introduction of new software and trainings. These initiatives start either in the Ministry of health and come down to the Region or begin locally at the Region. Most of these initiatives fail because they lack continuous follow-up and integration. For example, recently the Malaria Department nationally introduced a new Access-based database program provided by the 'Roll Back Malaria' program. The data personnel in the department and a staff member from the

HMIS unit in Tigray Region went for the training and came back with the new software. It was meant to replace Epi Info™ and MS Excel which were being used in the department; however it did not survive long. This was mainly because there was no follow-up after the training. The Malaria Department is the most donor-funded department in the bureau so things like this happen often there.

Administrative factors. These are factors related to the structure of the bureau and resource allocation. Even if the fragmentation of software or other information management tools and information practices are facilitated by external factors, mainly donor influence, the Tigray Regional Bureau still has the power to take steps to overcome fragmentation by creating strong integrated structures, by introducing a procedure in which the HMIS gets all the data from the districts and makes the raw data available to the departments at the lowest aggregation on time. For example, establishing local area networks (LANs) is a method frequently mentioned by the staff to realize this procedure. Even if the realization of LANs requires certain capacity-building activities in the HMIS, such as hiring a qualified network administrator, it would not be difficult for the Bureau to realize this. The departments are located together in a building which is not difficult to network, the departments all have adequate computers, and the technology is getting cheaper in the country. In the meantime, it is possible to use high-capacity storage devices, for example flash memories to deliver softcopy data to the departments, most of the staff now have flash disks.

The low capacity of the information system management body has influenced the level of the system's sustainability and its effective provision and use. Due to the lesser attention and priority given to strengthening the HMIS unit at all levels, low human resource capacity is one of the problems the system is facing, especially at the districts. Contributing to this, high turnover of staff, especially at the local level, has significantly affected the health system. At the district level, information management sections are one-person departments, therefore sustainability was affected by the departure of the staff. Instances that illustrate this point are the district level computerization effort and the geographic data collection, which could not be consistently sustained. Trainings have

been given to the staff so that they can manage these activities. However, the trained staff may leave the districts for another position or study not long after the trainings. Since the trainings are not continuous, there is always a gap even if there is someone to replace the staff person who left, which is not the case most of the time. Inefficient use of human and material resources exists as a result of the fragmentation of the system and lack of integration among departments at all levels. For example, the resources used to process data in each department could be put together to strengthen the HMIS unit.

Strengthening the information management units from the national level down to the district level is vital. This can be made possible by integrating the resources already in use. The existence of a strong national HMIS unit can help to strengthen the information management at all levels, for example, by coordinating all the Regional units, providing training, acting for representation at the national level in order to claim more resources and achieve the significant place it deserves in the overall health structure. As part of strengthening human capacity in the unit, among the issues that need attention is filling the mostly vacant statistician positions at the districts. The reason given by the managers is that no one has responded to the repeated vacancy advertisements. Even if it is difficult to find candidates qualifying for the requirements set for the post, it should be possible to suggest revision or flexibility considering the circumstances; such as post-recruitment trainings.

Our findings, thus, established the essentiality of a well-defined structure aiming at facilitating coordination between the subsystems of the health system and decentralizing the health information system to empower the district level in order to increase local level information management and use. Based on this, the interventions made by the researchers on the minimum standard data elements and indicators, revision of reporting formats, proposed integrated data flow model, software customization based on the end-users basic requirements, training for and implementation of DHIS as a supporting software program are believed to address the problems and create the framing structures in which they can be practiced.

What strategies and approaches need to be employed for the development and implementation of an integrated district-based health information system, aiming at increasing the possibility of optimum use and sustainability in the context?

Incremental restructuring of the health information system was the basic approach used in this study in order to address the root problems of the system. The restructuring was consist of decentralizing the health information system through local empowerment to the district level and unifying the fragmented data flows in the system caused by independent parallel data flows at all levels. We focused on the creation of framing structures aiming at using of their enabling and constraining features to realize the goals of the intervention; without structure practices are impossible. It is not yet possible to see whether the strategies of user participation and standardization will lead to sustainable and optimal use of the HIS, which are the objectives of the intervention. However, it is possible to reflect on the potentials observed during the primary phases that were carried out.

