The Routine Health Information System in Palestine:

Determinants and Performance

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DECLARATION

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ABSTRACT

A health information system (HIS) plays an important role in ensuring that reliable and timely health information is available for operational and strategic decision making that saves lives and enhances health. Despite their importance for evidence-based decisions, health information systems in many developing countries are weak, fragmented and often focused exclusively on disease-specific programme areas. There is a broad consensus in the literature that strengthening of national HIS is desirable. An integrated HIS will provide the basis for public health professionals to look at the health system from broader more comprehensive points of view.

The routine health information system (RHIS) in Palestine does not store data at the case level but aggregates them at the Facility level only. Additionally, establishment of multiple information databases in different Ministry of Health (MoH) departments causes incompatibility between the different databases and ineffective use of information.

This study examines the availability and the utilisation of information in support of health care organisation and delivery in Palestine which entailed an assessment of the current situation to identify determinants of the RHIS performance.

The Palestinian Ministry of Health at the Ministry, District and Facility levels was the study setting while systems and staff operating at these three levels were the target population**.** Employing a purposive sampling method a total of 123 respondents participated in the study. Performance of Routine Information System Management (PRISM) framework and its four tools package was used to assess the performance of RHIS at the Palestinian MoH. The PRISM framework empirically tests the relationships among technical, behavioural and organisational determinants on health management information system (HMIS) process and performance.

Data quality is measured in terms of accuracy and completeness at the Facility level. However, at Ministry HMIS and District levels it is measured in terms of timeliness, data accuracy and completeness.

Data quality was good at the Ministry HMIS level. However, data completeness and accuracy at the District level were good while timeliness was immeasurable on the basis of currently adopted procedures**.** At the Facility level, data completeness and data accuracy were only acceptable. Use of information was poor at all three levels; the Ministry HMIS level, District and Facility. The displaying of updated data on mother‘s health, child health, Facility utilisation, and disease

surveillance at both the District level and at the Facility levels were poor. RHIS processes at the Ministry HMIS level were good. However, they were poor at the two levels of District and Facility. Overall, technical and behavioural determinants fared poorly at all three levels while organisational determinants at the Ministry HMIS level were very good for RHIS governance and planning but were poor for supervision, training and finance.

These findings provide evidence on the need to establish a national RHIS the utilisation of which is made legally compulsory for all. Investing heavily and systematically in building relevant staff capacity and technical infrastructure to improve performance is a key conclusion from this project.

GLOSSARY

ANC	Antenatal Care
CDSS	Clinical Decision Support Systems
CESAG	Centre for Higher Management Studies
DHIS	District Health Information System Software
EPI	Expanded Programme of Immunisation
FP	Family Planning
GDP	Gross Domestic Product
HTA	Health Technology Assessment
HIS	Health Information System
HIV/AIDS	Human Immunodeficiency Virus Infection / Acquired Immunodeficiency Syndrome
HMIS	Health Management Information System
HMN	Health Metrics Network
ICT	Information and Communication Technology
INSP	National Institute of Public Health
IT	Information Technology
ITAM	Information Technology Adoption Model
JHU	Johns Hopkins University
MAT	Management Assessment Tool
MCH	Mother and Child Care
MEM	Multi-Methods Evaluation Model
MIS	Management Information System
MoI	Ministry of Interior
MoH	Ministry of Health
MOHSW	Ministry of Health and Social Welfare
NGOs	Non Governmental Organisations
NHIS	National Health Information System
OBAT	Organisational and Behavioural Assessment Tool
oPt	Occupied Palestinian Territory
PA	Palestinian Authority

PAHO	Pan American Health Organisation
PCBS	Palestinian Central Bureau of Statistics
PHC	Primary Health Care
PHIC	Palestinian Health Information Centre
PNA	Palestinian National Authority
PRISM	Performance of Routine Information System Management
RCT	Randomised Controlled Clinical Trials
RHIS	Routine Health Information System
TEAM	Total Evaluation and Acceptance Methodology
TB	Tuberculosis
SDLC	System Development Life Cycle
SPSS	Statistical Package for Social Sciences
UPS	Uninterruptible Power Supply
UNRWA	United Nations Relief and Works Agency
WHO	World Health Organisation

Chapter One

Introduction

Strategically, the role of Primary Health Care (PHC) is crucial if equity is to be achieved in health care delivery worldwide (WHO, 1978). Key international organisations working on global health including WHO have emphasised the importance of information systems if such health targets are to be reached. Achieving this grand vision requires information to be a key input to ensure rational allocation of limited resources and for arranging priorities in health care (Sandiford et al., 1992). A well established health information system results in information that is relevant and adequate for policy-makers, managers and health practitioners to inform strategic decisions, health services planning and delivery (Azubuike and Ehiri, 1999). The availability and use of such information contributes to efficiency, equity, proper allocation of scarce resources and proper provision of health care services.

The World Health Organisation (WHO) had long identified health information systems as critical for achieving "Health for All" in the year 2000. A report of a WHO meeting (1987) clearly links improved management to improved health information systems as it argues that, of the major obstacles to effective management, information support is the one most frequently cited (WHO, 1987). The supposition, also supported by experience from developed countries, is that improving health information systems will influence good health management. Good health management is a requirement for increasing the efficiency and efficacy of health services. As the health sector faces ever increasing demands while there not necessarily being a corresponding increase in resources, the need to do more with less is especially important. In addition, Tanner and Lengeler (1993) argue that the theoretical effectiveness of health interventions tends to get lost if those interventions are delivered by poorly run health services.

Health information systems facilitate the integration of health services focusing on primary health care (Alvarez, 2004). In particular they are vital for monitoring the health situation: the performance of promotive, preventive and curative health services and activities as well as the availability and utilisation of health resources (Alvarez, 2004).

The ultimate objective of health information systems, as stated by Sauerborn and Lippeveld is not only "to gain information" but "to improve action". They have a powerful potential to improve the

functioning of health care organisations, however, that potential can only be realised if they are successfully developed and implemented (Sauerborn and Lippeveld, 2000).

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

Restructuring and revisions of health information systems in developing countries is typically donor driven and their influence impacts on the performance of information systems operating in developing countries (Chilundo, 2004). The donor driven programmes often have an independent decision-making structure and an internal system for information reporting and resource allocation. The result is several parallel and overlapping information flows, a lack of integrated analysis, and a high burden of registration on health workers in the primary health care facilities.

1.1 Health Information Systems

Wilson et al. (2001) defined a health information system (HIS) as "*a set of tools and procedures that a health programme uses to collect, process, transmit, and use data for monitoring, evaluation and control in a health system*" (Wilson et al., 2001). A health information system includes: patterns of belief about the causes of illness, norms governing choice and evaluation of treatment, socially legitimated status, roles, power relationships, interaction setting, and institutions (Kleiman, 1980). Hardon et al. (2000) state that a health system is not a static phenomenon. It is a continuous process of changes due to pressure from both outside the system and from within the system (Hardon et al., 2001).

Data collection is the first step of the information process; the selection of data collection methods depends on both the nature of information required and the intended use of the information. In general, the information collected and used in national health information systems could be classified into two groups according to data collection methods: routine and non-routine (Lippeveld, 2000; Anderson et al., 1994).

Routine health information is the information that is obtained at regular intervals of a year or less through mechanisms designed to meet predictable information needs (Lippeveld, 2000; Anderson et al., 1994). Some examples of routine health information systems include:

- Health service statistics for routine service reporting and special programme reporting (Malaria, Tuberculosis (TB), and Human immunodeficiency virus infection / acquired immunodeficiency syndrome HIV/AIDS).
- Administrative data (revenue and costs, drugs, personnel, training, research, and documentation).
- Epidemiological and surveillance data.
- Data on community-based health actions.
- Vital events data (births, deaths and migrations).

The information that these different routine health information systems may generate will be used to support several health system functions, including service delivery, disease control, planning and management, and performance monitoring.

Non-routine health information, on the other hand, is usually obtained from data collected through surveys and special purpose studies conducted on an ad hoc or non repetitive basis. Examples of non-routine data collection approaches include:

- Large demographic and health surveys.
- Programme level baseline and impact studies.
- Facility surveys.
- National health accounts.

In fact, the information generated through non-routine approaches supports many of the same health system functions supported by routine methods, as well as various applications that are not served by routine sources. In contrast to routine information, the data generated by non-routine methods are not normally collected at predictable periods for routine decision making. They are not intended for immediate use to support day-to-day health system operations (RHINO, 2003).

1.2 Role of Routine Health Information in the Health System

The routine health information system (RHIS) and the health system at large are related in the sense that the health information system (HIS) cannot exist by itself. It is a functional entity within the framework of a comprehensive health system that offers integrated health services, including curative care, rehabilitative care, disease prevention, and health promotion services, hence making it a management information system (Sauerborn and Lippeveld, 2000).

Differences between routine and non-routine information reveal the frequency of data collection, and the intended primary use of those data. Normally, routine health information systems are an ingredient of the local service delivery system. They are used to document progress in health care provision, administration and financing, morbidity, births and deaths, and community-level public health actions. Therefore routine information systems may offer the only way to document and project, regularly, what happens between the health system and the communities it is serving. The primary data show operations related to management, service delivery, and public health interventions. They also monitor trends in morbidity and service coverage locally and nationally (RHINO, 2003).

The strength of routine information systems is that they provide data directly for decision makers and supervisors at all levels of the health system. This purpose is essential for making plans and budgets, quality improvement, and effective reactions to clients‘ needs. Based on routine data, managers can decide the effectiveness of case management and quality of care; resource generation patterns; and financial, human, and material resource management practice.

On the other hand, information collected through non- routine methods, such as survey data, often fails to reach the operational level because it cannot be disaggregated sufficiently or is only available long after the need to act.

Because the majority of routine health data are gathered at the initial level of meeting with the population, routine information systems also serve to bring together professional health services and the communities they serve. Successful collection and use of information at this level of the health system creates an essential connection between individuals and community health intervention that enables health workers to classify suitable medical and public health resolutions to widespread problematic issues. Sound community-based routine information systems have been effective in identifying underserved populations and helping to supply resources for them (RHINO, 2003).

Further, central-level decision makers usually profit from access to routine health information. At this level, national planners and health programme supervisors employ routine information to establish policies, follow expenditure and monitor performance through tracking trends in service provision and coverage gathered from accumulated service data. Responding to client needs requires regular information on service patterns to make decisions about resource allocation. As well, routine information generates a picture of the general distribution of public sector resources such as in the health sector (RHINO, 2003).

Routine information is a necessity for country-led decision making. It promotes local ownership and control of health system functions. It enables decision makers and managers at all levels of the health system to take the lead in setting priorities, regulating practices, and controlling costs.

1.3 Background and Significance

Lippeveld (2001) argues that routine health information systems have the potential to play a major role in facilitating integration between individual health and public health interventions (Lippeveld, 2001); since both individual health care services and public health functions are being carried out within the health services system, and the routine health unit based health information system is the main information source for both types of intervention. For example, the recording of routine health data by the health staff within the Facility while performing their regular daily health care activities is also the most obvious way of collecting data for patient management (Lippeveld, 2000).

WHO and other international agencies, government authorities, and researchers widely recognised that the strengthening of health information systems significantly contributes to enhancement of effective primary health care services (Braa et al., 2004). However, there are still obstacles hindering the countries from benefiting from them.

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

There are several reasons why national health information systems (NHIS) in developing countries do not provide the necessary information support for decision –making. The following reasons are reported in the literature (Allotey and Reidpath, 2000; Braa and Nermunkh, 2000; Gattini, 2007; WHO, 2007).

- lack of NHIS policy framework and its application to plans, projects and actions;

- Relative NHIS weak structure and limited resources;
- Limited NHIS performance with poor and limited availability of accurate, complete and timely information;
- Limited skilled staff and training for information and technology management;
- Health care staff overburdened by the collection of routine data with no corresponding benefit coming from the resulting information;
- Low and delayed production, analysis, reporting, dissemination and use of information;
- Statistical systems with low quality, integration and performance, limited training and high turnover of trainees;
- Lack of effective communication between producers and users of information;
- limited institutional culture for demanding, integrating, analysing and using information to support policy- and decision-making;
- NHIS isolated from policy- and decision making process and non responsive to information needs of decision-makers, thus isolated from health systems development and performance;
- Turnover of decision-makers and other key users of information;
- Fragmented and even overlapped specific information systems with lack of integration of specific and sub-national systems within a national HIS network;
- Lack of coordination and communication between the stakeholders (offices, institutions, sectors) that should be involved in the production and sharing of information;
- New demands for information not responded by traditional NHIS, leading to irresponsive irrelevant information, despite the amount of data collected and overwhelming burden for participating (clinical and administrative) staff;
- Limited analysis and use of the information;
- Lack of appropriate finance.

In general, those frequent limitations are usually taken into account in the tools for NHIS assessment, including the description, measurement and gap analysis of the limitations and problems probably to be found, so as to propose specific interventions for proper improvement (Sauerborn and Lippeveld, 2000; Gattini, 2007; WHO, 2007)

The territory of the Palestinian National Authority (PNA) includes two separated geographical areas (see Figure 1.1), the West Bank and the Gaza Strip with a total population of 4 293 313 (MoH, 2012). The West Bank and the Gaza Strip have been under occupation by Israel since 1967. The PNA was established in 1994 following the Oslo agreement between Israel and Palestinians and Arab states (Rogan and Shlaim, 2001).

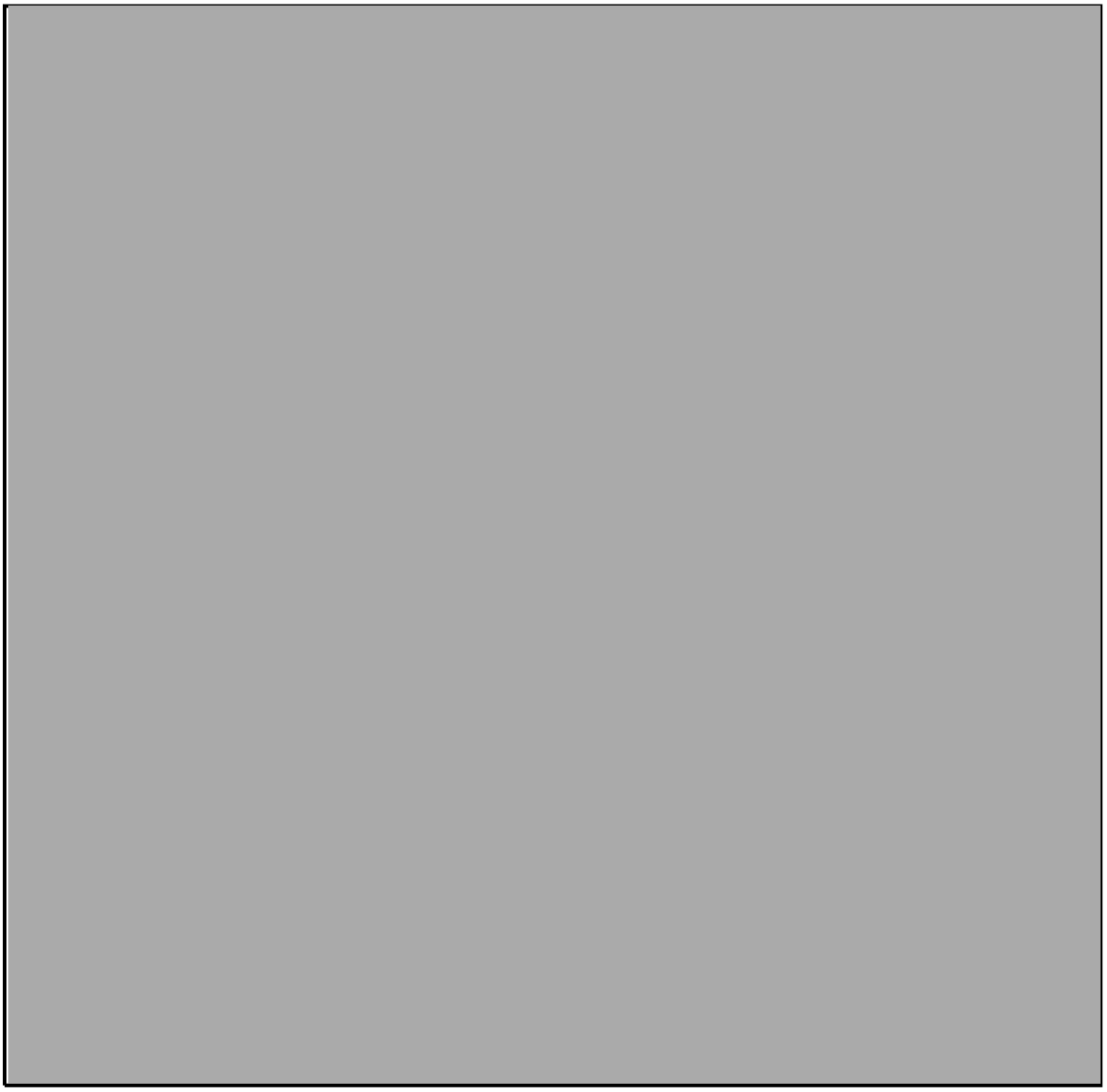

Figure 1.1 Map of Occupied Palestinian Territory
Source: The United Nation (2012)

One of the modern world's longest conflicts continues in the occupied Palestinian territories of the West Bank and Gaza. This conflict is the factor underlying the complex content of this region and influences all aspects of people's lives. The direct effect of the conflict on health status is observed through thousands of deaths, injuries, disabilities and mental health disorders (MoH, 2003).

The West Bank and Gaza have been going through years of conflict, through wars, military incursions, and internal civil conflicts. Restrictions and limitations over movement and economic constraints resulted in Palestinians losing control over taxes and trade, and provide challenges at the developmental level (Rogan and Shlaim, 2001).

The health care system in Palestine is composed of five major health care providers (MoH, 2010):

1. The Ministry of Health (MoH): the main health care provider, covering 64% of all Palestinian Health Care Facilities and the majority of hospital beds, providing primary, secondary and tertiary care and purchasing unavailable secondary and tertiary health care services from other providers, both domestic and abroad.
2. The United Nations Relief and Works Agency (UNRWA): provides primary health care and some secondary services to refugee populations, and purchases secondary and tertiary care services when needed.
3. Non Governmental Organisations (NGOs): a large sector that includes missionary hospitals, Facilities supported by international organisations and community health centres.
4. The private sector: also provides the three levels of care through a wide range of practices (reliable data on services delivered and other vital statistics are lacking).
5. Contracting out services: hospitals located in the West Bank and East Jerusalem or hospitals outside Palestine- Jordan, Egypt and Israel.

These systems have developed independently without any overall plan, lacking coordination and regulation. The result has been a costly health service, inefficient resource distribution with overlapping of services in some places while some areas are under-covered, great variation in quality of care, lack of standards and regulatory mechanisms, and unclear division of responsibility between the public and private providers.

Since 1995 the MoH has initiated development of some distinct information systems, taking into consideration that these information systems are working alone without any integration between each other.

The Palestinian Health Information Centre (PHIC) collects health-related data that include vital statistics and clinic-based data and publishes an annual report "Health Status in Palestine". Many types of epidemiological monitoring have been conducted by the Palestinian Central Bureau of Statistics (PCBS) and the MoH, including population- and clinic-based surveys of nutritional status and vaccine coverage, tracking of infectious disease, and data on the incidence and prevalence of non communicable and chronic diseases.

The private and NGO sectors have developed health information systems that are organisation-specific and largely not designed to link across organisations. Some have developed differing systems within one hospital. This bodes both positively and negatively for strengthening the health management information system (HMIS): positively there is keen interest in ensuring the availability of comprehensive decision-linked valid data and information. On the other hand, there has been

proliferation of numerous information systems of varying quality and with almost no ability for linkage.

The health information system lacks reliable, complete and accurate information in many areas such as maternal mortality rate, non-communicable diseases and behavioural risks, nutritional status, and health expenditure on human resources. The health sector is in urgent need of identifying basic health indicators (base-line indicators) and the development of an information system capable of collecting and analysing data and trends for these indicators and producing periodic reports routinely and in a timely manner.

1.4 Problem Statement

As already stated ideally we want to ensure that the right information for decision making is available at all levels within the Palestinian health sector. This requires both the appropriate generation of the information at each level and effective transfer of information between levels. In practice existing information systems are deficient.

Historically the Palestinian health sector has been lacking reliable data on health status. From a systems prospective this would appear to be caused by many factors including the absence of a state that can manage scarce resources, absence of the correct use of new technologies, and lack of well trained people in the Information Technology (IT) sector. Data are still collected manually and in an inefficient and slow fashion (in health centres) that results in a very long delay in preparing and publishing reports in a timely manner. Within these published data there is a kind of incompatibility that appears from report to report.

Figure 1.2 provides an overall initial picture of the NHIS status in Palestine indicating the major ingredients of the problems. Examining these ingredients it will be shown that they could arise from problems that might be technical, behavioural, or organisational in nature or some combination of these.

This Figure emerges logically from the work referenced in the previous section in Background and Significance given that Palestine is developing country and hence is likely to exhibit the shortcomings of such countries.

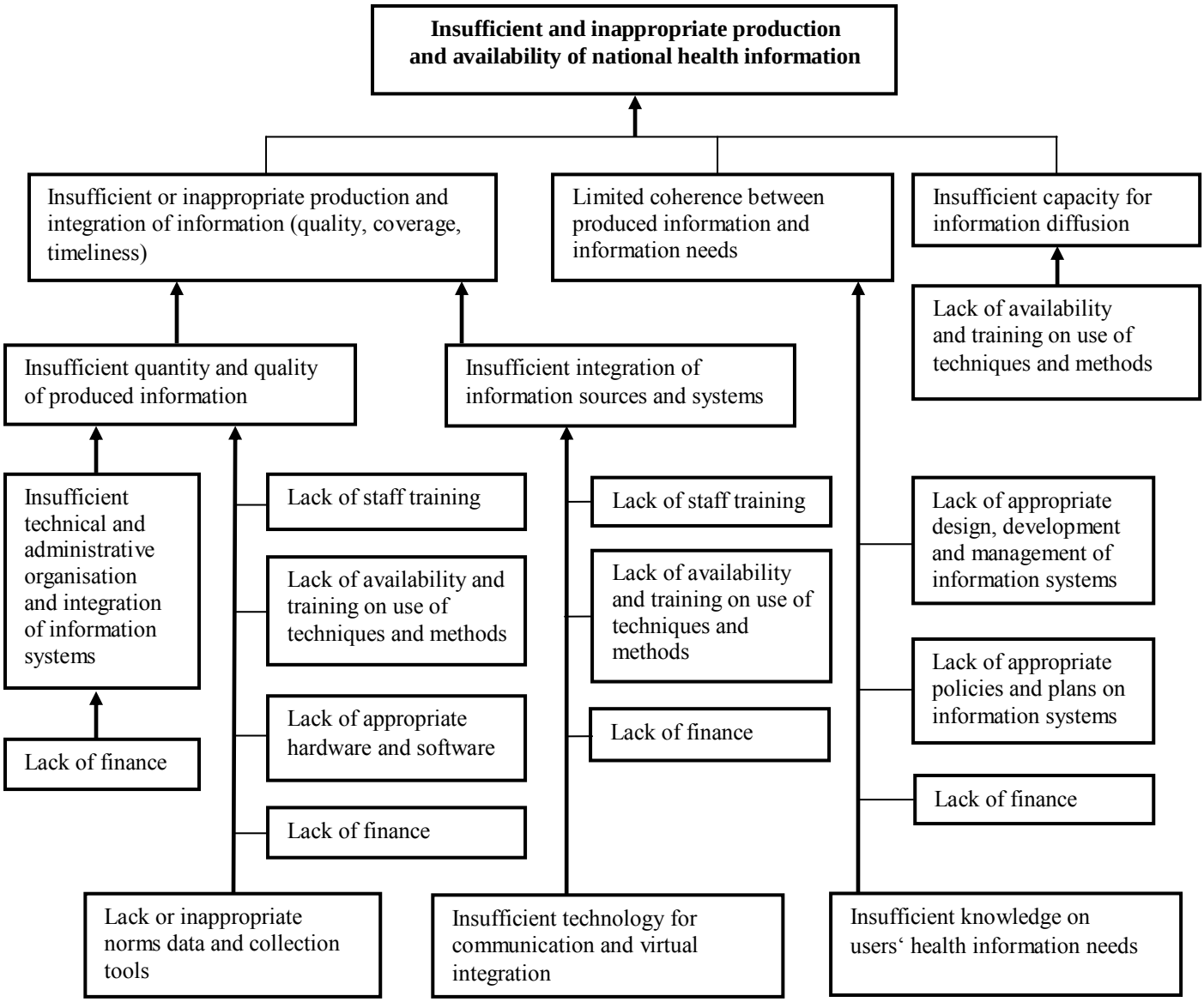

Figure 1.2 An Overall Initial Picture of the NHIS Status in Palestine

The overall efficiency in the chain of processes leading to the production of information depends on the level of adequacy and integration of the institutional, technological and functional NHIS components; all this provides the framework or pre-conditions for efficiency. Figure 1.2 shows the types of factors that hinder the adequate production and dissemination of information.

Based on the institutional, technological and functional components, it highlights aspects of organisation, technology, staff training, methodological and resource support for equipment and computer programs. It should be pointed out that there should also be sufficient capacity (involving personnel and the institutional context) to be able to produce and disseminate information, which should be responsive to users' needs.

As shown in Figure 1.2, insufficient capacity for information diffusion, limited coherence between produced information and information needs and insufficient or inappropriate production and integration of information will cause insufficient and inappropriate production and availability of national health information.

The Palestinian health information system should include a number of features such as:

- Surveillance of communicable and non-communicable diseases.
- Ability to collect and analyse data on human resources, national health accounts, nutritional status, pharmaceuticals, health insurance, treatment abroad etc.
- Well established medical records and clinical screening system.
- A system to regularly inform the policy making and management level in the health sector.
- Development of a patient medical information system which provides online information about the patient medical history. This will prevent overlapping among the various health care providers, which will lead to the rational use of available resources.
- Ability to assess the burden of disease in Palestinian society.

1.5 Aim of the Study

The study described in this thesis focuses on health care delivery in Palestine. The overall aim is to examine the availability and the utilisation of information in support of health care organisation and delivery. In the light of this examination, an assessment is made of the current situation with a view to identifying determinants of health system performance with its eventual impact on the health of the population of Palestine.

1.6 Objectives of the Study

In order to achieve this overall aim, the study described in this thesis has the following specific objectives:

1. Define the nature of the health information provision in Palestine.
2. Identify an appropriate methodology for undertaking the proposed substantive research.
3. Assess the current performance of the Routine Health Information System (RHIS) at the Palestinian Ministry of Health (MoH).
4. Identify the technical, behavioural and organisational RHIS determinants of the Health Management Information System (HMIS) performance.
5. Determine the extent to which the HMIS processes influence HMIS performance.

1.7 Outline Structure of the Thesis

Given the aim and objectives of this research work, the material presented in this thesis falls into seven chapters.

Chapter 2 provides an introduction to the health system in Palestine, which is the application domain for the research described in this thesis. Topics to be covered in the chapter will include: an historical overview, the health system in Palestine, population size, health care financing, health care delivery, human resources, and health information systems in Palestine.

Chapter 3 reviews the literature relevant to information systems, with particular application to the health sector, including specific issues relating to developing countries. The review will examine definitions of data, information, information theory, information types, information value, information challenges, information quality and information system. In addition chapter three will examine the definitions of management information systems and health information systems, including components. Moreover using information to make decisions, application of information and communication technologies in the health sector, challenges in implementation of health information systems in developing countries and evaluation of health information system will be discussed. This will be followed by consideration of the Health Metrics Network (HMN) and the performance of routine information system management (PRISM) frameworks, routine health information system **(**RHIS) performance, RHIS determinants and PRISM intervention.

Chapter 4 considers issues of methodology that should be adopted for the substantive research in order to address the objectives described in chapter 1. Major components will include: conceptual foundations and study design, including case study, system theory, combining case study with the system theory, theoretical background and conceptual framework for the necessary analysis. Chapter 4 also describes implementation of methodology in order to understand the nature and performance of currently adopted systems, study settings and target population, sampling and fieldwork, data collection tool, tool adaptation and pre-testing and methods of data analysis, research questions and ethical considerations.

Chapter 5 will discuss the results obtained from implementation of the methodology. In order to provide a context for these results, it is appropriate to revisit the nature of health care delivery in Palestine. Within this context results are presented for respondents‘ socio – demographic characteristics, respondents‘ educational level, level of RHIS performance (data quality and use of information), functionality of RHIS processes, and determinants of performance, including technical, behavioural and organisational determinants.

Chapter 6 will discuss major issues that have arisen in the course of the research. These issues correspond to principal ingredients of the PRISM framework and its underlying systems thinking. Discussion commences with RHIS performance, which in systems terms corresponds to the output of the health information system. This will be followed by consideration of the RHIS processes which produce that performance. Thirdly, the focus turns to inputs to these processes, which are the determinants that include technical, behavioural and organisational factors. From a systems perspective there is a need to recognize the importance of the feedback loops which are in operation. The chapter will conclude by reviewing the success in the application of the PRISM framework and its tools in a range of international settings, enabling comprising to be made with some of the results obtained in this Palestinian context.

Conclusions are presented in chapter 7 where there is consideration of the extent to which the objectives have been met. Also, the contributions to knowledge are indicated, and finally recommendations are made for future work.

Chapter Two
Health Systems in Palestine

2.1 Introduction

This chapter will provide an introduction to the health system in Palestine, which is the application domain for the research described in this thesis. Topics to be covered in the chapter will include: an historical overview, the health system in Palestine, population size, health care financing, health care delivery, human resources, and health information systems in Palestine.

2.2 Historical Overview

The term Palestinians refers to the people who lived in British Mandate Palestine before 1948, when the state of Israel was established, and their descendants (see Figure 2.1). As documented by several Israeli historians (Rogan and Shlaim, 2001), more than three-quarters of the Palestinian population were forcibly dispossessed and expelled between 1947 and 1949, becoming refugees in neighbouring Arab states (Kimmerling, 1992). This traumatic situation—called the nakba (or catastrophe) by Palestinians—is engrained in the collective memory, and is still felt by third-generation refugees, especially those living in refugee camps (Baker and Shalhoub, 1999). Since then, Palestinian identity has been reinforced through resistance to dispossession and extinction.

The occupied Palestinian territory is the term used by the United Nation for those parts of Palestine occupied by Israel after the Arab–Israeli war of 1967 (The United Nations, 2012). It consists of the West Bank, including East Jerusalem, and the Gaza Strip.

Figure 2.1 Map of Historical Palestine
Source: Rogan and Shlaim (2001)

In 1991, a peace conference on the Middle East was convened in Madrid between Israel and Palestinians and Arab states. Several subsequent negotiations led to mutual recognition between Israel and the Palestine Liberation Organisation and, in 1993, the Declaration of Principles on Interim Self-Government Arrangements, otherwise known as the Oslo Accords (Rogan and Shlaim, 2001).

The Oslo Accords aimed to obtain a resolution to the conflict and established the Palestinian National Authority for a transitional period, during which negotiation of a final peace treaty would be completed.

On the basis of these accords, the Authority assumed control over some, but not all, areas of the West Bank and Gaza Strip. The agreement divided the occupied Palestinian territory into three zones. The Palestinian National Authority assumed control of all civilian administration, including health, and became responsible for security in zone A, which includes the main urban areas of the West Bank, but only about 3% of the land. The Palestinian National Authority has civilian authority, but shares security responsibility with Israel in zone B, which includes about 450 Palestinian towns and villages, and covers about 27% of the West Bank. The authority has no control over the remaining 70% of the occupied Palestinian territory, zone C, which includes agricultural land, the

Jordan valley, natural reserves and areas with low population density, and Israeli settlements and military areas.

Palestinian National Authority territories comprise two areas separated geographically: the West Bank and the Gaza Strip. The West Bank lies within an area of 5800 square kilometers west of the river Jordan. It has been under Israeli Military Occupation, together with East Jerusalem, since June 1967. The West Bank is divided into four geographical regions. The Northern area includes the Districts of Nablus, Jenin and Tulkarem; the Centre includes the Districts of Ramallah and Jerusalem, whilst the South includes Bethlehem and the Al-khaliel District, and the Fourth area is the sparsely populated Jordan Valley including Jericho. Many areas of the West Bank have diversified communities. There are observable differences in life styles and living conditions not only among classes or socio-economic levels and religious affiliations, but also among urban, rural and refugee camp communities with their respective subdivisions (MoH, 2005).

The Gaza strip is a narrow piece of land lying on the coast of the Mediterranean Sea. Its position on the crossroads from Africa to Asia made it a target for occupiers and conquerors over the centuries. The last of these was Israel who occupied the Gaza Strip from the Egyptians in 1967. The Gaza strip is a very crowded place with an area of 360 square kilometres (MoH, 2005).

The Palestinian National Authority did not have, and still does not have, control over borders, movement of people and goods, and control over territory and water. Over time, the authority became troubled by other short comings, including corruption, absence of collective decision making and integrated planning, and the appointment of excessive numbers of civil servants as reward for the so called revolutionary heroism, political support, or both, causing a major drain on the national budget (Giacaman et al., 2003).

The eruption of the second Intifada in September 2000 and the Israeli re-occupation had a dramatic result. The Palestinian Authority (PA) has been confronted with unprecedented financial shortfalls following the Hamas victory in the January 2006‘s Palestinian legislative elections. Israel refused to give back the Palestinian tax revenues which account for around 50% of the PA budget. There was a partial termination of budget support from the donor community, with the United States of America warning that it would impose sanctions on banks engaging in financial transactions with the PA. There was also the aggravation of the fragmentation in the delivery of health services due to physical barriers. Together these were the key factors that led to the current crisis. Their combination resulted in precipitating the economic decline in the West Bank and Gaza and in further weakening and undermining the existing capacity of the PA and the Palestinian public infrastructure to provide

social services to the population. In addition, following the Hamas complete takeover of control of the entire Gaza Strip in June 2007, an already geographically-disconnected Palestinian territory has become even politically divided into two separately-governed rival entities: one in the West Bank under the new President's government formally recognised by the international community - including the Quartet - and the other one in the Gaza Strip ruled by Hamas.

2.3 Health System in Palestine

The current Palestinian health system is made up of fragmented services that grew and developed over generations and across different regimes. During the 19th century, Christian missionaries from the western countries established some hospitals that are still operating in East Jerusalem. During the early part of the 20th century, the British Mandate expanded these services (Ben-Arieh, 1975).

The 1948 nakba led the United Nations General Assembly to establish the United Nation Relief and Works Agency (UNRWA) in 1949. Since then, the United Nation Relief and Works Agency has been delivering various key services to registered Palestinian refugees, including food aid, housing, education, and health services, not only in the occupied Palestinian territory, but also in Jordan, Lebanon, and Syria.

From 1950 to 1967, the West Bank was annexed by the Hashemite Kingdom of Jordan, and the Gaza Strip came under Egyptian military administration. Although Egyptian and Jordanian state aids for education and health expanded, rural areas in the West Bank, where most people lived, stayed mainly untouched by these developments (Graham, 1984). Palestinians reacted by constructing a network of charitable health services. During this period, private Palestinian medical services also grew and developed (Barghouthi and Giacaman, 1990).

Between 1967 and 1993, health services for Palestinians in the occupied Palestinian territory were neglected and starved of funds by the Israeli military administration, with shortages of staff, hospital beds, medication, and essential and specialised services, forcing Palestinians to depend on health services in Israel. For example, in 1975 the West Bank health budget was substantially lower than that of one Israeli hospital for the same year (Katbeh, 1977).

The Palestinian response was to generate independent Palestinian services through health, women's, agricultural, and student social-action groups all promoting community steadfastness on the land (sumud). This response also led to the development of a Palestinian health and medical care infrastructure, independent of the Israeli military that still helps to meet the health needs of the population, especially during emergencies.

The Palestinian Ministry of Health was established after the Oslo accords in 1993, and inherited, from the Israeli military government, health services that had been neglected. Supported by enormous funding from international donors (Schoenbaum et al., 2005), the Ministry has since improved and extended the health-system infrastructure by institution building and human-resource development (Hamdan and Defever, 2003). The number of hospitals, hospital beds, and primary health-care centres in the country increased, a public-health laboratory was established, and a health information system and a planning unit were set up. Planning for the development of the health sector began during this period, and entailed some coordination with the UN Relief and Works Agency, local non-governmental organisations, and the private medical sector in developing policies and protocols (Giacaman et al., 2003).

The Palestinian Ministry of Health recognises its weak role in the organisation, regulation, and supervision of the health sector, and in the coordination of policy making and planning among health-care providers, especially those of the private sector. Several factors, some internal and some external to the health and political systems, account for the inability of the Ministry of Health to assume the stewardship role needed to make a health system.

The challenges facing occupied Palestinian territory (oPt) include:

1. Occupation, access restrictions and related emergency conditions that seriously affect the operation of health services.
2. Health system fragmentation, between the West Bank and the Gaza Strip and between different providers.
3. The rising burden of health expenditure, particularly from increased staffing, pharmaceuticals and referrals abroad raising questions about long-term affordability in the absence of strong economic growth.
4. Increasing poverty and high out-of pocket expenditure on health; the lack of adequate health promotion programmes to combat lifestyle-related diseases and conditions.
5. Inadequate capacity in the Ministry of Health to monitor environmental health safety.
6. Lack of human resource development and motivation, including retention of qualified staff, medical, nursing and midwifery education and continuing education of existing professionals.

The opportunities include:

1. Health status (as measured by key health indicators) is still relatively good.
2. Committed leadership for health development.
3. The active role of civil society organisations and academia.
4. A qualified health workforce.

5. The support and commitment of the international community.
6. Awareness of the need for better donor coordination and alignment.

The leading causes of death are cardiovascular disease, cancer, cerebrovascular disease and diabetes, reflecting the main health challenges currently facing the occupied Palestinian territory. The prevalence of noncommunicable diseases and their risk factors are high. Among Palestinians aged 15–64 years, data indicate that 58% are overweight, 36% have high levels of cholesterol, and 8.5% have diabetes mellitus (MoH, 2012).

Infant mortality rates have declined in recent years in both the West Bank and the Gaza Strip. Infant mortality in 2011 was 18.8 per 1000 live births and the under-five mortality rate was 21 per 1000 for the occupied Palestinian territory. Two thirds of infant deaths occurred within the neonatal period, mostly during the first days of life. Conditions originating in the perinatal period are the leading cause of under-five mortality in the West Bank, representing 36.7% of all causes of death for this age group in 2011. The maternal mortality ratio was reported as being 26.3 per 100 000 live births in 2011 in the West Bank and 29.9 per 100 000 live births in the Gaza Strip (MoH, 2011).

Anaemia and micronutrient deficiencies are longstanding areas of concern. There is a high prevalence of anaemia among pregnant women at 27.8% (17.4% in the West Bank and 36.8% in the Gaza Strip) but the vast majority of cases are mild (72%) or moderate (27.7%). Overall anaemia prevalence among children aged 9–12 months old was 57% (48.9% in the West Bank and 68.1% in the Gaza Strip) but less than 1% were cases of severe anaemia (MoH, 2011).

Communicable diseases have low incidence rates, although viral hepatitis A, B and C are endemic in the occupied Palestinian territory. In 2011, hepatitis A had an incidence rate of 23.1 per 100 000 population. The incidence rate for bacterial meningitis was 13.8 and that for viral meningitis 24.3 per 100 000 population, however incidence rates were much higher in the Gaza Strip (31.1 and 50.3 respectively) than in the West Bank (3.14 and 8.4 respectively). The incidence rate for leishmaniasis was 7.3 per 100 000 population for the occupied Palestinian territory as a whole, but found solely in the West Bank (11.9). The incidence rate for pulmonary tuberculosis was 0.5 per 100 000 population and 0.02 for HIV (MoH, 2011).

2.4 Population Size

The current population for the occupied Palestinian territory is 4 293 313 (2 649 020 in the West Bank and 1 644 293 in the Gaza Strip) (MoH, 2012). At the end of 2012 unemployment in the West Bank was 18.3% and in the Gaza Strip 32.2% (PCBS, 2012), due to restrictions on movement, imports and exports, and low private sector investment. Poverty remains widespread and the gap

between the West Bank and the Gaza Strip is widening: the poverty rate in the occupied Palestinian territory based on consumption patterns in 2011 was 25.8% (17.8% in the West Bank, and 38.8% in the Gaza Strip) (PCBS, 2012). Restrictions on the movement of people remain in place.

2.5 Health Care Financing

National health accounts are not available in occupied Palestinian territory (oPt); therefore there are no reliable recent estimates of health spending. Total health spending is estimated at about 8% of gross domestic product (GDP). GDP in 2007 was estimated to be US$ 4165.4 million; about US$ 1257 per capita. Ministry of Health expenditures amounted to 10.5% of the total PNA budget for 2009. Financing of the health sector derives from taxes, health insurance premiums, co-payments, out-of-pocket payments, international aid and grants as well as nongovernmental resources (MoH, 2010).

2.6 Health Care Delivery

Health services are delivered by the Ministry of Health, UNRWA, nongovernmental organisations and the private sector. The Police Medical Service provides medical care to the police forces and their families in the West Bank.

The Ministry of Health owns and operates the largest network of Facilities, with 425 PHC centres and 24 hospitals with 2857 beds in the West Bank and Gaza Strip (MoH, 2012).

The Ministry of Health provides preventive health services through four primary health care levels.

Level 1: maternal and child health medical care and immunisation; and therapeutic services; first aid.
Level 2: maternal and child health and immunisation; and therapeutic services: general practitioner medical care and laboratory in some centres.
Level 3: maternal and child health, immunisation, family planning and dental care; and curative services: general practitioner medical care, medical specialists, health education and laboratory.
Level 4: maternal and child health, immunisation, family planning and dental care; and therapeutic services: general practitioner medical care, medical specialists, gynaecology and obstetrics, laboratory, radiology, health education and emergency medical services.

There are 76 hospitals in occupied Palestinian territory (oPt), with 4878 bed capacity which is about 13 beds per 10,000 population. While Ministry of Health hospitals are often crowded, nongovernmental hospitals, private hospitals and mental health hospitals are underutilised (MoH, 2012).The average occupancy rate of Ministry of Health hospitals was estimated at 70%, while the overall average of occupancy rate of hospitals is 62% (MoH, 2012).

2.7 Human Resources

According to Ministry of Health figures, there are about 40000 staff working in the health sector. The Ministry of Health as the principal health care provider is the main employer. There are 966 specialists, 1455 general practitioners, 221 dentists, 391 pharmacists and 3647 nurses and midwives and1344 paramedical staff working at Ministry of Health Facilities. Approximately 59% of Ministry of Health staff are employed in the hospitals, 27% in primary health care and 14% in the other Ministry of Health directorates (MoH, 2012).

2.8 Health Information Systems in Palestine

The present budget of the Ministry of Health does not include any support for development of the health information system. All the budget items related to the health information system are mainly salaries for full time employees. The majority of activities that were heading towards development of the health information system were donor driven. Donor activities, however, have been irregular and inconsistent, making planning very challenging for creating a systematic health information system development plan.

There are laws that require private health facilities in the West Bank and Gaza to supply the Health Information Centre with data about morbidity and mortality as well as data about financial issues related to the services provided. But so far the MoH does not have the mechanism that encourages private sector health care facilities to provide reliable data for the MoH. Therefore, the reporting on health activities is limited to the governmental and NGO health facilities.

The 1994 Palestinian National Health Plan stated ―an efficient nationwide computerised information system is quite necessary for improving health care management". Given this critical role of a computerised information system, the 1994 plan identified an HMIS as a priority area for development of the health system.

Health information systems should be defined relatively broadly to include all types of data that are directly relevant to health system planning, operation, and evaluation. These data encompass vital statistics; epidemiological data, including but not limited to nutritional status, vaccine coverage, microbial resistance, behavioural risk factors, incidence of infectious disease, incidence and prevalence of chronic illness, and disease registries; hospital cost and discharge data; data on cost and use of ambulatory care; inventory and consumption data for pharmaceuticals and other medical products health insurance registry; tracking systems for international referrals, and medical records.

Many of these types of data are currently collected in some fashion in the Palestinian health system. For instance, vital statistics are maintained by the Palestinian Central Bureau of Statistics, which shares these and other data within the government and with outside parties. Many types of epidemiological monitoring have been conducted by the Palestinian Central Bureau of Statistics and the MoH, including population and clinic-based surveys of nutritional status and vaccine coverage, tracking of infectious disease, and data on the incidence and prevalence of non-communicable and chronic diseases. Anthropometric status has been included in paediatric medical records in the government health system since the 1980s. Some data are available on the use of inpatient and outpatient care, particularly within the government health system.

The Palestinian health information system collects data on a regular basis from primary health care centres (all levels) through standardised forms. These forms cover mother and child care (MCH), morbidity, dental health, vaccination, communicable diseases and non- communicable diseases. In the health care centres the staff responsible for filling in the form copy information from the patient records to the standardised statistical form on a daily basis.

The forms are sent on a monthly basis to the District health directorate. After the data are entered at the District health directorate, they are sent to the PHIC to be integrated and to produce a national data set.

The Health Information Centre has an experienced team in statistical data analysis. The team are experienced in analysing data using various statistical software such as Statistical Package for Social Sciences (SPSS), excel and Epi-info. The way data are being collected and stored limits the ability of the team at the Health Information Centre to conduct sophisticated data analysis. This is due to the fact that the data are being stored at the health facility level and not at the patient record level.

Some of the major weaknesses of the current health information system are as follows:

- Lack of allocated budget for HMIS.
- Lack of appropriate hardware and software.
- Delay in supplying resources due to a based bureaucratic administration.
- Inadequate existing HMIS, lacking standardised operations at both regional and national levels.
- Data not appropriately processed, leading to production of health data and indicators that were little used.
- Most organisations have their own information systems, which represent an entity composed of a variety of _logical' steps and physical resources. It is clear that this entity is strongly affected by all other subsystems of the organisation and also acts to affect them.

- There is an unnecessary recording and reporting burden on service staff which leads to great amounts of data accumulating while few are analysed and used.
- In general, data routinely reported by health services are considered to be of dubious quality (validity and completeness), and therefore are frequently not relied upon.
- Despite considerable investment in computers and data processing, inadequate use is being made of computers for better management and communication of health data.
- Effective co-ordination of health information is lacking which results in duplication and gaps in data collection, reporting use and management of data.
- Data are not stored at the case level (patient record). They are aggregated at the Facility level and at the level of visits. This weakens the ability of the PHIC personnel to do further analysis of the data; moreover it limits the indicators that can be produced out of the data. When data collection and data storage are performed at the patient record level, data access and confidentiality protocols will be developed. That is personal information will not be published. Data users can utilise raw data for statistical analysis purposes only without reference to use of personal information.
- No correlation analysis is possible among the various variables due to the current methodology in collecting and storing data at the Facility level.
- Vital statistics such as death notifications are gathered from the various health directorates. The death notifications suffer from deficiencies in terms of completeness of reported information about both the incidence and cause of death. For instance, occasionally for children who die under 5 years of age and were not registered at birth, their families might not inform the health authorities about the death—thus neither the death nor its cause are reported. This is most likely to happen in marginalised rural areas. However, the MoH has the most accurate database of death notifications; it is more comprehensive than the one available at the Ministry of Interior (MoI). An additional matter that makes it harder for the PHIC to calculate approximately maternal mortality is the lack of reporting on whether the deceased woman was pregnant or had given birth within 40 days of her death.
- Birth certificates go to the MoH database through the MoI. The MoI is the one responsible for issuing birth certificates. Sometimes birth notifications are delayed at the MoI prior to reaching the MoH; however, in general the level of cooperation between the two ministries is acceptable.
- Establishment of information databases in different MoH departments causes incompatibility between the different databases and ineffectiveness in analysing the data. The computerised

health information system used in the Ministry of Health is fragmented and differs from one department to another. Standardisation and integration are necessary.

- Many types of data that are crucial for effective health system planning and operation are not consistently available, including national health accounts that cover all health sectors, comprehensive chronic disease registries, and data on pharmaceutical prescribing and use. Even vital statistics data, which are relatively well developed, have important limitations. For example, births are recorded by the father's name and are not easily linked to the records of the mother. A related issue is that many types of data are collected in some divisions of the health system, but not in others and/or are collected in different and incompatible formats in different locations. Furthermore many types of data are documented on paper rather than electronically.

In spite of efforts made by the MoH and several partners to strengthen health information management, there is still much room for improvement especially in terms of comprehensiveness and integration of the system. The quality of data collection has to be improved, and data analysis capacity at Central and District level remains insufficient. The data have scarcely supported national planning efforts, policy development research and evaluation. Many types of data that are essential for effective health system planning and operation are not consistently available. Moreover, many providers, NGOs and International Agencies, are collecting and analysing data for monitoring purposes of their own programmes and activities, resulting in a scattered and sometimes inconsistent and contradictory flow of information.

2.9 Summary

This chapter has provided an introduction to the health system in Palestine, which is the application domain for the research described in this thesis. An historical overview, the health system in Palestine, population size, health care financing, health care delivery, human resources, and health information systems in Palestine have been discussed.

The next chapter will review the literature relevant to information systems, with particular application to the health sector, including specific issues relating to developing countries with particular reference to Palestine. The review will examine definitions of data, information, information theory, information types, information value, information challenges, information quality and information system.. In addition this chapter will examine definitions of management information systems and health information systems, including components. Moreover, using information to make decisions, application of information and communication technologies in the health sector, challenges in implementation of health information systems in developing countries and evaluation of health information system will be discussed. In the process, particular emphasis is

placed on the growing literature on the Health Metrics Network (HMN) framework and the performance of routine health information systems (PRISM) framework employed in different country and regional contexts, routine health information system **(**RHIS) performance, RHIS determinants and PRISM intervention.

Chapter Three

Literature Review

3.1 Introduction

This chapter will review the literature relevant to information systems, with particular application to the health sector, including specific issues relating to developing countries with particular reference to Palestine. The review will examine definitions of data, information, information theory, information types, information value, information challenges, information quality and information system. In addition this chapter will examine definitions of management information systems and health information systems, including components. Moreover, using information to make decisions, application of information and communication technologies in the health sector, challenges in implementation of health information systems in developing countries and evaluation of health information system will be discussed. This chapter will review the Health Metrics Network (HMN) framework. In the process, particular emphasis is placed on the growing literature on the performance of routine health information systems (PRISM) framework employed in different country and regional contexts, routine health information system **(**RHIS) performance, RHIS determinants and PRISM intervention.

