

Guidelines for **Data Management Standards** in Routine Health Information Systems

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Guidelines for Data Management Standards

in Routine Health Information Systems



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ACRONYMS

AFRO	World Health Organization African Regional Office
ANC	antenatal care
API	application programming interface
CDC	United States Centers for Disease Control and Prevention
CHIS	community health information system
CHW	community health worker
CPPMU	Central Planning and Project Monitoring Unit
CRDM	collaborative requirements development methodology
CSA	Central Statistics Agency - Ethiopia
DANIDA	Danish International Development Agency
DHIMS	District Health Information Management System
DHIS	district health information system
DHMT	district health management team
DIO	district information officer
DOTS	directly observed therapy, short course
DQA	data quality assessments
DSS	decision support system
EHR	electronic health record
EPI	Expanded Program on Immunization
FAQ	frequently asked questions
FMOH	federal ministry of health
FP	family planning
FTP	file transfer protocol
GDDS	World Bank General Data Dissemination System
GIS	geographic information system
GPS	global positioning system
HEW	health extension worker
HIS	health information systems
HMIS	health management information system
HMN	Health Metrics Network

HRH	human resources for health
HSDP	Health Sector Development Plan
ICD	International Classification of Diseases
ICT	information and communication technology
IMR	indicator and measurement registry
INASA	Instituto Nacional da Saúde Pública
IT	information technology
JSI	John Snow, Inc.
M&E	monitoring and evaluation
MAT	Management Assessment Tool
MDG	Millennium Development Goals
MED	Monitoring and Evaluation Directorate
MMEC	Ministerial Monitoring and Evaluation Committee
MOH	ministry of health
MS	Microsoft
NAC	National Advisory Committee
NAFDAC	National Agency for Food and Drug Administration and Control
NGO	nongovernmental organization
NHRM	National Rural Health Mission
NIMES	National Integrated Monitoring and Evaluation System
OBAT	Organizational and Behavioral Assessment Tool
OPD	outpatient department
OS	operating system
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PDA	personal data assistants
PEPFAR	United States President's Emergency Plan for AIDS Relief
PHC	primary health care
PMTCT	prevention of mother-to-child transmission [of HIV]
PNC	postnatal care
PRISM	performance of routine information system management
RDQA	routine data quality assessment
RHIS	routine health information system

SDMX	Statistical Data and Metadata Exchange
SMART	specific, <u>m</u> measurable, <u>a</u> agreed-upon, <u>r</u> realistic, <u>t</u> time-bound
SNNPR	Southern Nations Nationalities and Peoples Region
SOP	standard operating procedure
STI	sexually transmitted infections
SWOT	<u>s</u> trengths, <u>w</u> weaknesses, <u>o</u> pportunities, and <u>t</u> hreats
TB	tuberculosis
TWG	technical working groups
USAID	United States Agency for International Development
WAHO	Western African Health Organization
WHO	World Health Organization

Introduction

The regular use of reliable information from a well-designed routine health information system (RHIS) is indispensable for ensuring and sustaining improvements in health system performance. Using reliable information from RHIS over time is an important aid to improving health outcomes, tackling disparities, enhancing efficiency, and fostering innovation. In the work of the Commission on Information and Accountability for Women's and Children's Health, the United Nations underscored the essential role of routinely available information in accelerating progress toward the United Nations' Millennium Development Goals (MDGs).¹

In 2005, the Health Metrics Network (HMN) of the World Health Organization (WHO) introduced standards and guidelines for strengthening country health information systems (HIS),² catalyzing the use of a common HIS framework and strengthening approach in more than 85 countries over the last decade. Until this point, efforts to strengthen country HIS have been fragmented, largely uncoordinated, and duplicative, and have at times hampered countries' ability to collect data and use it to inform decisions. In addition, in the absence of standards for HIS software application design, donors and countries have developed a plethora of program-specific information and communication technology (ICT) solutions—all parallel, nonintegrated, and non-interoperable. A 2009 WHO HMN analysis of self-reported HIS assessment scores of 61 low-income countries found that data management was by far the weakest component of country HIS in all regions of the world.³ This is particularly true for facility- and community-based RHIS, as shown by a 2013 study on data quality and use in 23 countries.⁴

An RHIS is only as useful as its data management component is sound—and only as useful as its ability to produce relevant information products for routine dissemination and use is strong. When its ability to output pertinent reports is well-developed, HIS are better positioned to systematically and consistently convert data into usable information for decision making. A myriad of field experiences on data management, information products, and dissemination and use of information for decision making now

¹ World Health Organization. *Accountability Commission for Health of Women and Children*. Geneva, Switzerland: World Health Organization; 2013. Available at http://www.who.int/topics/millennium_development_goals/accountability_commission/en/.

² Health Metrics Network, *Framework and Standards for Country Health Information Systems*, 2nd ed. Geneva, Switzerland: World Health Organization, 2008. Available at http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf.

³ Health Metrics Network. *Country Health Information Systems Assessments: Overview and Lessons Learned, Working Paper 3* Geneva Switzerland:World Health Organization; 2012. Available at: http://www.who.int/healthmetrics/resources/Working_Paper_3_HMN_Lessons_Learned.pdf.

⁴ Belay H, Lippeveld T. *Inventory of PRISM Framework and Tools: Application of PRISM Tools and Interventions for Strengthening Routine Health Information System Performance*. Chapel Hill, NC: MEASURE Evaluation; 2013. Available at: <http://www.cpc.unc.edu/measure/publications/wp-13-138>.

offer a useful opportunity to study and harness new insights and learning and to forge a common approach in this area.

This document proposes standards on data management for RHIS, based on the results of an expert workshop, held in Johannesburg, South Africa, in May 2012. RHIS is a subsystem of HIS, devoted to routine reporting of health sector service statistics (e.g., monthly) for management, planning, and evaluation. (Other HIS subsystems include census, civil registration, population surveys, individual records, and resource records.) In the context of RHIS, *data management* comprises the development, execution, and supervision of plans, policies, programs, and practices that control, protect, deliver, and enhance the value of data and information assets for decision making. These guidelines are based on field experiences from all over the world and are considered “standards” or, at a minimum, “best practices.” Wherever possible, they are illustrated by case studies or use cases. Being focused on data management standards and the RHIS (as a component of the larger HIS), these guidelines build on previous efforts (e.g., the Health Metrics Network *Framework and Standards for Country Health Information Systems*, 2005)⁵ to define standards for HIS reform.

It is expected that these guidelines will be adopted by countries and used to strengthen their RHIS. In particular, a common approach to RHIS data management is likely to improve interoperability of RHIS within and among countries and to increase involvement of local health workers in improving governance of locally owned and relevant HIS.