During the development phase, the embodiment of enabling procedures into the introduced system was partially achieved. For the new data flow to work, the rules making up the structure of legitimation framing the new path of data flow up through the health structure need to be set. A standardization process was followed aiming to achieve sustainability through coordination across time and space, i.e., applying a standard way of working that enables sharing the same meaning between the components of the system physically located apart and through time in the future. For example, the data storage problem at the districts resulted from the subjectivity of individuals doing the work their way and leaving without communicating. At the Region level also lack of a standard procedure resulting in the multiple formats of data constrains integration. Therefore, it is possible to say, within framing structures for change in organizational and information use cultures, the implementation of software which can be used as a Regional standard has the potential to address this problem.

The initial data standard and the prototyping of a Regional database as a solution to the fragmentation were carried out. The Regional health information system is part of the

national system; meeting the national requirements while locally setting a Regional standard was the approach to the minimum dataset selection. Without similar initiative at the national level, the realization of an action-oriented dataset is difficult at the Region. Integrating the system can address the redundancies in the formats. However, without further measures to achieve minimum dataset by removing the un-useful data elements, the large number of data elements makes the information management difficult for the HMIS.

Aiming to achieve sustainability through a demand created by effective use was one of the strategies we used. This means by making the system more useable, institutionalization can be facilitated leading to sustainability. Increasing the capacity for meeting the contextual requirements was the approach taken. In order to realize this, we organized participation of the end users in the development process for increased organizational knowledge. This helped the development of a system to meet the requirements of the context, which is believed to contribute to increased future use. Participation might not be the only key to success. However, our observations during meetings with a ‘technical’ team confirmed that it can contribute. Being part of the effort from the very beginning created a sense of ownership. The system met as many requirements generated by local users’ participation as possible.

In the implementation process, capacity-building was the most emphasized activity in relation to future use and sustainability. We gave trainings to the staff to enable them to sustain the system. The training sessions were successful in helping health staff to understand the system. However, this may only be a temporary solution because there are districts where it is not possible to find computer-literate health workers. In those cases, coping up with the transfer of people (high staff turnover) with trainings is impractical. For a long term solution we recommend that to educational institutions need to include basic computer trainings in their curricula for health professionals.

The purpose of an information system is not to produce information, but to provide it for use. This study aimed at laying structural foundations enabling or facilitating change in

the information use culture. In addition to this, there are some practical measures that can be taken by the health managers to bring change in the system use. For example, the establishment of procedures motivating information use and provision of health workers and district managers with examples of lists of indicators and the types of decision they can support. This can help to lay the foundation for a new information culture.

What are the challenges and opportunities for implementing integrated district-based health information system in the context?

There were circumstances favoring the intervention, which we considered as opportunities. The current government policy of decentralization, the Region's current relatively encouraging focus on strengthening the information system and availability of supporting technology are the main ones.

We found that the government's policy of decentralization of administrative power to the districts is a facilitating factor for district-based health information systems. We also found the Region's structure of domination as an opportunity for the intervention at the districts. This structure of domination also enables achieving a Regional standard as a foundation for the national standard. Alterations in the design such as adding new functions should still be done at the Regional level to maintain consistency among the districts. Incorporating suggestions and requirements on the improvement of information management from the district staff during maintenance can be easily enabled. Even if there will be a time when the districts can be self-sufficient with technical capacity, it is possible to introduce a procedure enabling consistency across health districts. Since a Region is the major entity in the country in the present administrative structure, it is important to maintain consistency and coordination among the districts in a Region, which can also be a foundation for a national standard.

The current active movement in relation to strengthening health information systems and the concern at the Regional HMIS can be considered as facilitating factors for the change. The problems are currently well-recognized by the staff and the management is willing to

commit resources. Among the enabling factors at the local level, the time-consuming and tedious practices at the facility and district level are expected to compel the users to favor time-saving and easy-to-use tools when they are made available to them.

Accessibility of the software and hardware technology to be used in the integration process, for example database applications, was also a facilitator for this initiative to take place.

Implementing a successful local level system under the present resource and infrastructure constraints in the Region is obviously a difficult task. Success of interventions is influenced by political and administrative factors as much as by the methods employed (Lippeveld and Sauerborn, 2000). The challenges mainly come from constraining established structures.

Having the advantages of a bottom-up approach over top-down approaches in system development and implementation, and mixing both approaches to some extent as Wegerich (2001) suggests, appears to be practical in the present situation, considering the power structure. In our case, the structure of domination in the system is considered as constraining as well enabling. Braa, Monteiro and Sahay (2004) argue for bottom-up approaches as the appropriate approach to implement change in the health information system at local levels. However, this does not seem practical in the context of the strong legacy of established centralized practices in the case of Ethiopia. Even with the full support of the local health managers, the implementation process faced a tremendous number of problems due to the custom of waiting for approval from the national government.