3.2 Data and Information

3.2.1 Data, Information and Knowledge

The terms data, information, and knowledge often are used interchangeably. However, there is a conceptual difference between these three terms. Data are a representation of facts about things or entities in the real world (Agamalian et al., 2002).When data are put into context, they acquire meaning, and become information. The application of information in a specific context becomes knowledge (Agamalian et al., 2002). An important key concept regarding data is that processed information for one level of the organisation may be only raw data for another level (Mckeown and Leitch, 1997). Through experience, people learn to understand the significance of information, and use it to make ~~–in~~formed" decisions under all circumstances; crisis or normal. The outcomes associated with those decisions are more immediate and visible during crisis. These decisions often lead to an action that is taken with the goal of having a positive impact on a person or situation.

3.2.2 Information Theory

Shannon in 1948 laid the foundation of the modern science of Information Theory. He defined information in terms of reduction in uncertainty, making information and communication as the focal points of his theory, which was called "The Mathematical Theory of Communication" (Senn, 1999).

Schweber (2001) explained this theory by "A Mathematical Theory of Communication offered a precise definition of information content in terms of the number of bits you need to transmit".
Communication is any procedure by which one person might affect the mind of another. This includes all aspects of human behaviour, not merely, written narrative and oral speech. There are three levels of potential problems in the communication of information (Shannon and Weaver, 1994; Senn, 1999).

1- Technical: How accurately can the symbols of communication be transmitted?

   The technical problem concerns the accuracy of transmission of a set of symbols from the sender to the receiver.

2- Semantic: How precisely do the transmitted symbols convey the desired meaning?

   The semantic problem is concerned with how precisely the receiver understands and interprets the sender's meaning. Thus, designers of computer-based systems must ensure that output is presented in a way that can be understood and used by the recipients of the information.

3- Effectiveness: How effectively does the meaning affect the behaviour in the desired way?

   The effectiveness problem concerns the success of the communication in producing the desired actions or conduct. Effective communication makes clear the intended meaning and results in proper action being taken.

3.2.3 Information Types

Senn (1999) classified information needed by top level managers into seven categories:

- Comfort information: keeps managers informed about current situations or achievement levels; allows the individual to know that performance is on track and on time with general expectations in an area of interest.
- Status information: keeps managers abreast of current problems and crises as well as reporting advances to take advantage of opportunities that may disappear if not acted on.

- Warning information: signals that changes are occurring, either in the form of emergency opportunities or as omens of trouble ahead that will affect the success of the firm, its products or services.
- Planning information: description of major development and programmes due to begin in the future; includes assumptions on which plans are based or anticipated developments essential for the realization of the established plan.
- Internal operations information: key indicators of how the organisation or individuals are performing; useful for reporting the overall health of an organisation, subsidiary, division or product. Areas in which actual performance does not match expectations are reported as exceptions.
- External intelligence: information, gossip and opinions about activities in the environment of organisation.
- Externally distributed information: information the chief executive wishes to review before its release to stockholders.

3.2.4 Information Value

Attributes of information are the characteristics that are meaningful to the user of each individual item of information (Senn, 1999). They include accuracy (information is true or false), form (distinctions of form are qualitative and quantitative, numerical and graphic, printed and displayed), relevance (information is relevant if an individual needs it in a particular decision-making or problem-solving situation), completeness (if a set of information tells the user everything that needs to be known about a particular situation, we say that it is complete), timeliness (any manager has two important concerns: is the information available when I need it? And is it outdated when I receive it or when I want to use it?) , and value **(**amount of knowledge previously gathered or stored).

Value involves another key element in the entire analysis, the information receiver. The person who obtains and uses the transmitted knowledge is the one who should place an economic valuation on it (or a utility). This means that it may not be possible to establish a universal and absolute value for a unit of information (Senn, 1999).

The value of information in a message is relative to the value it adds to the total information or body of knowledge. In other words, the focus is on the incremental value of information in a message, the additional economic gains that can be obtained by using it. Value does not depend on how much

information the message contains, but on its relation to the amount of knowledge previously gathered or stored.

3.2.5 Information Challenge

One of the most important categories of challenge that are facing any organisation, especially healthcare ones, are those related to information itself. The primary problem resulting from these challenges was summarised in the concept "Data Toxicity" (Agamalian et al., 2002).

Data Toxicity is an overload of redundant, inaccurate, uninformative or confusing "facts" often leading to incorrect conclusions. In other words, enormous masses of data are being generated and disseminated, thus the ability to produce the needed information is lost in the process and the quality of the information that is being produced, is not optimised. The major challenges leading to the problem of data toxicity are the lack of data standardisation, including terminology and information representation, the absence of standard process for capturing and storing data, poor quality of data in both paper-based and electronic information sources, lack of skills in processing and dealing with gathered data, also lack of priority setting (i.e. it is easy to say we want to log everything and report on everything, but reading all reports takes time).

It is important to examine current data collection processes. Key personnel (working with real data) should be asked to group the data in one of the following categories defined by Agamalian et al. (2002).

- Essential to know.
- Nice to know.
- Useless to know.

The process assists in setting clear priorities. Those stakeholders (managers at various levels in a hospital, as well as front line staff) should be encouraged to consider what is missing from current data collection procedures and compared to what is required. By this, "Data Toxicity" can be limited and managers will be able to define essential data they need to run their hospitals especially in crises (where time is limited and decisions have to be taken).

3.2.6 Information Quality

Poor quality information used by organisation decision-makers can lead to terribly dangerous things (Agamalian et al., 2002). According to the ―quality" literature, it is the consumer who will judge whether or not a product is fit for use, and that of good quality (Juran, 1989). Agamalian et al. (2002) defined quality information as ―information that is fit for use by information consumers". Information experts also agree that to be of high quality, information should be intrinsically good, contextually appropriate for the task, accessible to the information consumer, and clearly represented (Strong et al., 1997).

The process of providing quality information, therefore, requires consistently meeting knowledge-worker (the one who works for a living at tasks of developing or using knowledge), end-customer expectations and enabling them to perform their jobs efficiently and effectively. The process of providing quality information applies to all purposes for which the information is used, including both present and likely future uses (Agamalian et al., 2002). Measuring, improving and maintaining the quality of information depends as much on organisational culture, organisational politics (who ―owns" the information) and process, as it does on technical factors.

This comes from the idea that considers information as an asset. Thieraul (1996) considered data as the sixth resource of a typical organisation. He expressed that it is not only useful for assisting the traditional 5 Ms (manpower or human resources, machines, money, material, management), but also more attention must be paid to information.

Thieraul (1996) expressed ―*the organisation's data resource is growing in size, complexity and value*", in this case a kind of ―Data Mining" is so essential.

This depends mainly on the process of creating, storing, and using data, having standard data definitions, and well defined data models; having standard processes for ensuring data quality; and having processes ensuring the data are turned into information and used appropriately and in a timely manner by the designated persons.

3.2.7 Information Systems

Information systems in organisations can be defined as a set of people, resources, and procedures, that use computer technology as a means to collect data and produce information for improving organisational efficiency (Boddy et al., 2005). According to Davis (2000), an information system can be defined from two perspectives: a system-oriented definition and a definition that describes the organisation and activities of the information system function. A system-oriented definition

describes information systems based on its components and the purpose it serves. According to this perspective, Davis defines information system as:

"Information system consists of the information technology infrastructure, application systems, and personnel that employ information technology to deliver information and communications services for transaction processing /operations and administration/management of an organisation. The system utilises computer and communications hardware and software, manual procedures, and internal and external repositories of data. The systems apply a combination of automation, human actions and user-machine interaction"

Conversely, Davis (2000) describes the information system on the foundation of the processes of system development, management and system evaluation. This approach engages not just with the technical components, but also organisational and human aspects such as: strategic planning, management of information system function, information system personnel, systems development processes, and system evaluation (Davis, 2000). Strategic planning activities include simultaneously aligning organisational strategy along with information system strategy; management of information system function refers to processes such as selecting and managing outsourcing contracts; information system personnel includes selecting, motivation and training human resource for information system analysis, design, and development; system development processes comprise specifying user requirements and producing prototype; and system evaluation deals with assessing satisfaction with systems in terms of economical or organisational effects (Davis, 2000).

The field of information systems, therefore, deals with systems for developing information and communication services in an organisation and activities and management of the information systems function in planning, designing, developing, implementing and operating the systems and providing services (Davis, 2000). These systems function to capture, accumulate, process and communicate data, information and knowledge. In doing so, information systems combine technical components, human operators and users, work procedures, and organisational matters.

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

Computerised information systems are believed by Alvarez to benefit organisations over paper-based information systems by (Alvarez, 2004):

- Processing and analysing 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.

3.3 Health Information System

Sauerborn (2000) points out that the objectives relating to health information and its use have changed over time. While starting out oriented towards collecting information on diseases, the ultimate goal of the health information system is now to improve action, not to gain information. There is generally made a distinction between two types of health information systems; patient-based and often complex clinical health information systems typically found in hospitals, and routine health information systems, based on aggregated data from clinics or specific geographical areas (Thorseng, 2008).

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.

There is a relationship between routine health information systems and the health system at large.
A health information system (HIS) cannot exist by itself, but is a functional entity within the framework of a comprehensive health system to improve the health of individuals and the population. As such it is a management information system. Although many definitions of a management information system have been proposed, Hurtubise (1984) defined a Management Information System (MIS) as: *"a system that provides specific information support to the decision-making process at each level of an organisation*".

Heeks (1998) defined a Management Information System (MIS) as "*the system that provides reports which assist the managerial monitoring and control of organisational functions and resources"*.

Health information is the key product (output) of the HIS and simultaneously a key input for decision-making and action, with a wide potential use to support all aspects of health action, such as planning, decision-making, operation, surveillance, monitoring, evaluation and research.

The ensure effectiveness, the production of suitable information should be centred on the needs of the users of such information, acceptable to those who participate (producers and users of information), standardised to permit for consolidation and comparisons, and supported by national health and political authorities. Decisions for investing in the HIS - to improve information - are justified by the high needs for information, when conditions for feasibility, readiness and cost benefit exist (Gattini, 2007; WHO, 2007).

Once the information has been produced by the HIS, some information-based processes - such as analysis, monitoring, surveillance and evaluation - facilitate information to become a meaningful input for action. Whilst information by itself has a large potential intrinsic value, the ultimate usefulness depends on the concrete use made by policy and decision-makers, and the contribution made by those monitoring processes that use information to orient action. The HIS is therefore responsible for the production of effective timely information, but cannot be entirely accountable for the actual use finally given to that information (Gattini, 2007; WHO, 2007).

The HIS – through collecting, processing and providing information for action - contributes to make health systems responsive to health needs of the population, by supporting health systems performance and effectiveness, as well providing evidence for appropriate health systems management, strengthening and reform.

New and higher demands for information are continuously coming from those who use it: health sector and decision-making processes tend to increase complexity and dynamism, health systems evolve under reforms, information is increasingly more used at the level of data collection, and there is the need for higher accountability. There are great and rapid changes in information-related technology. Also, there is country empowerment and accountability at different levels, leading to changes and increase in the needs, demand, access and use of information. Given that the demand usually overpasses the relatively limited supply of information, the HIS needs to give priority to the production of information that is relevant, accurate, meaningful, feasible and useful for health action (Gattini, 2007; WHO, 2007).

The consolidation of the HIS (i.e. a stage that has reached full organisation, coordination and optimum performance) is facilitated when a central NHIS management unit is in place and able to coordinate and integrate efficiently all the interrelated productive processes carried out by the nationwide series of particular information systems at different levels, with active integration and coordination of all stakeholders (Gattini, 2007; WHO, 2007).

Despite all efforts that could be made towards HIS consolidation, the HIS tend to face the progressive risk of technical and functional obsolescence as well as lower responsiveness to the increasing demand for information (irrespective of the consolidation level reached at one point by the HIS).

3.4 Components of Health Information System

The Health Metrics Network (HMN) framework identifies the key components and standards of a country‘s health information system. The framework describes health information system components in terms of resources, indicators, data sources, data management, information products, and dissemination and use. The framework lays out standards to be attained for each component and describes data-management, transformation of data into useable information, dissemination and use (WHO, 2007).

The framework divides the components into three categories: inputs, processes and outputs (see Table 3.1).

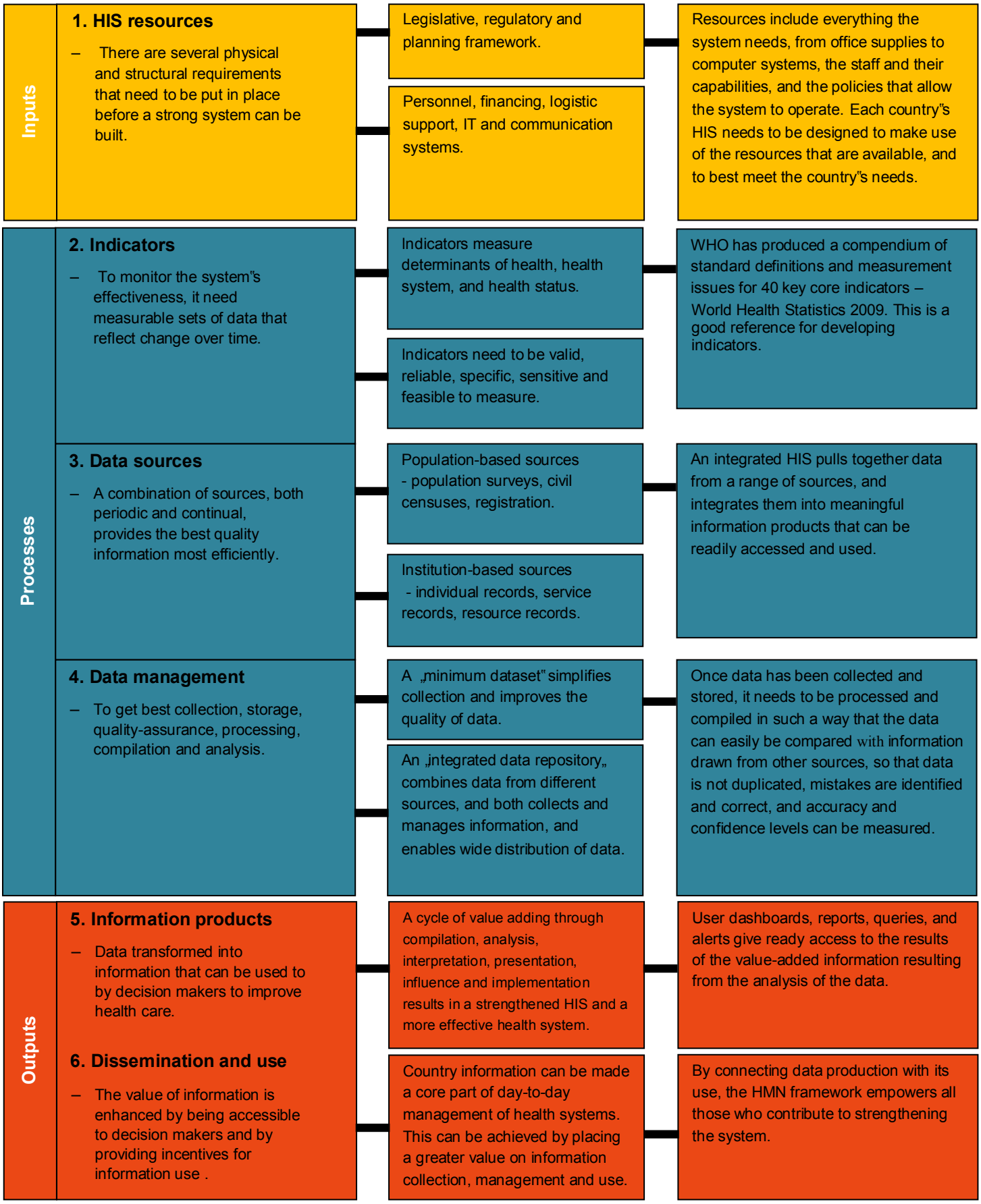

Table 3.1 Health Information System Components
Source: WHO (2007)

The inputs category includes all HIS resources – the physical and structural prerequisites of an HIS. These include the ability of those responsible to lead and co-ordinate the process; the existence of necessary laws and policies; financial resources and people with the necessary skills to do the work; and finally the infrastructure – everything from office space and desks to filing systems and computer networks (WHO, 2007).

The processes used by an HIS include:

- Indicators – a set of measures that monitor changes in the country‘s health profile;
- Data sources –data from a variety of sources that are combined to yield an integrated HIS.
- Data management -processing data to enable easy access to relevant information for those who need it, while protecting the privacy of individual patients.

The information produced – the HIS outputs – needs to be relevant, accessible, and useful evidence for decision making.

- Information products are collated from a range of sources, and synthesised into usable statistics that can be analysed and compared.
- Through widespread dissemination and use of information products, the HIS provides direct benefit to all those who participate in it, providing an ongoing incentive for users to continue to strengthen the system.

3.4.1 Resources of the Health Information System

During operation of the HIS there are certain prerequisites that should be fulfilled, legal, regulatory and planning frameworks need to be in place in order to guarantee a fully functioning of HIS and availability of resources for health information necessities, including human potential, logistical support, information and communication technologies and the coordinating mechanisms in terms of and between those six components (WHO, 2007).

Information policies. This refers to a legal and regulatory context within which the application of the health information is generated, which is actually a crucial element because it allows the establishment of mechanisms to ensure availability, exchange, quality and sharing data. The existence of a legal and policy framework which is consistent with international standards enhances confidence in the integrity of the results.

Human resources. Improvements of the healthcare information system cannot be achieved if a proper attention is not paid to the training, development, reward and career growth of staff at all levels. Numerous skilled epidemiologists, statisticians and demographers are needed on a national

level in order to monitor the quality of data and to ensure accurate analysis. At a peripheral level, health information staff should be responsible for collecting, reporting and data analysis.

Information and communication technology. Information technology can affect the improvement of the quality of data collected and communication technology can improve the timeliness, analysis and information usage. This indicates the need to adopt a clear policy of data management, which would also point out the issues of privacy and confidentiality. Ideally, at a national and sub-national level, health managers should have access to the information infrastructure that includes computers, email and internet access. National and regional statistical units should be equipped with transport and communication equipment in order to facilitate timely collection and compilation of data on sub-national level.

Coordination and leadership. It is necessary to establish an expert group drawn from the country's health and statistical sectors. The group should be responsible for development and maintenance of the healthcare information system and should ensure that information is shared between programmes and institutions.

3.4.2 Indicators

A healthcare information system is not restrictively limited to the health sector, at the same time, there is a strong connection between this system and the information systems in the other sectors. HIS should provide information that would meet wide range of needs, from the data for delivery of services to individual customers, statistical data for planning and management of health services and measurements relevant to health policy formulation and evaluation (WHO, 2007).
Some essential health indicators in the assessment of changes in the three main areas are required: determinants of health, healthcare system and health status (see Figure 3.1).

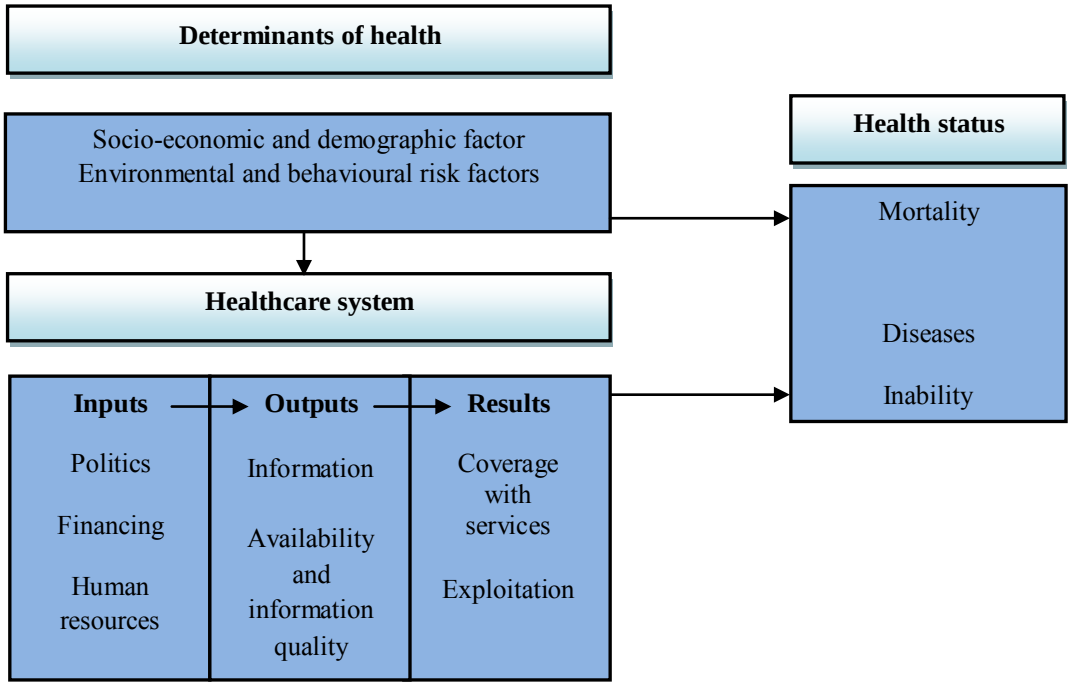

Figure 3.1 Measuring Areas of Healthcare Information Systems
Source: WHO)2007(

It is essential to make a rational selection of the minimum set of core health indicators. Health indicators should be valid, reliable, specific, sensitive and feasible to measure. They also need to be relevant or useful for decision making at the level of data that are collected or where necessity for data at higher levels is quite clear.

3.4.3 Data Sources

The selection of the most appropriate data source depends on the necessary information, the effectiveness and convenience of methods, human and technical capacity required for data collection, management and dissemination of data, as well as the financial and time constraints. All national healthcare information systems should be based on a set of core data sources. Sources of data, as seen from Figure 3.2 can be divided into two broad categories: those that generate data concerning the population as a whole (population-based sources) and those that generate data for operations related to health services (health service sources) (WHO, 2007).

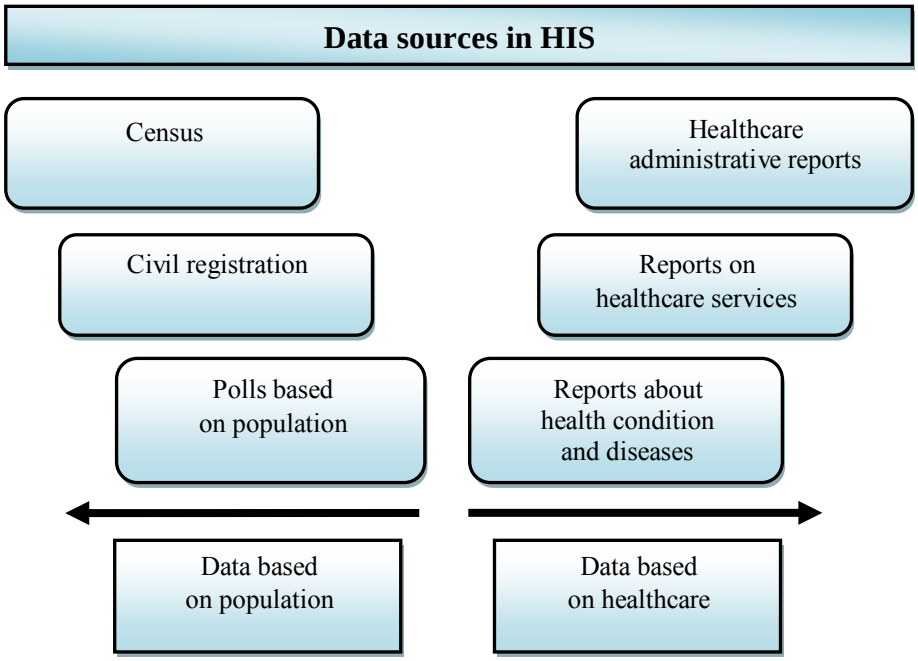

Figure 3.2 Data Sources into a Comprehensive Healthcare Information System
Source: WHO)2007(

Every important health indicator should be associated with one or more appropriate data sources. Sometimes there is only one method of data collection, but it happens very often that diverse data sources can be used in generating similar indicators. In such a situation, all the circumstances should be taken into account, in order to make decisions about the most appropriate data sources (see Table 3.2) (WHO, 2007).

	Health status	**Healthcare system**		**Determinants**
		Inputs and outputs	**Results (benefits)**	
Census				•
Life‘s statistics	•			•
Polls	•	•	•	•
Reports on health status	•		•	•
Reports on services	•		•	
Administrative reports		•		

Table 3.2 Data Source for Indicators According to Regions
Source: WHO (2007)

3.4.4 Data Management

Data management involves a set of procedures applied during collection, storage, analysis and distribution of data (see Figure 3.3) (WHO, 2007).

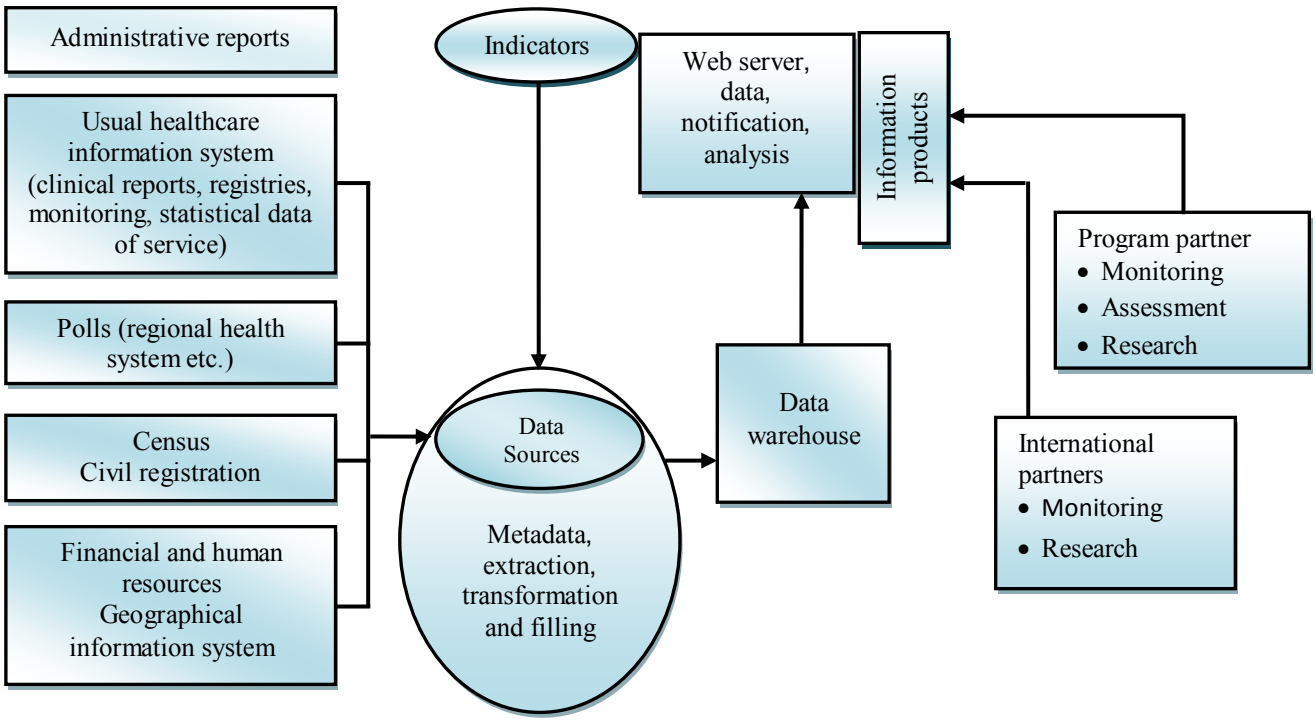

Figure 3.3 Data Management
Source: WHO)2007(

The collection of accurate and complete data is an essential prerequisite and a basic of data management plan. The tool used for this reason is the so-called metadata dictionary.

A metadata dictionary strictly defines the data elements and their usage in indicators. It specifies the method of collecting data, periodicity, and measurement techniques used, methods of assessment and possible inconsistencies in the data. It is an important factor in ensuring the quality and transparency of data.

Integrated data storage offers many significant benefits. Integrated data from different sources could perform the best application of complementarity and data synergy. Developing a data warehouse and metadata dictionary, it becomes possible to generate an integrated healthcare information system.

The analysis and presentation of data should improve their usage of local or district level where they could achieve the most significant impact on the delivery of health services.

A data repository provides instantaneous feedback of information to the institution or district level. At the national level, the data warehouse provides an adequate central location where all data are

available for analysis, evaluation and research, which in turn has an impact on decisions related to policy, planning and management.

The distribution of data at all levels within the country, beginning from the authorities as well as international partners, is eased owing to the data repository. It should be designed with a web internet network and is connected with suitable access control. A significant tool in the management of information is the electronic documentation centre where all related outputs of the country are accumulated.

3.4.5 Information Products

As previously discussed HIS data where defined in the form of products. However, the data represent just raw products. Appearing as such, they have a minor value until they are refined, controlled, organised and analysed. At this stage the data become information. Information should be available to the relevant users (WHO, 2007).

As in the case with this information system the quality of its information improves through cyclical processes of learning. This is necessary because individual information has only partial value until it is integrated with other information and can then be evaluated in the context of issues facing the healthcare system. At this level, information becomes evidence, which as such is used for making local decisions within the system (WHO, 2007).

In the course of the data‘s movement towards higher levels of the healthcare system through data repositories at these levels, they are synthesised and triangulated (comparison) with other sources and further on compiled into statistical data which are valuable for more thorough analyses and comparison within the healthcare system. The synthesis of the evidence is not complete until it is communicated and delivered to the management in a form that changes their understanding of issues and needs. At this level, the evidence becomes knowledge. Once knowledge is applied, it is logical to expect that through the planning process it could easily result in action or change, which in turn has an impact to the indicators. Such impact should be measurable through changes of statistical indicator data (see Figure 3.4) (WHO, 2007).

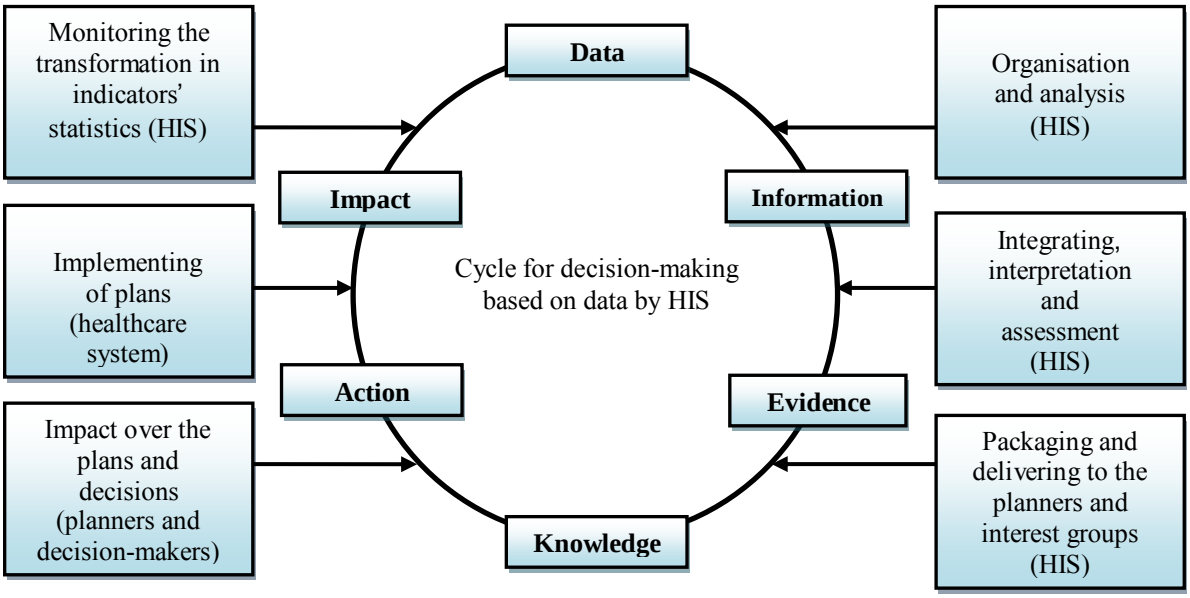

Figure 3.4 Relation of Data Impact over Healthcare System
Source: WHO)2007(

3.4.6 Dispersion and Usage

Information is used at various levels within the healthcare system through the processes of managing healthcare services, healthcare system management, planning, advocacy and policy development. Information dissemination should be planned in accordance with the specific characteristics of each user, in which the highest effective packaging and communication channel for transmitting information should be selected. The timing of the transfer of information should be carefully planned, in order to fully correspond with the planning cycle and the needs of users. Communication experts can be of immense assistance in packaging information for various audiences (WHO, 2007).

3.5 Using Information to Make Decisions

Information is critical at all management levels of health services from the periphery to the centre. It is essential for patient/client management, for health unit management, as well as for health system planning and management. This means that not only policymakers and managers need to make use of information in decision making, but also care providers, including doctors, health technicians, and community health workers. Unless this takes place, the substantial opportunity costs involved in set-up and maintenance for health information systems can be difficult to validate (WHO, 2000).

Information is not an end in itself, but part of a process to improve decisions in policy design, health planning, management, monitoring and evaluation of programmes and services including patient care, hence improving the whole health service performance and outcome (Sauerborn and Lippeveld, 2000).

The implied assumptions underlying information systems manifest themselves in two ways:

First, that once data were collected and categorised, they would be turned into useful information, which would impact upon decisions.

Second, that such information-based decisions will result in a more effective and proper use of limited resources through better procedures, programmes, and policies, the carrying out of which will lead to a new set of data which will then stimulate further decisions and so forth in a spiral fashion (see Figure 3.5). This generic view of the relation between information and decisions is applicable to patient care, health unit, and systems levels.

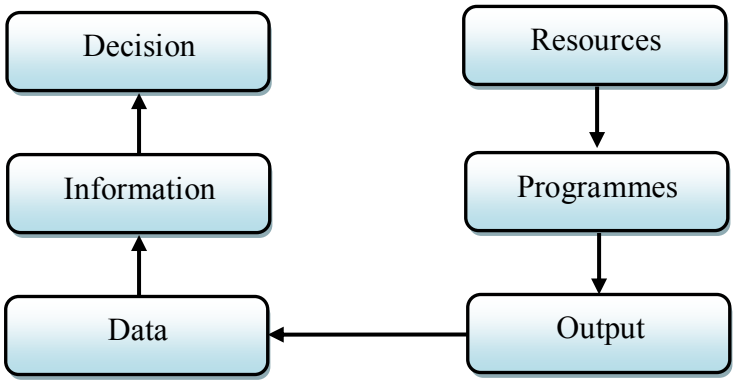

Figure 3.5 Idealized Relationship between Data, Decisions, Resources, and Programmes
Source: Sauerborn and Lippeveld (2000)

Most would agree that information can only provide a stimulus for decisions if it is applicable, reliable, and available for the decision-maker in a timely fashion. Unfortunately, the accessibility of

such high-quality information does not guarantee its appropriate use in the decision-making process (Sauerborn and Lippeveld, 2000).

For information to impact upon management in the best possible way, it has to be used by decision-makers at each point of the management cycle. Examples of these decision points include undertaking situational analysis, and setting priorities or implementing a programmed activity (see Figure 3.6).

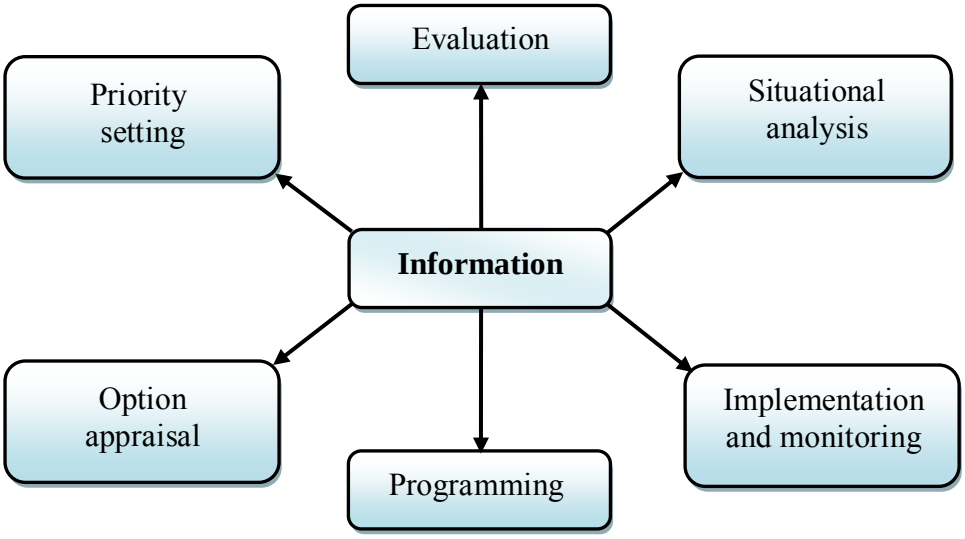

Figure 3.6 Information Support to each Step in the Management Cycle
Source: Green (1992)

A health information system allows health managers and service providers to document, analyse, and use information to improve coverage, continuity, and quality of health care services at all levels by better planning, monitoring, and evaluation of health services.

The ultimate success of a health information system (HIS) is measured by informed decisions that lead to action and positive change in the health system or health status, instead of depending on the quantity or quality of data produced. The most common problem that hinders use of information for decision making is the lack of feedback to local Districts and health care workers (Land and Kennedy, 2002). It is only when those providing the data begin to receive meaningful and useful feedback that they will begin to appreciate the value of data and will therefore take appropriate steps to improve the use of the data they provide.

There are a number of factors that foster or impede the use of information in decision-making. Behavioural, organisational and environmental factors greatly influence the extent to which information is used. Several models have been used to describe decision-making. The knowledge-driven model of decision-making by Van Lohuizen and Kochen (see Figure 3.7) and the classical model of decision-making by Lasswell (see Figure 3.8) represent decision making as a process

consisting of distinct linear steps. However, it has been argued that in the real world decisions are not made in a linear logical fashion but rather in an iterative way because the phases overlap. In addition, there are social and political dimensions that influence decision makers as shown in figure 3.9 below (Sauerborn, 2000). However as indicate in the figure without information the process of decision making cannot proceed.

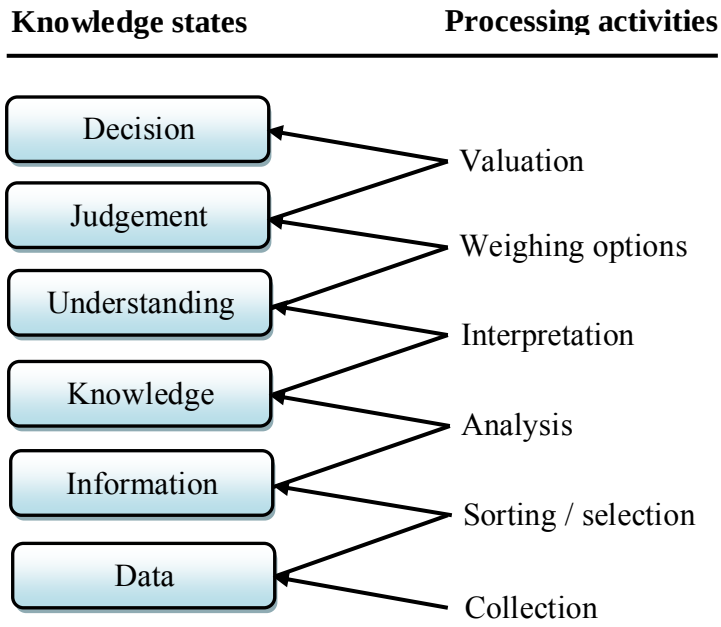

Figure 3.7 The Knowledge – driven Model for Decision Making
Source: Van Lohuizen and Kochen (1986)

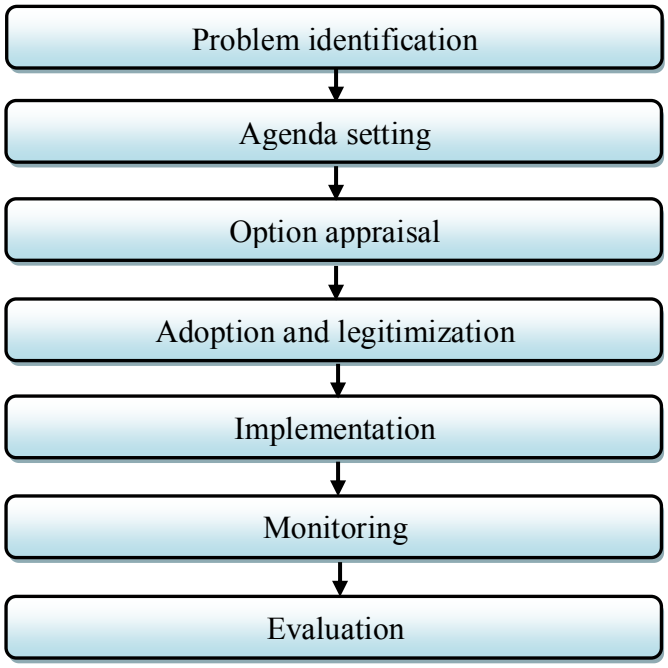

Figure 3.8 The Classical Model of the Decision – making Process
Source: Lasswell (1975)

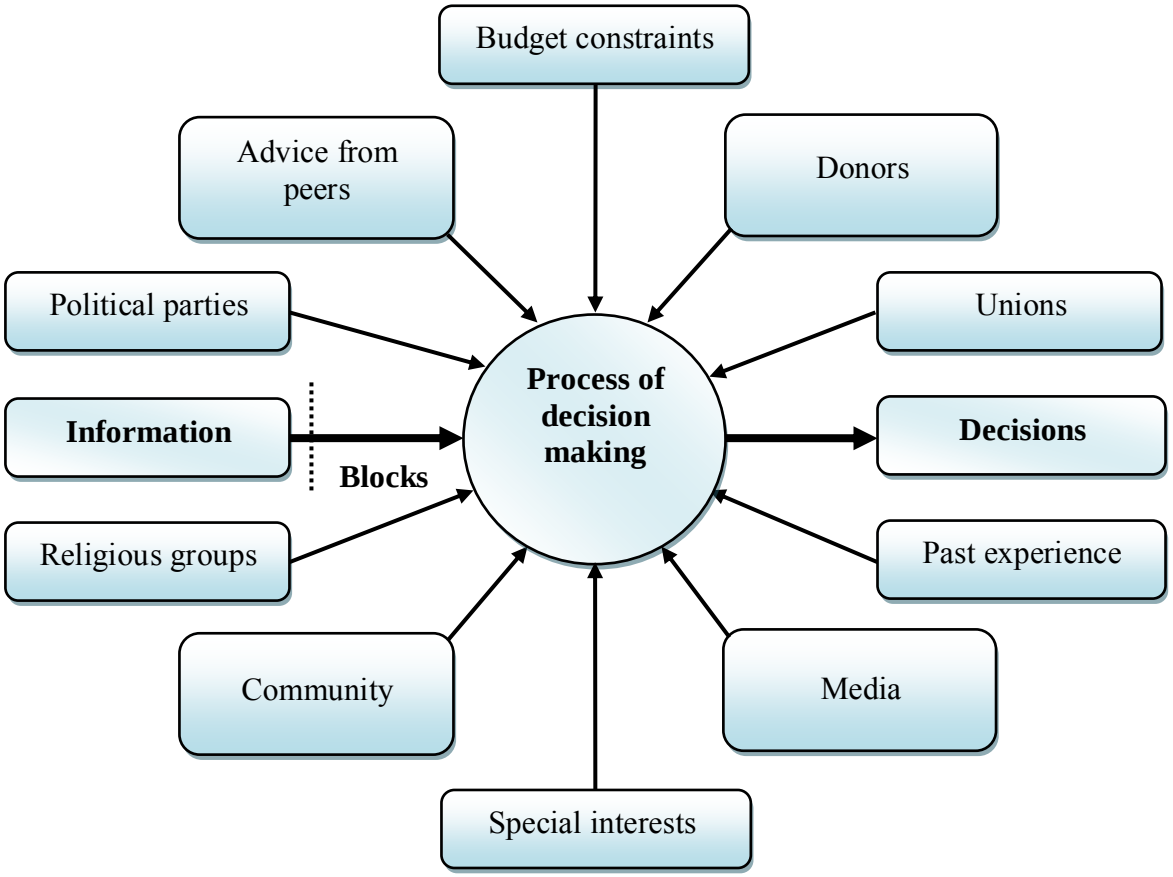

Figure 3.9 Political, Noninformational Factors Influencing Decision Makers
Source: Sauerborn (2000)

3.6 Application of Information and Communication Technologies in the Health Sector

Heeks (1998) defines information and communication technologies as "*electronic means of capturing, processing, storing, and communicating information*". These comprise computer hardware, software and networks, radio, television, telephone, books and newspapers.

The introduction of information technology (IT) is aimed at helping to manage limited resources, increase efficiencies and reduce workload. Thus, information and communication technologies (ICTs) and related systems can have potentially significant advantage to assist the economic growth and supply other developmental benefits to developing countries (Avgerou and Walsham, 2000). However, a diversity of factors retard the realisation of such benefits (Kimaro and Nhampossa, 2004). As Sahay and Avgerou (2002) argue there are two inter-related problems.

First, many organisations 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 organisational weaknesses they were intended to alleviate (Sahay and Avegerou, 2002)

Over the past fifteen years, several developing countries have increased their adoption of information and communication technology (ICT) for different applications in different sectors including health, education and public administration. Sahay and Avgerou (2002) point out:

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

Accordingly, many developing countries have been attempting to deploy ICT in different facets of governance, and health is a key focus area. As stated in a WHO (2006) report, a sound health information system depends on organised processes of gathering, sharing, analysing and using health-related data for decision-making.

Systematically designed ICT has the potential to create health information systems that are increasingly powerful management tools for the health sector by radically improving the availability, dissemination/transmission and use of health-related data (Walsham and Sahay, 2006; Stansfield et al., 2006).

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

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

Studies in the area of health information systems also indicated that the need for the application of ICT in routine health information systems is derived from two main reasons: First, the health care sector in general and routine health information systems in particular generate vast amount of data and this vast amount of unprocessed data prevents decision makers from obtaining useful information, thus, ICT is becoming the preferred option to process and present these data more quickly and accurately (Sandiford et al., 1992; Sahay and Avgerou, 2002). Second, the decreasing

costs of computer equipment have encouraged the health sector to apply ICTs even in low-income countries (Sandiford et al., 1992; Lippeveld, 2001).

Despite the potential of ICT in solving problems in health care, developing countries are failing to gain fully from these innovations (Stansfield et al., 2006). Avgerou and Walsham (2000) clearly stated this problem as: *"successful examples of computerisation can be found, but frustrating stories of systems which failed to fulfill their initial promise are more frequent."* Similarly, Heeks (2003) indicated 85% failure of e-government projects in developing countries. In a study done in Mozambique on the use and appropriation of ICT with a focus on the health sector, it was revealed that, "computers and internet are rapidly being spread to the provincial capitals and main districts in Mozambique. A major problem identified is the lack of ICT-skills and education and poorly developed infrastructure and network support" (Braa and Blobel, 2003; Hoffman and Podgurski, 2011).

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

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

Similarly, WHO (2004) has identified several constraints for not realising the potential of ICT in developing countries:

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

There is a long list of reasons in the literature for using computers in health information systems. Some of the reasons are as follows:

1. To improve health system efficiency by processing and analysing huge amounts of data quickly.
2. To generate a wide variety of outputs and feedback reports targeted for many levels of the health system from a single data set or by combining data set.
3. To reduce the duplication of work, this is typically seen in many hierarchical data collection systems.
4. To improve the quality of data collection through automatic validation during data entry and automatic preparation of instant feedback reports on errors for individual health facilities.
5. To improve analysis and information presentation to facilitate data interpretation and use for decision-making.
6. To train health personnel through computer-based interactive tutorials for self instruction and continuing education.
7. To improve data dissemination by providing online public access to data through Internet World Wide Web pages.

In addition to the direct reasons for using computer technology in health information systems, the process of computerisation itself can serve as an opportunity to review and improve dysfunctional manual systems and procedures.

The use of ICT in existing health systems according to Goldzweig et al. (2009) has helped to improve the delivery of health care in a number of ways. These include the use of telemedicine to improve diagnosis and enhance patient care, improvements in the continuing professional development of health workers and better sharing of research findings through e-health, and the use of health systems as an effort to extend the reach and coverage of health care to make an impact on specific conditions.

3.7 Challenges in Implementation of Health Information Systems in Developing Countries

Health care service delivery in developing countries is characterised by poor quality and inequity. The delivery of health services to the communities is a truly complex task (Braa et al., 2004). The 1978 World Health Organisation 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).

The declaration wrote up a worldwide vision of access and equity of health services in developing countries under the slogan "Health for All by the year 2000". In order to tackle the problems of primary health care, the declaration emphasised 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).

Information can be seen as a major source within this PHC framework both for making visible existing health status, and for improving coordination across different health services. Typically, both these goals have been difficult to achieve in practice because of different problems, and a majority of the population in the developing world still lives in very desperate conditions with inadequate sanitation and limited access to health care. The PHC approach is supposed to provide as the basis for reforms and the decentralisation of health services including the central role of health information systems to support decision-making, surveillance, reporting to higher levels of the health hierarchy, and improving and coordinating within and across health programmes (Braa and Hedberg, 2002).

The PHC approach entails the development of a district-based health information system to integrate different disperate information systems – paper and computer-based – so as to supply a holistic view of the health status of a region, and thus to better coordinate intervention efforts. The crucial assumption is that PHC services should be offered and managed using small geographic and demographic areas as the unit of focus so as to achieve effective communication with both the higher levels of the administration (Ministry of Health) and also the community. This framework has direct implications on the health information systems for enabling the local use of information, and consequently for strengthening the health information systems at all levels of management (Lippeveld, 2001).

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 achieved with well informed decision-making and resource management supported by effective information systems.

The introduction of appropriate information systems in developing countries is seen as a way to increase socio- economic development. The problems 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 (Krickeberg, 2007).