Four Themes

The guidelines have been structured around four themes:

Users’ Data and Decision Support Needs

Chapter 1 looks at defining RHIS user information needs and identifying a core indicator set for the RHIS. The text describes how to classify and operationalize indicators with formal definitions and how to set targets for indicators. It also covers RHIS data sources, including population data, and how to make estimates of facility and district catchment populations.

Data Collection Processing, Analysis and Dissemination of Information

Chapter 2 looks at collecting data with a variety of paper-based tools and electronic health records for community and clients (e.g., tickler files, registers, tally sheets). The text explores data transmission and data quality assurance processes, and data storage practices, including archives for paper records and servers; for

⁵ Health Metrics Network, 2008.

electronic data. Confidentiality for both paper and electronic systems is also covered. Finally, data analysis and dissemination best practices and tools are discussed.

Data Integration and Interoperability

Fragmentation of data is one of the greatest challenges to data management. Chapter 3 looks at what causes this problem and examines a stepwise approach to consolidate three dimensions of data management by integrating data collection and reporting tools and ensuring an integrated approach to data quality and analysis. The chapter also explores the mechanics of integration, presenting a decentralized information architecture model that integrates paper forms and electronic records, data standards, and computer software.

Governance of RHIS Data Management

Chapter 4 discusses best practices for RHIS management and oversight, from formal governance structures, including planning and financial structures and standard operating procedures (SOPs), to staffing and workforce management (e.g., training, supervision, and infrastructure management). The text speaks to policies and procedures for data management (e.g., regulatory authority, data governance councils, and metadata stewardship) and includes a discussion of RHIS monitoring and evaluation (e.g., via the toolkit for performance of routine information system management, or PRISM).

Three Management Levels

Throughout the document, we explore each theme using a health services system model with three management levels:

Beneficiary Management Level

Beneficiaries comprise patients and clients, including the community. We show how information is managed to benefit the health of individuals and groups of individuals via prevention, promotion, rehabilitation, and cure.

Health Facility Management Level

One purpose of managing information is to improve the functioning of the health facility (i.e., the dispensary, health post, health center, or hospital) to ensure adequate human, material, and financial resources—equipment, infrastructure, and organization—to provide services for the beneficiaries.

System Management Level

We also take a system-level look at the four themes, exploring the topics from district level and subnational levels (i.e., province, state, and region) through national and international levels. In covering system management, we look at inputs, processes, outputs, and outcomes, and occasionally measure impact.

Chapter 1. Users' Data and Decision Support Needs

RHIS is defined as the ongoing data collection of health status, health interventions, and health resources for decision making. It includes facility based service statistics, epidemiological and surveillance data, community-based health information, and health administration data (e.g. on revenue and costs, drugs, personnel, training, research, and documentation).

This chapter outlines the steps to be taken to identify and operationalize a core indicator set based on the information needs at all levels, describes the necessary components of a metadata dictionary that contains the definitions of data elements and indicators, and identifies their sources, reporting frequencies, and levels of use for monitoring achievement of targets and appropriate actions to take.

Defining HIS users' data and support needs is the starting point for RHIS design and management.

The chapter closes with a look at some of the challenges to data use—evidence-based planning and decision making, RHIS budgeting, and vertical programs.

You will learn about the following in this chapter:

- What is information culture and data demand?
- How to define information needs.
- How to define indicators for the RHIS.
- Why a core set of standard indicators are needed for a functioning RHIS.
- What data sources are available and the strengths and weaknesses of each.
- Elements of good targets for each indicator and why they are important.

Fostering an Information Culture and Demand for Data

The most visible outcome of a successful information culture is that information is in demand, valued as an important resource, and used at all levels to improve service delivery to clients and to strengthen facility management and management of systems at that level.

BENEFICIARY-LEVEL USE

Clinical practitioners need clinical data on a daily basis during ward rounds and use local laboratory and other diagnostic data to monitor patients' clinical improvement. They particularly need data to follow up on patients with significant needs, such as pregnant women, children under five, and patients with chronic infectious diseases and chronic noncommunicable diseases.

FACILITY-LEVEL USE

Facilities managers regularly need data to improve facility infrastructure, equipment, and human resources. They need to know norms for infrastructure and basic service packages and staffing and equipment standards, and then calculate indicators that will give them a picture of the resources required for their service areas.

SYSTEMS-LEVEL USE

From district level up to national level, system managers need data to monitor and plan for health service delivery: data on health status, on services provided, and on management of resources such as personnel, equipment, supplies, transport, drugs and vaccines, and finances.

Well-designed data management systems, combined with appropriate skills, adequate local resources, and effective standard operating procedures (SOPs), are the most important factors in ensuring information use. If the system is designed primarily to support district-level decision making and if some of this data flows up collaterally, then there is a high chance that data quality will consistently improve and that data will be used effectively for informed decision making.

The more data is used at lower levels, the better the quality of the entire HIS.

The health system's organization is intimately linked to information demand. The more that decision making and funding are decentralized, the better the chance that information will be in demand and used at lower levels to improve service delivery. Moreover, decentralized capacity and resources for decision making, combined with increased granularity of data and availability of user-friendly analysis and display tools, enhance the quality of decision making at all levels.

Indicators

Indicators are defined as “variables that help to measure changes, directly or indirectly.”⁶ Crafting useful indicators is at the center of the process of monitoring health services and systems and is one of the most important skills required in RHIS design.

Look for better indicators, not more indicators.

⁶ World Health Organization, *Managerial Process for National Health Development*, [57-60]. Geneva, Switzerland: World Health Organization, 1981.

Through a single measure, a good indicator provides information about a broad range of conditions and enables institutions to compare themselves to others doing similar work. Indicators are decision makers' most important tools for converting raw data into information for management, when they want to:

- monitor progress toward targets and to measure changes over time;
- relate raw data to standardized populations;
- enable comparison among and within different levels of the health system; or
- communicate how numbers compare, based on the same size of population or staff.

With the increasing emphasis on monitoring and evaluation (M&E), there is a proliferation of indicators, which often lack harmonization and increase workload without improving management. To reduce the burden of data management to health system staff, the number of indicators should be kept to a minimum and should be restricted to those needed for the decisions that are routinely made at a particular level.

CORE INDICATOR SET

A parsimonious set of broadly agreed indicators is the basic tool for countries and subnational areas to promote the shift from a data-led to an information-led information system—the foundation of evidence-based decision making. Each country should have a core indicator set for both national planning and M&E of priority programs as well as for lower-level management of clients, facilities, and systems. The indicator set should target all major attributes of the health system to end up with a well-balanced set of indicators that will provide complete, concise information on important aspects of the health system—health determinants, health systems, and health status—and that will be linked to the broader national statistics strategy.