The time that takes to effect the expected changes is subject to different constraining institutional properties. The process might take more time than anticipated because of factors such as the amount of time the staff can allocate for it and the time that takes to empower the health districts.

7.2. Conclusions

In Ethiopia, the need to strengthen health information systems is recognized by all stakeholders, especially international actors and the upper-level health managers. Their possible contribution to the performance of the health system is becoming unquestionable. However, the actual initiatives taken towards capacitating the health information systems to enable them to contribute at the operational level are very limited.

This thesis has presented an action research study on the development and implementation of a district-based health information system in Tigray Region, Ethiopia. It is aimed at increasing the efficiency of the information system by introducing changes to the way data are captured, transmitted, stored and used. These changes mainly targeted the structural framework in which the information activities in the health system are carried out. The interventions undertaken were based on the requirements identified from the empirical material, generated from methods of qualitative enquiry employed to carry out the assessment of the system. The interventions were also generated through participatory action research with users, i.e. mutual learning between researchers, technical team members and users in the context of the work, health service delivery and interactions in the bureau.

According to the research results discussed in this thesis, it was revealed that the performance of the health information system in Tigray Region is not adequate to provide information that can support decision-making in the health sector. Fragmented organization at all levels of the health structure is affecting its effectiveness and hindering the system from serving its purposes. Management of data is difficult due to lack of standardized formats and lack of accessibility for all users. Centralization contributed to the very limited use of information at all levels, especially at local levels; data are reported to the higher levels without benefiting the data collectors. Therefore, this research addressed these problems by proposing a redefinition of the data flow structure, standardizing the system and introducing a district-based health information system based on localization of the DHIS software.

The thesis employed analytical use of a theoretical framework based on structuration theory aiming at conceptualizing the empirical material, mainly reflecting on the enabling and the constraining features of structures and the resulting duality of framing structures.

The interactions among the staff and the health information system structures framing these interactions are interpreted in relation to the duality of structuration. Institutionalization of the introduced changes is interpreted as being the result of the duality of structuration. Analysis of the empirical data by comparing key findings from this study with previous knowledge in the domain confirmed most of the problems established by other researchers concerned with health information systems in developing countries.

In summary, the health information system and its parent health system are part of a wider complex social system. Therefore, with all the efforts and facilitating strategies employed, realizing change is still difficult and time-taking due to several intertwined factors which are beyond the scope of this study. However, the potential advantages of effective health information systems in order to improve the health service delivery in developing countries are worth the effort that is required to strengthen health information systems.

7.3. Contributions of the study

In this section we discuss the implications of this study and our contributions to knowledge in the relevant research domains, and the theoretical, methodological and practical contributions from the research study.

7.3.1. Contributions to knowledge

This research is believed to benefit the health sector as well as local and international researchers interested in health information systems development and implementation in the context of developing countries. It contributes to the existing knowledge about the situation of health information systems in developing countries and challenges that need to be addressed in order to succeed with new interventions for health information

systems. Our findings confirmed most of the problems analyzed in the research literature about health information systems in developing countries, such as their inadequacy, fragmented structure, low local level information use and centralized data management.

Specifically in the HISP context, under which this study is undertaken, this research adds to the knowledge on DHIS adaptation and implementation. The effective use of participatory prototyping as a tool for incremental customization is the recommended strategy to address challenges of requirement identification.

There are very few research studies conducted to date in Ethiopia in the area of information systems, specifically health information systems. Therefore, this study can be a point of departure for any studies in the future.

7.3.2. Theoretical Contribution

Structuration is not a widely applied theory in the field of information systems. It has been adapted to the field from the area of social studies by some information systems and information technology researchers. Information systems is a field dominated by the technology deterministic viewpoint. However, structuration theory introduced a new dimension of the relations between human agency and structures, which is, mutual dependency as a mediator in the debate between parties who want to put either agency or structure as a determinant of the interaction in an organization. In other words, structuration theory as a conceptualizing tool, brings a new dimension to the study of information systems, which is the social aspect.

The study employed structuration theory as an analytical device by drawing on the relevant concepts to assist in the understanding of the change process introduced by the action research. We used the concepts of structuration theory to emphasize the re-creation of framing structures through the interactions they enable and constrain. We found this useful in conceptualizing the idea of sustaining actions taken by this action research. For the changes introduced in the bureau to be sustained they should be practiced and

institutionalized through time. We looked at this process as interactions reinforcing structures and enabled by structures, which is duality of structure.