Heeks (1998) identified four kinds of health care information systems failure. The first one is –total failure" of system development which is never completed or if completed not used. Second is –partial failure" of system development where main goals are unfulfilled and thirdly, –sustainability failure" which refers to a system which is initially useful and productive but fails after some time due to multiple situation-specific factors that interrupt its durability. He further elaborated that sustainability failure is a type of failure that particularly affects developing countries. Lastly, Heeks (1998) mentioned –replication failure" which represents an initiative that succeeds in one area but can not be replicated in other areas.

Moreover, there are also other factors contributing to the inadequacy of health information systems in developing countries, some of them include:

3.7.1 The Problem of Data Quality

There are several reasons for data quality within health information systems being low. Reasons mentioned by Lippeveld (2001) are care providers receiving little, if any, training, rarely being given standardised instructions on how to collect data, and data collected being irrelevant for their own information needs. An additional reason for low quality of data is that health care providers at the lower levels are required to report vast amounts of data to higher levels, and get little or no feedback. This leaves them with little incentive to ensure quality of the collected data and to comply with reporting requirements (Lippeveld, 2001). These huge quantities of data reported lead to information overload at the higher levels, causing data often not to be used in practice (Abouzahr and Boerma, 2005).

Experience from South Africa has shown a negative correlation between the quantity of data collected and data quality, showing that the larger the data set to be collected, the poorer the quality of the data collected (Williamson and Stoops, 2001). According to Heywood and Rohde, worldwide experience is –that the more that information is used by people who collect it, the more accurate it will become". (Heywood and Rohde, 2001). Willamson and Stoops found that the mix of information that is available to health managers is often –inappropriate, difficult to understand and is generally accessed through interim, preliminary annual reports." (Williamson and Stoops, 2001).

A study of the data flow in the health information system in Tanzania (Lungo, 2003) and of the integration of health information systems in Zanzibar (Nyella, 2007) suggests that with efficient and extensive supervision, timeliness and completeness of reporting could reach an acceptable level.

3.7.2 Poor Infrastructure and Inadequate Resources

Any HIS requires appropriate infrastructure as well as human capacity and financial support in order to be successfully implemented and sustained. Yet most developing countries have an environment in which most essential resources are lacking. The health information systems operate in a state of inadequate human, physical, and financial resources (Lippeveld 2001). Health facilities are staffed by people who are poorly trained in both medicine and statistics, have no water or electricity supply, lack the most essential HIS supplies such as printed forms or registers, and are placed in geographically remote areas served with poor road infrastructure. The staff also are subject to high workloads. For example, a study in Mozambique by Mosse and Sahay (2003) shows that health personnel meet more than 100 patients a day leaving them without much time and energy to perform other administrative tasks relating to HIS. All this affects the quality of data generated from the process of data collection through data transfer and its analysis. Several countries have introduced computer equipment at the district level with attempts to strengthen HIS management, but have no qualified staff to maintain software and hardware, nor do they have enough capital to hire more staff. Basic supplies such as printer cartridges and paper are often out of stock. Often the most essential communication technology is lacking, such as a telephone line between the health unit and the district headquarters (Lippeveld, 2001).

3.7.3 Sustainability

Sustainability refers to the tendency of an information system to continue functioning over time, adequately serving its purpose regardless of certain changes in the organisation.

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

Heeks (2002) shows some examples of sustainability failure of a particular health information system initiative. Contextual factors such as transfer or resignation of key staff from his/her position and termination of financial support from donors are described as examples that cause sustainability failure to useful information systems. In the same way Korpela et al. (1998) also explain that software projects in developing countries may generate highly useful and operational systems but the sustainability of these systems may be problematic due to lack of long-term support or funds for

maintenance. Thus, lack of resources such as financial resource and skilled human resource can be described as factors that can adversely affect the sustainability of information systems. On the other hand, WHO (1993) indicated that a good information system can also be ineffective after it is implemented due to lack of adequate management and support structure that makes the information system to effectively operate. Therefore, although lack of financial resources and skilled human resource can be considered as factors that hinder the sustainability of information systems in an organisation, lack of managerial support is also an additional factor that can hinder the sustainability of computer-based information systems.

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 (2000) summarised some of them as:

- The folly of pursing 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 programmes in the Ministry of Health.
- Forms being reviewed and revised without confirming the service‘s information needs.
- Information needs based on detailed decisions or long lists of data elements.
- Mistaking computerisation for health information system restructuring.
- Donor-driven health information system restructuring.

3.7.4 Centralisation

Routine health information systems in most countries are centrally planned and managed. Indicators, data collection instruments, and reporting forms usually have been designed by centrally located epidemiologists, statisticians, and administrators (called data people), with minimal involvement of lower-level line managers and providers of the health services (called action people) (Lippeveld, 2001).

Decentralisation means a change of the exiting power relations, and the power and responsibility for decision-making need to be located at local level (Haux, 2006). Excessive centralisation is often a hindrance for manager to supervise efficacy of health services. Decentralisation should be planned and carried out within the local context to a void chaos in the system (Krickeberg, 2007).

Recent experiences have shown that decentralisation of information management toward the district level is an effective strategy to improve local use of health information in developing countries. In a survey of District Health Management Teams in Tanzania on the progress of the decentralisation process in that country, it was reported that, while decentralisation has been ongoing for over a decade, at least rhetorically, less than half of District Health Management Teams report that decentralisation is underway in their districts and the actual transfer of administrative and fiscal responsibilities is still limited for the majority of districts (Hutchinson, 2002).

It is expected that in decentralised health information systems most public health functions can be carried out by the District Health Management Team, in collaboration with and with active involvement of the community. Thus, delegation of information systems management responsibilities to the district level becomes a major step towards integrating individual and community health information systems (Lippeveld, 2001).

The importance and needs for appropriate decentralised district-based health information systems addressing the needs of local management and health workers has been widely acknowledged and emphasised by the World Health Organisation (WHO). According to the WHO definition,

A district health system based on primary health care is a more or less self contained segment of the national health system. It comprises first and foremost a well-defined population living within a clearly delineated administrative and geographical area. It includes all the relevant health care activities in the area, whether governmental or otherwise. It therefore consists of a large variety of interrelated elements that contribute to health in homes, schools, workplaces, communities, the health sector and related social and economic sectors. It includes self-care and all health care personnel and facilities, up to and including the hospital at the first referral level (Lippeveld, 2001).

3.7.5 Fragmentation

An integrated information system is advocated by many (Williamson and Stoops, 2001; Heeks, 1998; Mahundi, 2010). Yet, most health information systems are still found fragmented to various degrees. This fragmentation might have several causes; in developing countries one of them is the extensive involvement of development partners in the health sector.

Development partners are often represented in many countries, and anxious to maximise comparability between efforts in different countries, as well as being driven by demands for accountability; donors therefore support and implement their own data collection platforms (Abouzahr and Boerma, 2005). Development partners have traditionally had a huge amount of freedom to decide what data are to be collected. This, together with the fact that resources are

limited in the health sector, and in competing for these resource no one wants to be seen as part of the other, are causes for the fragmentation of the health information systems in developing countries (Lippeveld, 2001).

Historically, donor agencies or national programmes within the Ministries of Health developed their own specialised information systems, mostly under pressure and with financial assistance from external donor agencies (Sauerborn and Lippeveld, 2000). These vertical health programme information systems exist side by side and in addition to the routine health information systems, the latter being considered insufficient and unable to supply the information needed. While the vertical programmes were able to supply better quality data, the net result was that routine health information systems became "chaotic and bothersome" (Sauerborn and Lippeveld, 2000).

3.8 Evaluation of Health Information Systems

The term evaluation is generally understood to be a process of measuring. The approaches to the act of measurement are numerous and are tailored to the context of use. Although the act of evaluation is complex and wide-ranging, the succinct expression describing an evaluation as: "*the decisive assessment of defined objects, based on a set of criteria, to solve a given problem,*" (Ammenwerth et al., 2010) gives an accurate depiction of methods, parameters and outcomes. All of these are associated with the process of measurement.

Another related description notes that an evaluation is the process of describing the implementation of an information resource and judging its merit and worth (Friedman et al., 2006). The cause for an evaluation is also important to its definition. An evaluation has no value in itself; it is performed in the context of informing a decision (Brender, 2006). At the end of an evaluation, information from a selected perspective is made available for decision making (Ammenwerth et al., 2004).

It is vital to frame the context of the evaluation. This determines whether the activity is judged as an evaluation or a research project. The distinctive attribute is the influence of stakeholders in the process (Anderson and Aydin, 1994).This in no way diminishes the rigor and principles necessary for the evaluative activity. This "systematic application of social sciences research procedures," (Friedman et al., 2006) requires adherence to the guiding principles of good research; being "grounded in scientific theory and rigorous approaches" (Brender, 2008).

There are two trends in the evaluation of HIS; one being the shift in focus from technical to human and organisational issues and the other being the use of the qualitative approach (Yusof et al., 2008).

The emphasis of research and evaluation activities can be:

- The external environment of the organisation.
- The internal environment.

- The IS users.
- Systems development environment and staff.
- Management and operational environment of the system.
- Nature of the system including information processed.
- Patterns of utilisation.
- Organisational impacts: direct or indirect, intended or unintended.
- Social impacts: direct or indirect, intended or unintended.

This does not represent an exhaustive list as evaluation activities can be performed to address any areas of interest that are presented. The deciding factor in performing evaluations would be its worth in providing the answers being sought.

The realisation that robust technology does not guarantee a successful implementation gives impetus for evaluation activities in health informatics. It is known that "the most innovative technologies carry no guarantees of successful implementation or productive use by diverse populations of users" (Kaufman et al., 2006). Evaluations grant a mechanism for judging the success or failure of these implementations. One of the overarching aims of evaluations is to enable identification of the factors that contribute to the success of the implemented system (Protti, 2007).

The role of evaluation in the future development of HIS is well-known. Among its goals, evaluation facilitates an examination of the system's performance, safety and effectiveness while improving quality of care and cost-effectiveness (Yusof et al., 2008). Evaluation is also helpful for providing lessons to inform future actions (Yusof et al., 2008). Providing this evidence is crucial to validating the benefits that are often advertised. To provide evidence of benefits in health information technology utilisation there should be an account which includes cost, return on investment, critical success factors and alternative explanations for the successes (Stead and Lorenzi, 1999).These would become examples for future activities. In the absence of such evidence the authenticity of the supposed benefits must be questioned (Stead and Lorenzi, 1999).

In the specific context of health information systems evaluation is defined as: *"the act of measuring or exploring attributes of a HIS (in planning, development implementation or operation), the result of which informs a decision to be made concerning that system in a specific context"* (Ammenwerth et al., 2004).

This definition highlights the key issues of: measuring attributes of HIS and the support of decision making. Undertaking the evaluation is challenging as the decision making in design, development, purchase or management in HIS all requires evaluation (Moehr, 2002).

It is claimed that HIS evaluation is not straightforward and a number of problems pose challenges to its evaluators, which are partly due to HIS complexity (Friedman and Wyatt, 1997). HIS evaluation seeks to answer the why, who, when, what and how questions relating to technological, human and organisational issues surrounding it (Mohd et al., 2005). Additionally, HIS evaluation is unclear and confusing and it is argued that an existing strong foundation for good evaluation theory and practice is yet to be disseminated in an understandable form (Ammenwerth et al., 2004). This may explain why despite an increasing number of HIS being developed, the number of published evaluations is very limited (Ammenwerth et al., 2004). Evaluation of HIS is also hard to complete, particularly in selecting a framework to be applied and methods to be used. However, there are a number of proposed approaches that can be adopted/adapted to overcome these problems as well as deriving some more improved methods and extensions (Yusof et al., 2008).

Several researchers stated that evaluation of health information systems should be an on-going process throughout the life of a particular health information system project, (i.e. during system analysis, design and implementation as well as when the new system is operational) to realise a system that benefits the health care sector (Lippeveld, 2000; Ammenwerth et al., 2004; Kaplan and Shaw, 2004; Yusof et al., 2006). Based on the system development life-cycle, evaluation of information systems can be classified into two phases: pre-implementation and post-implementation evaluation. Kumar (1990) points out post-implementation evaluation as a type of evaluation that is conducted just before, or just after implementation and when the new system is running. With regard to an appropriate timetable for evaluation of a newly restructured health information system, Lippeveld (2000) proposed that the first evaluation of a newly restructured health information system should be conducted just one or two years after the new system has become operational.

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

The objectives of an evaluation of a health information system as indicated by Lippeveld and Sapirie (Lippeveld and Sapirie, 2000) are the following:

1. To determine the performance of one or more subsystems of the health information system in terms of the generation, use, and reporting of data required for essential indicators and database. These indicators and database are necessary in managing the delivery of priority health services and support systems, and monitoring the health situation.
2. To identify problems of the information systems and suggest activities for their resolution; and, as a by-product:
3. To provide first –time participation in the health information system assessment process with the potential to carry out evaluation in the future.

3.8.1 Early Approaches to Health Information System Evaluation

As mentioned above, evaluation seeks to answer the why (objective of evaluation), who (which stakeholders‘ perspective is going to be evaluated), when (which phase in the system development life cycle), what (aspects of focus of evaluation) and how (methods of evaluation) questions. A discussion of early studies on HIS evaluation is presented based on these evaluation questions and a summary presented in Table 3.3. Due to its relative popularity, there are a large number of evaluation studies on clinical decision support systems (CDSS).

Author(s)	Theme	Findings/conclusions
Ammenwerth et al.	Problems and challenges of HIS evaluation.	Research in health informatics evaluation is still at its infancy and what constitutes „good" HIS is still unclear. It seems desirable to have a broadly accepted, detail evaluation framework that could guide researcher to undertake evaluation studies.
Moehr	Comparison between objectivist and subjectivist approach.	Subjectivist approach has advantages over the limitations of objectivist approach.
Kaplan	Critiques for randomised controlled clinical trials (RCT) and experimental approaches.	The limitations of RCT/experimental approaches to evaluation call for alternative approaches that address contextual issues such as social interactionist.
Clarke et al. Brender	Methodology for the evaluation of CDSS.	Four iterative phase development evaluation cycle for CDSS have been identified. CDSS evaluation should start at the system conception while its integration in system development should ensure a more comprehensive evaluation, alert possible causes for failure, and thereby avoid wasted time and effort.
Hunt et al.	Review the effects of CDSS on physician performance and patient outcome based on the assessment of RCT.	There is a rapid increase in published CDSS studies with improved quality. The benefits of CDSS in enhancing clinical performances can be seen in drug dosing, preventive care and other aspects of health care but not convincingly in diagnosis. The studies on CDSS effects on patient outcomes are limited.
Kaplan	Review CDSS literature concerning evaluation.	Although CDSS is acknowledged for its potential to improve care, evidence is unclear in its diagnostic function. There is a general consensus on limited use of CDSS despite its proven or potential benefits. Most studies use experimental or RCT approach. Most studies focus on physicians and exclude other clinicians. Studies in understanding issues surrounding development, implementation and use of CDSS are lacking.
Gremy et al.	The importance of human factors in HIS evaluation.	Human factors are central to HIS evaluation. Systems that involve human interaction have the greatest failures in contrast with systems that work independently of the user. When it comes to the evaluation of most HIS, it appears that we are still in a "blind alley".
Kaplan Kaplan and Shaw	Review on human, organisational and social issues in HIS evaluation.	Human, organisational and social issues are important to address during system design, implementation and use. Newer evaluation trends are focusing more on these non-technical issues. An evaluation framework based on social interactionist theory is proposed. It is known as 4Cs (communication, care, control, and context).
Van der Meijden et al.	Review on success factors of inpatient patient care information systems using DeLone and McLean IS success model.	A wide range of attributes could be categorised according to IS success model but some attributes related to IS failure did not match any of the categories. IS success model is applicable in the evaluation of inpatient patient care information systems. More thorough evaluations of patient care information systems can be performed to address factors that contribute to systems" success and failures.
Currie	Review on evaluation frameworks of health informatics based on user-, context- and functionality-centric, SDLC recognition, theory based and qualitative approach employed.	Quantitative and qualitative methods are both rigorous in their own way. The use of qualitative approach is increasing in the evaluation of health informatics. The use of qualitative approach can potentially enhanced user acceptance and ideally avoid system failure.

Table 3.3 Early Studies on HIS Evaluation
Source: Yusof et al. (2008)

3.8.1.1 The Who

Evaluation involves many stakeholders who have diverse views on the systems. Stakeholders of HIS include developer, user, patient and purchaser. The perceived usefulness of the evaluation results varies for different individuals. The potential of HIS to improve patient care and the performance of clinicians is often thwarted by the users‘ reluctance to accept and adopt it (Williamson, 2014) Therefore, the usefulness of HIS depends largely on users (customers), because they are the experts in their work, not the developers (designers) (Beyer and Holtzblatt, 1995).

Goodhue employed user evaluation of task-technology fit as a measure of success. His study resulted in two main findings. First, the usefulness of a technology seems to relate to the tasks of the user. It appears that users regard their system as tools, which aid or hinder them in performing their tasks. Users respond positively to system‘s features that realise task demands. Second, users seem capable of performing the evaluation of the task-technology fit of a particular technology that they have been using. Goodhue‘s study also indicated that user evaluations could be beneficial to the practitioner as they give fair, detailed diagnostics of information systems and services (Goodhue, 1995; Yusof et al., 2008).

3.8.1.2 The When

In general, apart from the feasibility study, IS evaluation can be carried out during the three main phases when using the classical system development life cycle (SDLC)—pre-implementation (development), during implementation, post-implementation or routine operation (Willcocks, 1994). In the health informatics domain, four evaluation phases have been identified, which are also based on the SDLC: preliminary, validity, functionality and impact (Clark et al., 1994). Every phase addresses exact evaluation aspects. Depending when in the system development life cycle it is done, evaluation can be formative or summative. The aim of formative evaluation is to improve the system under development or during implementation; thus, problems can be identified as they emerge and the system can be improved as it is being developed. Evaluation should begin with the system conception while its integration into system development should guarantee a more comprehensive evaluation, alert possible causes for failure, and thereby avoid wasted time and effort (Clark et al., 1994; Yusof et al., 2008).

On the other hand, the aim of summative evaluation is to measure a system in operation and overall system effectiveness, and to provide information for determining system continuation (Clark et al., 1994). Most studies focus on summative aspects; thus, there is limited support by methods and guidelines for constructive (formative) evaluation in system implementation or installation.

3.8.1.3 The What

Many aspects of HIS can be evaluated. Evaluation involves humans, technology, organisations and interaction between them (Ammenwerth et al., 2004). Therefore, evaluation can cover technical, professional, organisational, economic, ethical and legal domains (Stoop and Berg, 2003). Brender (1997) compares evaluation studies in the field of health informatics and in the information systems field and observes that the focus of empirical evaluation studies in the health informatics literature was aspects of correctness, while in the IS literature, the emphasis was on theoretical and practical technological aspects. The evaluation trend of health informatics has been increasingly shifting towards the human and organisational factors (Yusof et al., 2008).

For example, Kaplan and Shaw (2002) presented a number of evaluation studies which concentrated on the following human and organisational issues: organisational readiness, diffusion of innovation, workflow, change management, and human factors, clinical context, cognitive factors, and methods of development and dissemination in determining the system success. Clearly evaluation should tackle not just how well a system works, but also how well the system works with particular users in a particular setting.

Coiera (2003) agrees with this view; stressing that the evaluation emphasis is frequently on technical issues or clinical processes although CDSS are frequently justified based on clinical benefit grounds.

3.8.1.4 The How

Evaluation can be conveniently classified into objectivist and subjectivist approaches (Friedman and Wyatt, 1997).The objectivist approach assumes that everyone agrees, or can be brought to a consensus, on what is good and right about important system properties. Numerical measurement, which is preferably derived from experiments, is superior in the objectivist approach, compared to verbal description. Conversely, the subjectivist approach assumes that, ―when phenomena involve people and become complex, there is no a single truth about them" (Friedman and Wyatt, 1997), leading to various perspectives on what is good and right about diverse systems and context, among individuals and groups. In contrast with the objectivist approach, verbal description is essential to illustrating these differing perspectives. In objectivist studies, objective assessment of subjects, variables and data collection methods are selected while in subjectivist studies, research is conducted based on the judgements of expert evaluators or system stakeholders in the natural environment of the subjects, without manipulating it, and themes of interview emerge during the study (Friedman and Wyatt, 1997; Yusof et al., 2008).

The subjectivist approach is viewed as being holistic, thorough, rigorous, economical and time efficient as opposed to the objectivist approach, which is viewed as being expensive, time consuming and labour intensive. In addition, "difficulties in conducting objectivist studies . . . make it hard to conduct such studies in the first place" (Moehr, 2002). The limitations of the objectivist approach suggest that the subjectivist approach is a better alternative .While objectivist approaches are excellent for examining system performance or particular changes in the behaviours of clinical practice, they are less appropriate for investigating why and how a system works with a specific user in a specific setting. Evaluation can be performed using quantitative and qualitative methods or ideally, a combination of both methods; the latter is strongly advocated as it provides a more comprehensive view of the evaluation studies (Yusof et al., 2008).

3.9 Health Information System Evaluation Frameworks

The approaches to HIS evaluation that have been developed are based on one or more domains such as technical, sociological, economic, human and organisational. In the next section, a number of frameworks are reviewed to recognise the evaluation dimensions and measures used to evaluate systems in a healthcare setting (see Table 3.4). Oveall, these frameworks complement each other in that they each evaluate different aspects of HIS, Thus, these different aspects can be combined in a single framework to allow comprehensive evaluation studies.

Framework/author(s)	Evaluation aspects		
	Technology	**Human**	**Organisation**
Generic evaluation frameworks			
House"s multiple approaches to evaluation (Friedman and Wyatt)	Information resources Archetypes Software	Designers Developers Administrators Users	Clinical environment
System development stage (Stead et al.)	System Hardware and software Infrastructure System development stages	Users	Social, cultural and functional environment
CHEATS (Shaw)	Technical	Human Education Social	Clinical Organisation Administration
System development life cycle (SDLC) based evaluation frameworks			
Evaluation methodology for knowledge based systems (Clarke et al.; Brender et al.)	Technical verification Functions completeness and correctness Functionality Transferability	Human-computer interaction Stakeholders	Effect on patient care, health care service, social relations among professionals, organisational structure, legal cases
Five step evaluation process (Gremy et al.)	HIS development stages Machine Program Model Aim Meaning Software Data definition and entry Output interpretation	Human Ethics	General impact
TEAM (Grant et al.)	IS based on management level	Role	Structure
MEM (Westbrook et al.)	Point of care clinical systems IT/ ICT Information exchange	Staff attitude, perception	Organisational structure Work practices Communication
Socio-technical based evaluation frameworks			
ITAM (Dixon)	IT adoption	Individual user	
HTA (Kazanijian and Green)	Technology assessment activity	Population at Risk	Population impact Economic concerns Social context
Social network analysis (Anderson)	Computer use System files HIS Information dissemination	Network Relation Physician role	Network Relation
Socio-technical approach (Berg)	Patient Care IS	Network Role and task	Health care practices Workflow
4Cs (Kaplan)	HIS and its development impact	Communication	Control, care, context

Table 3.4 Selected HIS Evaluation Frameworks
Source: Yusof et al. (2008)

3.9.1 Generic Evaluation Frameworks

The first two frameworks place emphasis more on methods to be used according to different system development stages. In Friedman and Wyatt (1997), evaluation is classified into eight approaches of subjectivist and objectivist evaluation types. Similarly, Stead et al. (1994) built a matrix of the relationship of the system development stage to the level of evaluation. Ideally, a system should play a part in the overall technological infrastructure within the organisation as well as in the overall social, cultural and functional environment of its intended users. However, the criteria as to how this can be evaluated would benefit from additional clarification (Yusof et al., 2008).

CHEATS is a generic framework for evaluating IT in healthcare that has six evaluation aspects: clinical, human and organisational, educational, administrative, technical and social (Shaw, 2002) CHEATS attempts to present a more comprehensive evaluation and some more specific measures, especially in the clinical aspect. However, the dimensions within some of the aspects, such as technical, human and organisational could benefit from further development.

3.9.2 System Development Life Cycle Based Evaluation Frameworks

Brender (1997) proposed an evaluation methodology based on the system development process, namely exploration, validity, functionality and impact phase based on the work of Clark et al. (1994). The evaluation aspects of this methodology are classified according to the evaluation phases shown in Table 3.4.

This methodology includes a comprehensive scope of technology and organisational issues, but it could benefit more from further clarification of human issues and overall evaluation dimensions and measures.

Gremy et al. (1999) presented a five step HIS evaluation process; each step is associated with system development stages, problems at stake and the role of human as actors alongside machines at work. While the human is central to this framework, organisational issues can also be given similar emphasis. Moreover, the evaluation criteria of this framework can be specified in more detail.

A global framework known as total evaluation and acceptance methodology (TEAM) was developed based on systemic and model theories (Grant et al., 2002) It has three dimensions: role, time (evaluation phase) and structure (strategic, tactical, operational management level). The 3D structure of this model illustrates clearly the components of system evaluation. However, apart from the role and time aspects, the structure aspect can be challenging as the selection of evaluation measures can be categorised into more than one management level. As a whole, this framework is quite broad for a specific type of information system evaluation (Yusof et al., 2008).

Westbrook et al. (2004) outlined a number of methods throughout pre, during and post implementation. This multi-methods evaluation model (MEM), which uses a multidisciplinary approach, provides a useful, specific guide to methodology selection. The evaluation criteria however, are disbursed among the methods presented.

3.9.3 Socio-technical Based Evaluation Frameworks

An IT implementation and evaluation framework for individual users known as the IT adoption model (ITAM) was constructed to study the individual user perspective and potential IT adoption (Dixon, 1999). From the individual user perspective, this framework includes comprehensive evaluation criteria and relationships among them. This framework is clearly insufficient for a wider scope of evaluation, which involves the organisational aspect (Yusof et al., 2008).

Aiming for a comprehensive framework, Kazanjian and Green (2002) proposed a multi-disciplinary model for supporting decision making of health technology assessment (HTA). The major evaluation dimensions are population at risk, population impact, economic concerns, social context (including ethical, legal and political concerns) and technology assessment information. The framework provides valuable guidelines on three key questions in the decision making process, namely stakeholders types, purpose and value of a new technology and benefit of technology adoption. Moreover, this framework includes a broader, comprehensive view of technology assessment.
Unlike the rest of the frameworks, the economic and impact dimensions are described in detail. The application of the framework is, however, limited by unspecified evaluation measures of technology and human factors.

Focusing on more specific framework, a social network analysis is proposed (Anderson, 2002). The framework is used to learn the pattern of relations among a group of individuals, departments and organisations relevant to HIS. The framework focuses on the relationships and communications among individuals and organisation; however, the balance can be kept by considering more technical issues in the assessment aspect. In a similar vein, Berg (1999) used the socio-technical approach where work practices are seen as networks of different related elements such as people, tools, organisational processes, machines and documents. This framework highlights the importance of an integrated network embracing technology, humans and the organisation. The specific evaluation criteria could be more clearly stated. Kaplan (1997) developed 4Cs from the Social Interactionist Theory, which stands for communication (interaction within department), care (medical care delivery), control (control in the organisation) and context (clinical setting). Again the evaluation

measures of this framework would help from more clarification and the control aspect needs further explanation (Yusof et al., 2008).

3.9.4 Other Approaches and Frameworks

The Health Metrics Network (HMN) framework identifies the key components and standards of a country‘s health information system. The framework describes health information system components in terms of resources, indicators, data sources, data management, information products, and dissemination and use. The framework lays out standards to be attained for each component and describes data-management, transformation of data into useable information, dissemination and use (WHO, 2007).

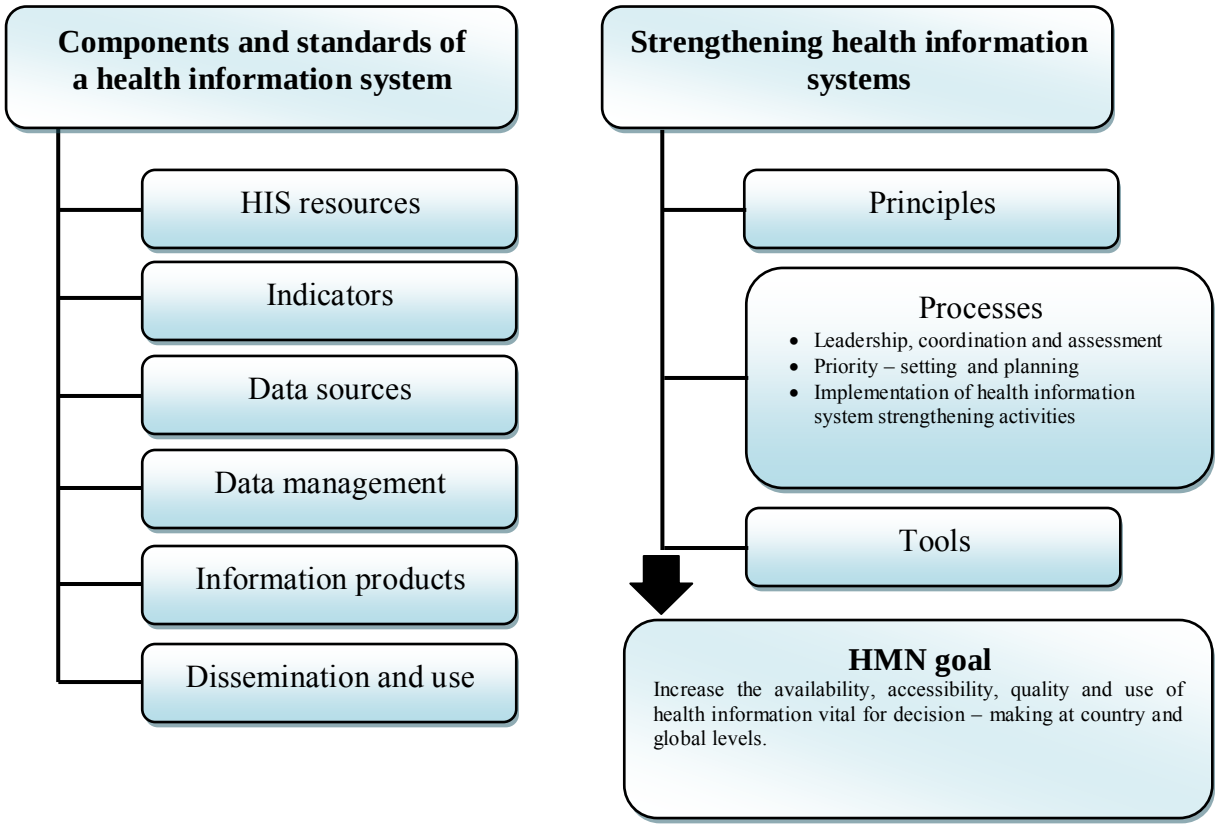

Figure 3.10 Health Metrics Network Framework
Source: WHO (2007)

As shown in Figure 3.10, the HMN framework consists of two major parts:

1. Components and standards of a health information system which describes the six components of health information systems and provides normative standards for each.
2. Strengthening health information systems which describes the guiding principles, processes and tools that taken together outline a roadmap for strengthening health information systems.

The assessment is covering the many subsystems of a national health information system, including public and private sources of health-related data. It addresses the resources available to the system (inputs), its methods of work and products (processes and outputs) and results in terms of data availability, quality and use (outcomes).

One of the significant emphasis of this evaluation framework is the role of the stakeholders. It is noted that these assessments should involve a wide range of stakeholders, representing all levels of interest .The assessment is designed to provide stakeholders with the ability to follow the progress of the country by providing checkpoint data in the areas of health statistics, data sources and information products. It is recommended that the composition could include personnel from the national statistics entity, government representatives from the Ministry of Health, associated ministries and governmental entities, academic institutions, donor agencies, United Nations organisations, non-governmental organisations and civil groups (WHO, 2007)

For its role as a country-wide evaluation tool the HMN assessment tool is lauded for its approach to acquiring comprehensive feedback; its ability to inform decisions on national strategic investments; the ability for its adaptation to the country and the potential for cycles of assessment and feedback over an extended period (WHO, 2007). As an assessment tool applied to countries, the challenges lie in the impracticality of comparative analysis of results between countries along with the inability to perform the assessment over shorter timeframes because of the detailed and extensive approach.

The HMN assessment tool includes an evaluation of the national health data sources. This examination of multiple sources can be useful in supporting the validity of data that have not been supplied in a timely manner and providing a comprehensive list of health status indicators. On the contrary the assessment tool cannot guarantee 100% accuracy and relativity can influence the responses provided. This can limit its capacity for use as a standard in between country comparisons. In reporting on the country-wide health status, the tool does not show how the result is connected to the other sectors of the HIS. While its use is encouraged for assessing health indicators, there is no evidence to maintain its use as a method for health surveillance (WHO, 2007).

The HMN assessment tool gives the ability to analyse the contribution of all of the national health data sources. This is valuable to the WHO because an assessment of the civil registration data source can provide regular information on population coverage in an easily understood format. But this would be counterproductive as regular trending would not yield significant changes (WHO, 2007).

The HMN assessment tool enables comprehensive review of the components of national HIS. The inclusion of a wide range of stakeholders in the evaluation process is an important accomplishment. However, the extensive list of indicators and the time required to complete the evaluation are limitations to its consistent use.

3.10 PRISM Framework

Lafond and Field (2003) proposed a comprehensive conceptual framework called "The Performance of Routine Information System Management (PRISM) Framework" which can be used as a lens to understand the performance of routine health information systems in developing countries. According to the authors, good performance of a health information system is: "sustainable production and use of good quality information".

Information system development until recently relied mainly on technical approaches, as originally described by Churchman (1971), from assessing information needs to developing data analysis and presentation tools, and using information and communication technology, with slight acknowledgment of the results of contextual issues. Information systems were defined as a set of correlated elements (Van Gigch, 1991) without any consensus on defining and measuring system performance. There was no consideration given to how people react to and use information systems for problem solving or self-regulating their performance (behavioural factors), nor was there any attention given to organisational processes for creating an enabling environment for using and sustaining a routine health information system (RHIS). When attention was given to these factors (Malmsjo and Ovelius, 2003), there was no attempt to set them in a coherent framework to understand their effects on RHIS processes and performance.

In response to this need, and based on empirical work by Hozumi et al. (2002), Lafond and Field (2003) presented a draft on Performance of Routine Information System Management (PRISM) framework at an international workshop on a District health information system in South Africa (RHINO, 2003). In the absence of an operational definition of RHIS performance in the literature, RHIS performance was defined as *'improved data quality and continuous use of information'*. It was stated that RHIS performance is affected by three determinants: technical, behavioural and environmental/organisational (see Figure 3.11).

RHIS performance occurs within an organisational setting. Members of the organisation need motivation, knowledge and skills (behavioural factors) to perform RHIS tasks, and specialised technical know-how/ technology (technical) is required for timely analysis and reporting.

A routine health information system is composed of inputs, processes and outputs or performance, which in turn affect health system performance and lead to better health outcomes (see Figure 3.11).

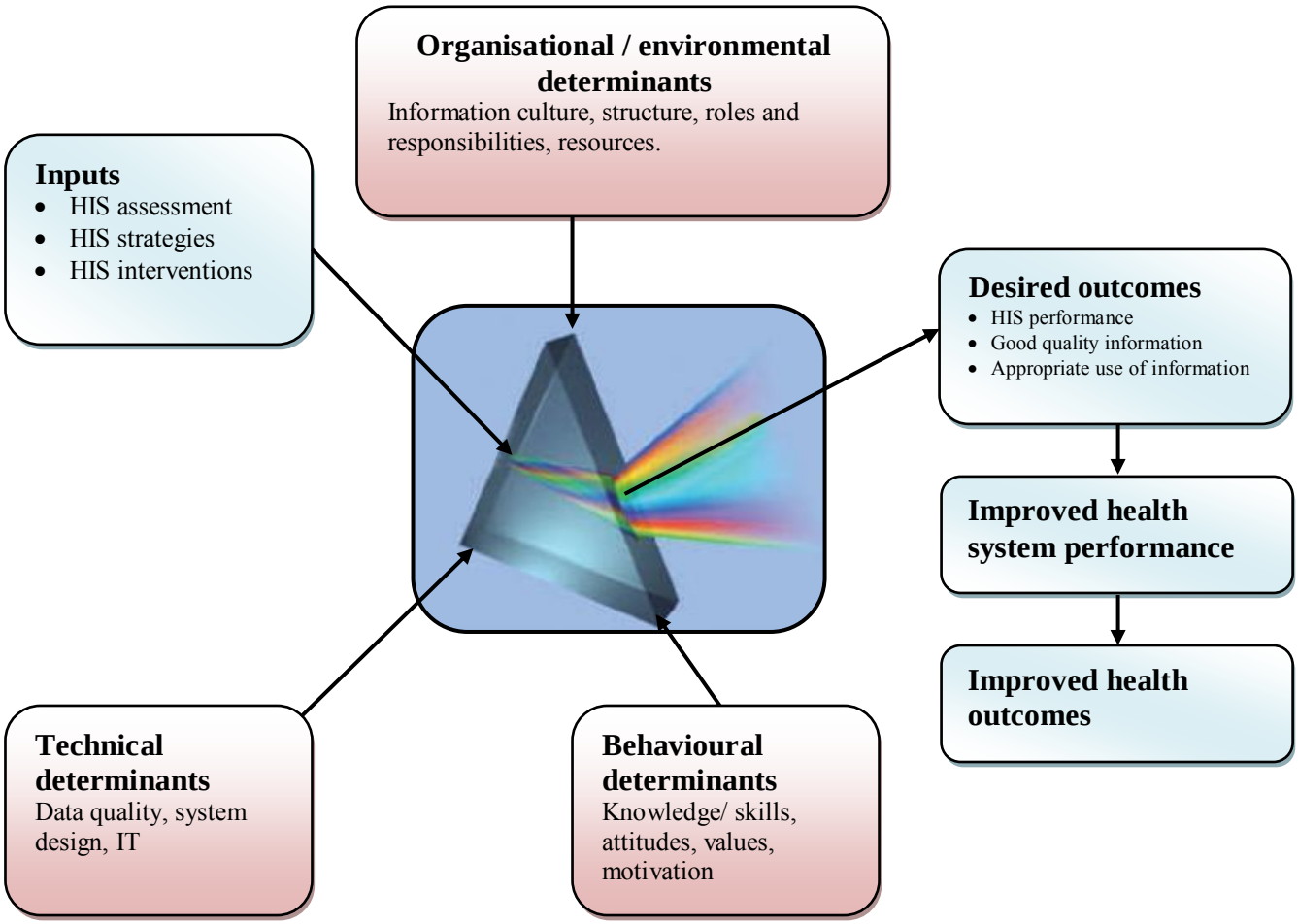

Figure 3.11 PRISM Framework for Understanding Health Information System Performance
Source: RHINO (2003)

Based on the PRISM framework, a set of tools has been developed to measure the RHIS performance output, processes, and determinants as well as their relationships: (1) the RHIS Performance Diagnostic Tool; (2) the RHIS Overview Tool and Facility/Office Checklist; (3) the RHIS Management Assessment Tool; and (4) the Organisational and Behavioural Assessment Tool (OBAT).

• Performance Diagnostic Tool — As the primary component in the PRISM tool kit, this tool determines the overall RHIS performance defined by the production of quality data and information use. Data quality is measured in three dimensions: completeness, timeliness, and accuracy. The diagnostic tool assesses use of information for problem identification and solving, decision making, resource mobilisation, and monitoring.

• RHIS Overview Tool, and Facility/Office Checklist — This tool examines technical determinants, such as the structure and design of existing information systems in the health sector, information flows, and interaction between different information systems. It allows users to understand the availability and status of RHIS resources such as staffing, RHIS supplies, equipment and infrastructure at health facilities.

• Management Assessment Tool — This tool is designed to take rapid stock of the RHIS management practices and to guide the development of interventions for better management. It measures different RHIS management functions including governance, planning, training, supervision, use of performance improvement tools, and financial resources.

• Organisational and Behavioural Assessment Tool — This tool identifies behavioural and organisational factors that affect RHIS performance, including data demand, motivation, confidence level, task competence, and problem-solving skills. It includes various questions used to assess the promotion of a culture of information within the health department.
Relationships among the tools are illustrated in Figure 3.12

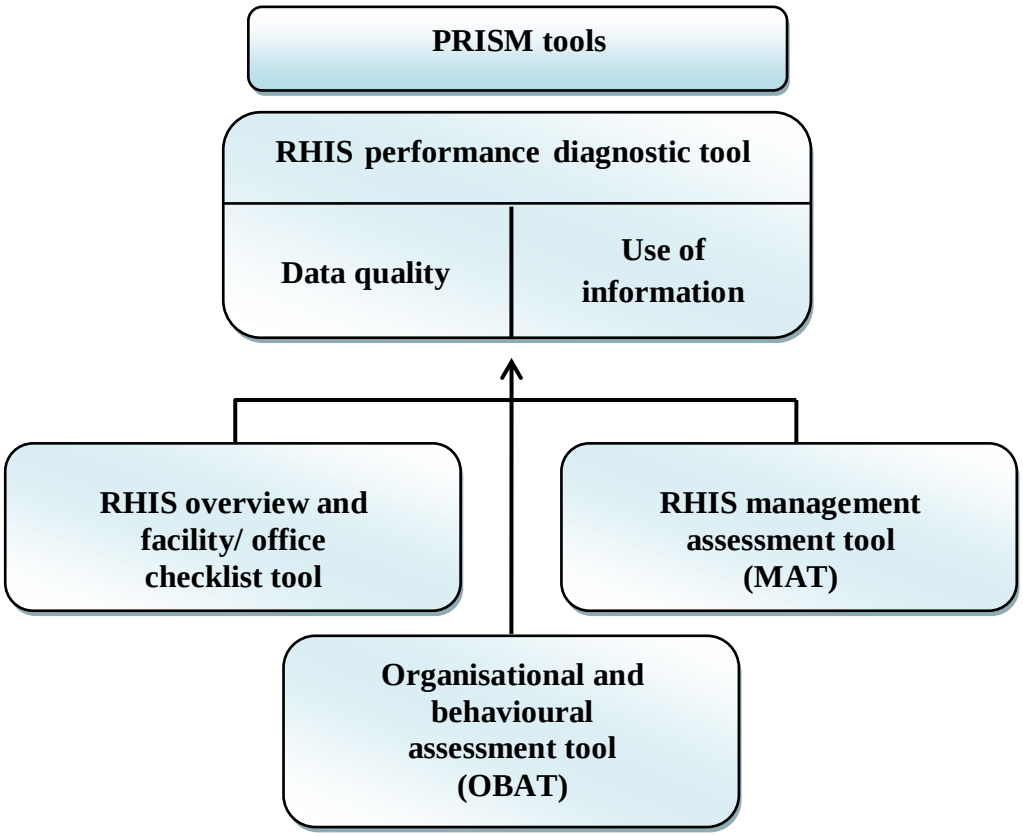

Figure 3.12 Relationships among the Tools
Source: Aqil et al. (2009)

Prior to the development of the PRISM framework, it was felt that several efforts to reform routine health information systems did not lead to sustainable improvement and even if they did it was difficult to measure the change. The quality of the data generated through RHIS and use of the information for decision making is analysed for all administrative levels of the health system in connection with the determining factors.

Hotchkiss et al. (2012) reviewed seven notable RHIS performance improvement conceptual frameworks found in the literature and concluded that PRISM is the only framework that differentiates between RHIS inputs, processes, outputs, outcomes, and impact. The PRISM framework and tools can aid countries to assess the state of their RHIS in a quantitative way and to identify a broad set of determinants of poor RHIS performance. This allows countries to set up a more structured RHIS reform effort through the identification of a set of interventions to address RHIS weaknesses. The PRISM tools can also be used to evaluate the effect of these RHIS strengthening interventions by comparing the baseline results with a mid-term or end-line results.

The PRISM framework defines information system performance as improved data quality and continuous use of information for decision-making. It hypothesises that improved performance leads to better health system performance which consequently affects the health status of the population (see Figure 3.13).

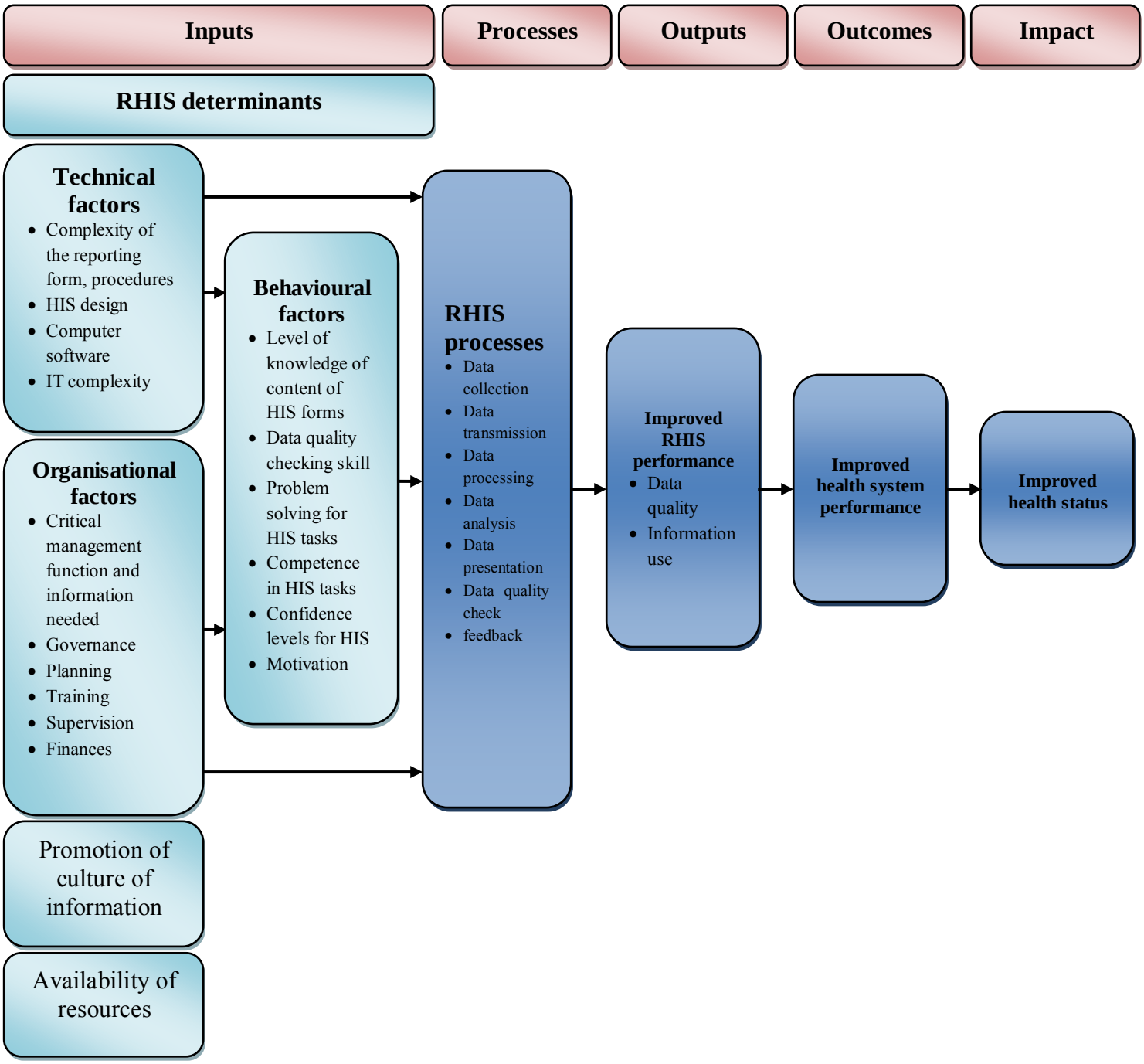

Figure 3.13 Performance of Routine Information System Management (PRISM) Framework
Source: Aqil et al. (2009)

The PRISM framework explores how much the RHIS processes (data collection, transmission, processing, analysis, display and feedback) influence RHIS performance. It also identifies technical, behavioural and organisational determinants. Some of the criteria used to shortlist the technical, behavioural and organisational determinants of performance include: how much control HIS designers and implementers have to change the determinants; the closeness of their relationship to performance, the urgency to handle them, and their perceived importance and feasibility (Aqil et al., 2009).

The PRISM framework is the first of its kind to empirically test the relationships among technical, behavioural and organisational determinants on RHIS process and performance. It creates opportunities to identify whether these determinants act directly or indirectly through behavioural determinants or processes or interaction with each other to influence RHIS performance (Aqil et al., 2009).

A routine health information system is composed of inputs, processes and outputs or performance, which in turn affect health system performance and consequently influence health outcomes.

The PRISM framework states that RHIS performance is affected by RHIS processes, which in turn are affected by technical, behavioural and organisational determinants. It shows that behavioural determinants have a direct influence on RHIS processes and performance (see Figure 3.13).

Technical and organisational determinants can affect RHIS processes and performance directly or indirectly through behavioural determinants. For example, the complexity of data collection forms (technical) could affect performance directly or indirectly by lowering motivation. Other technical factors affecting performance could include the way in which computers are networked and the bandwidth available for data transmission. Thus, the PRISM framework delineates the direct and indirect relationships of the determinants on RHIS performance and measures their relative importance. The PRISM framework also opens opportunities for assessing the relationships among RHIS performance, health system performance, and health status (Aqil et al., 2009).

The PRISM framework hypothesises that behavioural factors are important determinants of RHIS performance. High self-efficacy or confidence levels to complete a task ensure that the task will be done, and done correctly. Similarly, if one feels that performing a task will bring about a positive outcome, one is more likely to perform that task. The PRISM framework also hypothesises that a strong culture of information is associated with high RHIS competence levels.

PRISM represents a paradigm shift in designing, strengthening, monitoring and evaluating RHIS. First, by gauging performance in terms of improved data quality and continuous information use, it highlights RHIS performance. Second, PRISM places RHIS performance in the context of technical, behavioural and organisational determinants whose relative importance, as measured by PRISM tools, generate possible interventions. And third, it provides a mechanism to assess the role of RHIS in improving health system performance. PRISM is grounded in a systems perspective, focusing on problem solving and continuous improvement.