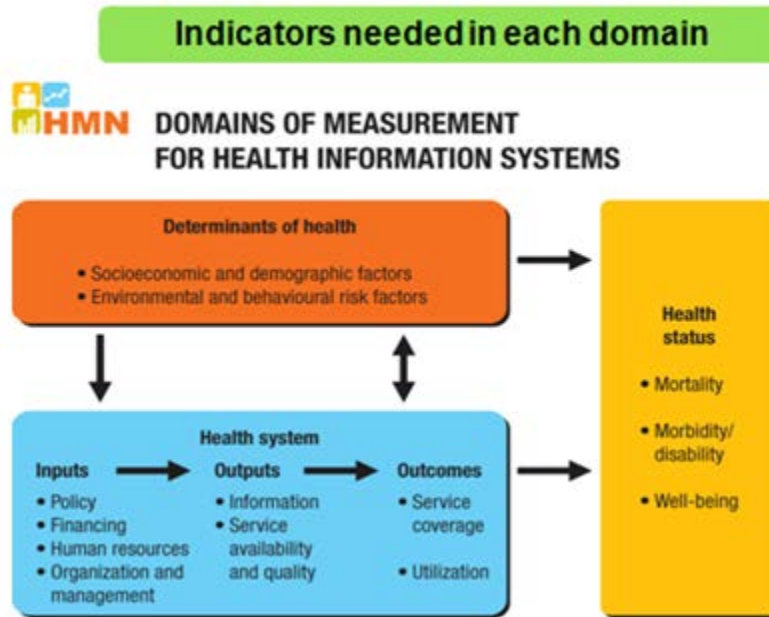


Figure 1. Domain for health indicators.⁷

A compendium of standards and measurement issues for 40 indicators has been produced by WHO⁸ and at regional level by the West African Health Organization (WAHO). Other models are the well-established national indicator data set in South Africa⁹ and the District Health Information System (DHIS) software,¹⁰ which contains a standard dictionary of data elements and indicators.

DEFINING INFORMATION NEEDS AND INDICATORS

All data collected by the RHIS should directly relate to indicators selected to monitor efforts to improve health system performance. Data for the core indicator set is therefore based on the national essential health service package and defined by the decisions that managers are able to make at their particular levels. The methodology described below¹¹ is based on using information to support management and decision-making processes at all three management levels of the health system:

- beneficiary management level (i.e., patients and clients, including the community);
- health facility management level; and

⁷ Health Metrics Network, 2008.

⁸ World Health Organization, *World Health Statistics 2013*. Geneva, Switzerland: World Health Organization; 2013. Available at http://www.who.int/gho/publications/world_health_statistics/2013/en/.

⁹ Department of Health. *District Health Management Information System (DHMIS) Policy*. Pretoria, South Africa: South Africa Department of Health; 2011. Available at <http://www.doh.gov.za/docs/policy/2012/dhmis.pdf>.

¹⁰ The Health Information Systems Programme [webpage], www.hisp.org.

¹¹ Bodart C Shrestha LB. Identifying Information Needs and Indicators. In *Design and Implementation of Health Information Systems*. Eds: Lippeveld T, Sauerborn R, Bodart C. Geneva, Switzerland: World Health Organization; 2000:49-72. Available at http://rhinonet.org/files/2013/06/hmis_chapter01_02_14_planning.pdf.

- system management level, from district and subnational levels (i.e., province, state, and region) up to national and international levels.

Step 1: A Functional Analysis of Management

Defining information needs starts with a participative analysis of management functions and decision-making processes (i.e., business process analysis) of all levels of the health system. The analysis should include both individual client care and essential public health functions for institution and system management.^{12,13}



This analysis could be organized in workshops, with participants, representing users from all management levels, reviewing day-to-day functions and identifying the management decisions they make regularly.

These decisions would then be reviewed to determine the information required to inform the decision. The analysis should take into account:

- priority health problems and national goals and strategies addressing them in national health policies and strategic plans;
- the essential package of health services defined for prevention, promotion, and management of these priority problems;
- health resources (e.g., manpower, materials, and money) available for carrying out these essential services;
- management processes to plan, monitor, and control the services and resources; and
- existing indicators and their current use in management and M&E.

Step 2: Identify Information Needs and Select Indicators

After priority services and available resources have been defined, it is possible to identify the information that would be relevant to managing and monitoring RHIS functioning.

Based on these information needs and an evaluation of existing indicators' use, a limited number of additional indicators can be developed or adapted. These additions should be based on indicators' reliability, validity, specificity, and sensitivity, as well as on the resources needed to collect the data and the decisions that could be based on the indicators.

¹² Lippeveld T, Sauerborn R. A Framework for Designing Health Information Systems. In *Design and Implementation of Health Information Systems*. Eds.: Lippeveld, T, Sauerborn, R, Bodart C. Geneva, Switzerland: World Health Organization; 2000:15-32. Available at: http://rhinonet.org/files/2013/06/hmis_chapter01_02_14_planning.pdf.

¹³ Health Metrics Network, 2012.

HIS Institutional Assessment in Kenya

Kenya's Ministry of Health has been moving forward with an HIS strengthening program since 2005. In 2012 and 2013, the initiative has taken a much broader approach, to include technology, knowledge management, and organizational development. This broadening of the work was informed by the fact that RHIS weaknesses were multifactorial. The need to include organizational development interventions was informed by the national need for a national integrated HIS that met all stakeholders' data and information needs, a system to which all health actors could report and that would thus resolve the problematic and longstanding proliferation of disease-specific and donor-specific reporting systems. Further, Kenya is implementing a new constitution that proclaims a devolved (i.e., decentralized) system of organizing government. Thus, the health sector, like all others, is in the process of working out possible new configurations to support service delivery and management.

AfyaInfo, funded by the U.S. Agency for International Development (USAID), which supports Kenya to achieve the HIS-strengthening strategic objectives described above, has been working with the Kenya Ministry of Health to assess HIS organizational capabilities in management of its HIS mandate, functions, and responsibilities.

Objectives

- Clarify and propose national and subnational governments' functional mandate in HIS management in line with relevant Kenya government legislation and MOH position papers.
- Identify institutional capacity gaps in the new HIS operating environment.
- Develop an institutional capacity building plan to address the gaps.

Proposed Process

STEP	TASK	TIMELINE
1.	Finalize the concept and scope of institutional review.	Jan/Feb
2.	Desk audit of existing documents.	Feb/Mar
3.	Communicate with target audiences.	Mar/Apr
4.	Workshop to clarify and propose the optimal HIS structure and capacity in a devolved system.	Apr
5.	Develop data collection tools.	Apr/May
6.	Engage and orient data collectors.	Jun/July
7.	Pilot test data collection.	Aug
8.	Collect and analyze data.	Sept/Oct
9.	Present preliminary findings.	Nov
10.	Finalize report.	Dec

Defining information needs according to this methodology will develop a RHIS that will be proactive, dynamic, and action-oriented.