We found the theory helpful for conceptualization and providing analytical framework for understanding empirical situation. However, interventions in the field of information systems, as an applied science, also aim at improved performance. Therefore, further investigation is needed to discover the implications of structuration theory for the field of information systems in this aspect.

7.3.3. Methodological contribution

Action research aims at changing the organization under study, while the actions are enabled by the existing structure in the organization. This action research was enabled and framed by the region's health structure and as the same time meant to restructure it. The complexity of the health system slowed the research and part of the phases remained uncovered, actual effects of the intervention remained unseen. We found action research as a useful approach for developing practical knowledge. However it takes a long time to see the effects of interventions under the complexity of the practical world; it is almost impossible to go as per the research's schedule. Therefore, it appears to be difficult to use the approach exhaustively for a study bounded by a shorter time like this one.

Participatory prototyping helped to facilitate the software customization as well as the rest of the system restructuring plan. We could identify a surprisingly large number of requirements through this approach. Trainings were found to be useful opportunities to enable user participation as well as for capacity enhancement. Due to time constraint we could not prepare a local manual with all the customizations carried out during the period of time in the research settings.

The use of a participatory team for the essential dataset identification was irreplaceable. We believe it served us well and made it possible to set the Regional standard and lay the foundation for the integration process.

During the customization of the software, the collaboration between different teams working in different Regions under HISP-Ethiopia, sharing experiences and communicating solutions can be considered as a strategy of using multiple coordinated local interventions towards achieving national standards.

7.3.4. Practical contributions

This research made practical contributions to the organization under study regarding the Tigray Regional Health Bureau through. The introduction of an integrated health information system at local level and the ongoing actions initiated by this research are believed to be the foundations for any future efforts to improve the health information system. The dataset prepared through the participatory approach was also a step forward. The customized District Health Information Software (DHIS) based on the Bureau's requirements as well as the designed integrated reporting flow were particularly our additions to the system. In addition, trainings on computer basics and DHIS were given to the staff. Technical support for the districts and the Region in order to help with the DHIS operation and maintenance and development of further requirements was also contributed to the Bureau through HISP's financial assistance.

During our stay in the Region, we could make the health information system 'the hot issue' and create the stage for the staff to exchange ideas. There were repeated meetings and discussions that resulted in practical decisions. Especially for the HMIS unit, they used those opportunities to communicate their problems with the bureau heads.

Furthermore, as part of the national and international HISP initiative, we contributed in expanding the HISP network to Ethiopia and enabled the country to benefit from the collaboration.

7.4. Further Study

This study has addressed the problem of limited information use in relation to the lack of structural support; we focused on how to recreate the foundation of enabling structures. However, this alone might not realize the change we need to see in information culture.

Therefore, we suggest further study focusing on the other dimensions of change in information culture, such as investigation of the information behaviour of the health staff.

Due to time limitations we did not have a chance to evaluate the actual changes and impacts of the approaches we used and thus complete the action research cycle that we initiated. We recommend a continuation of this participatory action research through the rest of the phases to enable further learning.