As of 2012, 23 countries in Africa, Asia, and Latin America had applied the principles and approaches of the PRISM framework as well as the tools to assess performance of their RHIS and to show the RHIS strengthening process (see Table 3.5). The PRISM tools were applied at health facilities (from primary care to hospitals or specialised institutions) and at various administrative levels (national or sub-national). Administrative institutions and central offices, such as health departments, provincial health directorates, or district health offices, were also assessed in some countries. Thirteen countries conducted national comprehensive health institution-based RHIS assessments. The majority of them (17 countries) adopted all four PRISM tools while four countries modified and implemented tools selectively (partially). The diagnostic tool was used in Rwanda, Malawi, Cambodia and Timor Leste, while Costa Rica, Honduras, and Mexico used the OBAT. The PRISM diagnostic tool has also been applied to assess the community orphans and other vulnerable children information system in Cambodia (MEASURE Evaluation, 2013).

Evaluation of the PRISM framework and tools in Uganda confirmed the reliability of the PRISM tools for assessing RHIS task self efficacy, motivation and promotion of a culture of information. The results also indicated that these tools are sensitive and suitable for assessing changes over time (Hotchkiss et al., 2012).

In many countries, partnerships have been created with national or regional training institutes and universities to develop and implement training courses on the PRISM framework, such as African Centre for Higher Management Studies (CESAG) in Senegal, National School of Statistics and Applied Economics in Côte d'Ivoire, National Institute of Public Health (INSP) in Mexico, and the University of Pretoria (South Africa). The courses intend to build knowledge and skills in using the PRISM tools as the basis for assessing, analysing, solving problems and ultimately to improve RHIS performance. In 2010, an international workshop was organised on measuring and improving RHIS performance by the Routine Health Information Network in Guanajuato, Mexico which gathered around 100 participants from all over the world (MEASURE Evaluation, 2013).

In addition, individuals, organisations and teaching institutions have accessed PRISM framework and tools from RHINO and MEASURE Evaluation Web sites3 and integrated it in their courses. For example, the Pan American Health Organisation (PAHO) has used the PRISM tools for training purposes in the Eastern Caribbean Countries. Johns Hopkins University (JHU) has made PRISM framework a central component of its health informatics training programs. Furthermore, Johns Hopkins University adopted the PRISM framework to assess performance of information technology applications such as eHealth and mHealth initiatives in developing countries (Weiss and Tappis, 2011). The PRISM framework has been used even beyond the health sector in Uganda to assess the Educational Management Information System (RHINO, 2010).

Country	Tools applied	Period
Cambodia	Diagnostic tool	2011
China	PRISM	2007-2010
Costa Rica	OBAT	2009
Côte d'Ivoire	PRISM	2003-2012
Dominican Republic	PRISM	2008-2009
Ecuador	PRISM	2009-2010
Ethiopia	PRISM	2011-2012
Haiti	PRISM	2008
Gabon	PRISM	2012
Honduras	OBAT	2006
Liberia	PRISM	2012
Malawi	Diagnostic tool	2010
Mexico	OBAT	2005-2006
Mexico	PRISM	2010
Mozambique	PRISM	2010
Pakistan	PRISM	2004
Paraguay	PRISM	2006-2007
Peru	PRISM	2008-2009
Rwanda	Diagnostic tool and facility checklist	2011-2012
Senegal	PRISM	2008-2013
South Africa	PRISM	2006
Timor Leste	Diagnostic tool	2010
Uganda	PRISM	2004
Zambia	PRISM	2012

Table 3.5 Selected HIS Evaluation Frameworks in Different Countries
Source: MEASURE Evaluation (2013)

3.11 RHIS Performance

RHIS performance can be defined as improved data quality and continuous use of information. Data quality may be identified by the following dimensions: relevance, completeness, timeliness and accuracy (Aqil et al., 2009).

Relevance is assessed by comparing data collected against management information needs, while completeness is measured not only as filling in all data elements in the Facility report form, but also as the proportion of Facilities reporting in an administrative area (e.g. Province or District). On the other hand, timeliness is assessed as submission of the reports by deadlines. Accuracy is measured by comparing data between Facility records and reports, and between Facility reports and administrative area databases, respectively.

The use of information depends on the decision making power of the people and the significance given to other considerations regardless of the availability of information (Grindle and Thomas, 1991; Sauerborn, 2000). On the other hand, without assessing use of information, it is difficult to recognise whether a RHIS is meeting its required objectives, improving decision-making, and consequently leading to better health system performance. The PRISM framework defines the use of information employing criteria such as use of information for identifying problems, for considering or making decisions regarding alternatives, and for advocacy. According to this definition, a RHIS performance diagnostic tool was developed for measuring RHIS performance.

Quality assurance of health care requires availability of the right information at the right time to support patient care and health system management decisions. The PRISM tools diagnose data quality, including accuracy, timeliness, and completeness of data, as well as information use as the two vital performance indicators in the process of RHIS strengthening. Figure 3.14 shows levels of RHIS performance at health Facility level in each country as measured by data quality and information use. Of the reviewed 25 PRISM assessment reports, 17 have captured the data accuracy while others have showed overall data quality levels. Even though availability of data improved in many countries, the quality and use of information at the point of data collection is limited. The baseline assessments showed an average of 55% data accuracy level in health Facilities. An encouraging progress in data quality at health Facilities emerged in the second round of PRISM assessments in Pakistan and Côte d'Ivoire. Between 2008 and 2012, data accuracy improved in Côte d'Ivoire by 17% at health facilities and doubled (from 40% to 81%) at District level (MEASURE Evaluation, 2013).

Evidence from the various PRISM assessments revealed that availability of quality data or information does not necessarily mean that information is used for making decisions. For instance, the observed positive change in data quality in Côte d'Ivoire is not accompanied with improvement in use of information at the point of data collection. Use of information in Côte d'Ivoire remained at 38% between 2008 and 2012 at health facility level. Though more than 90% data accuracy observed in the 2010 PRSIM assessment of 158 health facilities in Mexico, only 53% of the facilities demonstrated use of information. It is also true that suitable use of information does not guarantee the data are of good quality. This calls for better understanding of the drivers of RHIS performance (MEASURE Evaluation, 2013).

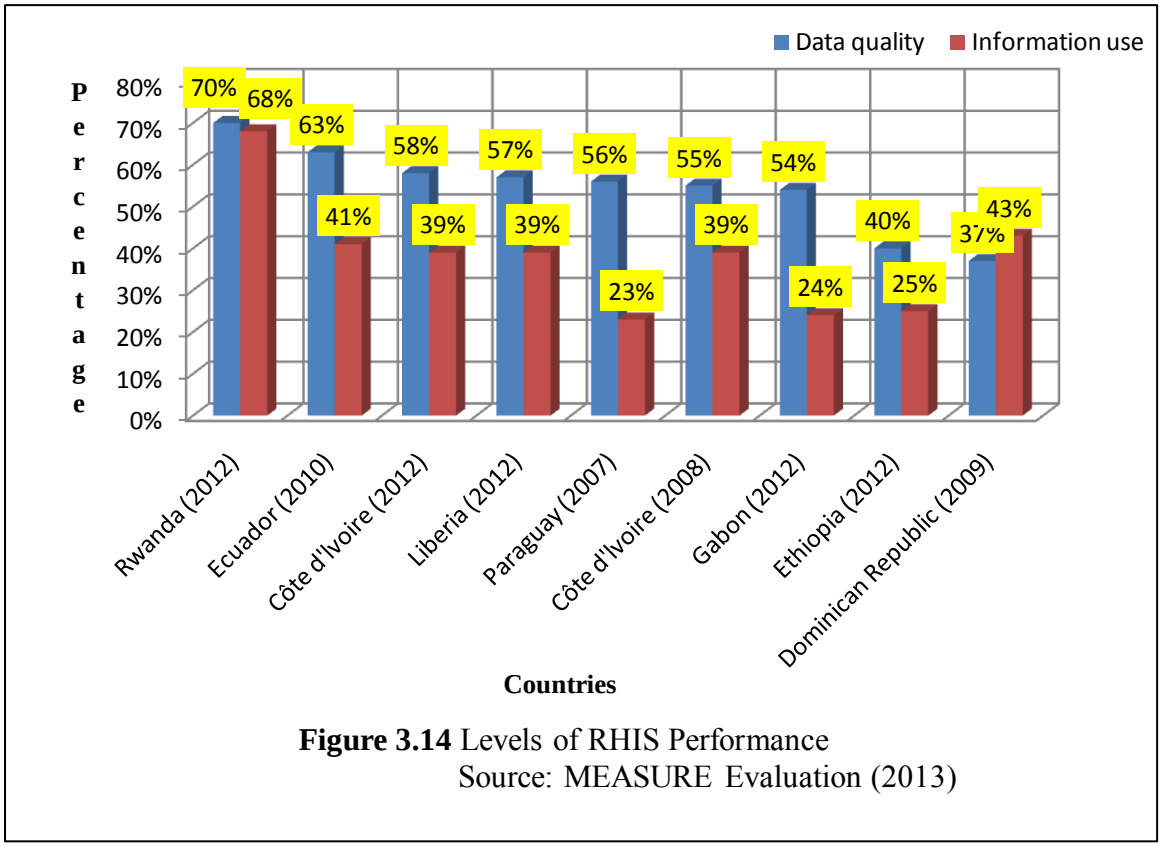

Figure 3.14 Levels of RHIS Performance
Source: MEASURE Evaluation (2013)

3.12 RHIS Determinants

The PRISM framework states that RHIS performance is affected by RHIS processes, which in turn are affected by technical, behavioural and organisational determinants. It shows that behavioural determinants have a direct influence on RHIS processes and performance. Technical and organisational determinants can affect RHIS processes and performance directly or indirectly through behavioural determinants.

The PRISM framework moves beyond the relationship between RHIS processes and performance, and adds a new layer of individual and contextual determinants. These determinants are captured under three categories: behavioural, organisational and technical (see Figure 3.13).

3.12.1 Behavioural Determinants

Health data are collected and utilised by people who participate in professional and personal roles in the health system. Even if structuring the capacity of these people is at the centre of strengthening data and information use, behavioural aspects of capacity are often the most difficult to identify and confront in a meaningful way. In terms of behavioural effects, demand for the data and its use often engage intangible concepts such as motivation, attitudes, and the values that people hold related to health information, job performance, responsibilities, and hierarchy.

RHIS users' demands, confidence, motivation and competence to complete RHIS tasks affect RHIS processes and performance directly (see Figure 3.13). The way an individual feels about the utility or outcomes of a task (Hackman and Oldham, 1980), or his or her confidence in performing that task (Bandura, 1977), in addition to the complexity of the task (Buckland and Florian 1991), all affect the likelihood of that task being performed. Limited knowledge of the usefulness of RHIS data is found to be a major factor in low data quality and information use (Rotich et al., 2003; Kamadjeu et al., 2005; Odhiambo-Otieno, 2005). Motivating RHIS users remains a challenge in spite of training on data collection and data analysis.

Negative attitudes such as _data collection is a useless activity challenge despite training on data collection and data analysis or a waste of care provider time' hinder the performance of RHIS tasks. The PRISM framework postulates that if people understand the utility of RHIS tasks, feel confident and competent in performing the task, and perceive that the task's complexity is challenging but not overwhelming, then they will complete the task diligently (Aqil et al., 2009).

The blind spot (Luft, 1969) shows that people are unaware of a gap between their perceived and actual competence in performing a task. It is possible to apply this gap for learning to change and

meet expected behaviours (Perloff, 1993). The PRISM framework postulates that organisational and technical determinants also affect behavioural determinants.

Performance of RHIS and processes such as data collection, data integration, capturing, transmission, processing, analysis, presentation, and feedback are directly affected by the gaps between real competencies and perceived competencies of health care professionals. Figure 3.15 shows a gap between self-perceived capacity and real competencies to carry out the functions of the RHIS among HIS staff at health facility level. RHIS task competencies in terms of checking data quality, analysis and use of information are limited in most countries. Health workers have limited knowledge on data quality review methods (see Figure 3.16). Lack of problem identification and solving skills are other common issues observed among health workers in the majority of the countries.

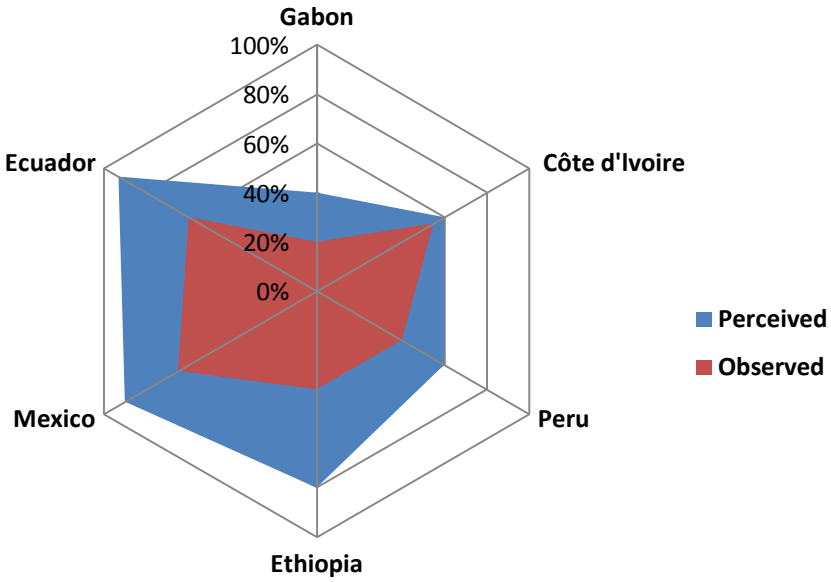

Figure 3.15 HIS Staff Competencies to Perform RHIS Tasks
Source:MEASURE Evaluation (2013)

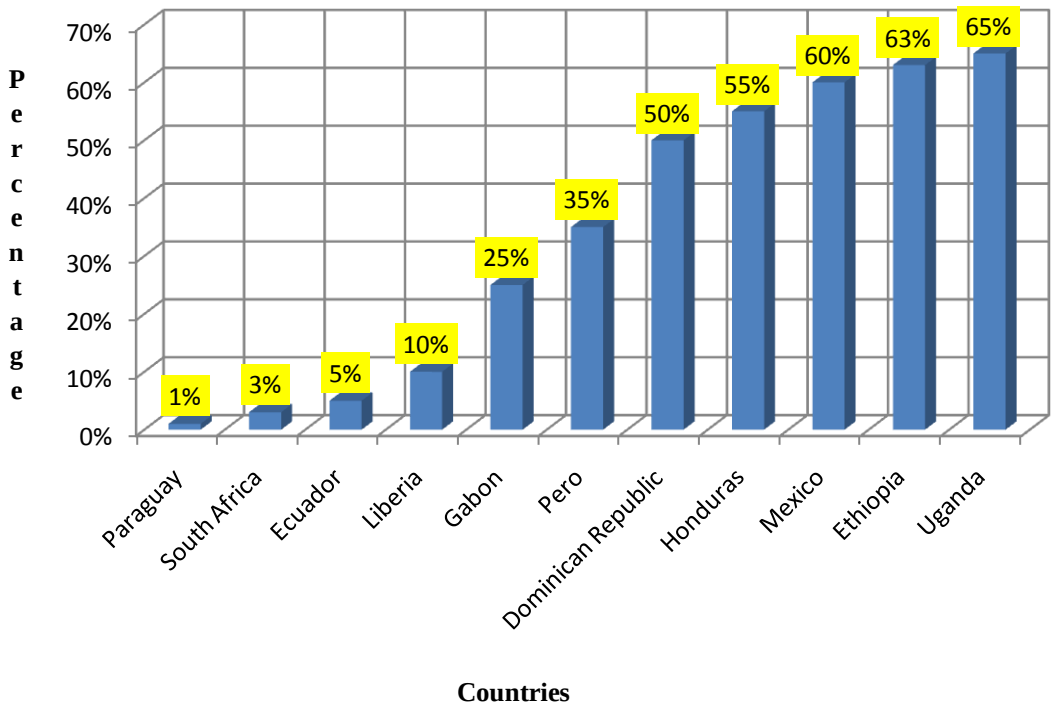

Figure 3.16 Knowledge on Data Quality Review Methods
Source: MEASURE Evaluation (2013)

3.12.2 Organisational Determinants

RHIS users work in an organisational context, which influences them through organisational rules, values and practices (see Figure 3.13).This organisational context is the health services system which can be managed by the public or the private sector (Aqil et al., 2009).

Organisational factors such as shortages in human and financial resources, low management support, lack of supervision and leadership affecting RHIS performance are identified in the information system literature (Nsubuga et al., 2002; Kamadjeu et al., 2005; Aqil et al., 2009).

The PRISM framework considers organisational determinants essential for affecting performance and defines this category as all those factors that are related to organisational structure, resources, procedures, support services, and culture to develop, manage and improve RHIS processes and performance. The organisational factors affect RHIS performance directly or indirectly through behavioural factors (see Figure 3.13) (Aqil et al., 2009).

Information systems promote evidence-based decision making, manage knowledge and create transparency and good governance without changing the organisational hierarchy.

Lippeveld et al. (1992) suggest that information systems need to follow the existing communications channels of organisational hierarchy. In socio-technical systems, the emphasis is on measuring organisational processes of human and technology interaction that lead to quality services and products (Aqil et al., 2009).

Berwick (1996) stated *‗Every system is designed to achieve exactly the results it achieves'*, indicating that performance is a system characteristic. Thus, the PRISM framework emphasises that all components of the system and its actors, managers and workers, are responsible for improving RHIS performance. The leadership role is seen as a role model and facilitates work processes (Deming, 1993; McLaughlin and Kaluzny, 1994; Aqil et al., 2009).

The regulation of organisational processes works better by using collective values than by using formal structure (Kahler and Rohde, 1996). In other words, people do not always perform on what they are told to do but act on sharing what is important and valued in an organisation. Shared values related to information systems are alluded to as a pre-existing culture of data collection (Kamadjeu et al., 2005) or ‗culture of information' (RHINO, 2001; Hotchkiss et al., 2006; Aqil et al., 2009). without specifying how these values originate and maintain themselves.

Studies in organisational culture (Mead, 1994; Triandis, 1994) assist in understanding how values are generated, sustained and amenable to change. Shein (1991) notes that organisational culture is a body of solutions to problems that have worked consistently. They are taught to new members as the correct way to perceive, think and feel in relation to those problems (Aqil et al., 2009).

Berry and Poortinga (1992) also showed the positive influence of values on organisational members' behaviour. Therefore, understanding collective values related to RHIS processes and tasks could open up opportunities for promoting values conducive to RHIS tasks and offer a guide to better performance.

The efficacy of organisational culture in improving performance is well organised (Glaser et al., 1987; Conner and Clawson, 2004; Aqil et al., 2009). Similarly, promoting a culture of information will improve RHIS performance. Nevertheless, even with the use of the term ‗culture of information' (RHINO, 2001; Hotchkiss et al., 2006), there is no operational definition or measurement for a culture of information. The PRISM framework proposes an operational definition (Hozumi et al., 2002): *'the capacity and control to promote values and beliefs among members of an organisation by collecting, analysing and using information to accomplish the organisation's goals and mission'*. To measure the culture of information, values related to organisational processes that emphasise data quality, use of RHIS information, evidence-based decision-making, problem solving, feedback from

staff and community, a sense of responsibility, and empowerment and accountability were chosen, based on the proximity principle (Ajzen, 2005). Demonstrating the existence of gaps in promoting a culture of information can be used to motivate senior management to renew their commitment to develop strategies for promoting an information culture and strengthening its linkage with RHIS performance (Aqil et al., 2009).

RHIS management (Worthley and DiSalvio, 1989) is vital for RHIS performance. It is measured through availability of the RHIS vision statement and the establishment and maintenance of RHIS support services such as planning, training, supervision, human resources, logistics and finance. By identifying levels of support services, it is possible to develop priorities for actions (Aqil et al., 2009).

The PRISM framework assumes that if organisations promote a culture of information, they will also improve their competence in conducting RHIS tasks, and thus improving their self-confidence to carry out RHIS tasks. If the work environment does not promote key RHIS attitudes and values, health workers do not internalise the values requisite to generate, maintain, and improve the information system. However, the countries‘ assessments also showed a gap between perceived promotion of a culture of information and actual competencies and knowledge of RHIS tasks (see Figure 3.17).

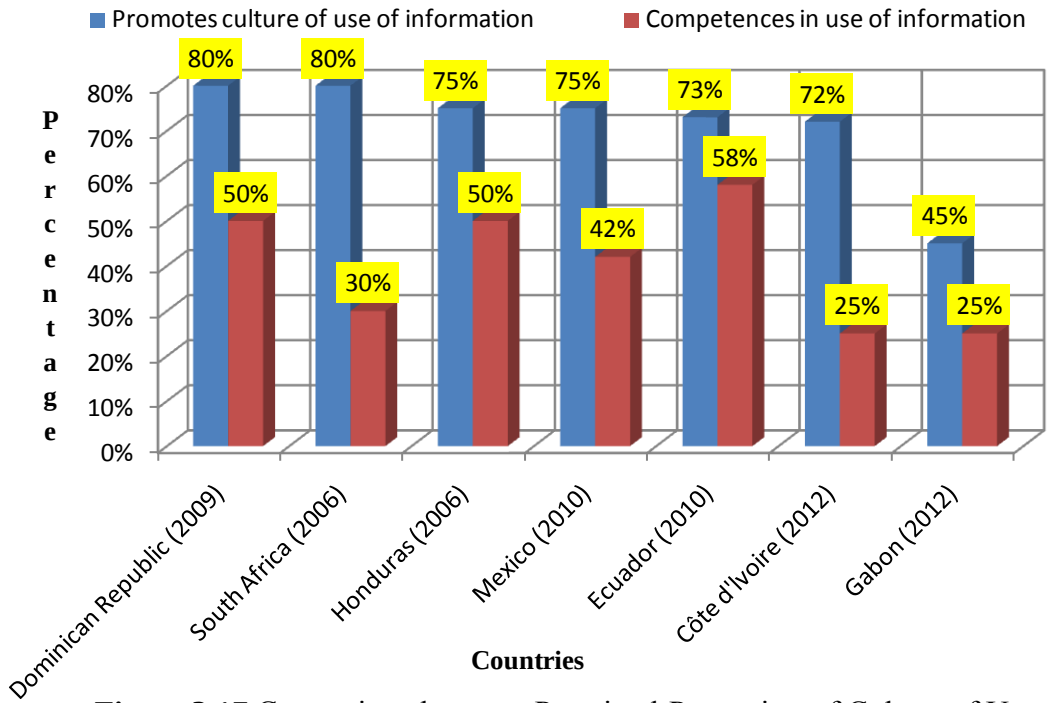

Figure 3.17 Comparison between Perceived Promotion of Culture of Use of Information and Actual Competence to Use Information
Source: MEASURE Evaluation (2013)

3.12.3 Technical Determinants

Technical determinants are defined as all the factors that are related to the specialised know-how and technology to develop, manage and improve RHIS processes and performance. These factors refer to development of indicators; designing data collection forms and preparing procedural manuals; types of information technology; and software development for data processing and analysis (see Figure 3.13). These factors also are described by others as potentially affecting RHIS performance (Nsubuga et al., 2002; Mapatano and Piripiri, 2005; Aqil et al., 2009). Information technology will remain the engine for information system development as computers operate and communicate faster. Therefore, it is important that RHIS users have good knowledge and information technology skills to effectively use and sustain it. However, in low technology settings, well-designed, paper-based RHIS can still achieve acceptable levels of performance (Aqil et al., 2009).

If indicators are irrelevant, data collection forms are complex to fill, and if computer software is not user-friendly, it will affect the confidence level and motivation of RHIS implementers. When software does not process data properly and in a timely manner, and resulting analyses do not provide meaningful conclusions for decision-making, it will affect the use of information (see Figure 3.13) Therefore, technical determinants might affect performance directly or through behavioural factors (Aqil et al., 2009).

The assessments highlighted technical challenges related to lack of information technology, problems of data management software, poor disease identification and classification, high burden of data collection, lack of standardised indicators and procedures accompanied with limited technical knowhow.

For instance, in Liberia the Ministry of Health and Social Welfare (MOHSW) installed District Health Information system (DHIS) software, which has the capability to generate raw data, pivot tables, dashboards, and maps to provide a comprehensive picture of health system performance.

Yet, it is hardly used by senior managers at county health offices due to lack of technical capacity. In Ethiopia, the assessment conducted in Southern Nations, Nationalities and Peoples Region showed that even if procedure manuals that guide data collection and analysis are developed they are not widely available at health facilities and district health offices. In Uganda, it revealed limited or no integration of HIV/AIDS and other service data in the health management information system (HMIS) (MEASURE Evaluation, 2013).

3.13 PRISM Intervention: Strengthening RHIS Performance

A health system needs internal mechanisms to develop performance targets, track progress, and create and manage knowledge for continuous improvement. PRISM allows countries to measure the causal pathways of the determinants for RHIS performance and how they influence systems prior to implementing interventions to improve the quality of the data and use of information, and to later evaluate the change brought about by the interventions. As such, it creates opportunities for improvement by identifying the strengths and weaknesses of the health information system (MEASURE Evaluation, 2013).

Many countries have taken measures to advance the performance of routine health information systems. The RHIS improvement interventions resulting from previous assessments based on PRISM approach as shown in Figure 3.18 ranged from supporting national HIS reforms to capacity building in use of information at all levels. In most countries, such as Dominican Republic, Haiti, Honduras, Mexico, Pakistan, Peru, and Uganda, the RHIS assessment led to development of national and local action plans to improve data quality and information use and decision making. In Mexico, the HIS assessment was used as input for the National Health Plan 2006-2012, thus establishing follow-up indicators (MEASURE Evaluation, 2013).

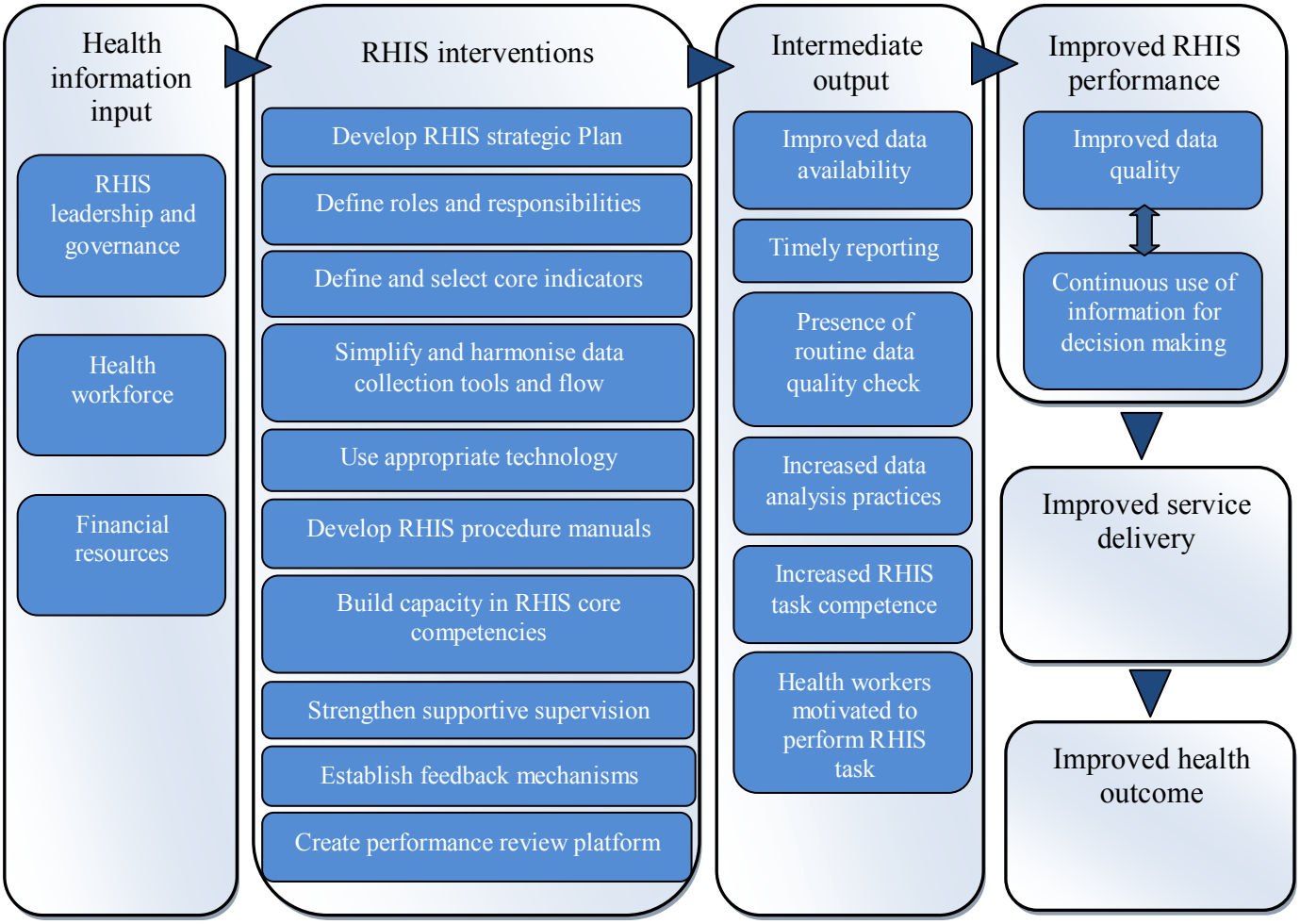

Figure 3.18 RHIS Performance Improvement Conceptual Framework
Source: MEASURE Evaluation (2013)

3.14 Summary

This chapter has provided definitions of data, information, information theory, information types, information value, information challenges, information quality and information system. In addition this chapter has provided definitions for management information systems and health information systems, including components. Moreover using information to make decisions, application of information and communication technologies in the health sector, challenges in implementation of health information systems in developing countries and evaluation of health information system have been discussed. This chapter has also defined the Health Metrics Network (HMN) and the PRISM frameworks, routine health information system **(**RHIS) performance, RHIS determinants and PRISM intervention.

The next chapter will set out the methodology chosen for the research described in this thesis. Major components will include: conceptual foundations and study design, theoretical background and conceptual framework for the necessary analysis. The next chapter will also describe the application of the methodology in order to understand the nature and performance of currently adopted systems. study settings and target population, sampling and sample size, data collection methods and tools, tool adaptation and pre-testing and methods of data analysis, research questions and ethical considerations.

Chapter 4

Methodology and its Application

4.1 Introduction

The previous chapters have provided an extensive review of the literature. In the light of this, chapter 4 considers issues of methodology that should be adopted for the substantive research in order to address the objectives described in chapter 1. Major components include: conceptual foundations and study design including case study, system theory, combining case study with the system theory, theoretical background and conceptual framework for the necessary analysis. This chapter will also describe the application of the methodology in order to understand the nature and performance of currently adopted systems, study settings and target population, sampling and sample size, data collection methods and tools, tool adaptation and pre-testing and methods of data analysis, research questions and ethical considerations.

4.2 Conceptual Foundations and Study Design

A requirement of an appropriate methodology is that it should have a firm conceptual foundation. This is an X-centred forward looking descriptive study where the focus is on the influence/impact of certain determinants/factors (Y) that interact in multiple processes and shape outputs (X).

This work is guided by the notion that such a conceptual foundation is fundamental to the research enterprise by adding to knowledge. This investigation is based on the premise of triangulation as articulated in the social sciences research literature. Three triangulation types were incorporated here; theoretical, methodological and data sources triangulations. Specifically, integrating theoretical triangulation that entails building multiple perspectives to the study, the design combines the use of case study and systems theory which are not often seen in combination in the literature (Anaf et al., 2007), but which are, however, quite relevant in the health field.

The merits of each component individually and then taken together are set out below.

4.2.1 Case Study

Case study research is one of the most common approaches applied in the information system (IS) field because it has multiple perspectives which are rooted in a specific context and provides multiple data collection methods (Cavaye, 1996). Therefore, case study research is not exclusively concerned with qualitative methods as all evidence will go to the data collection (Gillham, 2000).

In addition, a case study approach is well-suited to IS study because the nature of the discipline is the study of IS as the technology per se in the context of organisations (Yin, 2003).

Benbasat et al. (1987) indicated that the case study research method is particularly well-suited to information systems research, since the object of the discipline is the study of information systems in organisations, and "interest has shifted to organisational rather than technical issues". They identified three strengths of case study research in information systems:

1. The researcher can study information systems in a natural setting, learn about the state of the art, and generate theories from practice.
2. The method allows the researcher to understand the nature and complexity of the process taking place.
3. Valuable insights can be gained into new topics emerging in the rapidly changing information systems field.

A case study is "an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" and it "relies on multiple sources of evidence" (Yin, 1994). Case study research investigates pre-defined phenomena but does not involve explicit control or manipulation of variables: the focus is on in-depth understanding of a phenomenon and its context (Cavaye, 1996). Case studies typically combine data collection techniques such as interviews, observation, questionnaires, and document and text analysis. Both qualitative data collection and analysis methods (which are concerned with words and meanings) and quantitative methods (concerned with numbers and measurement) may be used (Yin, 1994). Case research may involve inductive theory building or have obvious a priori definitions of variables to be studied and the ways in which they can be measured (Benbasat et al., 1987; Yin, 1994).

Case study research can be used to achieve various research aims: to provide description of phenomena, develop theory, and test theory. Case study research has often been associated with description and with theory development, where it is used to provide evidence for hypothesis generation and for exploration of areas where existing knowledge is limited (Cavaye, 1996). Approaches such as grounded theory, in which theoretical concepts and propositions emerge as the researcher gathers data and investigates phenomena, may be used to develop theory.

Yin (1994) suggested that the three conditions could determine the type of research programme indicated: First, the type of research question; secondly, the degree of investigator control possible; and finally, the degree of focus on contemporary events desired.

Yin (2003) and Stake (1995) use different terms to describe a variety of case studies. Yin categorises case studies as explanatory, exploratory, or descriptive. He also differentiates between single, holistic case studies and multiple-case studies. Stake identifies case studies as intrinsic, instrumental, or collective.

- Explanatory: This type of case study would be used if you were seeking to answer a question that sought to explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies. In evaluation language, the explanations would link programme implementation with programme effects (Yin, 2003).
- Exploratory: This type of case study is used to explore those situations in which the intervention being evaluated has no clear, single set of outcomes (Yin, 2003).
- Descriptive: This type of case study is used to describe an intervention or phenomenon and the real-life context in which it occurred (Yin, 2003).
- Multiple-case studies: A multiple case study enables the researcher to explore differences within and between cases. The goal is to replicate findings across cases. Because comparisons will be drawn, it is imperative that the cases are chosen carefully so that the researcher can predict similar results across cases, or predict contrasting results based on a theory (Yin, 2003).
- Intrinsic: Stake (1995) uses the term intrinsic and suggests that researchers who have a genuine interest in the case should use this approach when the intent is to better understand the case. It is not undertaken primarily because the case represents other cases or because it illustrates a particular trait or problem, but because in all its particularity and ordinariness, the case itself is of interest. The purpose is not to come to understand some abstract construct or generic phenomenon. The purpose is not to build theory (although that is an option; Stake, 1995).
- Instrumental: is used to accomplish something other than understanding a particular situation. It provides insight into an issue or helps to refine a theory. The case is of secondary interest; it plays a supportive role, facilitating our understanding of something else. The case is often looked at in depth, its contexts scrutinised, its ordinary activities detailed, and because it helps the researcher pursue the external interest. The case may or may not be seen as typical of other cases (Stake, 1995).
- Collective: Collective case studies are similar in nature and description to multiple case studies (Yin, 2003).

Triangulation provides an important way of ensuring the validity of a case study. Triangulation refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings (Denzin 1970).

Denzin (1970) extended the idea of triangulation beyond its conventional association with research methods and designs. He distinguished four forms of triangulation:

1. Data triangulation, involving time, space, and persons;
2. Investigator triangulation, which consist of the use of multiple, rather than single observers;
3. Theory triangulation, which consists of using more than one theoretical scheme in the interpretation of the phenomenon;
4. Methodological triangulation, which involves using more than one method and may consist of within-method or between-method strategies.

By analogy Yin (1994) states that the use of case study principles and techniques has a long, well-established reputation in health care research while systems theory has its origins in the empirical science of biology having been developed by biologist von Bertalanffy in the 1930s (von Bertalanffy, 1968). However, the combined use of systems theory with case study methodology remains poorly explored and streamlined as a heuristic model for health settings (Anaf et al., 2007).

4.2.2 System Theory

Early systems theorists aimed at finding a general systems theory that could explain all systems in all fields of science. The term goes back to von Bertalanffy‘s basic work 'General Systems Theory'. Sociologists like Niklas Luhmann also worked towards a general systems theory (Plsek, 1999). As of today, although no systems theory can live up to this argument, there are general system principles which are found in all systems. For example, every system is an interaction of elements manifesting as a whole. Miller and Rice equated the commercial and industrial organisation with biological organisms (Plsek, 1999).

The development of the 'General Systems Theory' came as a result of Bertalanffy‘s perceived need for a theory to guide research in multiple fields. His theory helped to provide a common framework that created shared and common language that scientists from different disciplines can employ to communicate their findings (Plsek, 1999).

System theory can be used to clearly and concisely understand health care structures, processes and outcomes and their interactions within a health care system. It can be used as a framework to illustrate the components of systems and the relationships between these components, the boundaries

of the system, the goals of the system and the system‘s ability to change and adapt in response to internal and external forces.

System theory and thinking can help in understanding how health care organisation and systems behave and it allows to clearly assess, visualise, analyse and understand the structure, processes, and feedback loops that make up the organisation.

System theory looks at the world as a system composed of smaller subsystems. An organisation as a system receives input, transforms it through processes for output and operates in an environment; economic, social, regulatory and other forces that together form the context within which the organisation operates. A system is a set of different independent parts working together in an interrelated manner to accomplish a set of objectives. The parts of a system are the sub-systems. Each sub-system influences the other sub-systems and the system as a whole. The position and function of each sub-system can be analysed and understood only in relation to other sub-systems and to the organisation as a whole. Each sub-system derives its strength by its association and interaction with the other sub-systems. As a result the collective contribution of the organisation is greater than the aggregate of individual contributions of its sub-systems. This is known as synergy. Each system has a boundary that separates it from its environment. The boundary determines which parts are internal to the organisation and which are external. For example, employees are within the boundary and customers are external to a hospital setting. The reaction or response of the environment to the output is known as feedback. Feedback is useful in evaluating and improving the functioning of the system. Open systems actively interact with their environment. By interacting with other systems, it tries to establish exchange relationships. Organisations as open systems operate on the principle that they have several alternative ways of doing the same thing or achieving the same goal.

4.2.3 Combining Case Study with System Theory

When correctly applied, a systems approach to case study strategies can reflect the influence of the external environment on research, as well as the evolutionary nature inherent in hospital systems and broader health care environments (Flood and Jackson, 1991; Mickan and Boyce, 2002). Systems theory principles are ideally suited to exploring complicated social, organisational, and clinical features that are usually inherent in the cases explored by qualitative health care researchers.

Anderson et al. (2005) make a salient point about this connection when they suggest,

Many now believe that health care organisations are complex adaptive systems . . . in which relationships are critical, are generally nonlinear, and lead to unpredictable dynamics. . . . Case study designs can be more informative when they assist us in revealing these characteristics.

One must pragmatically consider how to combine systems theory with qualitative case study research while maintaining the characteristics that make each approach useful and rigorous. After all, both approaches are robust and defendable in their own right, and this aspect must not be diminished. One effective way of blending case study research with systems theory is to use the systems framework as a dominant methodology, with the case study being used as the research strategy of choice.

Petula (2005) in her argumentation for the significance of applying systems theory to improve quality in healthcare systems maintains that; *"Narrative discussion, concept mapping, and an integrative review of relevant literature demonstrate that the deliberate application of systems theory within an interdisciplinary framework supports healthcare system behaviours that can reduce error, improve quality, and promote health"* (Petula, 2005).

In her elaboration, she explicates that systems theory offers a framework for quality improvement in healthcare systems because systems theory is underpinned by systems thinking that permits seeing the whole system and the relationships of the parts rather than just the parts in isolation of one another. The likelihood of high-quality care in systems where relationships and interrelationships are considered important is high. When relationships are considered important, greater emphasis is placed on effective communication, team building, conflict management, behavioural competencies and skill competencies, process management, and education, because these elements strengthen relationships.

Arguing for the utility of this approach, the atypical combination that was employed in this study visualises the Palestinian Health Care System at its three levels/contexts of: Ministry, District and Facility, as the case study, while RHIS producing subsystems including people conducting relevant functions and the concomitant interactive processes were viewed as the survey units of analysis. The multiplicity of the key informants situated at the three different levels/spaces that are the subject of this examination ensured triangulation of data sources and hence consistency of the results.

This depiction corresponds with the views held by Benbasat et al. (1987), all being advocates of positivist case study research. Yin (1994) maintains that case studies typically combine data collection techniques that may include interviews, observation, questionnaires and document

analysis typically known as methodological triangulation. In this research, these techniques were deliberately selected because of the belief that strengths and weaknesses of each would counterbalance one another.

In the case of this investigation, the case study is used within the positivist philosophical tradition to describe a phenomenon. Validity and reliability in positivist case study research involve using clearly defined methodological guidelines for ensuring construct validity, internal validity, reliability and external validity (Lee, 1989; Yin, 1994). This was maintained and strictly safeguarded by adopting the well devised PRISM framework and its thoroughly established and tested tools whose application realise a mixed method approach whereby a hybrid of socio-technical field attests as being particularly appropriate for a pragmatist mixed methods approach employed in a pluralist methodology. The mixed methods literature has commonly cited pragmatism as a relevant philosophical approach. Tashakkori and Teddlie (1998) provided a historical context for mixed methods research. Some years later, Teddlie and Tashakkori (2003) positioned the pragmatist rationale for mixed methods as a reaction to the contestation between paradigms. The unique convergence of disciplines stemming in the three domains of knowledge: health sciences and practice, information technology and social sciences make the case of pragmatism application in health informatics (Scott and Briggs, 2009).

The use of this approach enables the specifics of the case to be combined with consideration of the influence of broader systems and external environments, offering in-depth exploration of the case under investigation.

Health care has obvious systems operations that may have developed from organisational hierarchies, funding mechanisms, or classical service delivery of health care. Systems theory is ideally suited to examine health care delivery at various levels and sites (Facilities) such as clinics and hospitals (WHO, 2009). Sites can use the principles of systems theory to explore innovation, change, and complexity of service delivery.

It is argued at a particular level that a system is a part, and it is a whole, at the same time. An example of this in the modern National Health System is care pathways for patients which will often require a range of health disciplines to work together and will often also include professionals from social services or the local authority as well. Another example of effective systems theory applications include information technology applied to key clinical systems. These systems include medication administration, electronic documentation, patient order entry, and physiological monitoring (Plsek, 1999).

WHO (2009) in its seminal report on system thinking for health systems strengthening identifies six building blocks of the health system, one of which is –health information" for ensuring the production, analysis, dissemination and use of reliable and timely information on health determinants, health system performance and health status. Logically, these blocks alone do not constitute a system but rather the multiple relationships and interactions among them and the means by which they influence, act, react and interact with one another is what turns them into a system.

In addition, the same report maintains that –information and communications technology" is one and –systems thinking to transcend complexity" is another revolutionary area that is currently underway and will transform health and health systems. So here the two constructs of systems and information are put closely together signifying a serious paradigm shift in health care provision and management.

In such a shift, the systems framework moves the organisation and individuals away from a punitive model (faulting individuals) to a process model (faulting processes). This encourages the self-reporting of errors or potential errors because the fear of punishment is taken away (Petula, 2005). In turn, this promotes transparency and good governance within the healthcare system because systems thinking acknowledges the complexity of human behaviour and welcomes alternate opinions without the fear of retaliation. System redesign is, therefore, enabled through rethinking these problematic processes. This happened at Duke University Hospital when a transplant mismatch occurred (Bonifazi, 2003). A safer process was designed by an interdisciplinary team to prevent similar errors from occurring.

Looking into this logic, section 4.3 on the conceptual framework of PRISM and Figure 4.1 below illustrate clearly how the PRISM framework espoused in this study is rooted in system thinking and systems theory as discussed above and elaborated further in the next section.

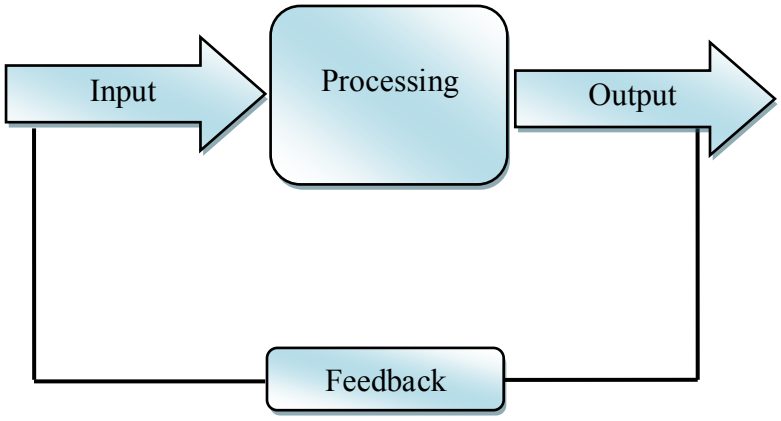

Figure 4.1 Systems and Systems Theory
Source: WHO (2009)

4.3 Conceptual Framework of PRISM

In this investigation, combining case study and system theory, the Performance of Routine Information System Management (PRISM) framework and its tools package was used to assess the performance of a routine health information system (RHIS) at the Palestinian MoH. The merits of PRISM in the Palestinian research context, as well as detail of the framework, are presented below.

The first version of the package was developed in 2004 by the MEASURE Evaluation Project-USAID and revised twice thereafter. As of 2012, 23 countries in Africa, Asia, and Latin America had applied the principles and approaches of the PRISM framework as well as the tools to assess performance of their RHIS and to guide the RHIS strengthening process (MEASURE Evaluation, 2013).

This study employed PRISM‘s version released in 2010. The rationale for using the PRISM framework is that the framework not only defines and measures information system performance but also explores determinants of performance. Thus, it creates opportunities for improvements by identifying the strengths and weaknesses of the information systems and the determinants of their performance.

The PRISM framework defines information system performance as improved data quality and continuous use of information for decision-making. It hypothesises that improved performance leads to better health system performance which consequently affects the health status of the population (see Figure 4.2).

The PRISM framework explores how much the RHIS processes (data collection, transmission, processing, analysis, display and feedback) influence RHIS performance. It also identifies technical, behavioural and organisational determinants. Some of the criteria used to shortlist the technical, behavioural and organisational determinants of performance include: how much control HIS designers and implementers have to change the determinants; the closeness of their relationship to performance, the urgency to handle them, and their perceived importance and feasibility (Aqil et al., 2009).

The PRISM framework is the first of its kind to empirically test the relationships among technical, behavioural and organisational determinants on RHIS process and performance. It creates opportunities to identify whether these determinants act directly or indirectly through behavioural determinants or processes or interaction with each other to influence RHIS performance (Aqil et al., 2009).

A routine health information system is composed of inputs, processes and outputs or performance, which in turn affect health system performance and consequently influence health outcomes (see Figure 4.2).

The PRISM framework brings a paradigm shift in RHIS design and evaluation by considering RHIS to be a system with a defined performance (Deming 1993), and by describing the organisational, technical and behavioural determinants and processes that influence its performance. The framework implies continuous improvement of RHIS performance by analysing the role of each of these determinants and by identifying appropriate interventions to address determinants that negatively influence RHIS performance. Through broader analysis of organisational information needs, it also prevents fragmentation of the existing RHIS and promotes a more integrated approach to information system development (Aqil et al., 2009).

The PRISM framework states that RHIS performance is affected by RHIS processes, which in turn are affected by technical, behavioural and organisational determinants (see Figure 4.2). It shows that behavioural determinants have a direct influence on RHIS processes and performance.

Technical and organisational determinants can affect RHIS processes and performance directly or indirectly through behavioural determinants. For example, the complexity of data collection forms (technical) could affect performance directly or indirectly by lowering motivation. Thus, the PRISM framework delineates the direct and indirect relationships of the determinants on RHIS performance and measures their relative importance. The PRISM framework also opens opportunities for assessing the relationships among RHIS performance, health system performance, and health status (Aqil et al., 2009).

The PRISM framework (see Figure 4.2) incorporates four complementary tools. These are; Diagnostic Tool, RHIS Overview and Facility/Office Checklist Tool, Management Assessment Tool, Organisational and Behavioural Assessment Tool. All have been developed to explore direct and indirect relationships of technical, behavioural and organisational determinants and provide opportunities for developing intervention(s) to bridge identified gaps (Aqil et al., 2009).