It is an iterative process—at any step, previous steps can be revisited and indicators revised and used either to identify new indicators or to revise an existing list. The final indicator set should be balanced and economical, improving the quality of routine data and defining indicators that are operationally feasible and that will meet national needs. These indicators should then be rigorously field tested and regularly reviewed.

Ethiopia — an Evolving Health Management Information System

A health management information system (HMIS) is a dynamic system that evolves with evolving and emerging needs in the health sector. However, if the evolution takes an erratic path, the HMIS can grow into a system overburdened with data, with overgrowth of several parallel data collection and reporting systems and inclusion of data items that are of limited utility or of interest to a limited audience or for a limited purpose and time. This was the situation of routine health information in Ethiopia before 2006. Health centers reported more than 400 data items every month — district health offices more than 500. Moreover, data was inconsistently defined across the nation's 11 regions. Most importantly, the routine information system was not serving the information needs for the monitoring of the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) or the Health Sector Development Program (HSDP III) or the Millennium Development Goals. In 2007, the Federal Ministry of Health (FMOH) embarked on HMIS reform. Basic principles set were:

- Standardization of indicators/data definitions throughout the health sector and standardization of the data collection and reporting instruments.
- Integration into a single source of data collection and a single channel of reporting.
- Simplification of the RHIS to limit the data items to those required for reporting HSDP III indicators and disease conditions relevant to Ethiopia.

HMIS indicator selection entailed systematic consensus building among various departments and programs of the health ministry, regional health bureaus, health institutions, and development partners. One hundred eight indicators were selected — broadly relating to family health, disease prevention and control, resources, and health service coverage and utilization — and health centers were required to report on only 150 data items. These 108 indicators addressed all the health system's major programs and administrative areas.

Efforts to scale up the reformed HMIS began in 2009. By 2011, it was obvious that further HMIS evolution was needed, as a result of changes in priorities and focus of HSDP IV (2011–2015). Only 69 percent of HSDP IV indicators could be monitored using the current reformed HMIS. New initiatives and programs were focusing on multidrug-resistant tuberculosis (MDR TB) and on pneumococcal and rotavirus vaccines, for instance; various program strategies such as nutritional services, treatment regimens for HIV and AIDS, and programs for prevention of mother-to-child transmission of HIV (PMTCT) have undergone significant modifications; emphasis on monitoring hospital key performance indicators and monitoring quality of health services has expanded. As a result, the FMOH has begun to launch yet another HMIS revision, with the goal of keeping the nation's HMIS fully abreast of changes in the health sector's emerging and changing data needs.

SYSTEMS CLASSIFICATION OF INDICATORS

Indicators are extensively used to monitor and evaluate plans and must be closely aligned to the planning process. A common systems-based typology used throughout these guidelines distinguishes five classes of indicators — input, process, output, outcome, and impact — based on a logical planning framework in which inputs eventually lead to outcomes:

An indicator is only as good as the action it provokes.

Table 1. Indicators Classified by Systems, with Examples for Delivery Services

SYSTEMS COMPONENT	DESCRIPTION	EXAMPLE (FOR DELIVERY)
Input	Resources needed to carry out the activities.	Delivery equipment, drugs, trained staff.
Process	Activities that are carried out.	Interventions during the three stages of labor.
Output	Results of activities, including coverage, knowledge, attitude, and behavioral changes.	Institutional delivery coverage. Skilled birth attendance rate. Emergency obstetric care coverage.
Outcome	Long-term developmental effects.	Morbidity and mortality from obstetrical complications.
Impact	Health status of the population.	Maternal mortality ratio.

The need for different classes of indicators varies with the level of management and, hence, the management functions.

- *National Indicators:* These are mainly from the outcome and impact classes, focusing on policy, planning, and priority setting while relying largely on survey data. They measure progress in national health sector strategic plans, national health policy frameworks, and other planning initiatives.
- *State/Provincial Level Indicators:* These monitor mainly system strengthening and resource allocation, informed by program indicators of service coverage and utilization.
- *District-Level Indicators:* The most important indicators, these monitor facility and system management as well as program implementation. They inform facilities' planning, management, and supervision and local resource allocation.
- *Facility-Level Indicators:* Mainly process and output indicators, these focus on beneficiary and facility management and on using available resources with maximum efficiency and effectiveness. At this level, because of challenges of denominator data, coverage estimates are less reliable, but the raw data can be used to measure trends.
- *MDGs:* Focusing on outcome and impact, these set an excellent international example for countries, with 19 clearly defined and agreed indicators aligned to SMART targets monitoring three health-related goals. MDGs inform the international health debate and help set donor priorities and sensitize the international community on global health issues.¹⁴

¹⁴ Millennium Development Goals. Available at: <http://unstats.un.org/unsd/mdg/Host.aspx?Content=Indicators/OfficialList.htm>

Data needs are different at different levels, and it is important to note that, although not all data should be reported upwards, lower levels need to collect and report all data necessary for higher levels. There is a hierarchy of indicators, which are used differently at every level of the system, depending on management functions (figure 2).