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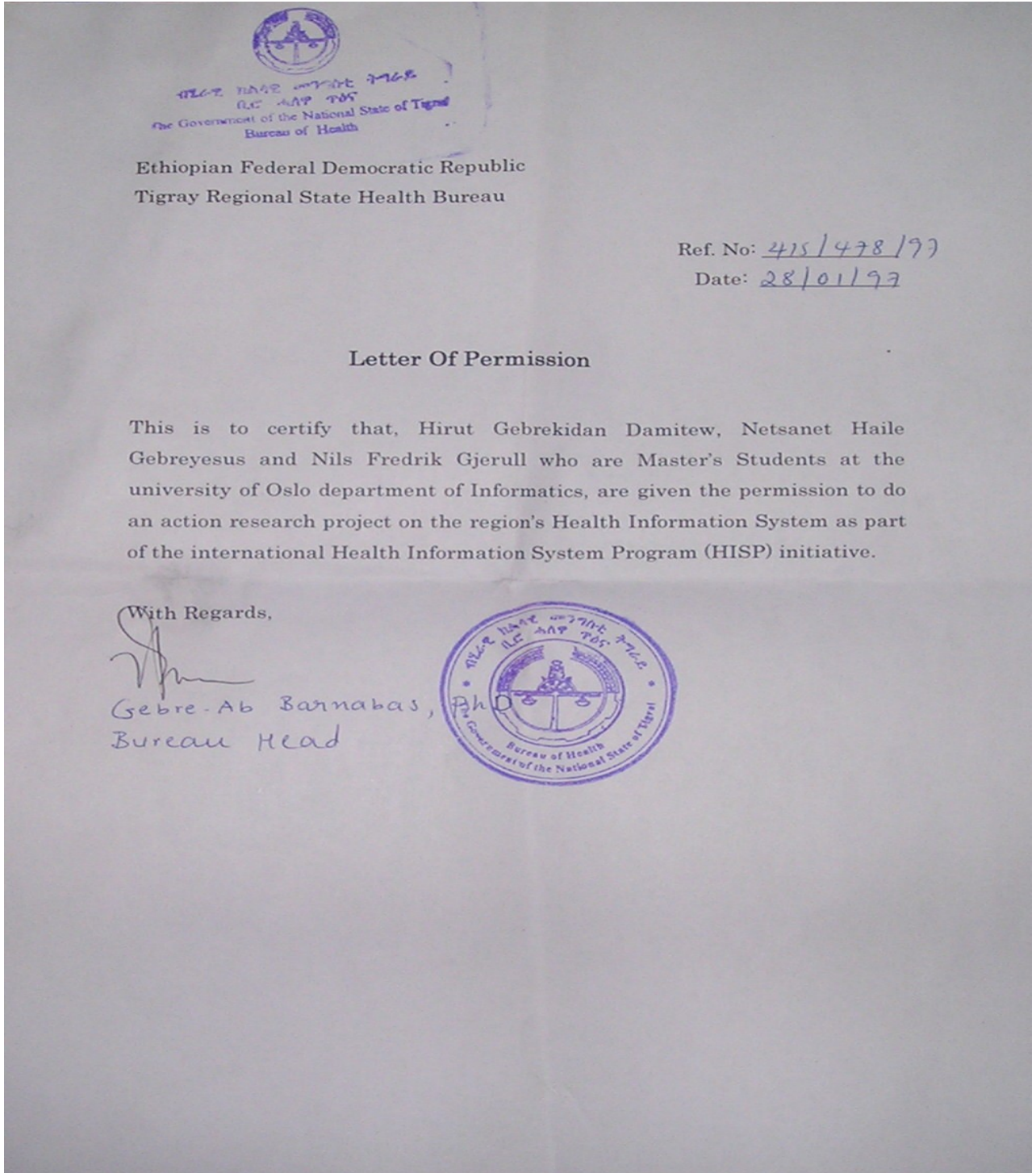
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APPENDICES

Appendix A: Ethical Clearance



Appendix B: Interview guide

Questions asked in order to assess the existing system

1. What types of data are collected in the bureau?
2. What are the major data collection tools?
3. From where do you get the data collection tools?
4. Is there a shortage of collection tools?
5. Are the forms easy to use?
6. What storage mechanism do you use to archive the data?
7. How many types of reports do you have?
8. To which departments you send the data?
9. How often do you send the report to the higher level?
10. What type of media are you using to report to the higher level?
11. How do you collect data from outreach services?
12. What are the major data analysis tools you are using?
13. What kind of data you analyze?
14. How often you analyze the data?
15. What kind of data/information are you using?
16. Who is responsible to send the report to the higher level?
17. Do you have a mechanism to check the quality of data before reporting?
18. Do you ever get feedback on data you report?
19. What gaps do you feel exist between the information you have and the information you need?
20. How can the information system and the use of information be improved?
21. How do you transmit information to potential users out of the health structure?
22. Do you have computers and internet access?

Questions asked in order to identify factors contributing to unsustainability and low use of information at all levels

23. How many systems did you implement since the bureau was established?
24. Did you have any problem with sustaining systems?
25. Did you have adequate computers, telephone line, internet, and electricity?
26. Who provided the systems you have been using to the bureau?
27. Were the systems fulfilling the bureau's requirement?
28. Did the bureau staff given training to use the system?
29. What trainings are given for upgrading the staff's capacity? How often?
30. Was the bureau getting technical assistance for the systems?
31. Did the bureau keep contact with the system developers after implementation?
For how long?
32. Were the systems easy to use?
33. Were the systems fully used by the bureau?
34. Were the systems manageable by the available technology, expertise and resources?
35. Who was allocating the budget for maintenance?