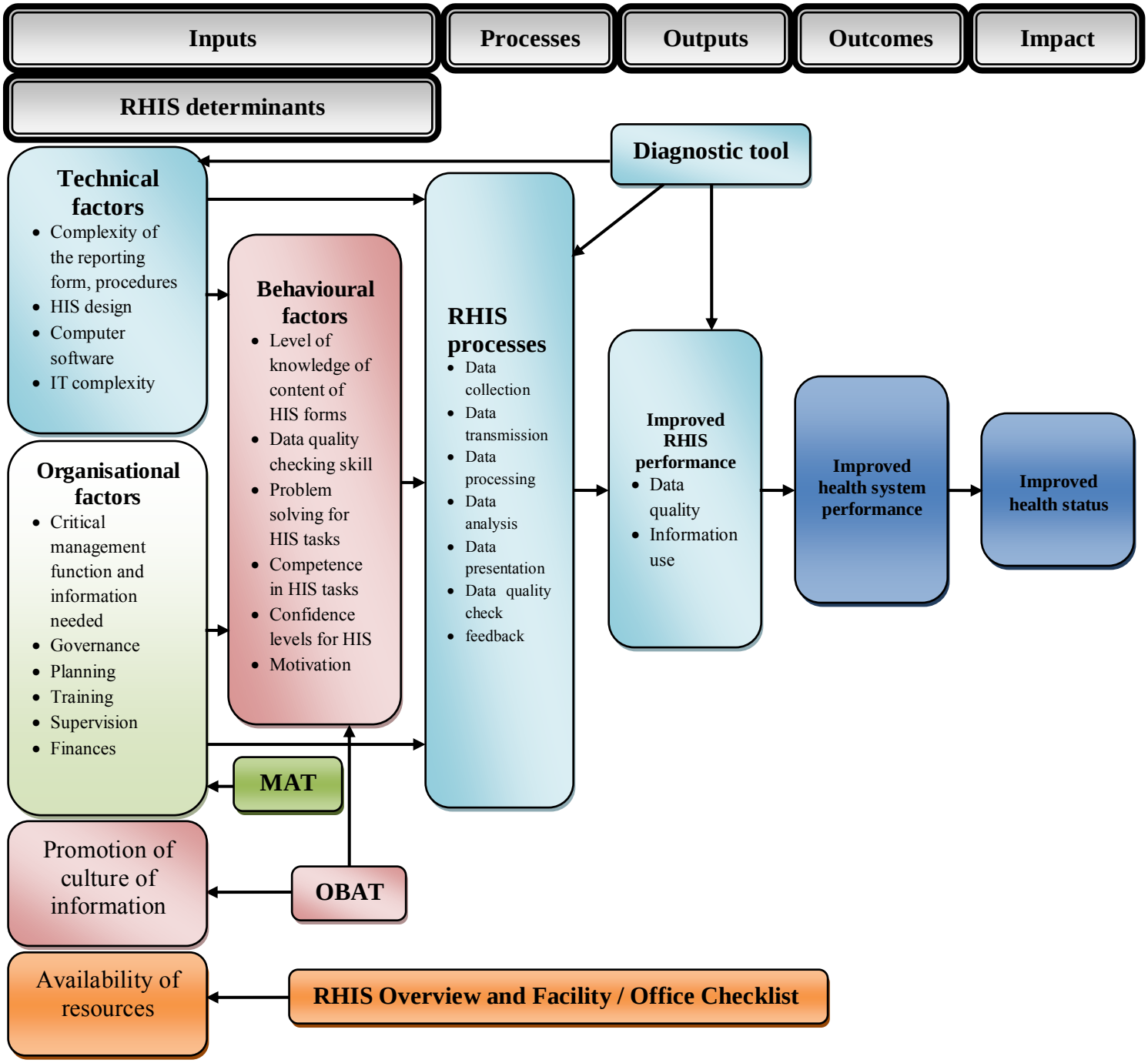

Figure 4.2 PRISM Framework and its Tools
Source: Aqil et al. (2009)

An empirical descriptive study method was undertaken to determine factors affecting information use in decision making. Both qualitative and quantitative approaches were used.

A descriptive study is an investigation aimed at ascertaining the status of a set of variables, such as the number and variety of persons with specific conditions in a specified population, but without any critical analysis or attempt to test hypotheses. Descriptive studies can yield valuable information about a population's health status, and they can be used to measure risks and generate hypotheses.

Descriptive studies are also useful in health service evaluation and can be used periodically to determine whether a particular service is improving, for instance, if serial description studies all show evidence of reduced sickness or disability rates over a period of years. This study employed descriptive design in order to evaluate the use of HMIS in the health area as a pilot.

This study also used a cross-sectional design. In this type of research study, either the entire population or a subset thereof is selected, and from these individuals data are collected to help answer research questions of interest. It is called cross-sectional because the information about X and Y that is gathered represents what is going on at only one point in time. This study employed a cross-sectional design to ascertain the use of information at the MoH in Palestine at the point in time where the fieldwork of this investigation was completed. This will enable comparison after the HMIS programme has been implemented.

This survey is a cross-sectional survey whereby the main limitation is that no causality statement can be made from these results, except for comparative analyses and exploring associations. This limitation was minimised by comparing the study findings to findings from other similar studies, as well as comparing quantitative to qualitative findings from anecdotes and gray and published literature. The findings are PRISM framework-based and hence are internally consistent, indicating high reliability and validity. The data were collected by the researcher of this investigation who is an external agent for the MoH, giving further credibility to the assessment because of no conflict of interest.

4.4 Study Setting and Target Population

The Palestinian Ministry of Health at the Ministry, District and Facility levels was the setting under investigation in this study while systems and staff operating at these three levels were the target population.

4.5 Sampling and Fieldwork

In carrying out the study the aim was to gain access to key individuals at the three levels. Given this requirement only the purposive sampling method was appropriate for to this investigation. A total of 123 respondents were selected from the Ministry of Health were interviewed: three respondents at the Ministry HMIS level, 15 respondents from 5 Districts and 105 respondents from 105 Facilities.

Fieldwork in this investigation was carried out during the two months of July- August 2010.

4.6 Data Collection Tool

This study employed PRISM's version released in 2010. When used as a whole, as the case in this study, the package provides a comprehensive picture of RHIS performance and its contributing factors in the technical, organisational and behavioural areas.

As already described the PRISM Tool Package contains four assessment and analysis tools that were employed in this investigation; these are: RHIS performance diagnostic tool comprising the two main parts on quality of data and use of information; RHIS Overview and Facility/Office checklist; Organisational and Behavioural Questionnaire; and RHIS Management Assessment Tool. These will each be considered in turn.

1. The RHIS Performance Diagnostic Tool is the main tool in the package. It determines the level of RHIS performance. The tool examines quality of data and information separately to identify areas of strengths and areas of weaknesses in RHIS performance. It captures the technical determinants of RHIS performance, such as level of complexity of data collection forms and user-friendliness of information technology. The other three tools are used to identify the factors that contribute to these strengths and weaknesses. Description of the RHIS Performance Diagnostic Tool is the following:
    - Appendix A is the RHIS Performance Diagnostic Tool at the Ministry level.
    - Appendix B is the RHIS Performance Diagnostic Tool at the District level.
    - Appendix C is the RHIS Performance Diagnostic Tool at the Facility level.
2. The RHIS Overview and Facility/Office Checklist is a combined tool where the first part, the RHIS Overview, looks at the structure and design of existing information systems in the health sector, information flows, and interaction between different information systems. The second being the Facility/Office Checklist used to understand available resources at Health Offices and Facilities (Appendix D).
3. The RHIS Management Assessment Tool is designed to rapidly take stock of the management and supportive practices of the RHIS processes, and to aid in developing a set of recommendations for the RHIS process (Appendix E).
4. The Organisational and Behavioural Questionnaire collects data at the individual personnel level to provide information about behavioural and organisational factors that affect RHIS performance (Appendix F). The behavioural factors include knowledge, skills, problem solving, confidence level for carrying out RHIS tasks, and motivation. The organisational part concerns

assessing perceptions of whether an organisation promotes a culture of information, by comparing these factors with RHIS performance. Gaps are identified for improvements.

PRISM Tools use various data sources and methods to collect information. These are self-administered questionnaires; observations; interviews, reviews of documents, office records, and RHIS feedback reports and information technology review.

For instance, the RHIS Performance Diagnostic Tool and the RHIS Overview and Facility/Office Checklist use observations and interviews, supplemented by document research. The RHIS Management Assessment Tool uses key informant interviews. The Organisational and Behavioural Questionnaire collects data via self-administered questionnaires.

Table 4.1 shows a summary of information collected via the PRISM tools by unit of analysis

Type of tool	Content	Ministry or District	Facility level
RHIS performance diagnostic tool	A. RHIS performance		
	– Data quality – completeness, timeliness, and accuracy	#	#
	– Information use – Report produced, discussion, decision, referral for action at higher level, advocacy	#	#
	B. Processes		
	– Collection, transmission, processing/analysis, display, data quality check, and feedback	#	#
	C. Promotion of culture of information		
	– Action plan, role modelling, newsletter, advocacy	#	#
	D. Supervision quality		
	– Frequency, discussion, checking quality, assist use for decision-making		#
	E. Technical determinants		
	– Complexity of forms, information technology, integration	#	#
RHIS overview, facility/office checklist tool	A. RHIS overview		
	– Mapping – list information systems, their overlap and distinctions	#	
	– Data collection and transmission – various forms and their user-friendliness	#	
	– Information flow chart – communication pattern	#	
	B. Office/facility checklist		
	– Availability of equipment, utilities, register/forms	#	#
	– Availability of human resources, % trained, types of training	#	#
RHIS organisational and behavioural assessment tool (OBAT)	A. Behavioural		
	– Self-efficacy (confidence) for RHIS tasks	#	#
	– RHIS tasks competence	#	#
	– Motivation	#	#
	– Knowledge of RHIS rationale, methods of checking data accuracy	#	#
	– Problem-solving skills		
	B. Promotion of a culture of information		
	– Emphasis on data quality	#	#
	– Use of RHIS information	#	#
	– Evidence-based decision-making	#	#
	– Problem solving, feedback	#	#
	– Sense of responsibility	#	#
	– Empowerment/accountability	#	#
	C. Reward	#	#
RHIS management assessment tool (MAT)	RHIS management functions		
	– Governance, planning, training, supervision, quality, finance	#	#

Table 4.1 Summary of Information Collected via the PRISM Tools by Unit of Analysis

4.7 Tool Adaptation and Pre-testing

Adapting the questions for the local Palestinian context in consultation with a panel of experts, the investigator reviewed and modified the questions in the tools to correspond to the Palestinian Routine Health information System (RHIS) design and settings.

Previously PRISM has been applied only at the District and Facility level. In contrast in this research investigation adaptation has taken place in order for PRISM to be applied in addition at the Ministry level.

4.8 Methods of Data Analysis

The data were analysed using the Statistical Package for Social Sciences (SPSS) software. Raw data were entered, checked for data quality and then appropriate statistical tests were performed to examine relationships and interpret them.

Use of information was assessed using two criteria. First, the availability of any kind of report (feedback, quarterly, health services etc.) and reviewing them for use of information; second, by reviewing records of Facility meetings on discussion of HMIS findings and decisions made based on those discussions.

The Facility checklist provided information about the availability of resources. Most of the question responses were either yes or no, while some questions asked for the availability of resources in quantity. Thus, a percentage distribution of responses easily shows where the responses fall most frequently. However, for quantity, the responses have been grouped into three categories: zero, one, or equal to or greater than two.

In the management assessment tool, the various management functions were assessed by more than two items. Thus, an index percentile score for each function is calculated. The percentile score informs how many criteria are met. For example, if all criteria are met then it will earn a score of 100%, while no criteria met will lead to a percentile score of zero. However, to make comparisons among various management functions, the mean score is used and presented in this report.

Qualitative methods included systematic document analysis of gray literature. Documents included anecdotes from health workers, work plans, minutes of meetings, policy, instruction manuals and system documentation. These were obtained from the selected Health Facilities at the MoH.

The governance functional level of HMIS management was measured by the presence of a mission statement, management structure, updated organisational chart, involvement of information system managers in senior management meetings, and distribution list of information reports. The planning

functional level was measured by the availability of a recent HMIS situation analysis report, HMIS long term plan and targets. The quality standards functional level was assessed by use of quality/performance improvement tools, availability of HMIS standards at Facilities and higher levels. The training functional level was assessed by the presence of training manuals, on-the-job training and schedule of planned training activities. The supervision functional level was measured by the presence of supervisory checklist, schedule and supervisory reports. The financial functional level was measured by the presence of an HMIS expense register, mechanisms for generating funds, financial reports and long term financial plans.

Positive outcomes were assessed as measures for determining the level of motivation. Understanding for the rationale for including certain types of information on data collection forms was also measured. Confidence levels were assessed on a scale of 0 to 100 from no confidence to full confidence in performing a particular HMIS task. HMIS task competence was measured by asking the respondent to solve a problem in a paper and pencil test.

4.9 Research Questions

The methodology was being implemented in order to address a number of research questions. These are as follows:

1. To what extent does the quality of RHIS data (completeness, timeliness, and accuracy) affect the level of information use?
2. To what extent do RHIS processes (transmission, processing, and analysis) affect RHIS performance?
3. To what extent do behavioural factors such as motivation, perceived confidence level to perform RHIS related tasks, data demand, and competence in performing RHIS related tasks affect RHIS performance?
4. To what extent do technical factors such as information technology, system design, complexity of forms, etc., affect RHIS performance?
5. To what extent do organisational factors such as governance, finance, training, supervision, and a culture of information influence RHIS performance?

4.10 Ethical Considerations

Administrative clearance to conduct the study and access written, verbal and observational data sources was obtained from the MoH. As part of the research process, consent was continuously sought from individuals whose personal insight on specific issues was obtained through interviews.

The following ethical principles were observed during the study:

1. Letters were submitted seeking cooperation in accessing information for study purposes. One was obtained from the School of Informatics- City University-London. A second letter was submitted by the author of this study. These letters assisted in gaining access to information in the MoH.
2. A letter from the MoH was provided to gain access to information at the levels of Ministry, District and Health Facility.
3. All informants that participated in the study were assured of confidentiality, and that their participation was voluntary.

4.11 Summary

This chapter has provided the methodology adopted for the substantive research, designed to meet the objectives described in chapter 1. Major components have included conceptual foundations and study design including case study, system theory, combining case study with the system theory, theoretical background and conceptual framework for the necessary analysis.

This chapter has shown how the methodology was implemented in order to understand the nature and performance of currently adopted systems, study settings and target population, sampling and sample size, data collection methods and tools, tool adaptation and pre-testing and methods of data analysis, research questions and ethical consideration. The next chapter will discuss the results obtained from implementation of the methodology.

Chapter 5
Results

5.1 Introduction

This chapter will discuss the results obtained from implementation of the methodology. In order to provide a context for these results, it is appropriate to revisit the nature of health care delivery in Palestine. Within this context results are presented for respondents‘ socio – demographic characteristics, respondents‘ educational level, level of RHIS performance (data quality and use of information), functionality of RHIS processes, and determinants of performance, including technical, behavioural and organisational determinants.

5.2 Overview of Palestinian Health Management System Indicating Types of Information and the Nature of the Principal Information Flows

As was described earlier in chapter one, the health care system in Palestine is composed of five major health care providers (MoH, 2010):

1. The Ministry of Health (MoH): the main health care provider, covering 64% of all Palestinian Health Care Facilities and the majority of hospital beds, providing primary, secondary and tertiary care and purchasing unavailable secondary and tertiary health care services from other providers, both domestic and abroad. According to MoH policies, PHC centres are classified from level I to IV, offering different health services according to the level of clinic. Services include maternal and child health, care of chronic diseases, daily care, family planning, dental, mental health services and others according to the level.
2. The United Nations Relief and Works Agency (UNRWA): provides primary health care and some secondary services to refugee populations, and purchases secondary and tertiary care services when needed.
3. Non Governmental Organisations (NGOs): a large sector that includes missionary hospitals, Facilities supported by international organisations and community health centres.
4. The private sector: also provides the three levels of care through a wide range of practices (reliable data on services delivered and other vital statistics are lacking).
5. Contracting out services: hospitals located in the West Bank and East Jerusalem or hospitals outside Palestine- Jordan, Egypt and Israel.

Since 1995 the MoH has initiated development of some information systems. However these systems are working alone without any integration between each other. The private and NGO sectors

have developed health information systems that are organisation-specific and largely not designed to link across organisations.

Table 5.1 shows a mapping of the Health Information System which lists the types of information that are associated with each of the different health programmes. It can be seen from this mapping that similar types of information are collected by different systems which suggests different accuracy and data quality issues.

Types of information handled by each system								
Type of information system	Service utilisation	Occurrence of selected disease	Disease outbreak (Immediate report)	Financial information	Drug, contraceptive vaccine, stock	Human resources	Equipment/ building	Vital events
Routine service based reporting system	X	X		X	X	X	X	X
Epidemiological surveillance for notifiable infectious diseases	X	X	X					
Special programme reporting systems (EPI)	X				X			
Special programme reporting systems (TB)	X							
Special programme reporting systems (HIV/AIDS)	X				X			
Special programme reporting systems (MCH)	X				X			X
Administrative system (Finance)	X			X	X	X	X	
Administrative system(human resource)	X			X		X		
Administrative system (drugs, contraceptive, vaccine, logistics)	X			X	X		X	
Vital registration	X							X
Health insurance	X			X	X			

Table 5.1 Information System Mapping (MoH)

Table 5.2 shows the data flows of different information systems throughout the organisational levels of the MoH. The level of vertical and horizontal communication indicates whether various people and/or departments are talking to each other and influencing decision making. Usually, horizontal communication is not made explicit in the information system design, which creates problems with integration and obtaining the big picture of the information system and, consequently, the health system.

Table 5.2 shows the data flows throughout the organisation levels of the MoH starting with those that collect information at the Facility level. Most of the information flows are in an upward direction with very little feedback to the lower levels of the organisation.

Cross programme data sharing is limited between specific programmes/information systems which makes the health information system fragmented and makes it very difficult to integrate the data from the different subsystems and programmes to produce intelligence and evidence to improve the performance of the health system.

Levels	**Types of information systems**									
	Routine service based reporting system	Epidemiological surveillance for notifiable infectious diseases	EPI	TB	HIV/AIDS	MCH	Finance	Human resources	Administrative system (drugs, contraceptive, vaccine, logistics)	Vital registration
Central/ national level	↕	↑	↑	↑	↑	↑	↑	↑	↑	↑
District level	↕	↑	↑	↑	↑	↑	↑	↑	↑	↑
Facility level	↕	↑	↑	↑	↑	↑	↑	↑	↑	↑

Table 5.2 Data Flows Throughout the Organisation Levels of the MoH by Type of Information System

5.3 Respondents' Socio – Demographic Characteristic

A total of 123 respondents from the MoH were interviewed (see Table 5.3). These included 3 respondents from Ministry HMIS level, 15 respondents from 5 Districts and 105 respondents from 105 Facilities.

Type of tool	Content	Number of respondents		
		Ministry level	District level	Facility level
RHIS performance diagnostic tool	A. RHIS performance			
	– Data quality – completeness, timeliness, and accuracy	3	15	105
	– Information use – Report produced, discussion, decision, referral for action at higher level, advocacy	3	15	105
	B. Processes			
	– Collection, transmission, processing/analysis, display, data quality check, and feedback	3	15	105
	C. Promotion of culture of information			
	– Action plan, role modelling, newsletter, advocacy	3	15	105
	D. Supervision quality			
	– Frequency, discussion, checking quality, assist use for decision- making	X	X	105
	E. Technical determinants			
	– Complexity of forms, information technology, integration	3	15	105
RHIS overview, facility/office checklist tool	A. RHIS overview			
	– Mapping – list information systems, their overlap and distinctions	1	5	X
	– Data collection and transmission – various forms and their user- friendliness	1	5	X
	– Information flow chart – communication pattern	1	5	X
	B. Office/facility checklist			
	– Availability of equipment, utilities, register/forms	3	15	105
	– Availability of human resources, % trained, types of training	3	15	105
RHIS organisational and behavioural assessment tool (OBAT)	A. Behavioural			
	– Self-efficacy (confidence) for RHIS tasks	3	15	105
	– RHIS tasks competence	3	15	105
	– Motivation	3	15	105
	– Knowledge of RHIS rationale, methods of checking data accuracy	3	15	105
	– Problem-solving skills			
	B. Promotion of a culture of information			
	– Emphasis on data quality	3	15	105
	– Use of RHIS information	3	15	105
	– Evidence-based decision-making	3	15	105
	– Problem solving, feedback	3	15	105
	– Sense of responsibility	3	15	105
	– Empowerment/accountability	3	15	105
	C. Reward	3	15	105
RHIS management assessment tool (MAT)	RHIS management functions			
	– Governance, planning, training, supervision, quality, finance	3	15	105

Table 5.3 Number of Respondents for each Tool

The respondents‘ age ranged from 20 to 59 years with an average of 36 years (see Figure 5.1 and Table 5.4)

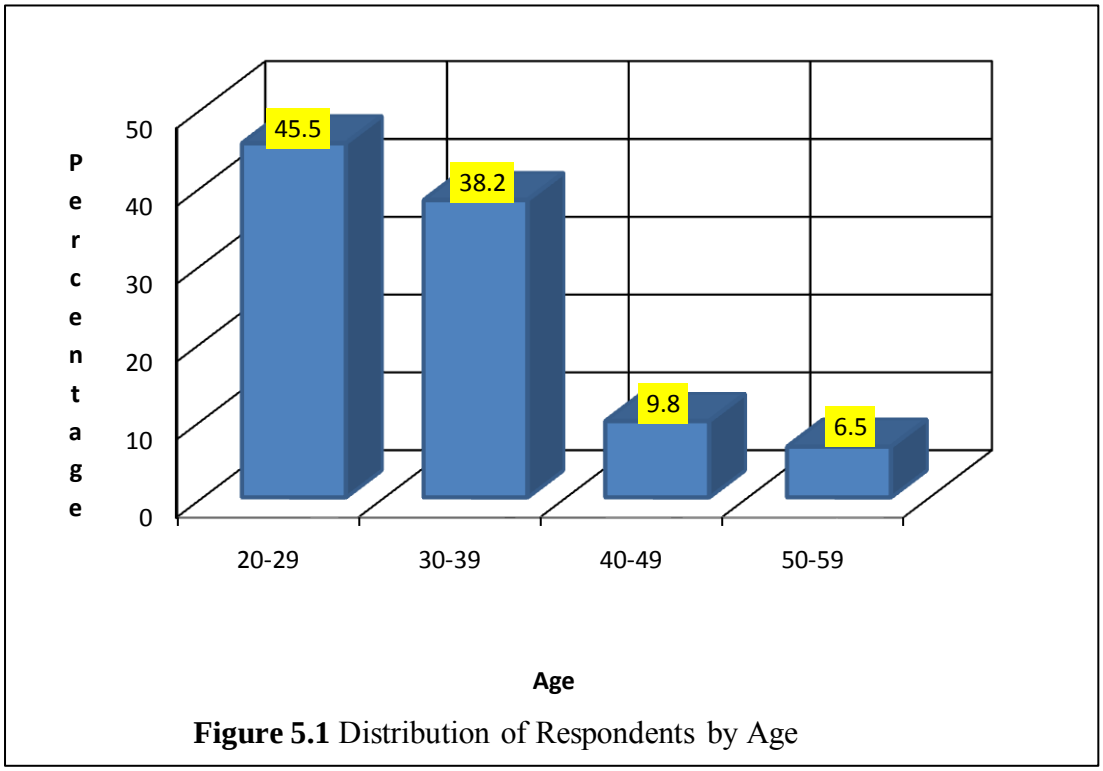

Figure 5.1 Distribution of Respondents by Age

Levels	Age			
	20-29	**30-39**	**40-49**	**50-59**
Ministry HMIS	X	X	2	1
District	X	1	7	7
Facility	56	46	3	X
Total	56	47	12	8

Table 5.4 Distribution of Respondents by Age

On average, the respondents had 13 years of experience in the relevant Health Departments (see Figure 5.2 and Table 5.5).

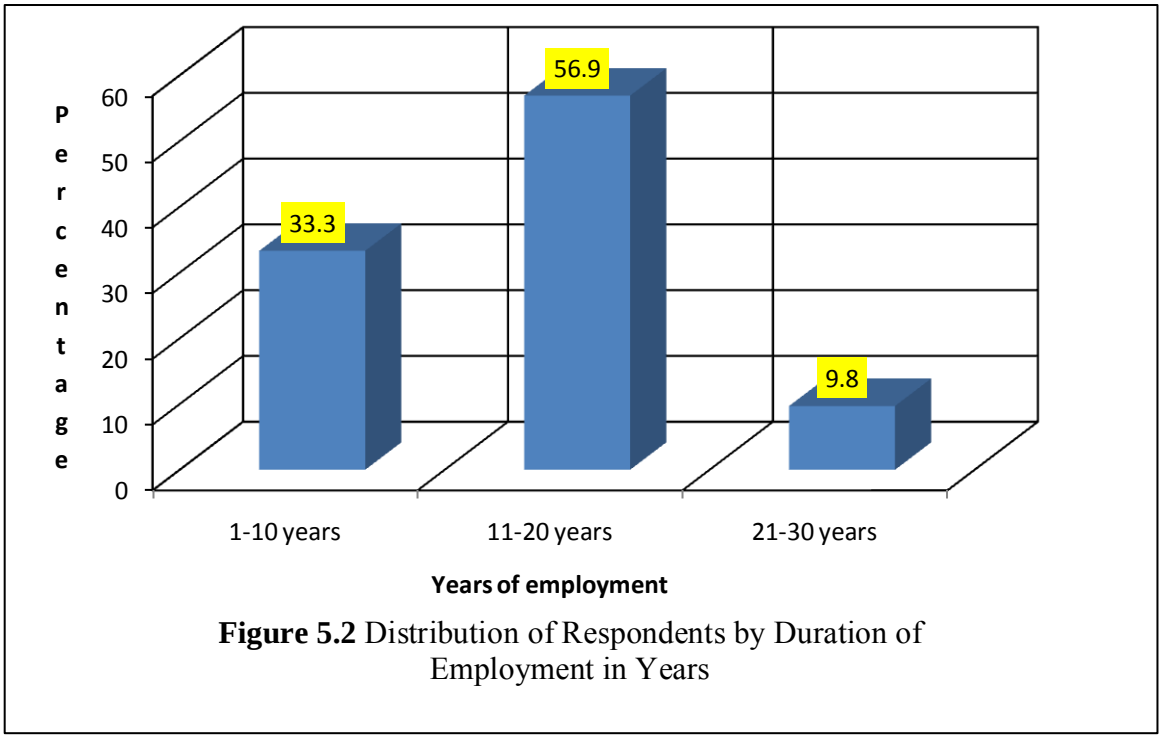

Figure 5.2 Distribution of Respondents by Duration of Employment in Years

Levels	Years of employment		
	1-10	**11-20**	**21-30**
Ministry HMIS	X	X	3
District	2	10	3
Facility	39	60	6
Total	41	70	12

Table 5.5 Distribution of Respondents by Duration of Employment in Years

The Health Management Information System Director, Primary Health Care Director and Statistician Director from the Ministry HMIS level were interviewed as they have access to all the data of the health information system. Moreover they have the responsibility for publishing an annual report –Health Status in Palestine" (see Table 5.6).

The District Health Officer, District Primary Health Officer, and District Statistician Officer from the District level were interviewed as they have access to all the data of the District health information system, and they also have the responsibility for data flows from the District to higher levels.

Physicians, Registered Nurses, Practical Nurses (Nurse Assistants) and Midwives were interviewed from the Facility level as they have the responsibility for Facility management and data flows from the Facility to the District.

		Mean	Median	Min-Max
1-Age of the respondent		36	35	20-59
2-Years in employment		13	11	1-30
			Frequency	**Percentage**
3-Sex	1.Male		23	18.7%
	2.Female		100	81.3%
	Total		123	
4-Post title of the respondents	HMIS director		1	0.8%
	Primary health care director		1	0.8%
	Statistician director		1	0.8%
	District health officer		5	4%
	District PHC officer		5	4%
	District statistician officer		5	4%
	Physicians		15	12.1 %
	Registered nurse		47	38.2 %
	Practical nurse (Nurse assistant)		32	26%
	Midwife		11	9%
	Total		123	
5-Educational attainment	1. Primary		3	2.4%
	2. Secondary		8	6.5%
	3.Diploma		43	35%
	4.Bachelor		65	52.8%
	5.Master		4	3.3%
6-Training in HMIS related activities in last six months	1.Yes		0	0%
	0. No		123	100%

Table 5.6 Respondents‘ Socio - demographic Characteristic (N=123)

The PRISM tool package contains four assessment and analysis tools that were employed in this investigation; these are: RHIS performance diagnostic tool comprising the two main parts on quality of data and use of information; RHIS overview and facility/office checklist tool; Organisational and behavioural questionnaire; and RHIS management assessment tool (see Table 5.7).

Type of tool	Content	Purpose of assessment
RHIS performance diagnostic tool	A. RHIS performance – Data quality – completeness, timeliness, and accuracy – Information use – Report produced, discussion, decision, referral for action at higher level, advocacy	RHIS performance assessment
	B. Processes – Collection, transmission, processing/analysis, display, data quality check, and feedback	Processes assessment
	C. Promotion of culture of information – Action plan, role modelling, newsletter, advocacy	Organisational determinants assessment
	D. Supervision quality – Frequency, discussion, checking quality, assist use for decision- making	Organisational determinants assessment
	E. Technical determinants – Complexity of forms, information technology, integration	Technical assessment
RHIS overview, facility/office checklist tool	A. RHIS overview – Mapping – list information systems, their overlap and distinctions – Data collection and transmission – various forms and their user- friendliness – Information flow chart – communication pattern	Organisational determinants assessment
	B. Office/facility checklist – Availability of equipment, utilities, register/forms – Availability of human resources, % trained, types of training	Organisational determinants assessment
RHIS organisational and behavioural assessment tool (OBAT)	A. Behavioural – Self-efficacy (confidence) for RHIS tasks – RHIS tasks competence – Motivation – Knowledge of RHIS rationale, methods of checking data accuracy – Problem-solving skills	Behavioural determinants assessment
	B. Promotion of a culture of information – Emphasis on data quality – Use of RHIS information – Evidence-based decision-making – Problem solving, feedback – Sense of responsibility – Empowerment/accountability	Organisational determinants assessment
	C. Reward	Organisational determinants assessment
RHIS management assessment tool (MAT)	RHIS management functions – Governance, planning, training, supervision, quality, finance	Organisational determinants assessment

Table 5.7 PRISM Tool Components

Table 5.8 below shows that 18.6% of the respondents were male while 81.4% of the respondents were female.

levels	Sex	
	Male	**Female**
Ministry HMIS	3	X
District	12	3
Facility	8	97
Total	23	100

Table 5.8 Distribution of Respondents by Sex

Figure 5.3 and Table 5.9 show that more than 52% had a bachelor degree while 35% had a diploma qualification.

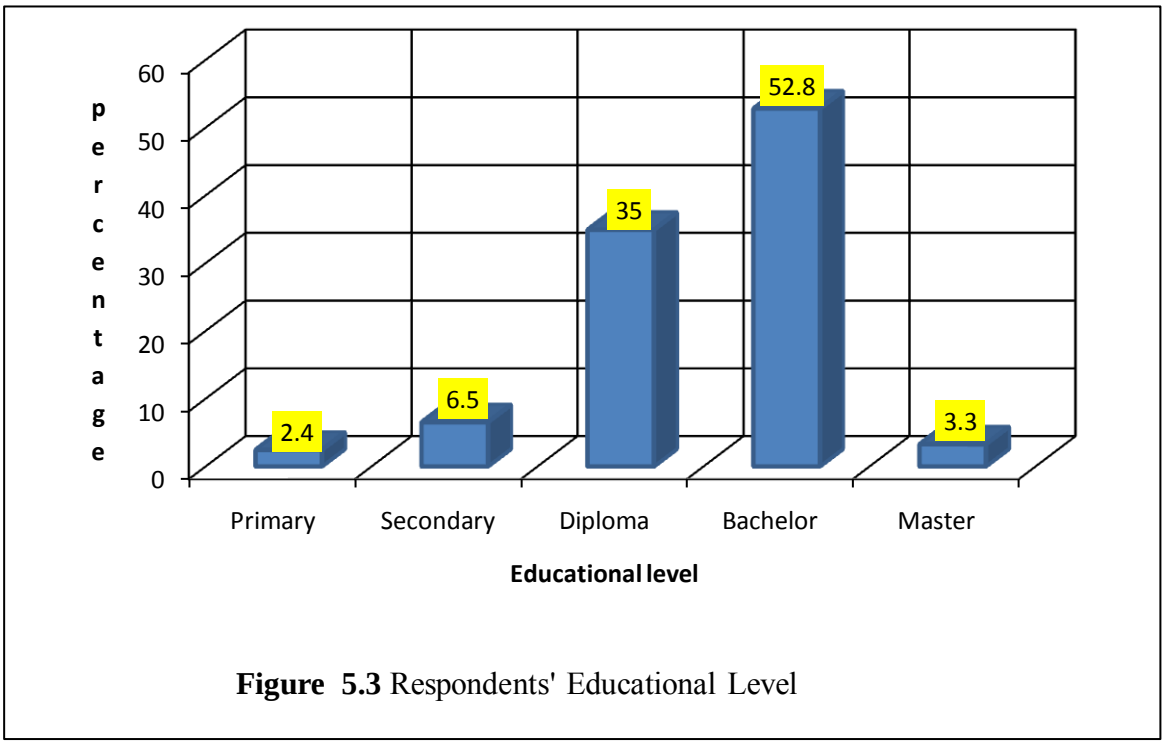

Figure 5.3 Respondents' Educational Level

Levels	Respondents' educational level				
	Primary	**Secondary**	**Diploma**	**Bachelor**	**Master**
Ministry HMIS	X	X	X	1	2
District	X	X	X	13	2
Facility	3	8	43	51	X
Total	3	8	43	65	4

Table 5.9 Respondents' Educational level

None of the respondents had engaged in training in HMIS activities in the previous six months, indicating a need for HMIS training activities for the staff.

5.4 Level of Routine Health Information System (RHIS) Performance

RHIS performance, the output of the routine health information system, is measured by two criteria; level of data quality and use of information.

5.4.1 Data Quality

Data quality is measured in terms of accuracy and completeness at the Facility level. However, at the Ministry HMIS and District levels it is measured in terms of timeliness, data accuracy and completeness.

5.4.1.1 Data Quality at the Ministry HMIS Level

1. Data completeness

   The completeness of the monthly report at the Ministry HMIS level is assessed by how many Districts which were supposed to report are actually reporting to the Ministry HMIS level. The results showed that all Districts submitted 100% of their monthly reports for the first month and second month of this investigation.

2. Data Timeliness

   In the diagnostic tool, meeting data submission deadlines from the District to a higher level is used as a proxy for timeliness. The results showed 100% timeliness was for the two months of this investigation.

3. Data Accuracy

Accuracy in the RHIS is defined as how accurately data are transferred between data collection tools. The diagnostic tool measures the accuracy of data transfer between the RHIS report and computer data entry at the Ministry HMIS level.

In the study, the data elements selected for checking data accuracy for two months were:

- Women receiving antenatal care (ANC).
- Children under 3 years of age receiving medical care.
- Women receiving family planning services (FP).

Data accuracy was checked by counting selected data elements in the submitted paper reports from the Districts and comparing it with what is available in the computer database at the Ministry HMIS level. The results showed an overall data accuracy at the Ministry HMIS level of 96.6% as can be seen in Table 5.10 below.

Name of the report		**Percentage of data accuracy**	
		Month July	Month August
1-	Women receiving antenatal care	98.9	93.7
2-	Children under 3 years receiving medical care	100	98.7
3-	Women receiving family planning services	91.7	96.7
	Percentage of overall data accuracy at the Ministry HMIS = 96.6%		

Table 5.10 Percentage of Data Accuracy at the Ministry HMIS Level

Figure 5.4 below shows the data quality at the Ministry HMIS level.

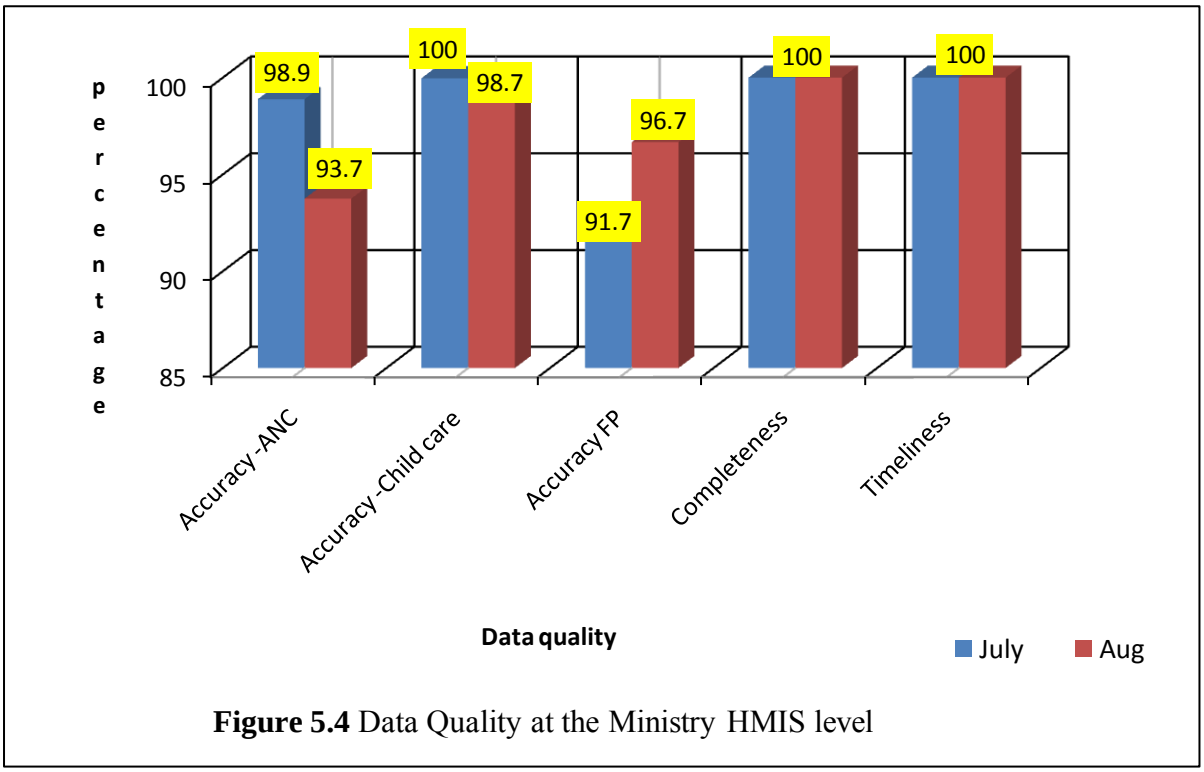

Figure 5.4 Data Quality at the Ministry HMIS level

5.4.1.2 Data Quality at the District Level

1. Data completeness

The completeness of the monthly report at the District level is assessed on the basis of how many Facilities which were supposed to report are actually reporting to the District level. The results showed that the overall percentage of completeness (Facility coverage) is 84% as indicated in Figure 5.5 below.

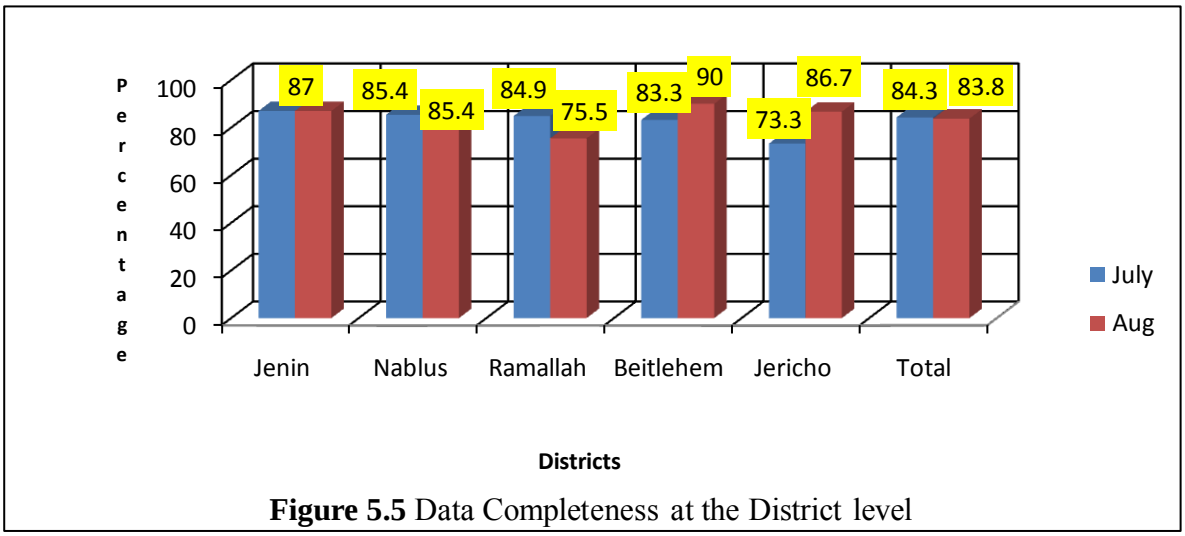

Figure 5.5 Data Completeness at the District level

Moreover, none of the Districts had records of submitting data to a higher level.

2. Data Timeliness

In none of the Districts was there any evidence of measuring timeliness since there was no recording of receipt dates of RHIS monthly reports from the Facilities.

3. Data accuracy

The diagnostic tool measures the accuracy of data transfer between the RHIS report and computer data entry at the District level. In this study, the data elements selected for checking data accuracy for the two month period were:

- Women receiving antenatal care (ANC).
- Children under 3 years of age receiving medical care.
- Women receiving family planning services (FP).

Data accuracy was checked by counting selected data elements in the submitted paper reports from the Facilities and comparing them with what is available in the computer database of the Districts. This revealed an overall accuracy of 85.1% at the District level (see Table 5.11).

Data accuracy (%) at the District level											
Name of the report		**Jenin**		**Nablus**		**Ramallah**		**Bethlehem**		**Jericho**	
		July	Aug	July	Aug	July	Aug	July	Aug	July	Aug
1-	Women receiving antenatal care	78.5	82.8	82.9	86.1	92.2	84.5	81.1	72.4	81.3	75.2
2-	Children under 3 years receiving medical care	92.4	93.7	91	91	95.8	94.7	91.4	89.1	83.1	81.2
3-	Women receiving family planning services	88.5	78.6	82.9	81.5	77.7	85.2	77.2	77.8	75.6	73.8
Percentage of data accuracy for July = 85.7 Percentage of data accuracy for August = 84.4 **Overall percentage data accuracy = 85.1**											

Table 5.11 Data Accuracy (%) at the District Level

Figure 5.6 shows data quality at the District level.

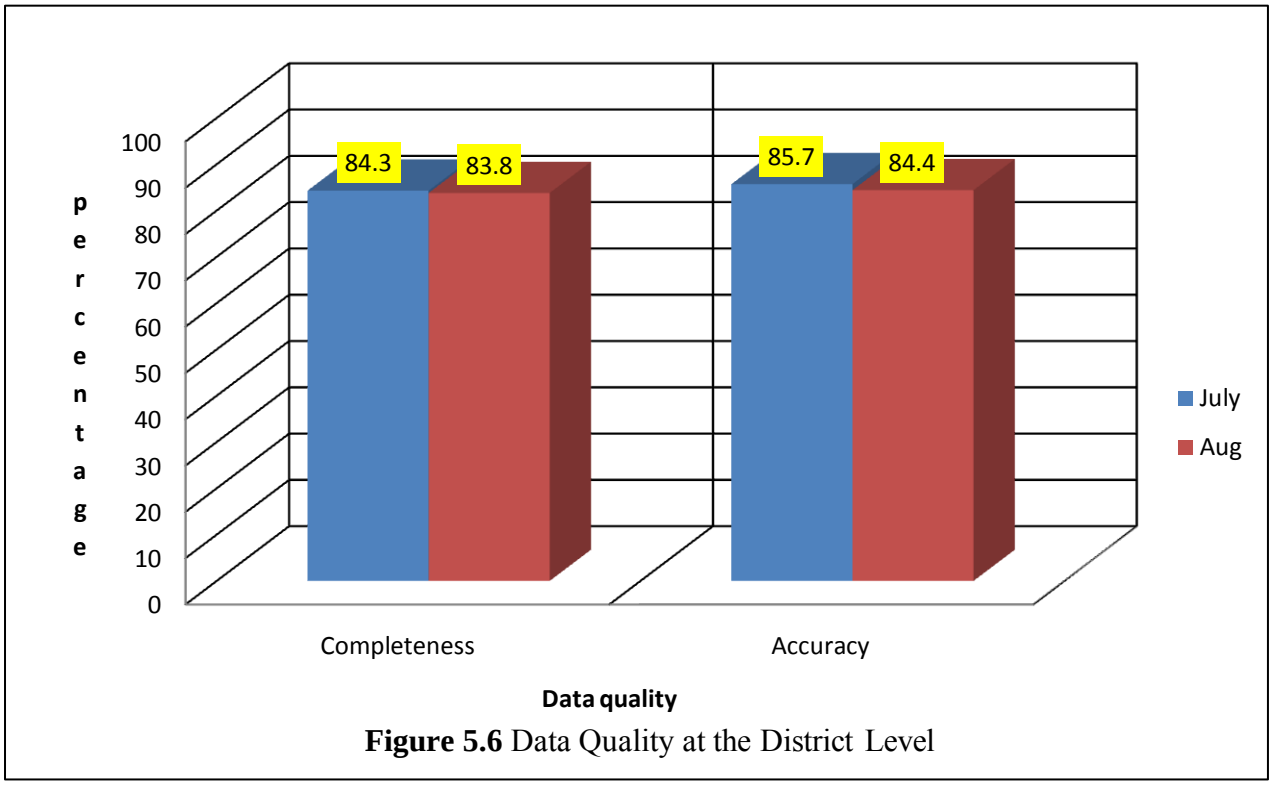

Figure 5.6 Data Quality at the District Level

5.4.1.3 Data Quality at the Facility Level

1. Data Completeness

Completeness of the monthly report is measured by how many data elements were entered against the total number of data elements the Facility was supposed to enter. The result showed an overall completeness by data element at the Facility level of 80.8% (see Figure 5.7).

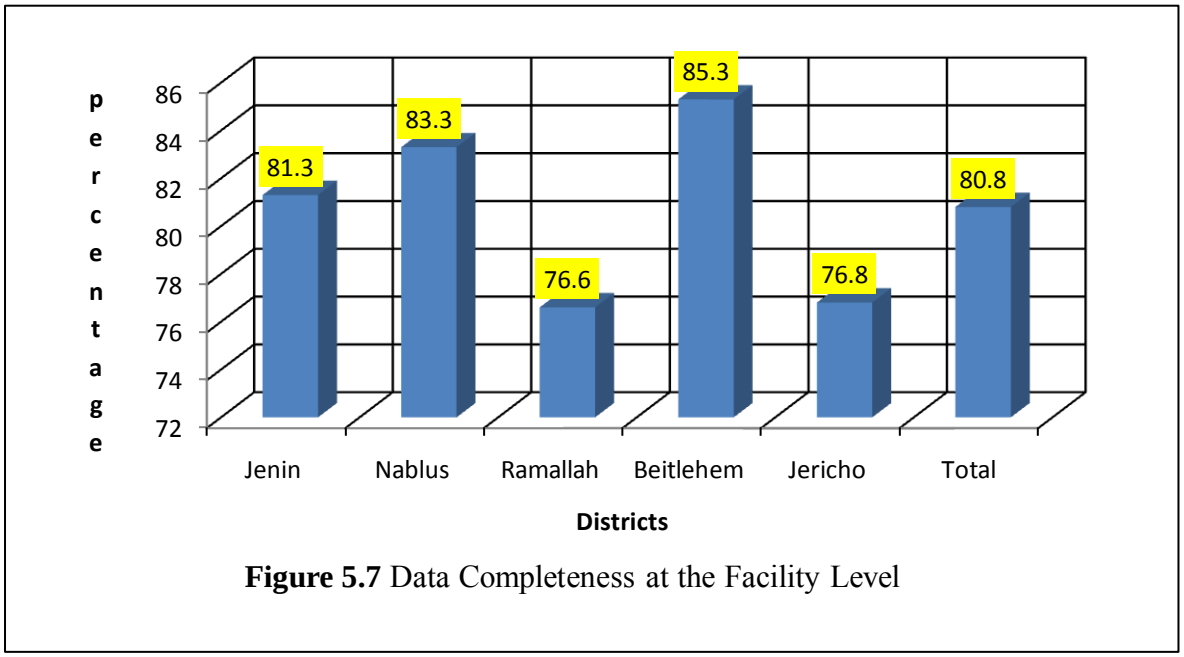

Figure 5.7 Data Completeness at the Facility Level

2. Data Accuracy

Data accuracy was observed by counting numbers in the registers and matching them with those included in the monthly report in relation to the same data elements. An overall figure of 89.1% was revealed (see Table 5.12).

Name of the report		Data accuracy (%) at the Facility level									
		Jenin		Nablus		Ramallah		Bethlehem		Jericho	
		July	Aug	July	Aug	July	Aug	July	Aug	July	Aug
1-	Women receiving antenatal care	81.2	83.6	88.4	88.5	94.5	95.4	91.7	93.2	82.1	83.7
2-	Children under 3 years receiving medical care	95.4	97	94.8	98.6	95.6	97.2	92.3	97.8	93.6	93.1
3-	Women receiving family planning services	83.6	81.8	69.6	84.1	90.9	87.7	80.4	96.2	76.7	84.2
Total		86.7	87.5	84.3	90.4	93.7	93.4	88.1	95.7	84.1	87
Percentage of data accuracy for July = 87.4 Percentage of data accuracy for August = 90.8 **Overall percentage data accuracy =89.1**											

Table 5.12 Data Accuracy (%) at the Facility Level

Figure 5.8 shows the data quality at the Facility level.

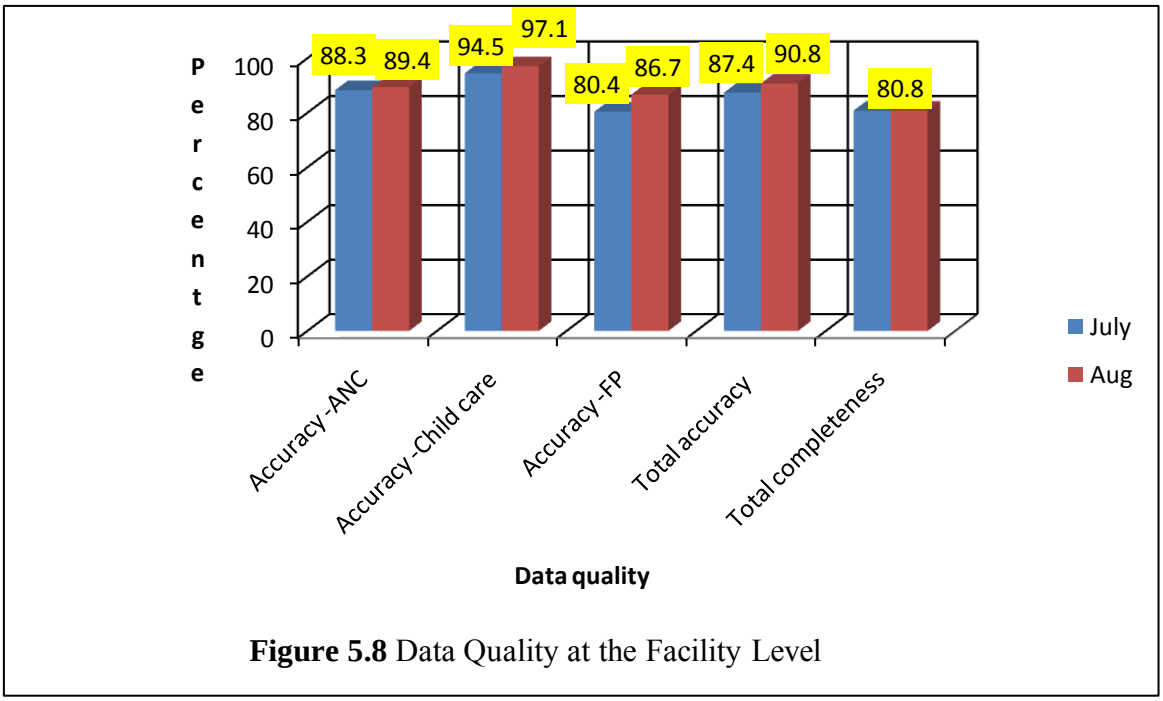

Figure 5.8 Data Quality at the Facility Level

Figure 5.9 and Figure 5.10 show the data quality at all levels in the MoH for July and August respectively.