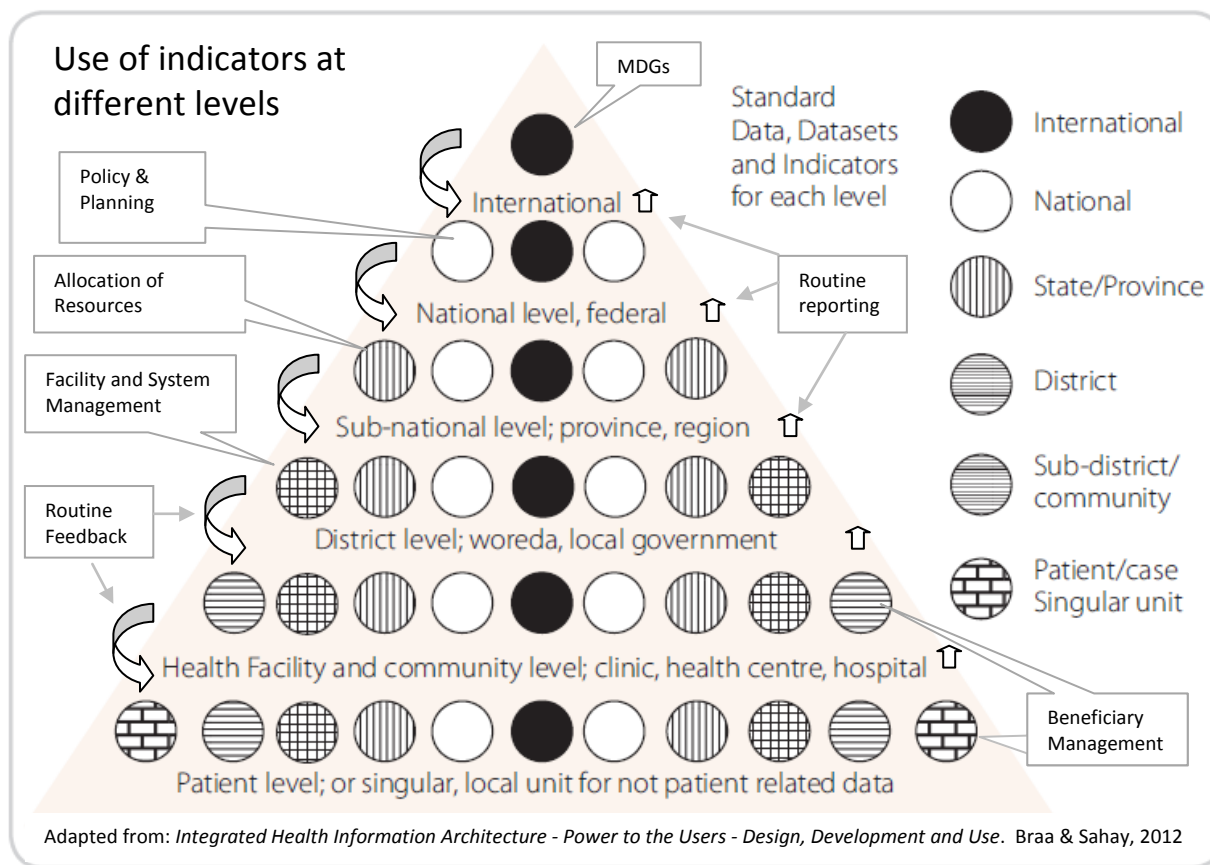


Figure 2. Use of indicators at different levels.

Operationalizing Indicators

Indicators need to be operationalized before they are used. Operationalizing indicators requires a *metadata dictionary* of data about data, which clearly defines basic criteria for each data element and indicator. Such clear definitions are essential for HIS standardization and to ensure comparability of data among facilities, districts, provinces, and countries.

OPERATIONALIZING INDICATORS

- Data definitions.
- Data sources.
- Reporting frequency.
- Targets.
- Indicator reference sheets.

DATA DEFINITIONS

It is essential to standardize definitions of individual data elements and indicators, applying international standards as feasible. This is always difficult, and obtaining consensus from a number of experts, each with strong opinions, requires patience, tact, and determination.

ICD-10 is the tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD), a WHO medical classification list that codes diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases.^{15,16}

The Eritrea National Health Information System uses ICD-10 codes for the collection of data for cases of 431 inpatient and outpatient diseases. The number of cases and deaths for these diseases seen are reported monthly using the codes.

Table 2. Representative ICD Codes in Eritrea

DIAGNOSIS	ICD CODE
Cholera	001
Typhoid/paratyphoid fever	002
Salmonella (food poisoning)	002.0
Food poisoning (bacterial, nonsalmonella)	002.1
Shigellosis	003
Amoebiasis	004
Acute amoebic dysenteries	004.0
Chronic intestinal amoebiasis	004.1
Diarrhea with dehydration	005
Other protozoal infectious disease	006
Balantidiasis	006.0
Giardiasis	006.1
Coccidiosis	006.2
Intestinal trichomoniasis	006.3
Respiratory TB	007
Other TB	008
Plague	009
Brucellosis	010

¹⁵ Programmes and Projects, World Health Organization, International Classification of Diseases (ICD), 2013, <http://www.who.int/classifications/icd/en/>.

¹⁶ World Health Organization ICD-10 Version 2010 (International Statistical Classification of Diseases and Related Health Problems, 10th revision), <http://apps.who.int/classifications/icd10/browse/2010/en>.

For more in-depth analysis, Eritrea also maintains a list of 86 *major diseases*. The list uses a group of ICD codes to analyze cases and deaths from these diseases. For instance, malarial diseases are collected as eight ICD codes, which are combined for a further analysis of “malaria: all cases.”

There is a strong push for all diseases to be coded according to ICD-10 codes to ensure international standardization. However, many data elements and indicators that describe public health interventions do not have a system of international coding.

MALARIA ICD-10 SUBCATEGORIES, ERITRIA	
IDC CODE	SUBJECT
043	Malaria clinical
043.0	Falciparum malaria
043.1	Vivax malaria
043.4	Mixed malaria
043.3	Ovale malaria
043.2	Malariae malaria
043.5	Malaria with pregnancy
043.6	Severe malaria with anemia

Although coding is not standardized for many indicators, efforts are being made internationally to define core sets of indicators for health programs. WHO has recently begun developing an indicator registry, the WHO Indicator and Measurement Registry (IMR),¹⁷ a central source of metadata of health-related indicators used by WHO and other organizations. It includes indicator definitions, data sources, methods of estimation, and other information that help users better understand their indicators of interest. It facilitates complete, well-structured indicator metadata, harmonization and management of indicator definitions and code lists, Internet access to indicator definitions, and consistency with other statistical domains.

Table 3. Service Delivery Data Definitions from South Africa

DATA FIELD	DEFINITIONS
Antenatal care: First visit.	A first visit by a pregnant woman to a health facility for the primary purpose of receiving antenatal care (ANC).
Antenatal care: Follow-up visit.	Any antenatal visit other than a first antenatal visit.
Antenatal care: tetanus toxoid third or booster dose.	The final tetanus toxoid dose given to a pregnant woman. Women who have proof of being fully immunized during a previous pregnancy need only a single booster.
Condoms distributed.	Condom given out or taken from distribution points in facilities or elsewhere.
Depo-Provera injection.	Depo-Provera/Petogen injection given to a woman between 15 and 45 years of age.
Facility visit for directly observed treatment–short course.	Visit for directly observed treatment–short course (DOTS), usually daily, by a diagnosed tuberculosis patient to receive medication.
Noristerat injection.	Any Noristerat injection given to a woman between 15 and 45 years of age.
Oral pill cycle distributed.	A packet (cycle) of oral contraceptives issued to a woman.
Primary health care headcount (under five and over five years).	All individual patients attending the facility during the period. Categories can include children under five and over five.
Primary health care nurse work days.	Work days by nurses, regardless of rank, performing services for primary health care (PHC) during the month.

¹⁷ World Health Organization, Global Health Observatory (GHO). *WHO Indicator Registry*. Geneva, Switzerland: World Health Organization; 2013. Available at: http://www.who.int/gho/indicator_registry/en/.