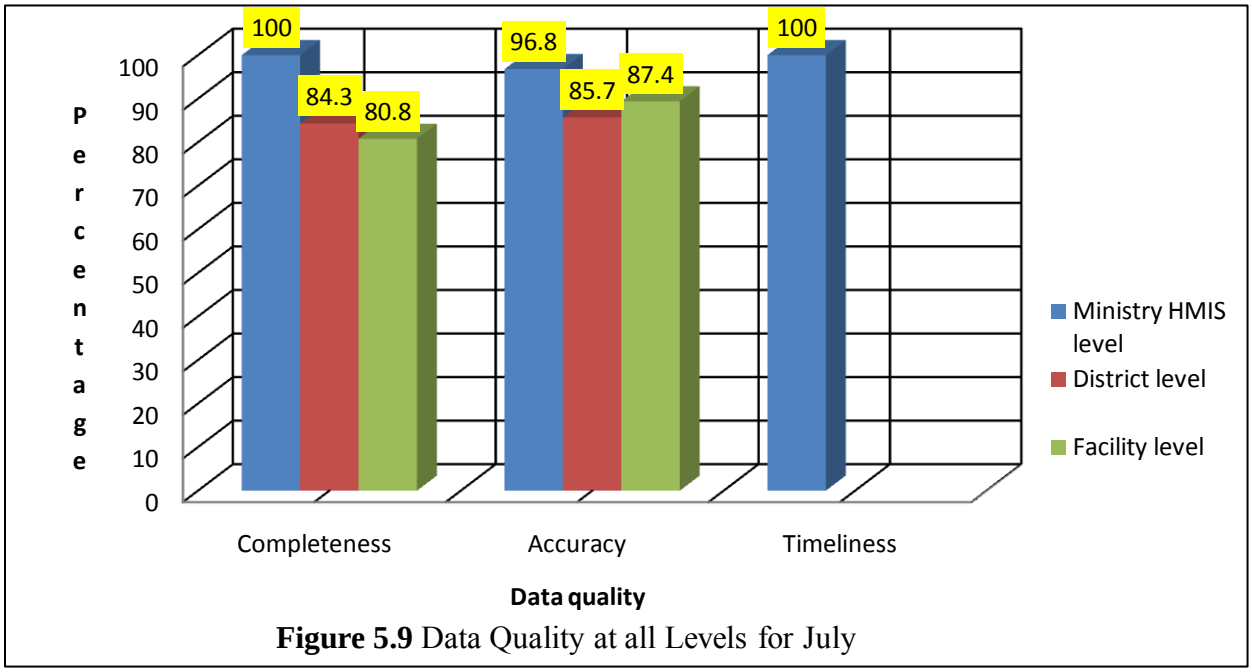

Figure 5.9 Data Quality at all Levels for July

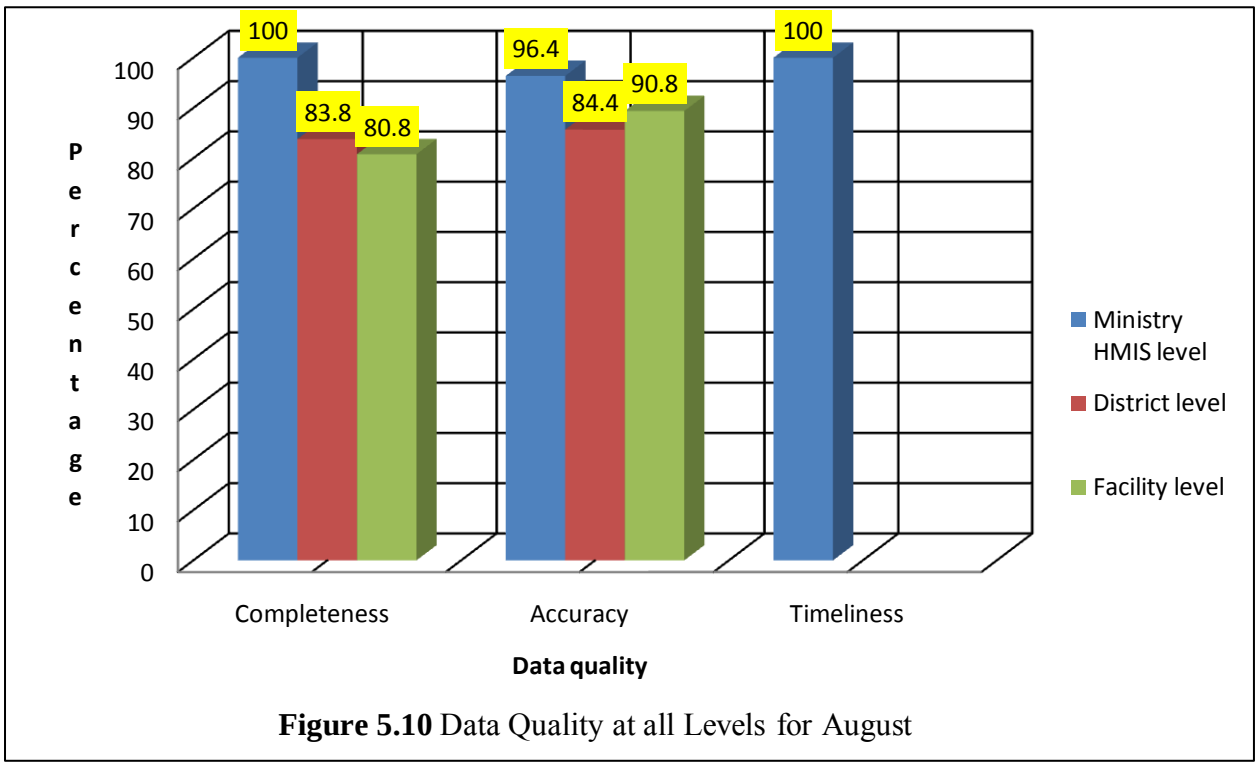

Figure 5.10 Data Quality at all Levels for August

5.4.2 Use of Information

The use of information, another aspect of RHIS performance, was assessed using two criteria:

1. The availability of any type of health service report (feedback, monthly, quarterly, etc.), also reviewing them for information use.
2. Observing records of meetings at all three levels of discussion of RHIS findings and decisions made based on those discussions.

5.4.2.1 Use of Information at the Ministry HMIS Level

Five different reports were selected to determine the percentage of actual vs planned reports produced by the Ministry HMIS. These are Antenatal Care, Child Care, Family Planning, Communicable Disease and Finance Reports.

The results showed an overall achievement of 100%. In addition the Ministry displayed updated data in tabular and graphical form for data related to maternal health, child health, facility utilisation, and disease surveillance.

The results also revealed that the Ministry HMIS level had no reports showing decisions by types of analyses, reporting of meetings with discussion on RHIS data (such as data quality, reporting, or timeliness of reporting) and discussion about RHIS findings (such as patient utilisation, disease data, service coverage, or medicines out of stock).

In addition, the Ministry HMIS level did not have any reports showing decisions based on RHIS information. Moreover, the percentage of activities related to promoting use of RHIS information at the Ministry HMIS level was zero.

5.4.2.2 Use of Information at the District Level

The same five reports were selected to find the percentage of actual vs planned reports produced by the Districts. The overall figure attained was 50.6% (see Figure 5.11).

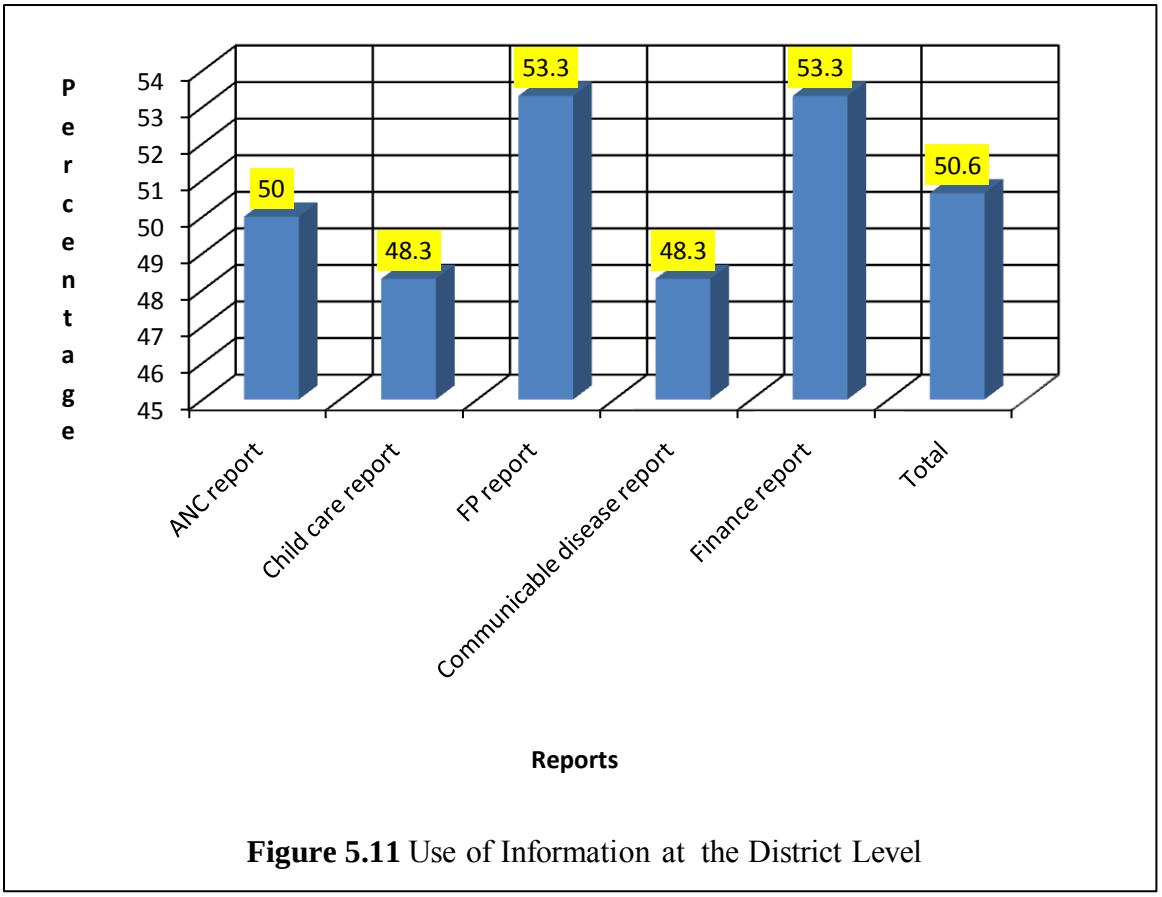

Figure 5.11 Use of Information at the District Level

Table 5.13 shows the percentage of actual vs planned reports produced by the Districts.

Actual vs planned reports produced by the District (%)						
Name of the report		**Jenin**	**Nablus**	**Ramallah**	**Bethlehem**	**Jericho**
1	ANC report	58.3	50	66.7	41.7	33.3
2	Child report	50	41.7	58.3	50	41.7
3	FP report	58.3	66.7	50	58.3	33.3
4	Communicable disease report	41.7	58.3	75	41.7	25
5	Finance report	50	58.3	58.3	58.3	41.7

Table 5.13 Actual vs Planned Reports Produced by the District (%)

None of the Districts was observed to display updated data for maternal health, child health, Facility utilisation or disease surveillance. The results also showed that the Districts did not have any reports indicating decisions by types of analyses, reporting of meeting with discussion on RHIS data (such as data quality, reporting, or timeliness of reporting), and discussion regarding RHIS findings (such as patient utilisation, disease data, services coverage, or medicines out of stock). Furthermore, no Districts had any reports showing decisions based on RHIS information. In addition, the percentage of activities relating to promoting the use of RHIS information at the District level was zero.

5.4.2.3 Use of Information at the Facility Level

Four different reports were selected to find the percentage of actual vs planned reports produced by the Facilities. These are Antenatal Care, Child Care, Family Planning and Finance.

Overall, the percentage of actual vs planned reports produced by the Facilities was 84.3% as shown in Figure 5.12

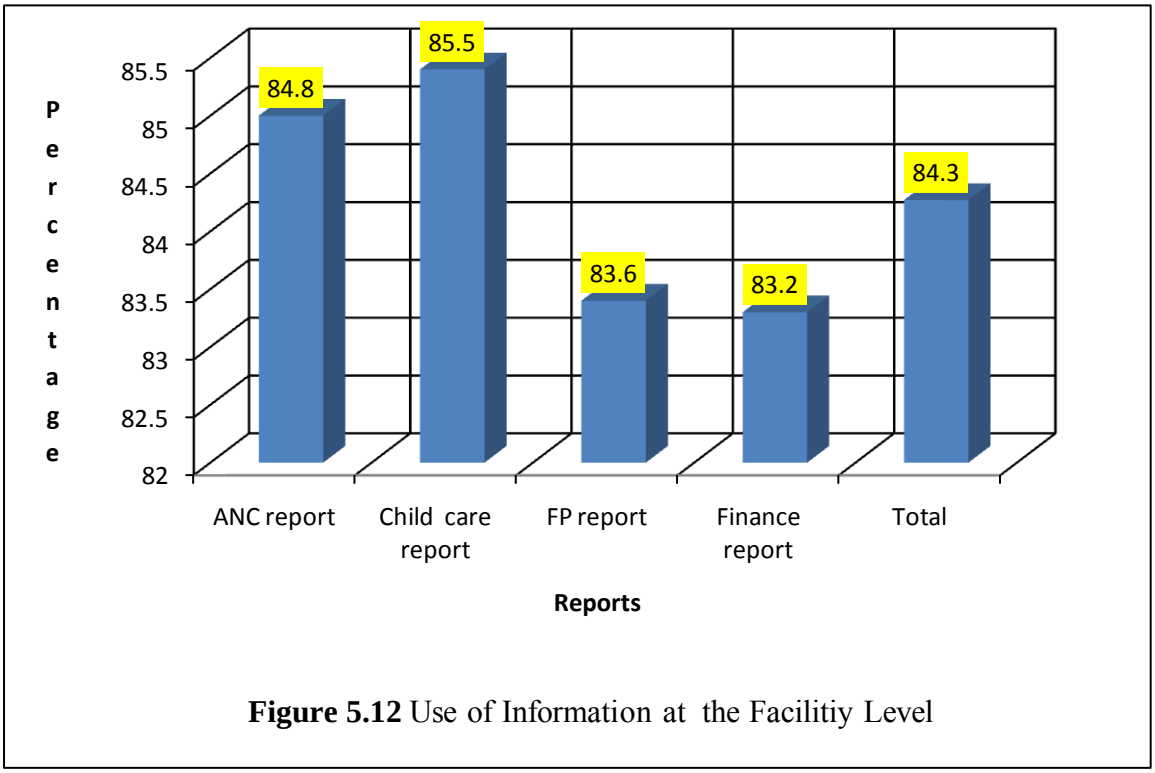

Figure 5.12 Use of Information at the Facilitiy Level

Table 5.14 shows the percentage of actual vs planned reports produced by the Facilities in the Districts.

Actual vs planned reports (%)						
Name of the report		**Jenin**	**Nablus**	**Ramallah**	**Bethlehem**	**Jericho**
1-	ANC report	85.8	85.3	86.7	83.3	82.8
2-	Child report	83.8	88	84.3	84.6	86.7
3-	FP report	82.9	83	83	82.9	86.1
4-	Finance report	85	82.3	85.3	80.4	82.8

Table 5.14 Actual vs Planned Reports Produced by the Facilities in the Districts (%)

None of the Facilities displayed updated data relating to maternal health, child health, Facility utilisation or disease surveillance. Moreover, no Facility showed decisions by types of analyses, reporting meetings with discussion on RHIS data, reporting decisions based on RHIS information or

reporting referral of problems for action based on RHIS information. In addition the percentage of activities relating to the promotion of use of RHIS information at the Facility level was zero.

Figure 5.13 below shows the extent to which information is transmitted from Facility to District and from the District to the Ministry. In essence while the Facilities are transferring nearly all the reports to the Districts, only approximately half of reports are being forwarded by the Districts to the Ministry. This is a consistent pattern a cross all types of reports. The reason for this is unclear, unless there is some particular factor attached to the fact that the data were collected during the two summer months of July and August.

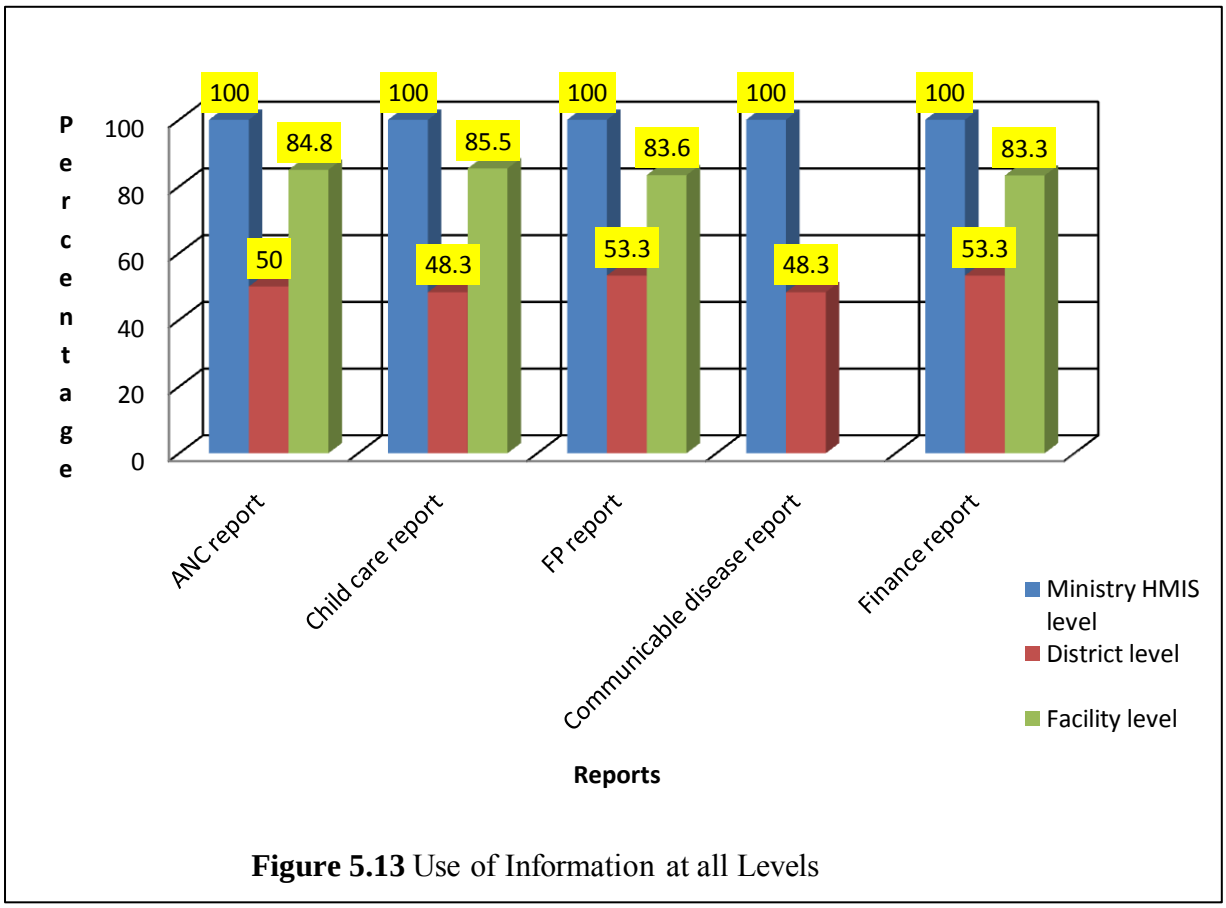

Figure 5.13 Use of Information at all Levels

5.5 Functionality of RHIS Processes

RHIS processes are essential if an information system is to run smoothly. This is necessary in order to produce high quality data and to facilitate the use of information. The RHIS processes include: data collection, data quality check, data transmission, data processing, data analysis, data display and feedback.

5.5.1 RHIS Processes at the Ministry HMIS Level

The results showed that the Ministry HMIS level displayed data related to maternal health, child health, Facility utilisation and disease surveillance. However, no feedback reports were sent using RHIS information relating to Districts during the last three months of this investigation.

5.5.2 RHIS Processes at the District Level

100% of Districts reported the presence of data processing. In contrast, only 20% of Districts displayed data relating to maternal health, child health and Facility utilisation. None of the Districts displayed data relating to disease surveillance or reported the presence of a feedback process.

5.5.3 RHIS Processes at the Facility Level

The investigation indicated a total absence of guidelines for routine data collection. Furthermore there was no evidence of data transmission, data accuracy checks, data completeness assurance or data processing. None of the Facilities displayed demographic data or maps of the areas of operation. In addition there was no reporting of any feedback process. The percentage of Facilities displaying data relating to maternal health, child health, Facility utilisation and disease surveillance was zero.

5.6 Determinants of Performance

5.6.1 Technical Determinants

The PRISM tools can identify many technical issues which can affect RHIS performance. These include the user-friendliness of the procedure manual, data collection forms, software for routine data handling, and management of information technology. Another issue is software integrating information from other information systems. This software provides a comprehensive picture of health system performance. A further issue is the use of information technology to create access to information for senior managers.

Figure 5.14 shows that in 93% of the Districts, respondents perceived that the RHIS procedure manual was user friendly and that the monthly report form was easy to use. In 80% of the Districts, respondents perceived that the data software was user friendly and that the information technology was easy to manage, that the information design provided a comprehensive picture of health system performance and that the RHIS has information that is also included in other information systems.

In 86% of the Districts, respondents perceived that the information technology existed to provide access to information to all District managers and senior management. Respondents also perceived

that the RHIS software integrates data from different information systems. Overall, the technical competence of RHIS is highly thought of by the study respondents.

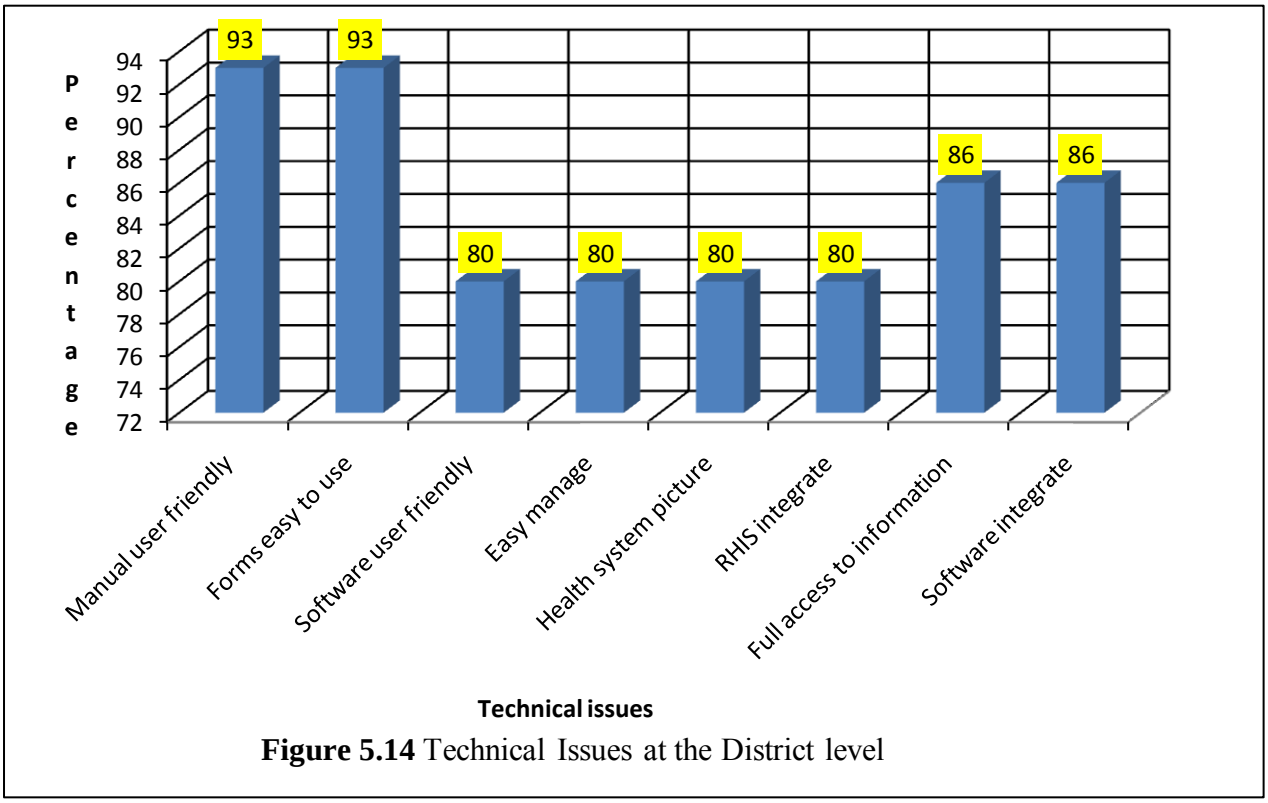

Figure 5.14 Technical Issues at the District level

The database at all three levels did not calculate indicators for each Facility catchment area nor did it produce data summary reports for the District. Furthermore, there were no comparisons among Districts and Facilities, with District / national targets, among types of service coverage or comparisons of data over time.

5.6.2 Behavioural Determinants

The PRISM framework hypothesises that behavioural factors are important determinants of RHIS. The factors considered are self-efficacy; confidence in performing RHIS tasks; competence in performing RHIS tasks; knowledge of the rationale for RHIS data collection; problem- solving skill; and motivation.

5.6.2.1 Self-Efficacy, Confidence in Performing RHIS Tasks

Confidence level provides information about how comfortable the respondents feel in performing certain tasks. It is also a reflection of their motivation. Under PRISM, confidence levels are assessed on a scale of 0 to 100, from no confidence to full confidence in performing a particular RHIS task.

Self –efficacy in checking data quality refers to the respondents‘ perception of their capability of performing this task. The average for this indicator is 82%. In terms of calculating indicators the respondents were asked if they thought they were capable of calculating percentages/rates correctly. The average for this indicator is 77%.

In response to the question as to whether respondents perceived that they were capable of plotting data by months or years. The average for this indicator is 78.4%.

In terms of interpreting data, including computing trends from bar charts, and explaining findings and their implications. The average for this indicator is 85.4%.

Self –efficacy in using information refers to the question as to whether respondents perceive that they are capable of using data for identifying gaps and of using data for making various types of decision and providing feedback. The average for this indicator is 83.4%

The average confidence level for checking data quality, performing calculations, data plotting, data interpretation and use of information was 81.3% (see Figure 5.15).

Figure 5.16 below shows the average confidence level for checking data quality, performing calculations, data plotting, data interpretation and use of information at all levels at the MoH.

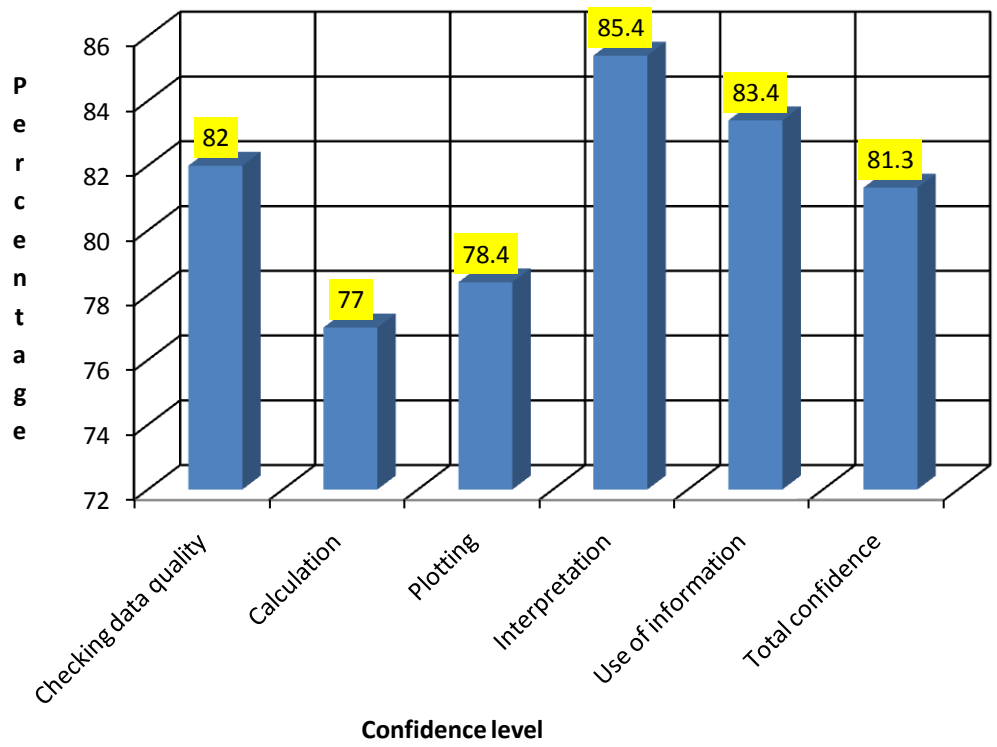

Figure 5.15 Mean Comparisons among Perceived Confidence Level for RHIS (N= 123)

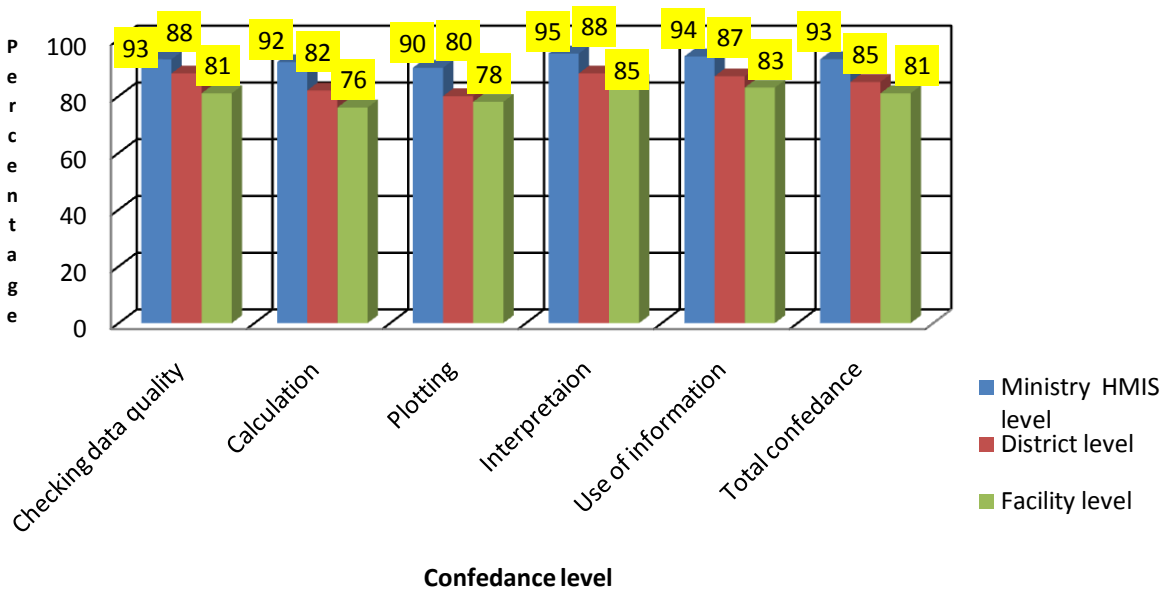

Figure 5.16 Mean Comparisons among Percevied Confidence Level for RHIS at all Levels (N=3, N=15, N=105)

5.6.2.2 Competence in Performing RHIS Tasks

A paper and pencil test in problem solving was used to assess RHIS task competence among the respondents. The average task competence for checking data quality, performing calculations, data plotting, data interpretation, and use of information was 47.9% (see Figure 5.19).

Respondents were asked to describe three ways of checking data quality. The average for this indicator is 45.8%.

To assess competence regarding dealing with calculations, respondents were asked to undertake tasks such as "Calculate the percentage of pregnant women who receive antenatal health care services in the District, or calculate the index of malnutrition and the number of children suffering from malnutrition". The average for this indicator is 52%.

Competence in plotting data has been tested through the following exercise: "prepare a bar graph to illustrate vaccination coverage by years". The average for this indicator is 48.3%.

Graph interpretation was tested by asking the respondents to look for any trends in the data. The average for this indicator is 42%.

In terms of using information respondents were asked to indicate at least one way of using conclusions at different levels, including at the Facility, community and at the policy level. This indicator showed an average of 51.2% able to use information in this way.

The average competence level for checking data quality, performing calculations, data plotting, data interpretation and use of information was 47.9% (see Figure 5.17).

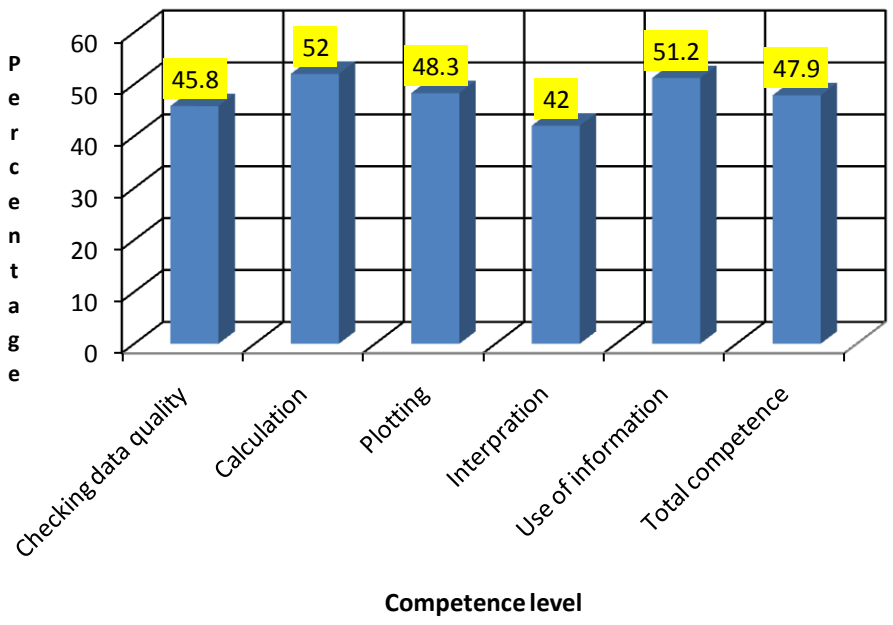

Figure 5.17 Mean Comparisons among Observed RHIS Task Competence (N=123)

Figure 5.18 below shows the average competence level for checking data quality, performing calculations, data plotting, data interpretation and use of information at all levels at the MoH.

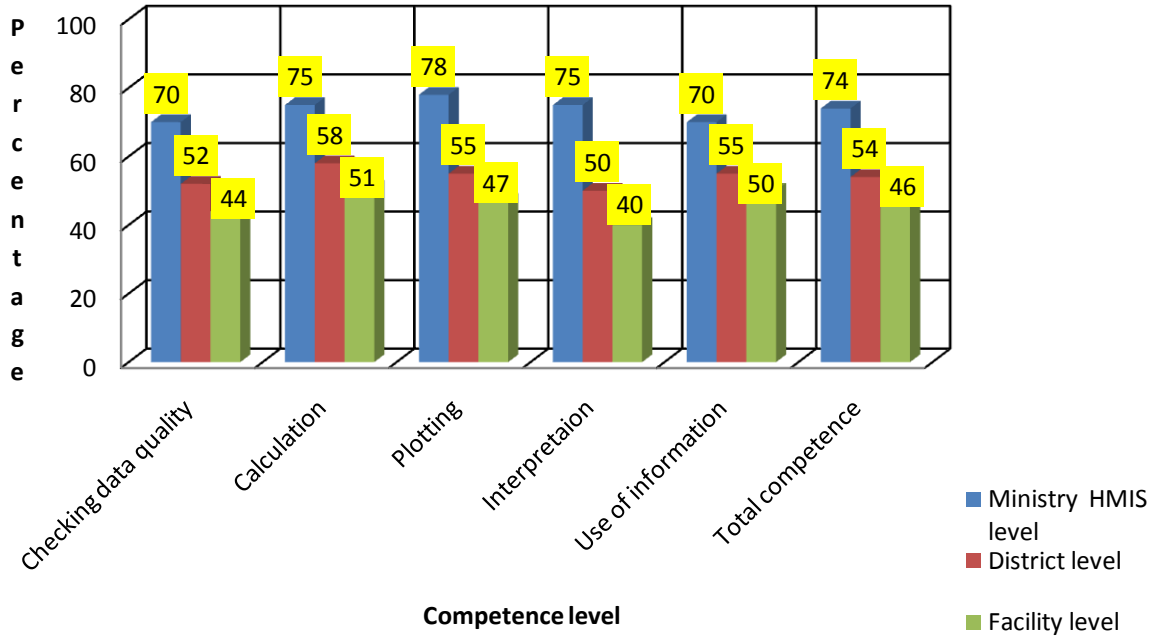

Figure 5.18 Mean Comparisons among Observed RHIS Task Competence at all Levels (N=3, N=15, N=105)

A high confidence level for RHIS tasks is associated with high level of RHIS task competence. The results showed that there were important gaps between confidence and competence level for checking data quality, performing calculations, data plotting, interpretation and use of information which indicates that improvements are needed for all these tasks.

5.6.2.3 Knowledge of the Rationale for RHIS Data Collection

Respondents had low knowledge of the rationale for including diseases, immunisation and population data in the information systems, the average for this indicator is 67%, 47.6% and 32.9% at the Ministry, District, and Facility levels respectively indicated that they were collecting data without understanding completely why they were doing so. In addition data utility has not being demonstrated, creating little appreciation among staff as to why they should be collecting such data.

5.6.2.4 Problem Solving Skills

There are two particular benefits from acquiring problem solving skills. First such skills help personnel to: define a problem in operational terms and to identify where the opportunity for a solution exists; study the root cause(s) of the problem; identify and prioritise solutions; and implement and evaluate the solution to achieve positive change.

Secondly, building problem-solving skills leads to increased autonomy, empowerment, and higher motivation to perform. This reduces the need for close supervision and its associated costs, and enhances trust and responsibility.

To assess problem solving skills, a story with an opening and ending is used and respondents were asked to fill in the middle part. The answer was broken down into defining the problem quantitatively and describing the activities for solving it. The scoring scheme is described below.

Problem solving

―Dr. Akram, District Health Officer, read a recent District report and found that data quality was only 40% and felt very disturbed by it. ―I need to take action," he thought. He paced back and forth thinking about his next steps to improve data quality. After some time, he calmed down and wrote his action plan.

Please describe how Dr. Akram defined the problem and what major activities Dr. Akram would have included in his action plan for improving data quality".

Definition of the problem

The participant is supposed to assume a target of data quality to find the gap between the target and the actual level of data quality, because no data are provided on the target in the scenario. Second, the problem needs to be defined as a gap in performance. Thus, if these two criteria are met, the definition of the problem would be considered correct and would get a score of one. If incorrect, the score is zero. For example:

Data quality was found to be 40% and has a gap of 20% to reach a target of 60% in six months.

Major Activities

Each described activity is given a raw score of one. The overall percentile score is obtained by adding up the scores, dividing by the total number of items (10) and multiplied by100. The range will vary between 0 and 100. A lower score shows less ability to solve problem, while a higher score shows the opposite.

The action plan should indicate specific steps to solve the problem as well as define monitoring and evaluating mechanisms. The activities should include:

- Analyse causes for gaps in data quality.
- Collect data to provide evidence for those causes.
- Prepare selection criteria for causes.
- Select one or two cause(s) affecting most of the problem.
- Develop solutions to eliminate the cause(s).
- Develop criteria for selecting the solution.
- Implement the selected solution.
- Describe the monitoring mechanism.
- Include the evaluation plan.
- Involve staff in the problem solving process.

The results of applying this tool showed that the respondents at all levels had only 17.5% problem solving skills, 55% defining problem and 13.8% solving problem.

Table 5.15 shows the average score for problem solving skills, defining problem and solving problem at all levels at the MoH.

levels	Problem-solving skill	Defining problem skill	Solving problem skill
Ministry HMIS	63.6	100	60
District	23	66.7	18.7
Facility	15.5	52.4	11.8
Overall	17.5	55	13.8

Table 5.15 The Average Score for Problem Solving skills, Defining Problem and Solving Problem at all Levels

The results shows that the respondent at the Ministry level had a higher index score in problem solving skills, defining problem and solving problem than the District level. The results also shows that the respondent at the District level had a higher index score in problem solving skills, defining problem and solving problem than the Facility level.

5.6.2.5 Motivation

Personal motivation was assessed by employing six items related to perceived positive and negative outcomes of HMIS activities. The positive outcomes included: meaningfulness; monitoring progress; better services; appreciation from supervisors; and respect from co-workers.

The negatives outcomes included: wasting time; no one cares about data; feeling bored; and feeling forced to collect information. The responses from positive and negative outcomes were combined to obtain a motivation score.

Low motivation (49.3%) was revealed indicating significant scope for improvement.

5.6.3 Organisational Determinants

5.6.3.1 RHIS Management

In general, management of a system involves managing resources and functions to produce better outcomes. However, RHIS management is defined as "the presence of mechanisms for managing RHIS functions and resources effectively for better RHIS performance".

RHIS management functions comprise RHIS governance, planning, training, supervision, finances, and use of performance improvement tools.

The governance functional level of RHIS is measured by the presence of a mission statement, management structure, updated organisational chart, involvement of information system managers in senior management meetings, and a distribution list for information reports.

The planning functional level was measured by the availability of a recent RHIS situation analysis report, RHIS long term plan and targets.

The training functional level was assessed by the presence of training manuals, on-the-job training and its scheduling, and supervisory reports.

The supervisory functional level was measured by the presence of a supervisory checklist, schedule and reports.

The financial functional level was measured by the presence of an RHIS expense register, mechanism for generating funds, financial reports and long term financial plans.

The quality standards functional level was assessed by use of quality/performance improvement tools, and the availability of RHIS standards at Facility and higher levels. The results showed that at Ministry RHIS level, the governance functional level was on average 75%. The planning and supervisory functional levels were both on average 100%, the training functional level was 33.3%,

use of quality functional level was 50% and the finances functional level was on average 25% (see Figure 5.19).

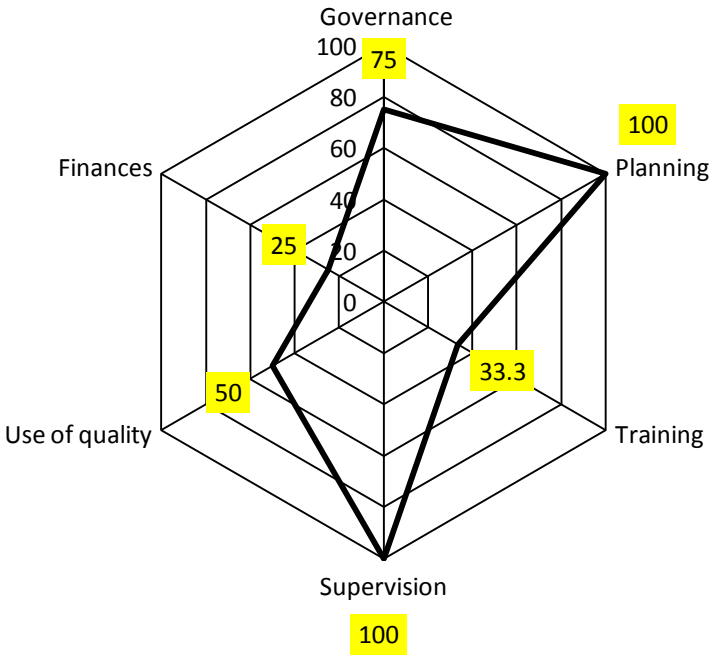

Figure 5.19 Mean Level of RHIS Management Functions at the Ministry HMIS level

At District level, governance, planning, supervision, training, finance, and use of quality functions were respectively on average 65%, 53%, 2%, 0%, 25% and 7% (see Figure 5.20). The corresponding figure at the Facility level were 4.5%, 16.5%, 1.3%, 19% and 0% (see Figure 5.21).

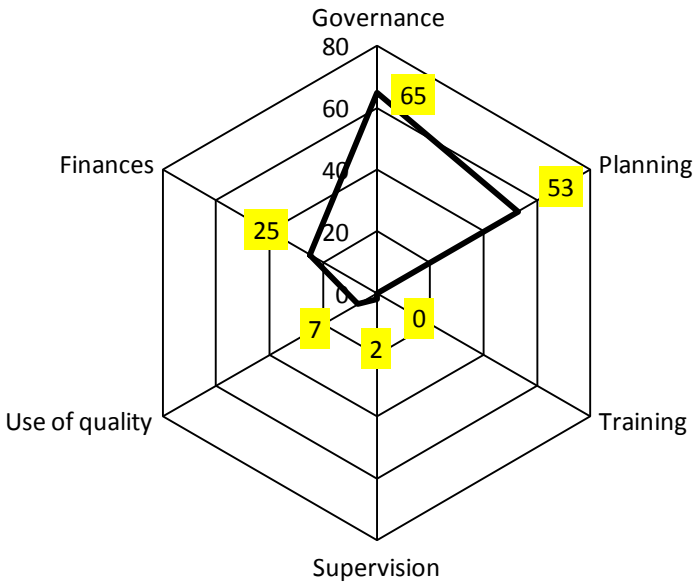

Figure 5.20 Mean Level of RHIS Management Functions at the District level (N=5)

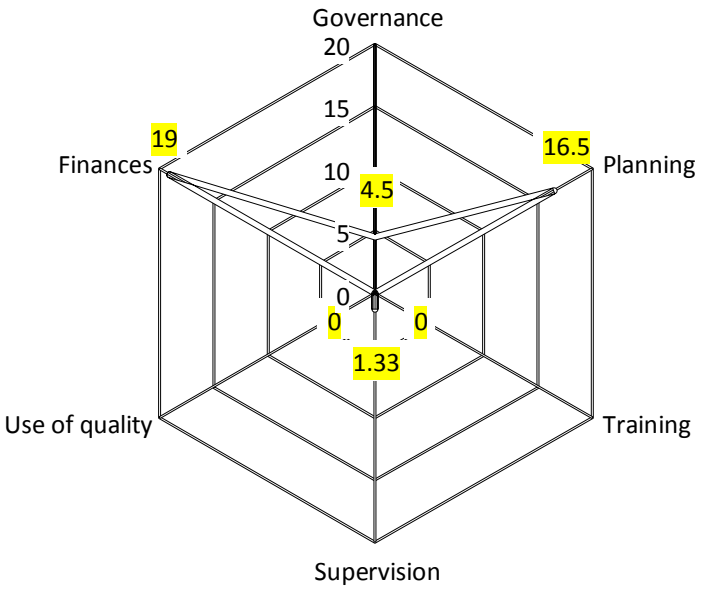

Figure 5.21 Mean Level of RHIS Management Functions at the Facility Level (N=105)

5.6.3.2 Perceived Promotion of a Culture of Information

People working within an organisation perform tasks and exhibit behaviours which they believe the organisation values and promotes. In other words, organisations create a culture for promoting and sustaining certain values around organisational functions to be performed at optimal levels. When these values relate to the way the information systems function, it means that the organisation is promoting a culture of information.

Under the PRISM framework, a culture of information was operationally defined as *"*a department having the capacity and control to promote values and beliefs among members of an organisation for collection, analysis and use of information to accomplish its goals and mission."

The PRISM framework assesses a culture of information by determining how strongly people believe that the MoH promotes values such as: emphasis on data quality; use of information; evidence based decision making; feedback from staff and community; a sense of responsibility; empowerment and accountability; and problem solving.

The data quality indicator has been obtained from the answers to the questions regarding the extent to which: –Superiors in a health department emphasise data quality in monthly reports, check data

quality at the Facility and higher level regularly and report data accuracy regularly". The average for this indicator was 72%.

The use of the information indicator has been obtained from the answers to the questions identifying the extent to which: –Superiors in the MoH use HMIS data for setting and monitoring targets, staff display data for monitoring their set target, staff can gather data to find the root cause(s) of the problem and staff use HMIS data for community education and mobilisation". The average for this indicator is 75%.

The evidence based decision making indicator has been obtained from the answers to the questions seeking the extent to which: –Decisions in the MoH are based on personal liking, superiors' directives, evidence /facts, political interference, comparing data with strategic health objectives, health needs and consideration of costs". The average for this indicator is 78.2%.

The perceived feedback indicator has been developed as follows: In your health service institution managers seek feedback from relevant persons, discuss conflicts openly to resolve them, seek feedback from the community and provide regular feedback to their staff through regular communication based on evidence. The average for this indicator is 73%.

The responsibility indicator has been developed through analysis of the following: In your work unit, staff are punctual, feel committed in improving health status of the target population, set appropriate and do-able target of their performance, feel guilty for not accomplishing the set target/performance and admit mistakes in taking corrective actions. The average for this indicator is 75.3%.

The empowerment and accountability indicator has been developed through analysis of the following: In your work unit, staff document their activities and keep records, are empowered to make decisions, are able to say no to superiors and colleagues for demands/ decisions not supported by evidence, and are made accountable for poor performance. The average for this indicator is 73.2%.

The problem solving indicator has been developed as follows: In the health service institution staff can collect data to identify the underlying cause or causes of a given problem, develop appropriate criteria to select an intervention for a given problem, develop appropriate results from a given intervention or decision, and assess if objectives have been met or the expected results have been achieved. The average for this indicator is 71%.

The results showed that overall the respondents strongly believe (73.9%) that the MoH emphasises data quality, promotes use of information, problem solving, feedback, sense of responsibility, empowerment and accountability, and evidence based decision making (see Figure 5.22).

Figure 5.23 shows the mean comparisons among different dimensions of culture of information at all levels at the MoH.

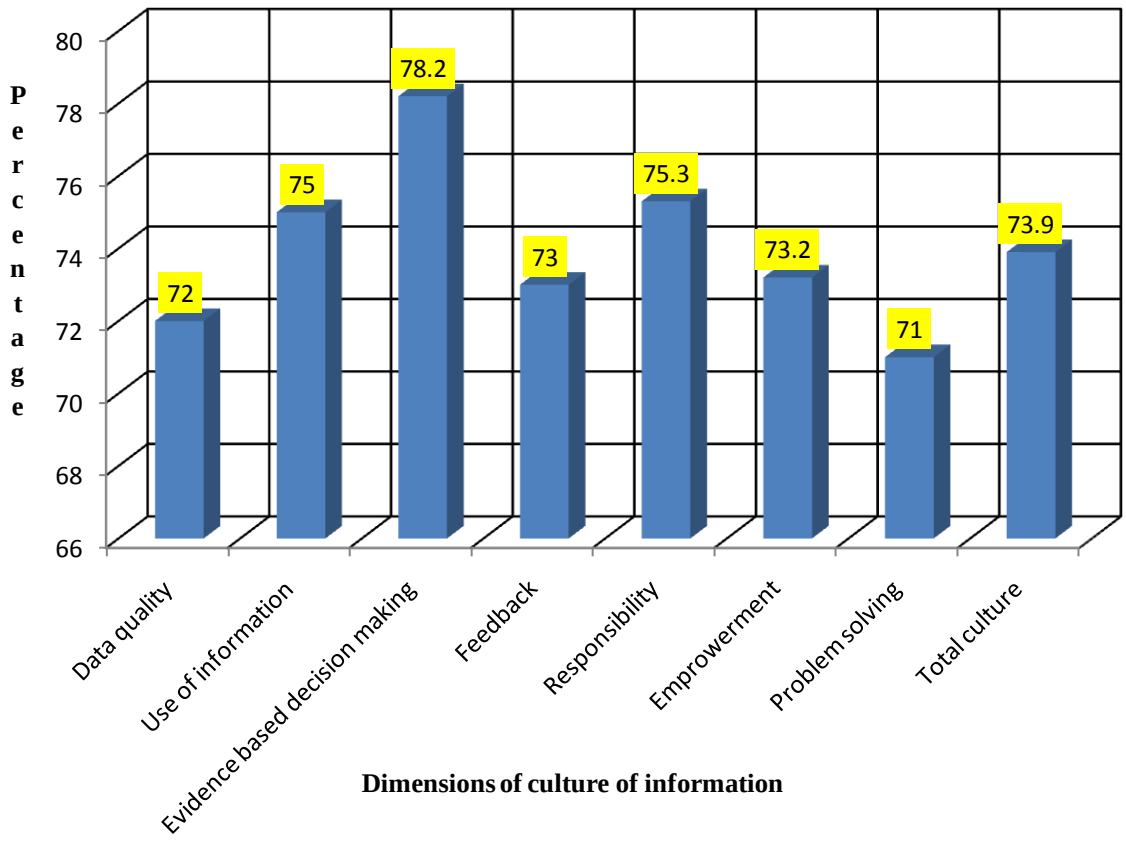

Figure 5.22 Mean Comparisons among Different Dimensions of Culture of Information (N=123)

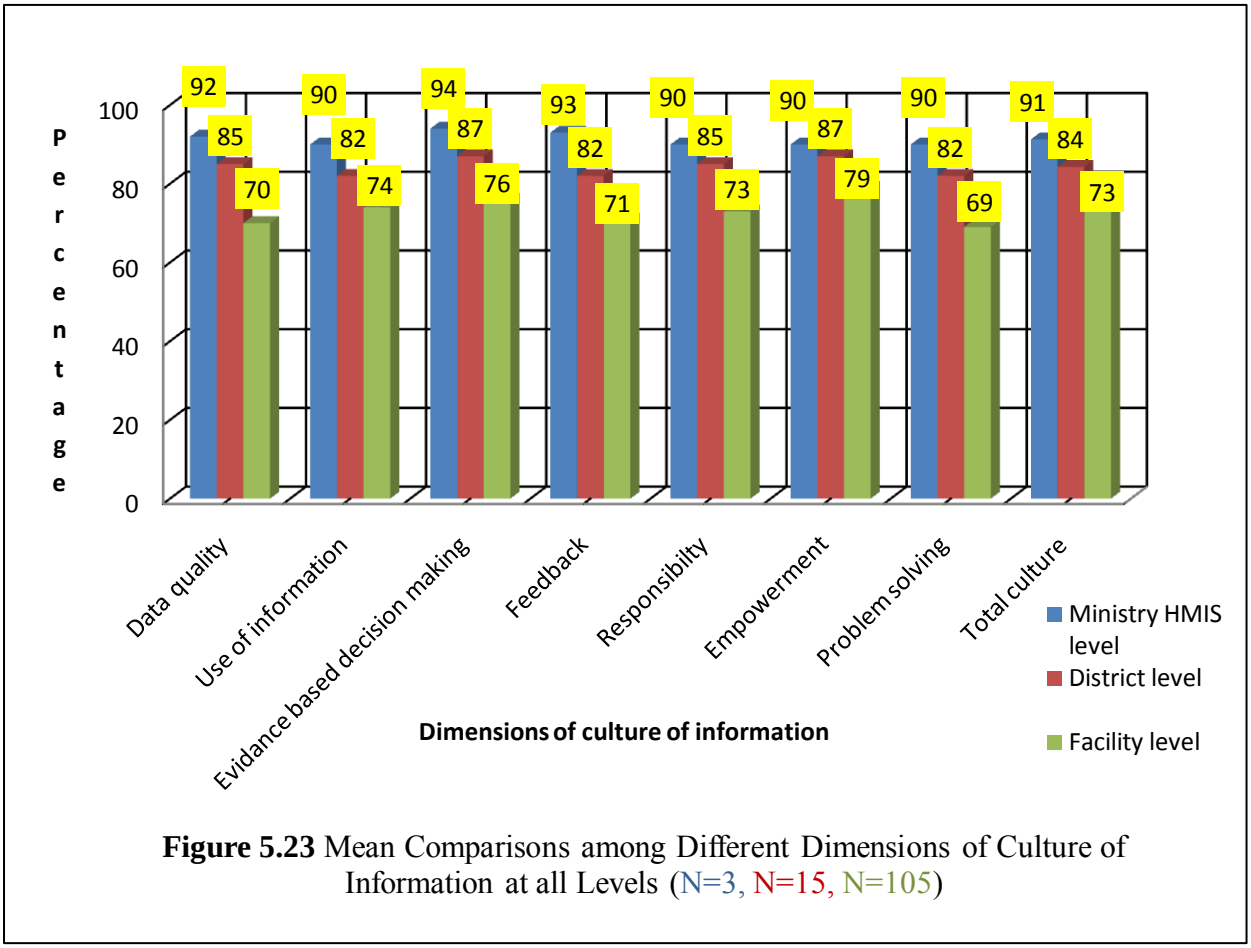

Figure 5.23 Mean Comparisons among Different Dimensions of Culture of Information at all Levels (N=3, N=15, N=105)

5.6.3.3 Rewards for Good Work

Rewards differ from motivation because they are tangible benefits provided by the organisation for good performance rather than an internal feeling of doing something meaningful, useful, or receiving acknowledgment or appreciation by others. Assessment of perception relating to the existence of a reward system has been developed based on questions such as: Do colleagues in your work unit recognise your good work? The average response for this was 42%.

5.6.3.4 Supervision Quality

Supervision is very important for providing support to staff and also is a means for on-the job training. The results showed that 7.6% of the Facilities reported receiving a supervisory visit in the last three months. None of those Facilities reported that the supervision checked data quality, helped them make a decision based on information from RHIS, or discussed Facility performance using RHIS information. The Facilities also reported that the supervisor did not send a report (feedback) note on the last two supervisory visits.

5.6.3.5 Availability of Resources

The availability of resources to perform RHIS tasks is crucial. Table 5.16 below indicates the availability of the needed equipment at the Ministry HMIS level.

Hardware equipment	Total quantity available	Total quantity worked
Computer	10	10
Printers	3	3
Uninterruptible power supply (UPS)	3	3
Generators	1	1
Landline	5	5
Calculator	2	2

Table 5.16 The Availability of RHIS-related Equipment at the Ministry HMIS level

The result also showed that the Ministry had access to the internet and data back-up unit.

Table 5.17 below, however, indicates gaps in availability and functionality of equipment at the District level.

Hardware equipment	Average quantity available	Average quantity worked
Computer	5.2	3.2
Printers	3.2	2
Uninterruptible power supply (UPS)	1.6	1.6
Generators	1	1
Landline	5.6	5.6
Calculator	2.8	2.6

Table 5.17 The Availability of RHIS-related Equipment at the District Level

The results also showed that all Districts had access to the internet and data back- up unit.

Table 5.18 below indicates a distinct gap in availability of equipment at the Facility level compared to the Ministry and District levels.

Equipment	Available		Working	
Dimension	Frequency	Percentage	Frequency	Percentage
Computer	0	30.5	0	20.5
	1	48.6	1	58.9
	2	15.2	2	19.2
	3	5.7	3	1.4
	Average	0.96	Average	1.01
Printers	0	30.5	0	28.8
	1	69.5	1	71.2
	Average	0.70	Average	0.71
Uninterruptible power supply (UPS)	0	79.0	0	0.0
	1	21.0	1	100
	Average	0.21	Average	1.00
Generators	0	95.2	0	0.0
	1	4.8	1	100
	Average	0.05	Average	1.00
Landline	0	25.7	0	0.0
	1	68.6	1	92.3
	3	5.7	3	7.7
	Average	0.86	Average	1.15
Calculator	0	94.3	0	0.0
	1	5.7	1	100
	Average	.06	Average	1

Table 5.18 The Availability of RHIS-related Equipment at the Facility Level

Alarmingly, only 5% of the Facilities had access to the internet and 3% had a data backup unit, although it is this level where the raw data are for most systems are generated.

5.6.3.6 Utilities

At Ministry HMIS and at District levels continuous electricity supply was assured, the room housing computer hardware was kept air conditioned, and running water available at the Ministry HMIS Unit. Conversely, at the Facility level, only 70.5% had a continuous electricity supply. In approximately a third of the Facilities the electricity supply was never interrupted, in 54.3% it was interrupted only once a month and in the remainder twice a month.

In 90% of the Facilities, the room housing the computer hardware was not air conditioned. Some 80% of them had running water available.

5.6.3.7 Availability of Registers Forms

At both Ministry HMIS and District levels, there had been no shortages over the last 12 months of forms relating to antenatal care, child care, family planning, communicable disease and health insurance. Conversely, at the Facility level, Table 5.19 indicates some deficiencies in the availability of forms in the last 12 months.

Type of form	Availability of forms at the Facility level (%)
Antenatal care	73.3
Child care	69.5
Family planning	66.7
Communicable disease	70
Health insurance	67.6

Table 5.19 The Availability of Forms at the Facility Level (%)

5.6.3.8 Human Resource

Table 5.20 shows the number of staff at the Ministry HMIS level.

Category of staff	Number
HMIS director	1
PHC director	1
Statistician director	1
MCH director	1
Physician	3
Data entry clerk	5
Secretary	6
Support staff	7

Table 5.20 Number of Staff at the Ministry HMIS Level

Table 5.21 shows the number of staff in 5 Districts.

Category of staff	Number
District health officer	5
District PHC officer	5
District finance and management officer	5
Physician	38
Registered nurse	15
Practical nurse (Nurse assistant)	12
Accountant	7
Pharmacist	11
Pharmacist assistant	18
District statistician officer	5
District IT manager	5
District laboratory officer	5
Laboratory technician	12
X- ray technician	8
Secretary	16
Support staff	23

Table 5.21 Number of Staff at the District level

Table 5.22 below shows the number of staff at the Facility level.

Category of staff	Number
Registered nurse	32
Practical nurse (Nurse assistant)	56
Physician	12
Midwife	18
Pharmacist	6
Pharmacist assistant	10
Accountant	6
Laboratory technician	6
X- ray technician	8
Secretary	6
Support staff	22

Table 5.22 Number of Staff at the Facility Level

5.6.3.9 Training of Staff

Table 5.23 below shows the categories of staff who received training in the three year period ending in 2009 and the number who received training across all levels at the MoH. The subject of training was data collection, data analysis and data display. All staff only underwent a single series of training.

Category of staff	Number of staff	Level	Number of training
HMIS director	1	Ministry HMIS	1
PHC director	1	Ministry HMIS	1
Statistician director	1	Ministry HMIS	1
MCH director	1	Ministry HMIS	1
District health officer	2	District	1
Physician	6	District	1
Registered nurse	3	District	1
District statistician Officer	1	District	1
Practical nurse (Nurse assistant)	3	Facility	1
Physician	2	Facility	1
Midwife	3	Facility	1

Table 5.23 Categories of Staff and Number Receiving Training in Last Three Years and at all Levels at the MoH

5.7 Summary

This chapter has documented the results obtained from implementation of the methodology. Context has been provided by a review of the Palestinian health management system. Within this context results have been presented for respondents‘ socio – demographic characteristics, respondents‘ educational level, level of RHIS performance (data quality and use of information), functionality of RHIS processes, and determinants of performance, including technical, behavioural and organisational determinants.

The next chapter will discuss in detail the analysis of the results. Major components will include; level of RHIS performance (data quality and use of information), functionality of RHIS processes, and determinants of performance including technical, behavioural and organisational determinants of the RHIS at the MoH in Palestine. The next chapter will conclude by reviewing the success in the application of the PRISM framework and its tools in a range of international settings, enabling comprising to be made with some of the results obtained in this Palestinian context.

Chapter 6

Analysis and Discussion of Results

6.1 Introduction

In the previous chapter the results of this major investigation have been documented. In carrying out this work extensive use has been made of the PRISM framework. As shown in chapter 4 this has been an appropriate methodology with which to tackle a complex scenario such as presented by health care organisation and delivery in Palestine. This present chapter discusses major issues that have arisen in the course of the research. These issues correspond to the principal ingredients of the PRISM framework and its underlying systems thinking.

Discussion commences with RHIS performance, which in system terms corresponds to the output of the health information system. This is followed by consideration of the RHIS processes which produce that performance.

Thirdly, the focus turns to inputs to these processes, which are the determinants that include technical, behavioural and organisational factors. From a systems perspective there is a need to recognise the importance of the feedback loops which are in operation. The chapter concludes by reviewing the success in the application of the PRISM framework and its tools in a range of international settings, enabling comprising to be made with some of the results obtained in this Palestinian context.

6.2 RHIS Performance

The key performance issues are level of data quality and use of information. At the Ministry level data quality was found to be good in terms of accuracy, completeness and timeliness. At the District level data completeness and accuracy were good but timeliness could not be assessed due to the absence of relevant reports. Conversely, at the Facility level data quality was only acceptable indicating scope for some improvement.

Use of information was found to be poor across the board due to a serious lack of reporting. At the Ministry level the principal failing related to reports on decision making. In addition, there was a failure to promote the use of RHIS at Ministry level. Reasons included: the Ministry annual action plan not showing decisions based on RHIS information; an absence of senior management directives on the use of information; and no advocacy plans based on use of information. At the District level,

there was a similar lack of reporting which limited subsequent actions based on RHIS information. The same defects were apparent at the Facility level.

6.3 RHIS Processes

The RHIS processes included: data collection; data quality checks; data transmission; data processing; data analysis; data display; and feedback.

At the Ministry level, processes were generally good and relevant data were well displayed. However, the absence of feedback to Districts indicates an area for improvement. In contrast, at the District level, RHIS processes were generally poor with inadequate display of data and a near total absence of feedback. Processes were even less satisfactory at the Facility level with a general absence of data display or feedback.

6.4 RHIS Determinants

6.4.1 Technical Factors

At the Ministry and District levels much was positive with regards to technical factors influencing performance. Reasons include; user friendly procedure manuals, simple and accessible monthly report forms, user-friendly data software, easy to manage information technology, comprehensive information system design and information made available to all relevant managers.

However there are a number of clear deficits. These included an absence of calculated indicators for each Facility catchment area, which in turn hinders production of data summary reports for the District. In addition, it also limits comparisons among Facilities or with District/national targets, let alone production of comparisons among types of service coverage or data over time.

6.4.2 Behavioural Factors

Behavioural factors considered under PRISM include: confidence in performing RHIS tasks; competence in performing RHIS tasks; knowledge of the rationale for RHIS data collection; problem- solving skills; and motivation.

As shown in Figure 5.16 the average confidence level for checking data quality, performing calculations, data plotting, data interpretation and use of information at the Ministry HMIS, District, Facility levels is 93%, 85% and 81% respectively.

Figure 5.17 also shown that the average competence level for checking data quality, performing calculations, data plotting, data interpretation and use of information at the Ministry HMIS, District, Facility levels is 74%, 54% and 46% respectively.

In addition the average score for knowledge of the rationale for RHIS data collection is 67%, 47.6% and 32.9% at the Ministry HMIS, District, Facility levels respectively.

As shown in table 5.15 the respondent at the Ministry HMIS level had higher average score in problem solving skills, defining problems and solving problems than the District level. The results also show that the respondent at the District level had a higher score in problem solving skills, defining problems and solving problems than the Facility level.

There are many possible reasons for these gaps. First, the respondents at the Ministry HMIS level had higher educational level and years of employment than the respondents at the District and Facility level. Second, the respondents at the District level had higher educational level and years of employment than the respondents at the Facility level.

Overall, there was a generally high level of confidence for performing RHIS tasks. The same was not true for competence. Although it is generally assumed that there is a strong association between confidence and competence this premise was not supported from the results obtained. Particular gaps were identified in relation to checking data quality, performing calculations, plotting data and the interpretation and use of information (see Figure 6.1).

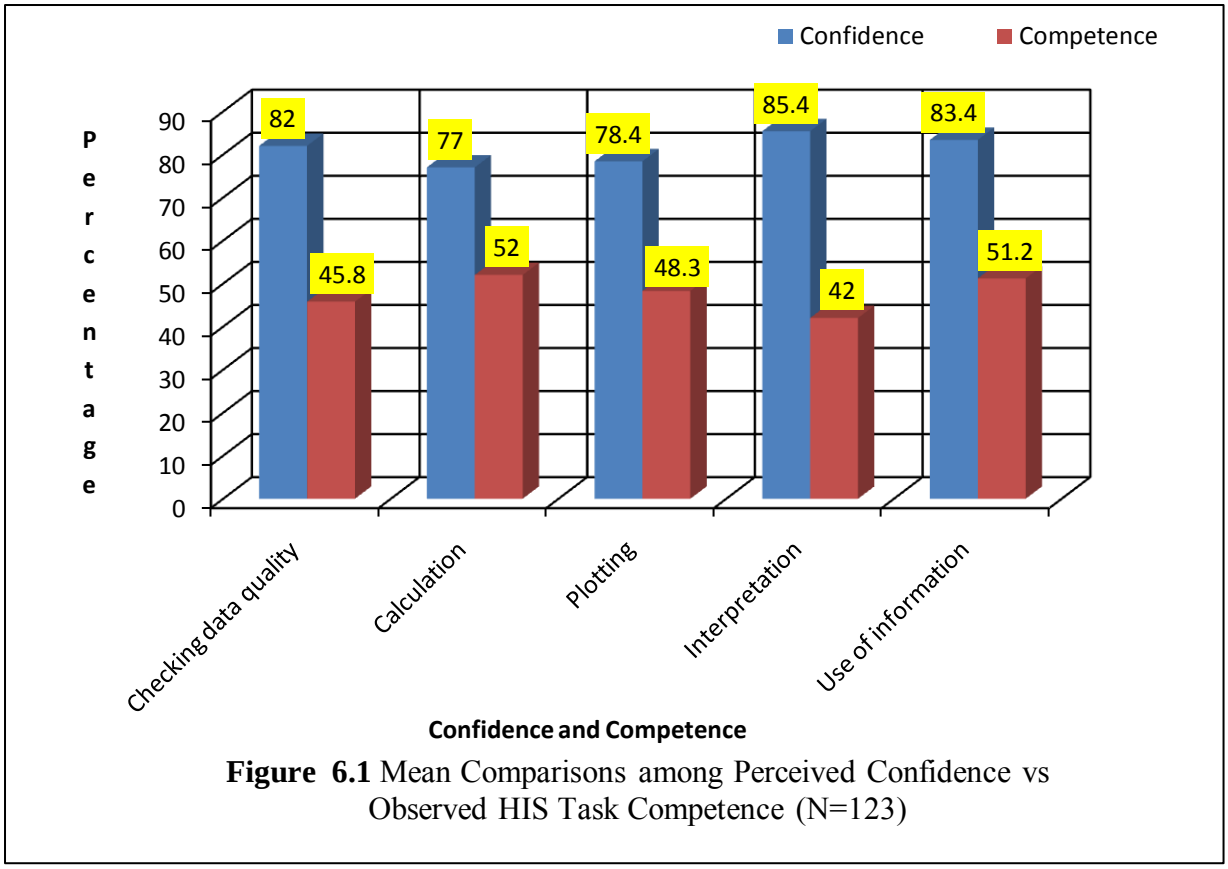

Figure 6.1 Mean Comparisons among Perceived Confidence vs Observed HIS Task Competence (N=123)

There was generally poor knowledge of the rationale for RHIS data being collected highlighting an area for improvement. Furthermore, there is a need to create greater appreciation among staff as to why they should be collecting such data.

With regards to problem solving skills the results highlighted a very real need for improvement. In terms of motivation there is a similar need for improvement.

6.4.3 Organisational Factors

Organisational factors include the management functions of: governance; planning; training; supervision; finance; and use of quality improvement standards. Other factors include perceived promotion of a culture of information; rewards for good work; supervision; availability of resources; and training.

At Ministry level, governance, planning and supervision were good, however, there was evidence on the need for improvement in training, finance, and use of quality standards. In contrast at both at District and Facility levels results were overwhelmingly poor.

There was a generally high perception of a culture of information being promoted as indicated in Figure 6.2.

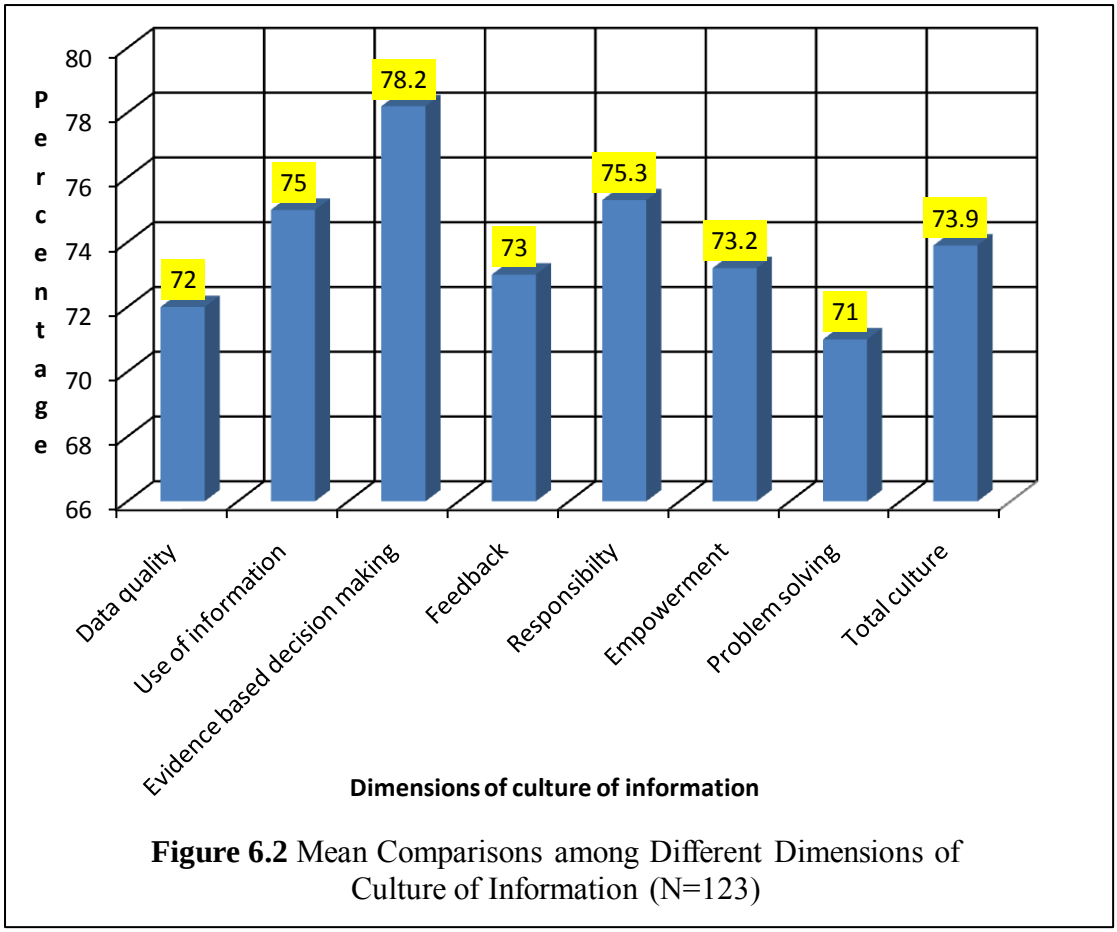

Figure 6.2 Mean Comparisons among Different Dimensions of Culture of Information (N=123)

Figure 5.23 shows that mean comparisons among different dimensions of culture of information at the Ministry HMIS, District and Facility level are 91%, 84% and 73% respectively. This may be because the respondents at the Ministry HMIS level had higher educational level and years of employment than the respondents at the District and Facility level. In addition the respondents might have exaggerated perceptions of the promotion of an information culture at the Ministry HMIS level more than the respondents at the District and Facility level.

It had been hypothesised on the basis of the discussion of PRISM in chapter three that a strong culture of information is associated with high RHIS competence levels. However. A comparative analysis (see Figure 6.3) showed that there are still significant gaps between perceived promotion of data quality, use of information, problem solving and observed RHIS task competence. This agrees with the results of MEASURE Evaluation (2013) that indicates low RHIS competence combined with high perceptions of promotion of a culture of information and self-efficacy for RHIS tasks are consistently reflected in PRISM assessments in Pakistan, Mexico, Côte d'Ivoire, Uganda, Gabon, Dominican Republic, and Honduras

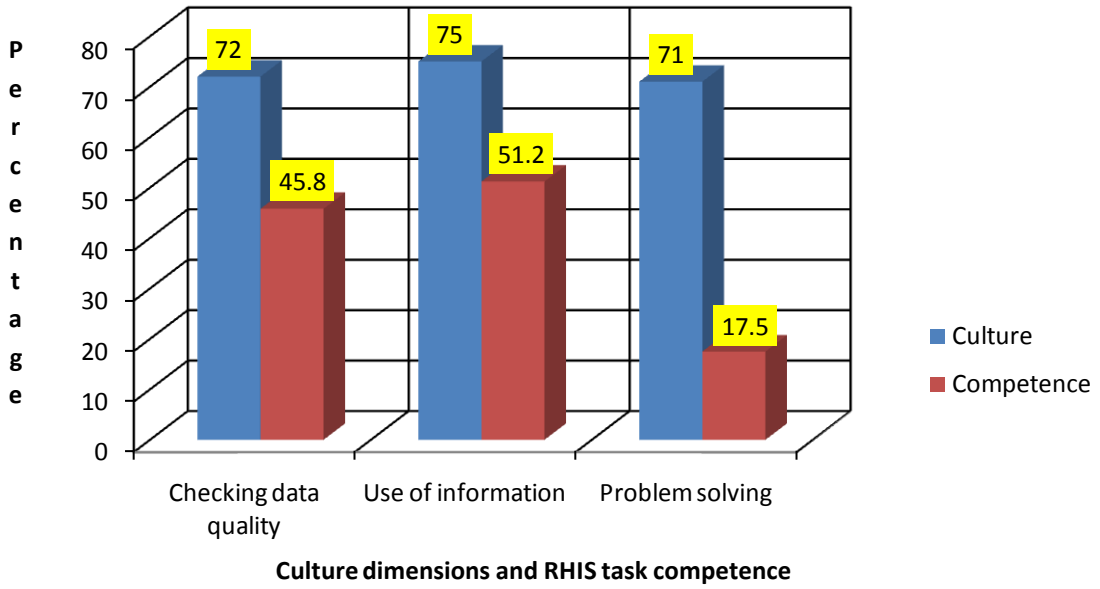

Figure 6.3 Mean Comparisons between Promotion of a Culture of Information and RHIS Task Competence (N=123)

There are many possible reasons for these gaps. First, the respondents might have exaggerated perceptions of the promotion of an information culture by the MoH. Second, they might be unaware of the existing situation or have tried to paint a better picture of the MoH than the reality. On the other hand, competence is measured objectively through a pencil and paper test thus reducing the possibility of over estimation. However, it is assumed that the MoH will produce some minimum level of RHIS task competence in alignment with the promotion of a culture of information, leading to less discordance between perceptions of a culture of information and the objective assessment of existing RHIS task competences. This study showed that perception and reality were not aligned. Hence there is a need to bridge this gap to improve RHIS performance further.

The value of comparing dimensions of a construct (e.g. promoting a culture of information) lies in being able to recognise which dimensions are weak and which are strong. Targeted intervention for weak dimensions is then possible, with the aim of increasing the overall effectiveness of the construct (e.g. promoting a culture of intervention). Similarly, it is possible that the findings of different components of the HMIS on their own might give a picture of strength, but when compared against other components, produce a different picture of the system.

Respondents believed strongly that their Ministry promotes data quality, use of information, and problem solving. This is similar to studies carried out in Zambia, Uganda, Pakistan and Mexico (Hozumi et al., 2002; Aqil, 2004; Torres, 2007; Boone and Aqil, 2008; Gnassou et al., 2008. Aqil et

al. 2009). One might expect to find a correspondingly high level of RHIS competence in these areas as well. However, this was not the case; in practice the respondents' perceptions did not align with the observed competence levels for checking data quality, use of information, and problem solving. There was a difference between confidence levels in performing HMIS tasks and observed competence in checking data quality, calculation, plotting, interpretation, and use of information as found out by MEASURE Evaluation (2013) and Aqil et al. (2009).

Another comparison – between knowledge of why particular data are collected under RHIS and the ability to solve problems – showed a gap indicating that if people do not know why they are collecting data, they will find it hard to solve problems (because they will not be able to identify the problems using data). In addition, they will have less motivation to change the current situation.

All of these situations illustrate discordance among various components of the HMIS and reveal some systemic issues. Therefore, contextual knowledge of the RHIS is a key for understanding the gaps between perceptions and objective reality.

Gaps identified between perceived confidence and observed skills for the interpretation and use of information could, in the Palestinian context, relate to the definition of interpretation and use of information, and how well the questions were understood. Since there was consistency between various questions and responses, the Palestinian context or understanding of the questionnaires most likely does not play a significant function in explaining this difference. An additional explanation is that there is limited training on data interpretation and use of information, which does not permit the respondents to self-assess their perceived confidence level, and their actual data interpretation and use skills properly, creating the gap. Similar experiences have been found in relation to Kenya, Mozambique, South Africa and other studies (MEASURE Evaluation 2006; Aqil et al. 2009).

The low skill level in data interpretation and use of information is also consistent with findings that very few respondents could describe at least one reason for collecting data on diseases, immunisation and target population. Similarly there was low knowledge of methods for checking data quality. Problem-solving skills were also low. This indicates that more importance is placed on how to collect data rather than why to collect data as found out by MEASURE Evaluation (2013) and Aqil et al. (2009). This is a good approach if the data collectors are part of a supply line with no other responsibilities. However, this approach is limited when data collectors are the Facility managers, responsible for the health of the catchment area population, and information is both needed and useful to fulfil that responsibility.

In terms of rewards for good work there was only limited evidence of this being recognised.

District supervisor visits were few and those undertaken failed to include the procedures that should have been expected. It is very important that supervisory visits should supply learning opportunities for staff to improve data quality as well as understanding the significance of data and their use. Therefore, verification of information, checking display of information to show changes in collected information and its use are all significant aspects of supervisory function and feedback.

There is a discrepancy in the availability between three levels. While it was acceptable at the Ministry level, it was insufficient at the District level and severely lacking at the Facility level.
Training functions are extremely weak. This is clearly an area for major investment in terms of material and human resources.

6.5 The Application of the PRISM Framework and its Tools

The PRISM framework hypothesises that improved RHIS performance is a function of technical, behavioural and organisational factors that constitute the inputs to the processes that shape output performance. Weaknesses in performance signify that the underlying causes within the system should be explored. Instead of blaming individuals, systems processes need to be changed.

Improving HMIS performance is a systemic function. Therefore, all management and staff should be accountable for it, with no distinction being made between data collectors and users. Thus, the management needs to work very closely with all those involved in RHIS, facilitating their job and empowering them to make decisions about their own work. Empowerment increases the sense of responsibility and accountability. It improves motivation (Aqil et al., 2009).

The application of the PRISM framework and its tools in various countries has shown that they produce consistent and valid results. The diagnostic tools for measuring data quality and information use are based on the gold standard for observing records, which validates the results. In the validation study on the PRISM tools in Uganda (Aqil et al., 2008), the Chronbach alpha for the RHIS task confidence scale was found to be 0.86 and 0.95 in 2004 and 2007, respectively. The culture of information scale values were found to be 0.87 and 0.85 for 2004 and 2007, respectively. This all shows inherently high reliability as well as the ability to maintain reliability over time. Similar results were obtained in the Yunnan and Guangxi provinces of China (Aqil et al., 2007a, b).

The PRISM framework states that in an efficient RHIS, different components should be working together harmoniously. For example, to get high quality data, it is assumed that staff should have a high level of confidence to perform data accuracy checks, demonstrate knowledge of different methods by which to check data accuracy, and have support from an organisational culture that

emphasises high quality data. If there is a gap in any of these components, data quality would suffer (Aqil et al., 2009).

The application of PRISM tools in various countries supported this assumption. A comparative analysis of the means of these variables (see Figure 6. 4) indicates whether various components of the information system are in line with each other in four countries. Figure 6.4 shows that the data accuracy was 49% in Uganda (Aqil et al., 2008), while the average perceived confidence level of the respondents to check data accuracy was 61%. This gives some idea as to why data accuracy is low. When data accuracy is compared with knowledge of methods for checking data (32% of respondents capable of describing one or more methods of checking accuracy), the low accuracy level is further explained. As well, a wider gap is detected based on whether an organisation is perceived to emphasise the need for high quality data or not. These gaps explain why data accuracy is low, and also indicate that respondents are unaware of these gaps in the existing information systems, creating a chance for interventions regarding better self-assessment, sense of responsibility, ownership and accountability. This agrees with findings of MEASURE Evaluation (2013) and Aqil et al. (2009).

Despite diversity in geography and culture, the results shown in Figure 6.4 were similar for Pakistan (JICA HMIS Study Team, 2004) and Mexico (Measure Evaluation, 2006), though not for China (Aqil et al., 2009), indicating that the tools can accurately differentiate among situations in different countries.

Three points need to be noted. First, China has a system of checking data accuracy at the provincial and national levels. Most Facilities have computers and data are directly entered into an online database, which is then checked at a higher level using historical trends (Aqil et al., 2009). This provides an explanation as to why, despite low staff knowledge of methods of checking data accuracy, the data accuracy is high. However, there was acknowledgment that this weakness is not good for catching mistakes and managing the system locally and thus needs to be improved.

Second, in Mexico the study used Lot quality assurance sampling, which is based on a small sample size (Measure Evaluation, 2006). The results were comparable, indicating that it is not necessary to have large sample sizes to illustrate gaps among different components of the system.

Third, comparative analyses among RHIS performance indicators and different components of the information system demonstrate existing strengths and gaps, provide a comprehensive picture of the information systems, and specify opportunities for improvements. For example, the Uganda study (Aqil et al., 2008) illustrated that there is low information use (24%), which was consistent with the limited observed skills level to interpret (41%) and use information (44%). Otherwise, the study

participants, managers and Facility staff, showed a high subjective confidence level for these skills (56% and 58% for data interpretation and information use, respectively), as well as strong perceptions that the health department promotes the use of information (78%). These gaps between existing perceptions and observed skills and performance in interpreting data and information use opened a dialogue about what needs to be done to bridge these _perception' gaps, and about distributing responsibilities rather than blaming each other. It consequently led to the development of interventions such as skills training, supportive supervision and feedback processes, and sharing success stories through existing communication channels to promote the use of information (Aqil et al., 2009)

In Uganda, Pakistan, Haiti, Paraguay and Côte d'Ivoire (Aqil, 2004; JICA HMIS Study Team, 2006; Aqil et al., 2009; Torres, 2007; Boone and Aqil, 2008; Gnassou et al., 2008), the PRISM assessment illustrated a limited availability of skilled human resources and of data collection forms, which were a constant cause of low performing RHIS. Thus, these studies showed that the PRISM framework is able to recognise gaps in various components of the RHIS, which affects its ability to improve performance (Aqil et al., 2009).

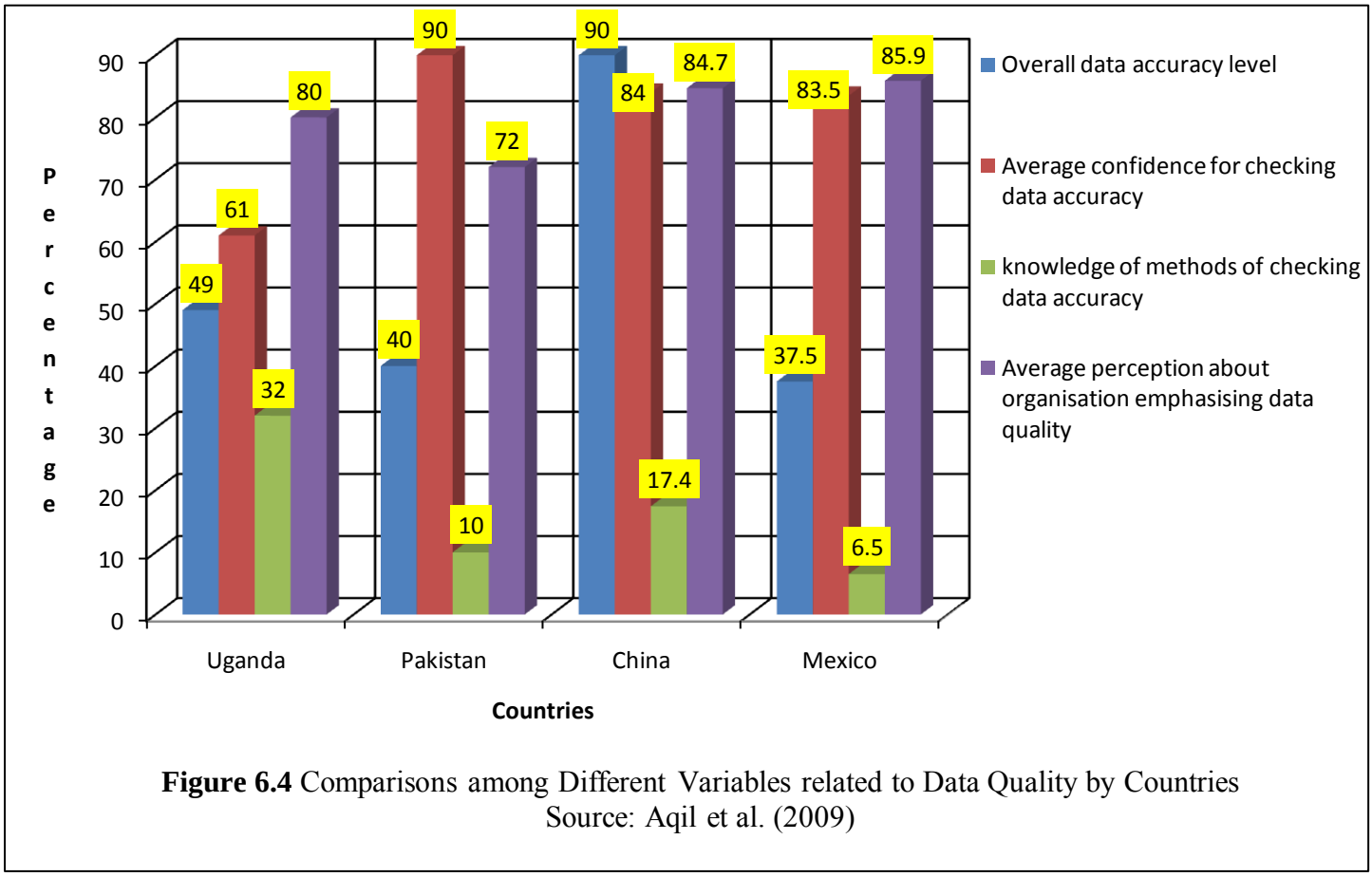

Figure 6.4 Comparisons among Different Variables related to Data Quality by Countries
Source: Aqil et al. (2009)

Figure 6.5 shows the average confidence for checking data quality accuracy, knowledge of methods of checking data accuracy, and the average perception about organisation emphasising data quality in Palestine. This agrees with findings of MEASURE Evaluation (2013).

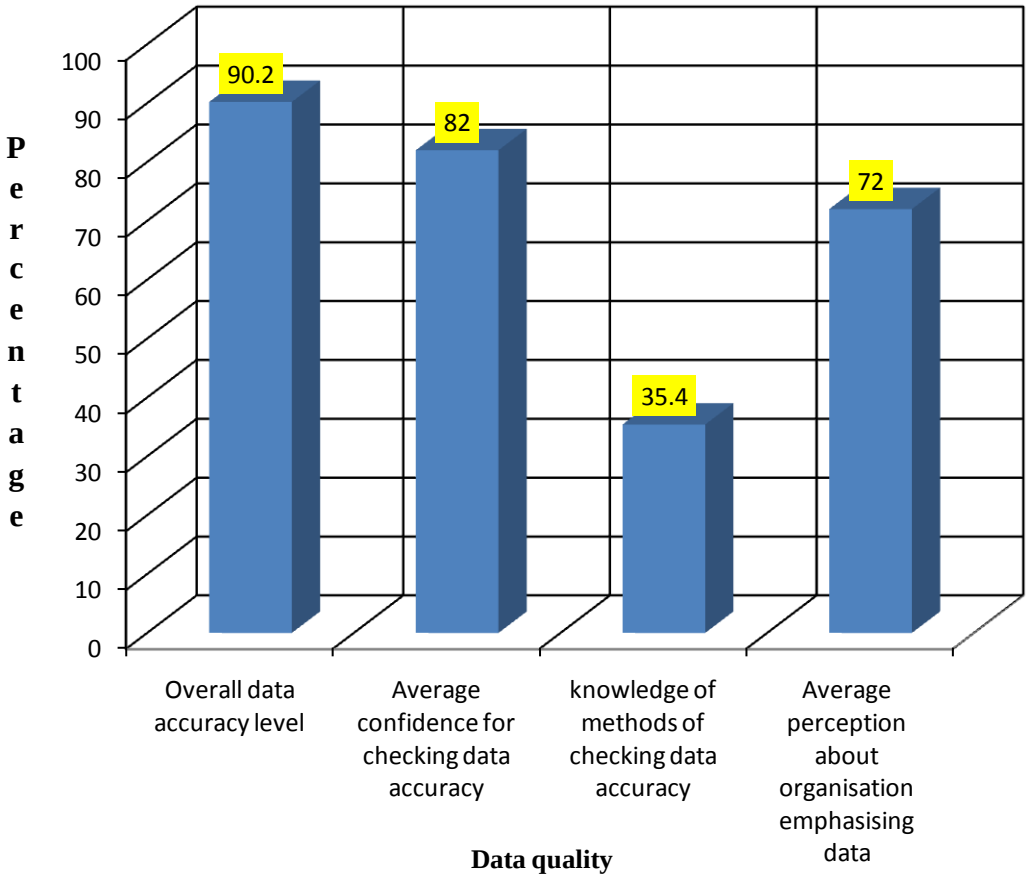

Figure 6.5 Comparisons among Different Variables related to Data Quality in Palestine

Figure 6.6 shows a gap between self-perceived capacity and real competencies to carry out the functions of the RHIS among HIS staff at health Facility level. RHIS task competencies in terms of checking data quality, analysis and use of information are limited in most countries including Palestine. This agrees with findings of MEASURE Evaluation (2013).

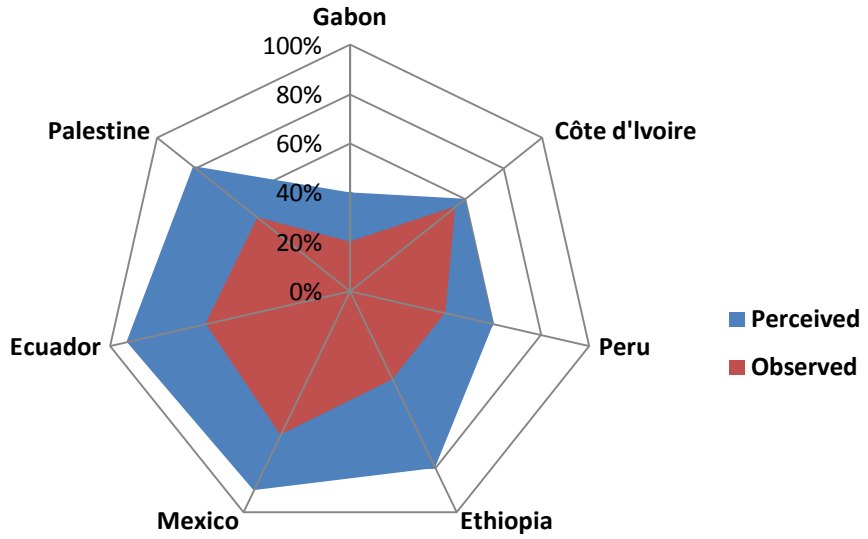

Figure 6.6 HIS Staff Competencies to Perform RHIS Tasks

Health workers have limited knowledge on data quality review methods in many countries including Palestine (see Figure 6.7). Lack of problem identification and solving skills are other common issues observed among health workers in the majority of the countries including Palestine as indicated by MEASURE Evaluation (2013).

On average, 37% of the health workers were able to demonstrate skills to identify and solve problems related to information use in 10 countries including Côte d'Ivoire, Dominican Republic, Ecuador, Ethiopia, Gabon, Honduras, Mexico, Peru, South Africa, and Uganda (MEASURE Evaluation, 2013).

Furthermore, in most countries, the limited knowledge about usefulness of data has been the primary factor linked to lack of demand for data quality and use of information. Respondents indicated that there is no or little demand for the generated information and the information is not systematically analysed. The assessments underlined the need to strengthen capacities in use of information of the workforce involved in RHIS (MEASURE Evaluation, 2013).

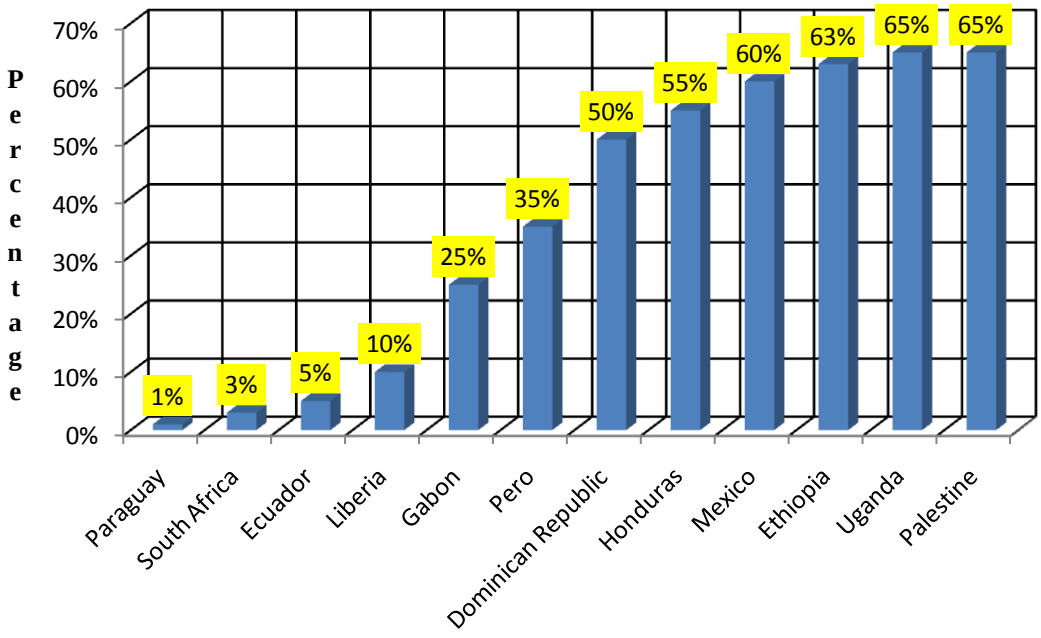

Figure 6.7 Knowledge on Data Quality Review Methods

The PRISM framework assumes that if organisations promote a culture of information, they will also improve their competence in conducting RHIS tasks, and thus improving their self-confidence to carry out RHIS tasks, the countries‘ assessments including Palestine showed a gap between perceived promotion of a culture of information and actual competencies and knowledge of RHIS tasks (see Figure 6. 8). This indicates that perceptions among the respondents that their organisation promotes data quality and use of information were not aligned with actual competence to check data quality and use information. These results of low RHIS competence combined with high perceptions of promotion of a culture of information and self-efficacy for RHIS tasks are consistently reflected in PRISM assessments in Pakistan, Mexico, Côte d‘Ivoire, Uganda, Gabon, Dominican Republic, and Honduras (MEASURE Evaluation, 2013).

In regard to organisational functions of RHIS, the assessments also highlighted that the absence of rewarding good performance, low quality of supervision visits, and feedback affected health workers‘ motivation to perform RHIS tasks. A PRISM study in Uganda showed that, although the health facilities received a number of supervisory visits, less than 45% had received feedback. The

Zambia assessment highlighted that motivation to do RHIS tasks apart from collecting and reporting data is limited. There is no incentive to produce quality data to analyse and use information as there is no supervisory or monthly report feedback provided at various levels of the system (MEASURE Evaluation, 2013).