DATA SOURCES

For routine data indicators, the numerator should normally come from institutional data, while denominator data can come from the population census data or from the institutional sources (e.g., total births as denominator for calculating percentage of caesarean deliveries).

Figure 3 shows the major data sources both population based and institutionally based, with all coming together to support disease surveillance.

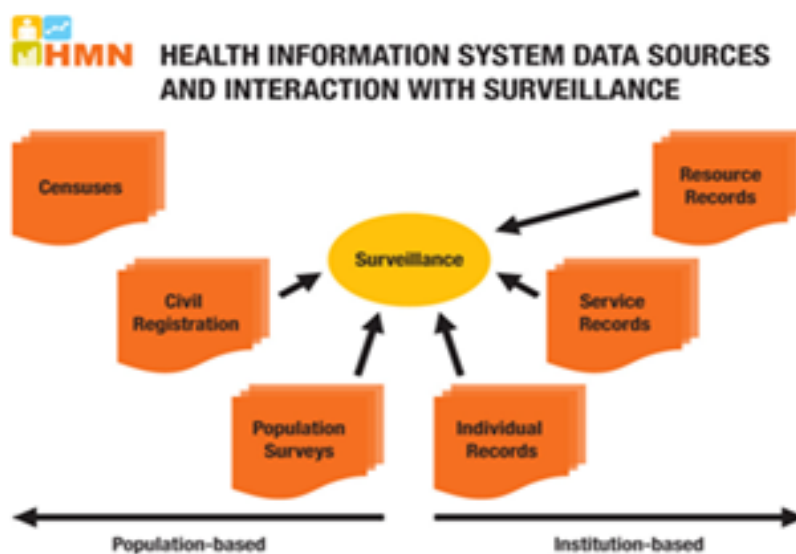


Figure 3. Health Metrics Network population- and institution-based data sources.

Data sources can be used on a routine or non-routine basis, but in general institution-based data is more routinely collected than the population-based data (e.g., surveys), and thus this manual emphasizes institution-based data (see introduction section).

Deficiencies in routine reporting are common, and efforts need to be made to improve data accuracy, completeness, timeliness, and consistency, as well as gaps in the routine system as a whole, rather than creating vertical, program-based information reporting. Gaps in data sources should be identified and addressed using alternative, low-cost, system-strengthening mechanisms—for example, regular data quality verification, annual health facility assessments, and record reviews.

A broader perspective promoted by HMN¹⁸, includes strengthening health research, improving vital registration, harmonizing health surveys, and strengthening facility-based reporting, as well as improving administrative data sources.

TARGET POPULATIONS

At all levels, and particularly at facility level, it is important to know how many people live in the catchment area and how many need health services. knowing your catchment area population allows you to calculate coverage for services. Indeed, the overall population in the catchment area is the denominator for overall use of services. It also is the basis to estimate subgroups at risk for service coverage based on standard percentage-specific data to each country or even to each region in the country. Yet these data are usually unavailable, or if available, are inaccurate. Incorrect coverage indicators are often the result — the denominator is wrong!

Census
is the benchmark
for population
denominators

Census

The census, usually undertaken every 10 years, is the national gold standard, the population survey by which all other population estimates are calculated.¹⁹ In situations where recent census data are not available, population estimates from other sources can be used, such as:

U.S. Census

www.census.gov

United Nations World Population Prospects

<http://esa.un.org/wpp/index.htm>

The AfriPop Project

www.afripop.org

¹⁸ See Health Metrics Network, 2008, for a further explanation of data sources; Available at http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf.

¹⁹ United Nations Department of Economic and Social Affairs, Population Division, Population Estimates and Projections Section. World World Population Prospects: The 2010 Revision, Frequently Asked Questions [webpage]. Available at <http://esa.un.org/wpp/other-information/faq.htm>.

Census and population estimates often contain useful data on age, gender, occupation, and economic status of the populations served by health facilities; census data provides the population figures that government ministries use for national and subnational resource allocations.

Despite flaws, censuses are the only official population source for a country and must be used for all HIS calculations from district level on up. All demographic data projections used in HIS electronic information systems should be built on census projections, which are based in turn on population growth estimates, and adjusted to reflect the population at mid-year.

Estimating Facility Catchment Population²⁰

Although each facility should know the population it serves and where that population lives, facility staff are often unable to calculate that information without help, due to the overlap of adjacent health facility catchment areas. Often, people do not go to the facilities that are closest to their homes for a variety of reasons. For example:

- They go to the facility nearest to their work.
- They travel farther to ensure privacy from family or neighbors.
- Transportation routes may make another facility more accessible.
- Physical obstacles such as rivers and mountains may make a more distant facility easier to reach.

Getting accurate facility population data is an essential responsibility of the district management team. Working with facility staff, they can help derive catchment area population estimates and help ensure that the total of all the district's facility catchment populations is the same as the updated census population projection for the district.

FACILITY POPULATION DATA

- Census enumeration areas
- Proportion of headcount
- Estimation from mapping exercises or crude counts

There are a number of ways to estimate facility catchment population, and each has its advantages and disadvantages.

²⁰ The EQUITY Project. *Mapping for Primary Health Care, District Maps, Clinic Catchment Areas & Community Mapping in the Eastern Cape Province*, 2nd ed. Pretoria: South Africa: Department of Health, 2003. Available at http://pdf.usaid.gov/pdf_docs/pnacx655.pdf.

Census Enumeration Areas: When a census is conducted, the physical landscape is divided into small units called *enumeration areas*, each with 150 to 200 households, and all the people living in these areas are counted. These enumeration areas are added up to give locality, district, provincial, and national totals. The data can be made available on geographic information system (GIS) maps depicting enumeration areas with known populations, which can be identified to determine a facility's catchment area.

These computerized GIS maps, combined with facility attendance registers containing client addresses, enable planners, working with district and facility staff familiar with the area, to draw lines around villages (or *buffers*—a circle with a predetermined radius, say 5km, around the facility), known to be in the catchment area. From there, the total population served by the facility is calculated.

In this way, it is possible for each facility to identify specific communities and/or populations that come, or do not come, to the facility and understand the real use of the facility. Some populations outside the 5km circle use one facility, while others tend to go to another, as noted.

This approach, in conjunction with health facility mapping, permits a more accurate knowledge of a facility's catchment population. However, it requires GIS population data, computer skills, and direct knowledge of each village, and all three are often not available at state or provincial level.

Proportion of Headcount: At district or subdistrict-level, an estimate of the population served by each facility can be made—for example, by using the RHIS computer software—based on the proportion of the overall headcount coming to each facility in the district or subdistrict. Although this is a quick and easy method of apportioning population to health facilities, it often yields less-than-accurate results, due to differences in utilization rates across facilities, reflecting, for example, differences in types of services offered, perceptions of quality, or the availability of private sources of care.

For example, in a subdistrict with a population of 60,000, there are three health facilities and a mobile clinic, which together see 10,000 patients in a month. Clinic A sees 2,000, Clinic B sees 3,000, the health center sees 4,000, and the mobile clinic sees 1,000. With this information, you can calculate the population served by facility.

Table 4. Representative Facility Catchment Populations Based on Headcount.

FACILITY	OUTPATIENT DEPARTMENT HEADCOUNT	PROPORTION OF HEADCOUNT	POPULATION SERVED (% HEADCOUNT POPULATION)
Clinic A	2,000	20%	12,000
Clinic B	3,000	30%	18,000
Health Center	4,000	40%	24,000
Mobile Y	1,000	10%	6,000
Total	10,000	100%	60,000

Mapping Exercises or Crude Counts: Local authorities sometimes use house-to-house counting by community volunteers, known as *enumeration*, for surveys. It is a useful (if expensive) team-building and awareness-raising exercise to develop catchment area maps based on local knowledge and information recorded in clinic registers. Local estimates of clinic populations are often too high, since coverage is often divided between two or more clinics.

The development of catchment area maps helps orient clinic staff to the communities and the environment from which they draw patients. This orientation is particularly helpful when community members themselves participate in developing the map. When such a catchment area map is present on a clinic wall, it is a good indicator that the staff is “population oriented” and aware of who is depending on the facility for care.

DATA REPORTING

Most data collected at facilities should stay at the facility and should not be reported to higher levels. This includes most client and facility management data, which should be reported selectively and only in aggregate form.

Frequency of upward reporting should be based on the frequency of decision making and actions that managers and information users can actually take at higher levels.

Input and Output Indicators

These are reported according to frequency of health plan monitoring and use by program managers at different levels. For example:

- immediate (epidemic disease outbreaks)
- weekly (disease surveillance)
- monthly (financial, logistical and service delivery data)
- semiannual (human resource data)

- annual (data on health care delivery infrastructure).

Outcome Indicators

These may be reported annually or every two years nationally, or more frequently at implementation level.

Impact Indicators

- These indicators are complex, require large numbers to be accurate, do not change rapidly, and tend to be reported with a frequency relevant to the health strategic plan—that is, every three to five years.

TARGETS TO BE ACHIEVED

Institutionalized self-assessment of progress toward locally planned targets should be regular and systematic; workers at all levels of the health system should be involved in assessing:

- *Progress*: Movement toward achievement of local targets, health system goals, and MDGs.
- *Equity of Progress*: This is a particular consideration with regard to disadvantaged groups.
- *Efficiency of Resource Use*: The aim is to provide maximum benefit to the society for resources invested.
- *Contextual Changes*: Political changes and changes in security, the policy environment, leadership, and accountability are among the changes inside and outside of the health system that are relevant to it.

Each indicator needs to be related to relevant, well-documented targets; the targets should be “SMART”—that is, specific, measurable, agreed upon, realistic, and time-bound—and based on local ability to meet national and international targets. That ability will be determined by availability of funding and human resources and the capacity to convert these into measurable interventions.

For example, where the national measles coverage is 80 percent, some districts—well-resourced, urban districts—should achieve better than 90 percent coverage, while those that are poorly resourced and rural can realistically be expected to reach no more than 70 percent, or less.

SMART Targets

- Specific.
- Measurable.
- Agreed.
- Realistic.
- Time-bound.

INDICATOR REFERENCE SHEETS

Documentation of these operationalized indicators should be put together in an *indicator compendium*. For each indicator, an *indicator reference sheet* needs to be developed; it should include:

- A definition of the data elements.
- The data source.
- The frequency of reporting.

- The intended use of the indicator at various management levels.

For More Information

Indicator Reference Sheet

<http://usaidprojectstarter.org/content/pmp-performance-indicator-reference-sheet>

MEASURE Evaluation, Tools for Data Demand and Use (identifying routine decisions made by managers and decision calendar)

<http://www.cpc.unc.edu/measure/tools/data-demand-use/data-demand-and-use-strategies-and-tools.html>

MEASURE Evaluation, Monitoring and Evaluation Systems (developing good indicators)

<http://www.cpc.unc.edu/measure/tools/monitoring-evaluation-systems>

World Health Organization, International Classification of Diseases (ICD Coding)

<http://www.who.int/classifications/icd/en/>

From Lippeveld and colleagues (Lippeveld, Sauerborn & Bodart, 2000), Chapter 2: A Framework for Designing Health Information Systems, and Chapter 4: Identifying Information Needs and Indicators.

http://rhinonet.org/files/2013/06/hmis_chapter01_02_14_planning.pdf

Chapter Summary

This chapter discussed the following standards around data and decision support needs:

CULTURE OF INFORMATION

To make RHIS work, a culture of information is imperative, comprising:

- Commitment from the leadership.
- Creation of demand for information at all levels of the health system.
- The understanding that different levels of the RHIS have different kinds of data needs.

IDENTIFYING DATA NEEDS AND REPORTING PATTERNS

All data needs and reporting patterns should be identified during the development of the system.

- This should be based upon a participatory analysis of management functions and decision making processes at the three management levels of the health system.

CORE INDICATORS

RHIS need a core set of indicators that are uniform throughout the system.

- Although each level of the health system uses different data sources and will have different support needs, all are integral to a functioning RHIS.
- In creating the core set of indicators the following must be clear and agreed upon among all levels of the RHIS:
 - Indicators must be clearly defined.
 - Reasonable and varied data sources should be used.
 - Frequency of reporting, processing, and feedback (from input to impact) should be quantified.
 - Targets should be set with a view to system self-improvement (with a clearly articulated goal).
 - Indicator reference sheets should be developed for each indicator as part of an indicator compendium.

Chapter 2. Data Collection, Processing, Analysis and Dissemination of Information

Data are collected in two ways—routinely and non-routinely—and all national systems use both routinely and non-routinely collected data for planning and managing their health services. The choice of appropriate data collection methods is linked to frequency of decision making, and complexity and cost of data collection.

This chapter addresses health facility and community data collection, based on patient and client encounters, for ongoing program monitoring using input, process, and output indicators.

After data are collected, they need to be processed, checked for quality, and transmitted up to higher levels. At all levels, data need to be stored in a way that ensures confidentiality and that encourages regular analysis at local level and regular use to improve service delivery.

Once analyzed, data need to be disseminated to data collectors through feedback and, through modern web portals, to users—other health workers and managers, policy makers, and the international community.

You will learn about the following in this chapter:

- Methods of health facility and community-based data collection.
- How to report and transmit data.
- How to ensure data quality.
- How to ensure data confidentiality.
- How to analyze data.
- How to store data.
- How to disseminate data.