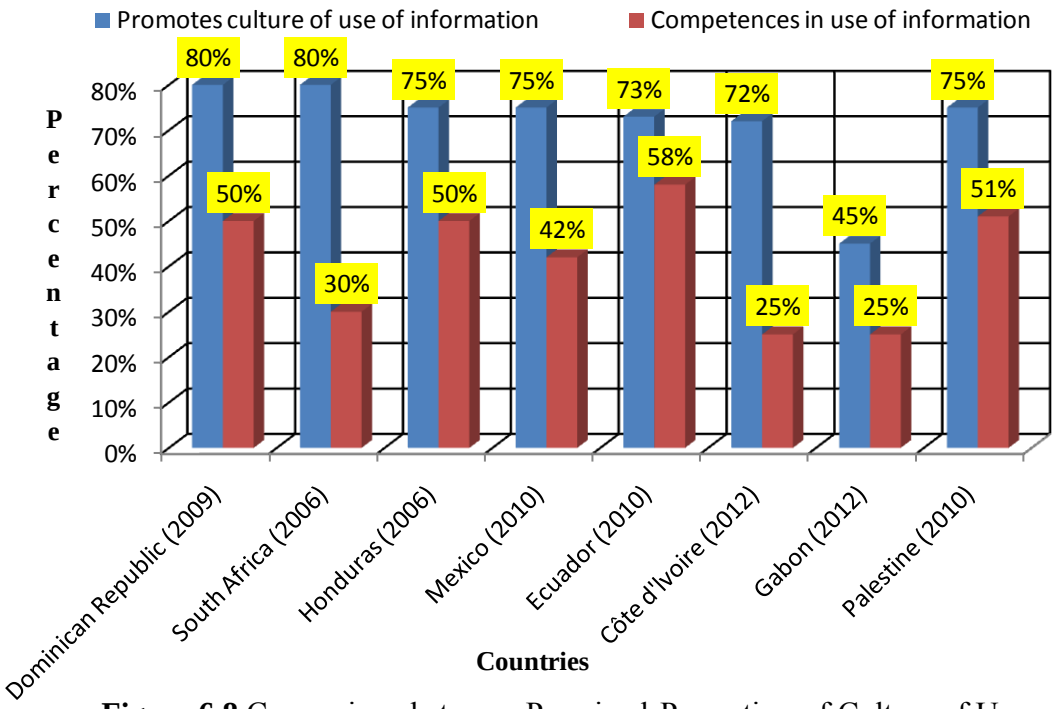

Figure 6.8 Comparison between Perceived Promotion of Culture of Use of Information and Actual Competence to Use Information

6.6 Summary

This present chapter has discussed major issues that have arisen in the course of the research. These correspond to the principal ingredients of the PRISM framework and its underlying systems thinking. Discussion commenced with RHIS performance, which in system terms corresponds to the output of the health information system. This was followed by consideration of the RHIS processes which produce that performance.

Thirdly, the focus turned to inputs to these processes, which are the determinants that include technical, behavioural and organisational factors. From a systems perspective there was a need to recognise the importance of the feedback loops which are in operation. The chapter concluded by reviewing the success in the application of the PRISM framework and its tools in a range of international settings, enabling comprising to be made with some of the results obtained in this Palestinian context.

The next chapter concludes the thesis, demonstrating the extent to which the objectives have been achieved, stating the contributions to knowledge, identifying future research opportunities and making recommendations for enhancement of RHIS operation in Palestine.

Chapter 7

Conclusions

7.1 Introduction

Having analysed the results obtained and discussed the major issues arising, this chapter will provide a set of conclusions to the thesis. First there will be an examination of the extent to which the specific objectives of the research have been achieved. This will be followed by a consideration of the significant contributions to knowledge made by the research. One of the outcomes of any research programme is a realisation that further work is needed, so a discussion is provided of further avenues of research that should be explored. Finally a set of recommendations is presented that should be considered for implementation by the Palestinian Ministry of Health.

7.2 Achieving the Objectives

The research described in this thesis has aimed at providing a comprehensive picture of the performance of health information systems as are currently to be found in Palestine, with particular emphasis on the routinely available health information data and the factors contributing to them from technical, organisational and behavioural perspectives. From this analysis carefully studied interventions can then be proposed aimed at bringing about tangible improvement in Routine Health Information System (RHIS) performance at the Palestinian Ministry of Health (MoH).

In seeking to meet this overall aim, the research has addressed a number of specific objectives. These are restated below, together with a description of the manner in which they have been achieved.

Objective 1 – Define the nature of the health information provision in Palestine: As a precursor to assessing the current performance of health information systems, it has been necessary, first, to understand the nature of the Palestinian context in terms of the structure and organisation of health care and its delivery and then the manner in which health information is obtained and utilised (at the Ministry, District and Facility levels). This has been fully documented in the introductory chapters of the thesis.

Objective 2 – Identify an appropriate methodology for undertaking the proposed substantive research: Relevant methodological approaches have been identified and discussed in Chapter 4, where appropriate conceptual foundations and study design have been described. The importance of adopting a systems (feedback) model has been emphasised in conjunction with the value of case study. The theoretical background has been considered and the Performance of Routine Information

System Management (PRISM) framework, with its four complementary tools, identified and justified for the necessary substantive analysis.

Objective 3 – Assess the current performance of the Routine Health Information System (RHIS) at the Palestinian Ministry of Health (MoH): Performance generally, as is to be found in the health systems of many developing countries, has been found to suffer from a number of generic weaknesses, including: poor data quality and subsequent poor data analysis; the lack of an information culture with as a consequence health information systems being regarded as a burden; and an absence of properly trained personnel. Chapter 4 has described the implementation of the chosen methodology in order to understand the nature and performance of currently adopted systems. On this basis, an assessment has been made of the RHIS at the Palestinian MoH. This provides the answer to my first research question.

Objective 4 – Identify the technical, behavioural and organisational RHIS determinants of the Health Management Information System (HMIS) performance: This objective has been achieved, making use of the PRISM framework as described in Chapter 5. In this way it has been possible to identify the RHIS, technical, behavioural and organisational determinants, examining these at all three levels, Ministry, District and Facility within the healthcare system. This provides the answers to my third, fourth and fifth research questions.

Objective 5 – Determine the extent to which the HMIS processes influence HMIS performance: The analysis performed in Chapter 6 has enabled the relationships between process and performance to be better understood, carrying out the examination within an overall systems perspective which recognises the importance of the feedback loops that are in operation. The analysis has revealed the way in which system inputs (technical, behavioural and organisational determinants) are modulated by the RHIS processes to yield outputs which, in turn impact upon the performance of the HMIS. This provides the answer to my second research question.

7.3 Contributions to Knowledge

The research described in this thesis makes significant contributions to knowledge, both from a methodological and contextual viewpoint, and at a strategic and operation level in the Palestinian setting.

At a methodological level, the research has taken the PRISM framework (Performance of Routine Information System Management) and its associated tools and demonstrated its transferability to the Palestinian context. Moreover, in contrast to previous applications in widely diverse international settings, the Framework has been successfully applied across all levels from Ministry, through District to the Facility level. The application has enabled experiments to be designed resulting in data collection that has provided clear insights into the multi-faceted nature of the operation of health information systems. Having demonstrated the applicability of the framework in the specific Palestinian setting, contextually it would clearly be transferable to other Arab State health systems and more generally those of West Asia, and potentially the developing world, where there is the need for equivalent analysis, given the centrality of health informatics to future health care delivery.

Undertaking the analysis in the Palestinian setting utilising the PRISM framework has also resulted in strategic and operational contributions. It has enabled experiments to be designed by which empirical data have been collected that have yielded, for the first time, a detailed understanding of the current nature of information acquisition, processing and utilisation across all levels of the healthcare structure in Palestine. This has revealed some current areas of strength, but more importantly many areas of weakness where change and improvement is urgently needed; the degree of change varying across the different levels of Ministry, District and Facility. In the light of these revelations, a range of recommendations are made as to ways in which the functioning of the health information systems might be enhanced, with potential consequent positive impact on health care delivery. From the results obtained a range of further range of investigations, again aimed at enhancing health information provision and utilisation, have been identified.

7.4 Future Research

The research study reported in this thesis is the first of its type to have been undertaken in the Palestinian context. Given the issues revealed, resulting in the recommendations for change as outlined in section 7.5, it is important that that similar studies should be undertaken periodically in order to measure progress with respect to the RHIS and its usage over time.

However, health informatics can, and rightly should, apply to every aspect of health care provision. This is all the more important, given the setting in which the political conflict remains unresolved. The issues raised by this study have serious implications both for the efficiency and effectiveness of the health care systems on the one hand and access to health care by the Palestinian people on the other. Therefore a wide range of relevant health informatics is now needed to enable a data (and hence information) driven planning approach to health that takes full account of human rights.

Key areas for future research include:

- Investigating in the Palestinian context the role of electronic health records from both clinician and consumer perspectives;
- Assessing the role of health informatics in increasing accessibility to health care;
- Exploring methods for collaborative online medicine and telemedicine;
- Creating best practice guidelines for documentation (health care records), and for health information system utilisation in the Palestinian Ministry of Health;
- Exploring the manner in which health informatics can be utilised by all the health care professions including nursing, laboratory technicians, pharmacy, dentistry, midwifery and others;
- Demonstrating how consumer empowerment can be brought about through a range of e-health scenarios.

All of these are areas of research that need to be explored, building on the achievements reported in the thesis.

7.5 Recommendations

In the light of the findings of the programme of research, the following recommendations are made to be considered for implementation by the Palestinian Ministry of Health (MoH) in relation to health information and its use:

7.5.1 RHIS Performance Recommendation

- Strengthen the RHIS performance through better data quality and improved use of information in order to gain better health system performance which consequently affects the health status of the population.

This was highlighted by the results shown in section 5.4. Activities to achieve this should include:

1. Conduct periodic evaluations in order to measure performance. Formally evaluate the RHIS in terms of data quality, data use, and management functions on a periodic basis.
2. Promote transparency of HMIS data – ex. Display data in public, make it available to media for sharing and verification. Make it available at donor coordination meetings, even if the quality is poor)
3. Promote accountability – for example, use HMIS information to make everyone accountable for HIS and health system performance. Create procedures for dealing with non-compliance with performance targets.
4. Identify local partners (NGOs) to support HMIS- find a mechanism to generate budget for HMIS supplies locally to ensure sustainability of the system.
5. Link HIS performance to annual performance appraisal.
6. Improve RHIS processes, which in turn are affected by technical, behavioural and organisational determinants.
7. Improve technical, behavioural and organisational determinants.

7.5.2 Processes Recommendations

- Improve RHIS processes at all health levels in order to produce quality data and facilitate the use of information, where the RHIS processes include data collection, data quality checks, data transmission, data processing, data analysis, data display and feedback.

This was highlighted by the results shown in section 5.5. Activities to achieve this should include:

1. Promote transparency of data, for example by displaying appropriate data publicly, making them available to the media for sharing and verification, or making them available at donor coordination meetings, even if the quality is poor.
2. Perform interventions to establish the proper procedures for recording receipt dates of RHIS monthly reports from the Facilities and for submitting data to the higher level in order to improve data quality at the District offices.
3. Design new regulations that set the standards for information management and information flow within the various departments at the Ministry of Health and the Health Information Centre.
4. Improve the operation of feedback/supervision system, focusing on checking the use of information and ensuring that comparison is made among the Facilities on health service indicators. Activities should include preparing feedback guidelines for the various health areas, developing a supervisory checklist for checking information use, training all health area supervisors on checklist use and activities and ensure, on the part of the MoH, that there are appropriate budgets in place for technical supervisory visits and for RHIS training.
5. Set up regulations for information flow from various departments at the MoH to the Health Information Centre, including tracking information flow.
6. Enhance linkages between the Health Information Centre and the various departments within the Ministry of Health in terms information flow. This can be done through producing a set of regulations that allows the health information centre to standardise databases and to obtain access to information.

7.5.3 Technical Determinants Recommendations

- Integrate the various health information systems within the private sector and the MoH.

The need for such integration was highlighted by section 5.2 and section 5.6.1. Activities to achieve this should include:

1. Develop mechanisms for integrating data between the existing databases from the different programmes.
2. Design a system for data entry auditing that will be managed by the health information centre at MoH. This can be done through conducting double entry for a sample of the records to check if the data is being entered without errors or with minimal number of errors.
3. Standardise the software necessary for data entry at the various health care facilities such as Oracle, Access, Epi-Info, etc.

4. Enhance linkages between the health information system and other governmental and nongovernmental organisations, such as the Ministry of Interior, Palestinian Central Bureau of Statistics, etc.

7.5.4 Organisational Determinants Recommendations

- Improve the performance gap by promoting a culture of information; recognising that a comprehensive plan for promoting a culture of information is needed.
  This was highlighted by the results shown in section 5.6.3.2 which indicated significant scope for improvement. Activities to achieve this should include:
  1. Regular discussions of Facility and District levels of monthly reports;
  2. Sharing of success stories on the use of information through regular official communications, feedback reporting or newsletters;
  3. Stressing the use of information for decision-making in staff meetings;
  4. Regular monthly or quarterly feedback reports from the higher level to their immediate lower level.
- Ensure that the MoH budget contains a developmental component for the Palestinian Health Information Centre (PHIC).
- Support the PHIC with proper human resource especially in the area of epidemiology and biostatistics.
- Replace outdated computers at all levels (Ministry, District and Facility). Provide additional computer hardware at both District and Facility levels.
- Implement appropriate policies to establish performance criteria and promotion criteria for staff, in accordance with resource availability.
- Strengthen the rewards system for reinforcing positive behaviours in relation to RHIS tasks. This could take either intangible or tangible form for such things as recognition of good work, or could provide recognition in the form of a certificate, monetary reward or early promotion.
- Set up a set of procedures for allocating resources and planning based on information products of HIS.

7.5.5 Behavioural Determinants Recommendations

- Improve routine health information system (RHIS) skills in checking data quality, performing calculations, plotting, interpretation, use of information, problem solving and performance improvement tools (such as cause and effect analysis, flow charts, the priority matrix, control charts etc.).

This was highlighted by the results shown in section 5.6.2.2. Activities to achieve this should include:

1. Developing the RHIS training curriculum, training ~~–m~~aster trainers"
2. Conducting training for all heath area management team members.
3. Increase personal motivation towards performing RHIS tasks.

Appendix A						
RHIS Performance Diagnostic Tool **Quality of Data: Ministry HMIS Level Assessment Form**						
Date of assessment:						
Name of person interviewed:		Title of person interviewed:				
Data transmission						
MQ 1	Does the Ministry office keep copies of RHIS monthly reports sent by health district?		1. Yes		0. No	
MQ 2	What is the number of districts that are supposed to be reporting to (enrolled in) RHIS?					
MQ 3	What is the number of districts that are actually reporting to (enrolled in) RHIS?					
MQ 4	Count the number of monthly reports submitted by the districts for any two months?		a. Month		b. Month	
MQ 5	What the deadline for the submission of the RHIS monthly report by the district?				If no deadline is set, write no and go to MQ8	
MQ 6	Does the Ministry office record receipt dates of RHIS monthly report?		1.Yes	0.No	If receipt dates are not recorded, go to MQ8	
MQ 7	If MQ6 yes, check the dates of receipts for the two months					
		a. Month(specify)		b. Month (specify)		
	Item	1.Before deadline	2.After deadline	3.Before deadline	4.After deadline	
	Number of districts					
MQ 8	Does the Ministry have a record of people who receive monthly report data by a certain deadline after receiving monthly reports from the districts?		1.Yes		0.No	
Data accuracy						
MQ 9	Manually count the number of following data items from the RHIS monthly reports for the selected two months. Compare the figures with the reports from the computer or paper database.					
	Item	a. Month (specify)		b. Month (specify)		
		Manual count	Paper/computer	Manual count	Paper/computer	
MQ a						
MQ b						
MQ c						
	Data Processing / Analysis					
MQ 10	Does a database exit to enter and process data?		0.No	1.Yes,by paper database	2.Yes,by computer database	
MQ 11	Does the database produce the following:					
MQ 11a	Calculate indicators for each facility catchment area			1.Yes	0.No	
MQ 11b	Data summary report for the district			1.Yes	0.No	
MQ11c	Comparisons among districts			1.Yes	0.No	
MQ11d	Comparisons with district/national targets			1.Yes	0.No	

MQ11e	Comparisons among types of services coverage	1.Yes		0.No
MQ11f	Comparisons of data over time (monitoring over time)	1.Yes		0.No
MQ 12	Do you think that RHIS procedure manual is user friendly?	1.Yes		0.No
MQ 13	Do you think that the monthly report form is complex and difficult to follow?	1.Yes		0.No
MQ 14	Do you find the data software to be user-friendly?	1.Yes		0.No
MQ 15	Do you find that the information technology is easy to manage?	1.Yes		0.No
MQ 16	Do you think that the information design provide a comprehensive picture of health system performance?	1.Yes		0.No
MQ 17	Do you think RHIS has information that is also included in other information system?	1.Yes		0.No
MQ 18	Does the RHIS software integrate data from different information systems?	1.Yes		0.No
MQ19	Does the information technology (Land Area Network-LAN or wireless network) exit to provide access to information to all district managers and senior management?	1.Yes partially	2.Yes completely	0. No

Appendix A					
RHIS Performance Diagnostic Tool **Use of Information: Ministry HMIS Level Assessment Form**					
Date of assessment:					
Name of person interviewed:		Title of person interviewed:			
RHIS report production					
MU 1	Does the Ministry office compile RHIS data submitted by districts?		1.Yes	0.No	
MU 2	Does the Ministry office issue any report containing RHIS information?		1.Yes	0.No	If no go to MU4
MU 3	If yes, please list reports that contain data/information generated through RHIS. Please indicate the frequency of these reports and the number of times the Reports actually were issued during the last 12 months				
	1.Title of the report	2.No.of times this report is supposed to be issued per year	3.No. of times that report are actually issued for the last 12 months		
MU3a					
MU3b					
MU3c					
MU3d					
MU3e					
MU 4	Did the Ministry office send a feedback report using RHIS information of districts during the last three months?		1.Yes	0. No	
Display of information					
MU 5	Does the Ministry office display the following data? Please indicate the type of data displayed and whether the data are updated for the last reporting period.				If no go to MU6
	1. Indicator	2. Type of display(please tick)		3. Updated	
MU5a	Related to mother health	Table		1.Yes	0.No
		Graph/chart			
		Map			
MU5b	Related to child health	Table		1.Yes	0.No
		Graph/chart			
		Map			
MU5c	Facility Utilisation	Table		1.Yes	0.No
		Graph/chart			
		Map			
MU5d	Disease surveillance	Table		1.Yes	0.No
		Graph/chart			
		Map			
MU 6	Does the office have a map of the catchment area?			1.Yes	0.No
MU 7	Does the office display a summary of demographic information such as population by target group(s)?			1.Yes	0.No

MU 8	Is feedback, quarterly, yearly or any other report on RHIS data available, which provides guidelines/ recommendations for actions?	1.Yes	0.No	If no go to MU10
MU 9	If yes to MU8, what kinds of decisions are made in reports of RHIS data/information for actions? Please check types of decision based on types of analysis present in reports.			
	Types of decisions based on types of analysis			
MU9a	Appreciation and acknowledgement based on number /percentage of facilities showing performance within control limits overtime (month to month comparisons)	1.Yes	0.No	
MU9b	Mobilization /shifting of resources based on comparison by districts	1.Yes	0.No	
MU9c	Advocacy for more resources by comparing performance by areas (sub-districts, cities, villages), human resources and logistics	1.Yes	0.No	
MU9d	Development and revision of policies by comparing types of services	1.Yes	0.No	
	Discussion and decisions about use of information			
MU 10	Does the Ministry office have routine meetings for reviewing managerial or administrative matters?	1.Yes	0.No	
MU 11	How frequently is the meeting take place during the last three months ?circle appropriate answer 0. No schedule 1.Quarterly 2.Monthly 3.After every two weeks 4.Weekely			
MU 12	How many times did the meeting take place during the last three months? Circle appropriate answer 0. None 1. 1 time 2. 2 times 3.3 times 4.4 times 5. 5 times 6. 6 times 7. Between 7 and 11 times 8. 12 times			
MU 13	Is an official record of management meeting maintained?	1.Yes	0.No	If no go to MU15
MU 14	If yes , please check the meeting records for the last three months to see if the following topics were discussed :			
MU14a	Management of RHIS, such as data quality , reporting , or timeliness of reporting	1.Yes , observed	0.No	
MU14b	Discussion about RHIS findings such as patient utilisation, disease data, or service coverage , or medicine stock out	1.Yes , observed	0.No	
MU14c	Have they made any decisions based on the above discussions?	1.Yes , observed	0.No	
MU14d	Has any follow-up action taken place on the decisions made during the previous meetings?	1.Yes , observed	0.No	
MU14e	Are there any RHIS related issues/problems referred to regional/national level for actions?	1.Yes , observed	0.No	
	Promotion and use of RHIS information at Ministry office			
MU 15	Did Ministry annual action plan showed decisions based on RHIS information?	1.Yes	0.No	
MU 16	Did records of Ministry office of last three months show that district/senior management issued directives on use of information?	1.Yes	0.No	

MU 17	Did district/national RHIS office publish newsletter report in last three months showing examples of use of information?	1.Yes	0.No
MU 18	Does documentation exit showing the use information for various types of advocacy?	1.Yes	0.No
MU 19	Does the Ministry staff meeting records show attendance of persons in charge of the districts for discussion on RHIS performance?	1.Yes	0.No
MU 20	Please describe examples of how the Ministry office uses RHIS information for health system management	1.Yes (details follows)	0. No examples

Appendix B					
RHIS Performance Diagnostic Tool **Quality of Data :District Level Assessment Form**					
Name of the district:			Date of assessment:		
Name of person interviewed:			Title of person interviewed:		
Data transmission					
DQ 1	Does the district office keep copies of RHIS monthly reports sent by health facilities?		1. Yes		0. No
DQ 2	What is the number of facilities in the district that are supposed to be reporting to (enrolled in) RHIS?				
DQ 3	What is the number of facilities in the district that are actually reporting to (enrolled in) RHIS?				
DQ 4	Count the number of monthly reports submitted by the facilities for any two months?		a. Month		b. Month
DQ 5	What the deadline for the submission of the RHIS monthly report by the facility?				If no deadline is set, write no and go to DQ8
DQ 6	Does the district office record receipt dates of RHIS monthly report?		1.Yes	0.No	If receipt dates are not recorded, go to DQ8
DQ 7	If DQ6 yes, check the dates of receipts for the two months				
		a. Month(specify)		b. Month (specify)	
	Item	1.Before deadline	2.After deadline	3.Before deadline	4.After deadline
	Number of facilities				
DQ 8	Does the district have a record of people who receive monthly report data by a certain deadline after receiving monthly reports from the facilities?		1.Yes		0.No
DQ 9	Does the district have a record of submitting data on time to regional and/or national levels?		1.Yes		0.No
Data accuracy					
DQ 10	Manually count the number of following data items from the RHIS monthly reports for the selected two months. Compare the figures with the reports from the computer or paper database.				
	Item	a. Month (specify)		b. Month (specify)	
		Manual count	Paper/computer	Manual count	Paper/computer
DQ a					
DQ b					
DQ c					
	Data processing / analysis				
DQ 11	Does a database exit to enter and process data?	0.No	1.Yes,by paper database	2.Yes,by computer database	
DQ 12	Does the database produce the following:				
DQ 12a	Calculate indicators for each facility catchment area		1.Yes		0.No
DQ 12b	Data summary report for the district		1.Yes		0.No
DQ 12c	Comparisons among facilities		1.Yes		0.No
DQ12d	Comparisons with district/national targets		1.Yes		0.No

DQ12e	Comparisons among types of services coverage	1.Yes	0.No	
DQ12f	Comparisons of data over time (monitoring over time)	1.Yes	0.No	
DQ 13	Do you think that RHIS procedure manual is user friendly?	1.Yes	0.No	
DQ 14	Do you think that the monthly report form is complex and difficult to follow?	1.Yes	0.No	
DQ 15	Do you find the data software to be user-friendly?	1.Yes	0.No	
DQ 16	Do you find that the information technology is easy to manage?	1.Yes	0.No	
DQ 17	Do you think that the information design provide a comprehensive picture of health system performance?	1.Yes	0.No	
DQ 18	Do you think RHIS has information that is also included in other information system?	1.Yes	0.No	
DQ 19	Does the RHIS software integrate data from different information systems?	1.Yes	0.No	
DQ20	Does the information technology (Land Area Network-LAN or wireless network) exit to provide access to information to all district managers and senior management?	1.Yes partially	2.Yes completely	0. No

Appendix B						
RHIS Performance Diagnostic Tool **Use of Information :District Level Assessment Form**						
Name of the district:		Date of assessment:				
Name of person interviewed:		Title of person interviewed:				
RHIS report production						
DU 1	Does this district office compile RHIS data submitted by facilities?		1.Yes	0.No		
DU 2	Does the district issue any report containing RHIS information?		1.Yes	0.No	If no go to DU4	
DU 3	If yes, please list reports that contain data/information generated through RHIS. Please indicate the frequency of these reports and the number of times the Reports actually were issued during the last 12 months					
	1.Title of the report		2.No.of times this report is supposed to be issued per year	3.No. of times that report are actually issued for the last 12 months		
DU3a						
DU3b						
DU3c						
DU3d						
DU3e						
DU 4	Did the district office send a feedback report using RHIS information of facilities during the last three months?			1.Yes	0. No	
Display of information						
DU 5	Does the district office display the following data? Please indicate the type of data displayed and whether the data are updated for the last reporting period.				If no go to DU6	
	1. Indicator	2. Type of display (please tick)		3. Updated		
DU5a	Related to mother health	Table		1.Yes	0.No	
		Graph/chart				
		Map				
DU5b	Related to child health	Table		1.Yes	0.No	
		Graph/chart				
		Map				
DU5c	Facility utilisation	Table		1.Yes	0.No	
		Graph/chart				
		Map				
DU5d	Disease surveillance	Table		1.Yes	0.No	
		Graph/chart				
		Map				
DU 6	Does the office have a map of the catchment area?			1.Yes	0.No	
DU 7	Does the office display a summary of demographic information such as population by target group(s)?			1.Yes	0.No	

DU 8	Is feedback, quarterly, yearly or any other report on RHIS data available, which provides guidelines/ recommendations for actions?	1.Yes	0.No	If no go toDU10
DU 9	If yes to DU8, what kinds of decisions are made in reports of RHIS data/information for actions? Please check types of decision based on types of analysis present in reports.			
	Types of decisions based on types of analysis			
DU9a	Appreciation and acknowledgement based on number /percentage of facilities showing performance within control limits overtime (month to month comparisons)	1.Yes	0.No	
DU9b	Mobilization /shifting of resources based on comparison by facilities	1.Yes	0.No	
DU9c	Advocacy for more resources by comparing performance by areas (sub-districts, cities, villages), human resources and logistics	1.Yes	0.No	
DU9d	Development and revision of policies by comparing types of services	1.Yes	0.No	
	Discussion and decisions about use of information			
DU 10	Does the district office have routine meetings for reviewing managerial or administrative matters?	1.Yes	0.No	
DU 11	How frequently is the meeting take place during the last three months ?circle appropriate answer 0. No schedule 1.Quarterly 2.Monthly 3.After every two weeks 4.Weekely			
DU 12	How many times did the meeting take place during the last three months? Circle appropriate answer 0. None 1. 1 time 2. 2 times 3.3 times 4.4 times 5. 5 times 6. 6 times 7. Between 7 and 11 times 8. 12 times			
DU 13	Is an official record of management meeting maintained?	1.Yes	0.No	If no go to DU15
DU 14	If yes , please check the meeting records for the last three months to see if the following topics were discussed :			
DU14a	Management of RHIS, such as data quality , reporting , or timeliness of reporting	1.Yes , observed		0.No
DU14b	Discussion about RHIS findings such as patient utilisation, disease data, or service coverage , or medicine stock out	1.Yes , observed		0.No
DU14c	Have they made any decisions based on the above discussions?	1.Yes , observed		0.No
DU14d	Has any follow-up action taken place on the decisions made during the previous meetings?	1.Yes , observed		0.No
DU14e	Are there any RHIS related issues/problems referred to regional/national level for actions?	1.Yes , observed		0.No
	Promotion and use of RHIS information at district			
DU 15	Did district annual action plan showed decisions based on RHIS information?	1.Yes	0.No	
DU 16	Did records of districts office of last three months show that district/senior management issued directives on use of information?	1.Yes	0.No	
DU 17	Did district/national RHIS office publish newsletter report in last three months showing examples of use of information?	1.Yes	0.No	
DU 18	Does documentation exit showing the use information for various	1.Yes	0.No	

	types of advocacy?		
DU 19	Does the district staff meeting records show attendance of persons in charge of the facilities for discussion on RHIS performance?	1.Yes	0.No
DU 20	Please describe examples of how the district office uses RHIS information for health system management	1.Yes (details follows)	0. No examples

Appendix C					
RHIS Performance Diagnostic Tool **Quality of Data :Health Facility Level Assessment form**					
Date of assessment:		Name of person interviewed:		Title of person interviewed:	
District:		Facility:		Type:	
Data recording					
FQ 1	Does this facility keep copies of the RHIS monthly reports which are sent to the district office?		1.Yes	0.No	If no, go to FQ5
FQ 2	Count the number of RHIS monthly reports that have been kept at the facility for the last twelve months				
FQ 3	Does this facility keep an outpatient register?		1.Yes	0.No	If no, go to FQ5
Data accuracy check					
FQ 4	Find the following information in the outpatient register for the selected two months. Compare the figures with the computer-generated reports.				
	item	a. Month (specify)		b. Month (specify)	
		# from register	# from report	# from register	# from report
4A					
4B					
4C					
FQ 5	Did you receive a directive in the last three months from the senior management or the district office to				
5A	Check the accuracy of data at least once in three months?		1.Yes, Observed	0.No	
5B	Fill the monthly report form completely?		1.Yes, Observed	0.No	
5C	Submit the report by the specified deadline?		1.Yes, Observed	0.No	
FQ 6	During the last three months, did you receive a directive from the senior management or the direct office that there will be consequences for not adhering to the following directives?				
6A	if you do not check the accuracy of data		1.Yes, Observed	0.No	
6B	if you do not fill in the monthly reporting from completely		1.Yes, Observed	0.No	
6C	if you do not submit the monthly report by the specified deadline		1.Yes, Observed	0.No	
	Data completeness				
FQ 7	How many data items does the facility need to report on in the RHIS monthly report? This number does not include data items for services not provided by this health facility.				
FQ 8	Count the number of data items that are supposed to be filled in by this facility but left blank without indicating ~~–0~~" in the selected month's report.				
Data transmission /data processing /analysis					
FQ 9	Do data processing procedures or a tally sheet exist?		1.Yes, Observed	0.No	
FQ 10	Does the facility produce the following?				
FQ 10 a	Calculate indicators facility catchment area		1.Yes, Observed	0.No	
FQ 10 b	Comparisons with district national targets		1.Yes, Observed	0.No	
FQ 10 c	Comparisons among types of services coverage		1.Yes, Observed	0.No	
FQ 10 d	Comparisons of data over time (monitoring over time)		1.Yes, Observed	0.No	
FQ 11	Does a procedure manual for data collection exist?		1.Yes, Observed	0.No	

Appendix C					
RHIS Performance Diagnostic Tool **Use of Information: Facility Level Assessment Form**					
Data of assessment:		Name of respondent :			
Facility Name:		Title of respondent :			
Facility Type:		District:			
FU 1	Does this facility compile RHIS data?		1. Yes	0. No	
FU 2	Does the facility compile any report containing RHIS information?		1. Yes	0. No	If no, go to FU14
FU 3	If yes, please list reports that contain data/information generated through the RHIS. Please indicate the frequency of these reports and the number of times the reports actually were issued during the last 12 months. Please confirm the issuance of the report by counting them and putting the number in column 3.				
	1. Title of the report	2. No. of times this report is supposed to be issued per year	3. No. of times this report actually has been issued during the last 12 months		
FU3a					
FU3b					
FU3c					
FU3d					
FU 4	During the last three months, did the facility receive any feedback report from district office on their performance?		1.Yes	0.No	
	Display of information				
FU 5	Does the facility display the following data? Please indicate types of data displayed and whether the data have been updated for the last reporting period.				If no go to FU6
	1. indicator	2. Type of display (please tick)		3. Updated	
FU5a	Related to maternal health	Table		1.Yes	0.No
		Graph/Chart			
		Map/other			
FU5b	Related to child health	Table		1.Yes	0.No
		Graph/Chart			
		Map/other			
FU5c	Facility utilisation	Table		1.Yes	0.No
		Graph/Chart			
		Map/other			
FU5d	Disease surveillance	Table		1.Yes	0.No
		Graph/Chart			
		Map/other			
FU6	Does the facility have a map of the catchment area?			1.Yes	0.No
FU7	Does the office display a summary of demographic information such as population by target group(s)?			1.Yes	0.No
FU8	Is feedback, quarterly, yearly or any other report on RHIS data available, which provides guidelines/ recommendations for actions?			1.Yes	0.No	If no go to FU10
FU 9	If you answered yes to question FU8, what kinds of action-oriented decisions have been made in the reports (based on RHIS data)? Please check the boxes accordingly				
	Types of decisions based on types of analyses				
FU9a	Review strategy by examining service performance target and			1.Yes	0.No

	actual performance from month to month			
FU9b	Review facility personnel responsibilities by comparing services targets and actual performance from month to month	1.Yes	0.No	
FU9c	Mobilization /shifting of resources based on comparison by services	1.Yes	0.No	
FU9d	Advocacy for more resources by showing gaps in ability to meet targets	1.Yes	0.No	
	Discussion and decision based on RHIS information			
FU 10	Does the facility have routine meeting for reviewing managerial or administrative matters?	1.Yes	0.No	If no go to FU15
FU 11	How frequently is the meeting supposed to take place? 0. No schedule 1.Quarterly 2.Monthly 3.After every two weeks 4.Weekely			
FU 12	How many times did the meeting actually take place during the last three months? 0. None 1. 1 time 2. 2 times 3.3 times 4.4 times 5. 5 times 6. 6 times 7. Between 7 and 11 times 8. 12 times			
FU 13	Is an official record of management meetings maintained?	1.Yes	0.No	If no go to FU15
FU 14	If yes, please check the meeting records for the last three months to see if the following topics were discussed:			
FU14 a	Management of RHIS, such as data quality, reporting, or timeliness of reporting	1.Yes, observed	0.No	
FU14 b	Discussion on RHIS findings such as patient utilization, disease data, or service coverage, medicine stock out	1.Yes, observed	0.No	
FU14 c	Have they made any decisions based on the above discussions	1.Yes, observed	0.No	
FU14 d	Has any follow-up action taken place regarding the decisions made during the previous meetings?	1.Yes, observed	0.No	
FU14 e	Are there any RHIS related issues or problems that were referred to the district or regional level for actions?	1.Yes, observed	0.No	
	Promotion and use of RHIS information by the district/higher level			
FU 15	Observed facility received annual/monthly planned targets based on RHIS information	1.Yes	0.No	
FU 16	Do facility records for the last three months show that district/senior management issued directives concerning the use of information?	1.Yes	0.No	
FU 17	Did the facility receive a district or national RHIS office newsletter or report in last three months giving examples of use of information?	1.Yes	0.No	
FU 18	Does documentation exist showing the use information for advocacy purposes?	1.Yes	0.No	
FU 19	Did the person in charge of the facility participate in meetings at district level to discuss RHIS performance for the last three months?	1.Yes	0.No	
FU 20	Please give examples of how the facility uses RHIS information for health system management			

	1. Yes (details follows) 0. No examples			
Supervision by the district health office				
FU21	Did the district supervisor visit your facility during the last three months?	1. Yes	2. No	If no, go to FU26
FU22	Did you observe a supervisor having a checklist to assess the data quality?		1.Yes	0.No
FU23	Did the supervisor check the data quality?		1.Yes	0.No
FU24	Did the district supervisor discuss performance of health facilities based on RHIS information when hi/she visited your facility?		1.Yes	0.No
FU25	Did the supervisor help you make a decision based on information from the RHIS?		1.Yes	0.No
FU26	Did the supervisor send a report/feedback/note on the last two supervisory visits?		1.Yes	0.No

Appendix D

Routine Health Information System Overview
Overview of information Systems in Health Sector

Respondent‘s name : Title:

Mapping existing routine information systems in health sector

1- Types of information handled by each systems

Type of information system	Service Utilisation	Occurrence of selected disease	Disease Outbreak (Immediate report)	Financial Information	Drug, contraceptive vaccine, stock	Human resources	Equipment/ building
Routine service based reporting system							
Epidemiological surveillance for notifiable infectious diseases							
Special program reporting systems (EPI)							
Special program reporting systems (TB)							
Special program reporting systems (Malaria)							
Special program reporting systems (HIV/AIDS)							
Special program reporting systems (MCH)							
Special program reporting systems (specify)							
Community Base information system							
Administrative system (Finance)							
Administrative system (human resource)							
Administrative system (Training)							
Administrative system (drugs, vaccine, contraceptive, logistics)							
Administrative system (infrastructure, equipment, transport)							
Vital registration							
Other system							

2. Data collection and transmission	
Please list all data collection tools/forms that are used at the community/health facility level. If space is not enough, please add an additional sheet of paper.	
Facility-based data collection tools :(such as patient registers)	Comments on tools. Is the form easy to use? Enough space to record data? Takes too much time?
• ..... • ..... •	• ..... • ..... • .....
Data transmission/reporting forms	Comments on forms. Is the form easy to use? Enough space to record data? Takes too much time?
• ..... • ..... •	• ..... • ..... • .....

3. Information flowchart										
levels	**Types of information systems**									
	Routine service based reporting system	Epidemiological surveillance for notifiable infectious diseases	EPI	TB	HIV/AIDS	MCH	Finance	Human resources	Administrative system (drugs, contraceptive,	Vital registration
Central/national level										
District level										
Facility level										

Appendix D
Facility/Office checklist **(Interview Facility Manager or person in charge of RHIS at the office)**
Person interviewed(name, title, organisation)
Facility/ Office name:
Facility/Office address:
Facility type:

A. Verify if the following equipment is available in the facility

1. Equipment		
Hardware Equipment	Total quantity	How many are in working condition?
A. Computer		
B. Data Back-up Unit(e.g. floppy, CD, zip)	0. No	1. Yes
C. Printers		
D. UPS		
E. Generators		
F. Landline		
G. Access to the internet	0. No	1. Yes
H. Calculator		

2. Utilities		
A. Is there a continuous electricity supply?	0. No	1. Yes
B. How often is the electricity supply interrupted? 0. Never/occasionally 1. Once a month 2. Twice a month 3. Weekly 4. Daily		
C. Is the room, where the computer hardware is kept, air-conditioned?	0. No	1. Yes
D. Is running water available in the facility?	0. No	1. Yes

3. Availability of registers, forms		
Type of record, report or register	Have you run out of this form in the past 12 months? If so, why?	
A. Antenatal care	0. No	1. Yes
B. Child care	0. No	1. Yes
C. Family planning	0. No	1. Yes
D. Communicable disease	0. No	1. Yes
E. Health insurance	0. No	1. Yes

B. Organisation of the health facility			
B.1. Please describe total number of persons and their title working at the facility			
B. 2. Title/ post	Number	Title/ post	Number
1.		8.	
2.		9.	
3.		10.	
4.		11.	
5.		12.	
6.		13.	
7.		14.	

B.3. Who fills in the HMIS monthly reports?			
B.4. List those staff members who received any training in the recording, processing, or reporting of health information during the last two years, the number of training received, and the year of the latest training.			
B.4.a Title	B.4.b how many trainings courses/sessions did this person received in the past three years?	B.4.c Year of last Training?	B.4.d. Subjects of last training 1. data collection 2. data analysis 3. data display/report 4. 1&2 5. 1&3 6. 2&3 7. 1, 2&3 8. Other (specify)
1.			
2.			
3.			
4.			
5.			

Appendix E					
RHIS Management Assessment Tool **(Observation at facility and higher levels)** Questions under blue areas are not for the facility level					
MAT1. Name the facility:					
MAT2. Name of the district:					
MATG1	Presence of RHIS Mission displayed at prominent position(s)			0. No	1. Yes
MATG2	Presence of management structure for dealing with RHIS related strategic and policy decisions at district and higher levels			0. No	1. Yes
MATG3	Presence of an updated (last year)district health management organisational chart, showing functions related to RHIS/health information			0. No	1. Yes
MATG4	Presence of distribution list and documentation of RHIS past monthly/quarterly report distribution at district or higher level			0. No	1. Yes
MATP1	Presence of RHIS situation analysis report less than 3 years old			0. No	1. Yes
MATP2	Presence of RHIS 5 year plan at district or higher level			0. No	1. Yes
MATP3	Presence of RHIS targets at facility or higher level			0. No	1. Yes
MATQ1	Presence of a copy of RHIS standards at district or higher levels			0. No	1. Yes
MATQ2	Presence of a copy of RHIS standards at facility			0. No	1. Yes
MATQ3	Presence of performance improvement tools (flow chart, control chart etc.) at the facility			0. No	1. Yes
MATT1	Does facility/district have a RHIS training manual?			0. No	1. Yes
MATT2	Presence of mechanisms for on-job RHIS training (see documentation)			0. No	1. Yes
MATT3	Presence of schedule for planned training	0. No	1. Yes, for one year	2. Yes, 2 years or more	
MATS1	Presence of RHIS supervisory checklist			0. No	1. Yes
MATS2	Presence of schedule for RHIS supervisory visit			0. No	1. Yes
MATS3	Presence of supervisory reports			0. No	1. Yes
MATF1	Presence of RHIS related to expense register			0. No	1. Yes
MATF2	Presence of mechanisms for generating funds for RHIS			0. No	1. Yes
MATF3	Presence of RHIS monthly/quarterly financial report			0. No	1. Yes
MATF4	Presence of long term financial plan for supporting RHIS activities			0 .No	1 .Yes

Appendix F

Organisational and Behavioural Assessment Tool

Introduction

This survey is part of the PhD study in Health Informatics, to improve Management Information Systems at MoH. The objective of this survey is to help develop interventions for improving information system and use of information. Please express your opinion honestly. Your responses will remain confidential and will not be shared with any one, except for presented table forms. I appreciate your assistance and co-operation in completing this study.

Thank you.

Yousef Mimi

ID1. Name of facility .....
ID2. Name of district …….....
DD1. Title of the person **.....**
DD2. Age of the person **.....**
DD3. Sex ..... 1. Male ..... 2. Female.....
DD4. Education.....
1.10 years 2. Intermediate (11-12) 3. Bachelor (13-14) 4. Master
5. Professional diploma/degree (specify**)** ----------
6. Other (specify**)** ----------
DD5. Years of employment ----------
DD6. Did you receive any training in HMIS related activities in the last six months?
0. No 1.Yes

I would like to know your opinion about how strongly you agree with certain activities, there are no right or wrong answers, but only expression of your opinion on a scale. The scale is about assessing the intensity of your belief and ranges from strongly disagree (1) to strongly agree (7). You have to determine first whether you agree or disagree with the statement. Second decide about the intensity of agreement or disagreement. If you disagree with statement then use left side of the scale and determine how much disagreement that is -strongly disagree (1), somewhat disagree (2) or disagree (3) and circle the appropriate answer. If you are not sure of the intensity of belief or think that you neither disagree nor agree then circle 4. If you agree with the statement, then use right side of the scale and determine how much agreement that is – agree (5), somewhat agree(6) or strongly agree (7) and circle the appropriate answer . Please note that you might agree or disagree with all the statements and similarly you might not have the same intensity of agreement or disagreement and thus variations are expected in expressing your agreement or disagreement. I encourage you to express those variations in your beliefs.
This information will remain confidential and would not be shared with anyone, except presented as an aggregated data report. Please be frank and choose your answer honestly.

Strongly disagree	Disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

To what extent, do you agree with the following on a scale of 1-7?

In health department, decisions are based on	Strongly disagree	Somewhat disagree	Disagree	Neither disagree nor agree	Agree	Somewhat agree	Strongly agree
D1. Personal liking	1	2	3	4	5	6	7
D2.Superiors' directives	1	2	3	4	5	6	7
D3.Evidence/facts	1	2	3	4	5	6	7
D4.Political interference	1	2	3	4	5	6	7
D5.Comparing data with strategic health objectives	1	2	3	4	5	6	7
D6.Health needs	1	2	3	4	5	6	7
D7.Considering costs	1	2	3	4	5	6	7

In health department, superiors	Strongly disagree	Somewhat disagree	Disagree	Neither disagree nor agree	Agree	Somewhat agree	Strongly agree
S1. Seek feedback from concerned persons	1	2	3	4	5	6	7
S2. Emphasise data quality in monthly reports	1	2	3	4	5	6	7
S3. Discuss conflicts openly to resolve them	1	2	3	4	5	6	7
S4. Seek feedback from concerned community	1	2	3	4	5	6	7
S5.Use HMIS data for setting targets and monitoring	1	2	3	4	5	6	7
S6. Check data quality at the facility and higher level regularly	1	2	3	4	5	6	7
S7. Provide regular feedback to their staff through regular report based on evidence	1	2	3	4	5	6	7
S8.Report on data accuracy regularly	1	2	3	4	5	6	7
In health department, staff							
P1. Are punctual	1	2	3	4	5	6	7
P2. Document their activities and keep records	1	2	3	4	5	6	7

P3. Feel committed in improving health status of target population	1	2	3	4	5	6	7
P4. Set appropriate and doable target of their performance	1	2	3	4	5	6	7
P5. Feel guilty for not accomplishing the set target/performance	1	2	3	4	5	6	7
P6. Are rewarded for good work	1	2	3	4	5	6	7

In health department, staff	Strongly disagree	Somewhat disagree	Disagree	Neither disagree nor agree	Agree	Somewhat agree	Strongly agree
P7. Use HMIS data for day to day management of the facility and district	1	2	3	4	5	6	7
P8. Display data for monitoring their set target	1	2	3	4	5	6	7
P9.Can gather to find the root cause(s) of the problem	1	2	3	4	5	6	7
P10.Can develop appropriate criteria for selecting intervention for a given problem	1	2	3	4	5	6	7
P11.Can develop appropriate outcomes for a particular intervention	1	2	3	4	5	6	7
P12.Can evaluate whether the targets or outcomes have been achieved	1	2	3	4	5	6	7
P13.Are empowered to make decisions	1	2	3	4	5	6	7
P14. Able to say no to superiors and colleagues for demands /decisions not supported by evidence	1	2	3	4	5	6	7
P15. Are made accountable for	1	2	3	4	5	6	7

poor performance							
P16.Use HMIS data for community education and mobilisation	1	2	3	4	5	6	7
P17. Admit mistakes for taking corrective actions	1	2	3	4	5	6	7
Personal							
BC1. Collecting information which is not used for decision making discourages me	1	2	3	4	5	6	7
BC2. Collecting information makes me feel bored	1	2	3	4	5	6	7
BC3. Collecting information is meaningful for me	1	2	3	4	5	6	7
BC4. Collecting information gives me the feeling that data is needed for monitoring facility performance	1	2	3	4	5	6	7
BC5. Collecting information give me the feeling that it is forced on me	1	2	3	4	5	6	7
BC6. Collecting information is appreciated by Co-workers and superiors	1	2	3	4	5	6	7

U1. Describe at least three reasons for collecting data on monthly basis on the followings:
U1A. Diseases
1.
2.
3.
U1B. Immunisation
1.
2.
3.
U1C. Why is population data of the target area needed?

1.

U2. Describe at least three ways of checking data quality.
1.
2.
3.

Dr. Akram, District Health Officer, read a recent district report which showed that the data quality was 40% and felt very disturbed by it. –I need to take actions" he said aloud. He paced back and forth thinking about his next steps to improve data quality. After sometime, he calmed down and wrote his action plan. Please describe how Dr. Akram defined the problem and what major activities Dr. Akram must have included in his action plan for improving data quality …

PSa. Definition of the problem
1.
PSb. Major activities
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SELF- EFFICACY
This part of the questionnaire is about your perceived confidence in performing tasks related to health information systems. High Confidence indicates that person could perform the task, while low confidence means room for improvement or training. I am interested in knowing how confident you feel in performing HMIS-related asks. Please be frank and rate your confidence honestly.

Please rate your confidence in percentages that you can accomplish the HMIS activities.

Rate your confidence for each situation with a percentage from the following scale

0 10 20 30 40 50 60 70 80 90 100

SE1. I can check data accuracy	0	10	20	30	40	50	60	70	80	90	100
SE2.I can calculate percentage/rates correctly	0	10	20	30	40	50	60	70	80	90	100
SE3.I can plot data by months or years	0	10	20	30	40	50	60	70	80	90	100
SE4.I can compute trend from bar charts	0	10	20	30	40	50	60	70	80	90	100
SE5.I can explain findings and their implications	0	10	20	30	40	50	60	70	80	90	100
SE6.I can use data for identifying gaps and setting targets	0	10	20	30	40	50	60	70	80	90	100
SE7. I can use data for making various types of decisions and providing feedback	0	10	20	30	40	50	60	70	80	90	100

I would like you to solve these problems about calculating percentages, rates and plotting and interpreting information.

C1. The estimated number of pregnant mothers is 340. Antenatal clinics have registered 170 pregnant mothers. Calculate the percentage of pregnant mothers in the district attending antenatal clinics?

C2. The full immunisation coverage for 12-23 month-old children were found 60%, 50%, 30%, 40%, 40% for years 1997, 1998, 1999, 2000, and 2001 respectively.

C2a. Develop a bar chart for coverage percentage by years

C2b. Explain the findings of bar chart

C2c. Did you find a trend in the data? If yes or no, explain reason for your answer

2d. Provide at least one use of above chart finding at:

UD1. Facility level

UD2. District level

UD3. Policy level

UD4. Community level

C3. A survey in a district found 500 children under five years old that were malnourished. The total population of children less than five years old was 5000. What is the malnutrition rate?

C4. If the malnutrition rate in children less than 2 years old was 20% and the number of total children less than 2 years old was 10,000, then calculate number of children who are malnourished.

THANK YOU

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