Overview of Data Collection Tools

The quality and usability of the data collected by routine information systems will depend substantially on the relevance, simplicity, and layout of the data collection tools. This section focuses on data collected from health facilities and communities via beneficiary record systems as well as by facility and community record systems.

Electronic health records are becoming increasingly common, and with advancing mobile, tablet, and computer technology, data collection will change very fast in the years to come. These new tools will provide significant advantages.

Beneficiary Record Systems

Patients and clients, the beneficiaries of the system, come to a facility in need of good-quality care with continuity. Data from beneficiaries comprises the majority of data collected at a health facility and needs to be kept to a minimum to reduce the burden of data management on health workers. Parsimony in data collecting requires careful design of data collection tools and reporting of only a minimum of data to the next level of the health system.

TYPES OF INFORMATION INCLUDED

Individual patient management data is potentially massive and includes:

- Name, address and other identifying data.
- Clinical diagnosis, results of laboratory and diagnostic tests.
- Drugs prescribed.
- Money paid.
- Health education and other information given to the patient on potential risks and plans for future care.
- Preventive activities undertaken, including ANC, postnatal care (PNC), and treatment as part of the expanded program on immunization (EPI).
- Promotive activities (e.g., behavior change communication and education on healthy lifestyle and nutrition).
- Rehabilitation (e.g., prostheses, nutrition rehabilitation, and physiotherapy).

DATA COLLECTION TOOLS

- Individual patient records (including electronic records).
- Family record cards.
- Tally sheets.
- Registers.
- Tickler files.
- Electronic systems.
- Mobile phones.

Most data is for local use and need not be reported to higher levels unless it is part of facility or system management.

FAMILY RECORD CARDS

Integration of data collection tools has been attempted for many years in such projects as Kasongo, Democratic Republic of Congo and Khanna, India to provide beneficiary continuity of care and to improve facility management.²¹ More recently, in 2010, health authorities in Ethiopia have created a family folder;

²¹ Lippeveld T. Routine Data Collection Methods in Lippeveld, Sauerborn & Bodart, 2000.

now, all information for an entire family is collected in one place, complete with individual record cards, providing a wealth of community information at household level.

The challenge remains how to integrate these data into facility records and to enter it into the database without overwhelming health staff with excessive data collection duties.

Ethiopian Family Folder — A Family-Centered Information System

Aragash is a health extension worker (HEW) in the Southern Nations Nationalities and Peoples Region (SNNPR), where John Snow, Inc. (JSI), is providing technical assistance to the regional health bureau to scale up the HMIS. Aragash and her fellow HEW, Zulfah, received training on community health information system (CHIS) by their supervisor. The centerpiece of CHIS is the family folder, which is issued to every household. Health records of individual family members are maintained on health cards and all are kept in the family folder. Aragash and Zulfah liked the simple, easy-to-follow guide in Amharic on how to implement the family folder. After their training, the first thing they did was to inform the *kebele* (Amharic “neighborhood”) administration of the importance and use of the family folders. Next, they trained four community health volunteers to help them with household numbering and collecting family data on the folder. The family data was later used to prepare a master family index—a village-wide list of the names of household heads arranged in alphabetical order. This is used to retrieve family folders from the shelf where all the family folders are filed serially according to the household number and village number.

Aragash believes that the quality of work has improved since the advent of the family folders. She thinks that the family folder is “family centered,” in that it shows all the services given to the family. “If I go out in the village for educational activities, any one of us can know in my absence the status of any individual coming to the health post for service,” said Aragash.

Aragash and Zulfah use the household numbers to plan for their field visits. Accordingly, they pick the family folders of eight to ten households to see during a given day. The family folders “help us to know the latrine status, water source, and so on, of the households we’re visiting and provide them with health education that’s appropriate to their situation.”

Aragash likes the tickler file system, which is also a part of the records system at her health post, because the tickler system helps her identify defaulters and quickly follow up. It works this way: She puts the health cards of the mothers who need follow-up in the boxes arranged according to the month when the follow-up should be done. In the tickler boxes, she puts the health cards of women who are receiving family planning services or ANC and of children getting their vaccines. Later every day, the health post team reviews the health cards in the current month’s box and plans follow-up accordingly.



One example of how the tickler file system helped HEWs to improve child immunization is from Dilla-Zurai District in SNNPR. Since the HEWs began using the system at 27 health posts in the district, they vaccinated 752 children in one month alone with the first dose of pentavalent vaccine and 986 children with their third dose. This was a considerable improvement from the previous three months, when only 275 infants received their first dose and 256 infants their third dose on average per month—a clear indication that not only children who were previously missed out got their shots but also those who had defaulted were brought back to complete their pentavalent vaccination.

Federal Ministry of Health
Family Folder for the Health Extension Program

Federal Ministry of Health

Region: _____ Woreda: _____ Kebele: _____ Gote: _____

Family number/House number _____ Date of first registration ____/____/____

Name of head of the family _____ Father _____ Grand father _____ TIN _____

Household members' description

Individual ID	Name	DOB	Place of Birth	Sex M/F	Occupation	Marital status S/M/D/W	Date died	Cause of death

Latrine

Latrine N / Y	Type	Date having latrine ____/____/____
------------------	------	---------------------------------------

Hand washing facility

Hand washing facility N / Y	Type	Date securing hand washing facility with soap/ash/sand ____/____/____
--------------------------------	------	--

Waste disposal system

Solid/liquid waste disposal system available N / Y	Solid <input type="checkbox"/>	Type	Date having waste disposal system ____/____/____
	Liquid <input type="checkbox"/>		

LLITN issued

ITN Issued Date	Number issued	Currently available enter date			
		Yes	No	Yes	No
____/____/____	____	____	____	____	____

Drinking water source

Drinking water source (type) _____

Figure 4. Ethiopia’s FMOH family folder.

INDIVIDUAL RECORD CARDS

All individual beneficiaries need a card or file in which to record the details of their interaction with the health service provider. This important document contains key patient identification details as well as diagnosis and treatment of all visits. Although some health authorities provide such a record for each patient, others record their information in a simple school copy book and still others enter data into an electronic database.

In case of a medico-legal dispute, the patient record is legally binding. Traditionally, these documents are kept at individual health facilities, but studies in many countries have shown that misfiling and loss of cards is a recurring problem and that these records are more secure in patients’ own hands. Therefore, many facilities are moving toward a patient-held record system that allows health staff to see the full history and treatments, regardless of where the client has been treated previously. It is the patient’s responsibility to produce the record at each visit as well as in the event that evidence is needed during a medico-legal dispute.

A variety of categories of individual patient records exist, defined by age group or disease category: the Road to Health card, the Child Health booklet, the Women’s Health book, the Chronic Disease card, the TB patient treatment card.

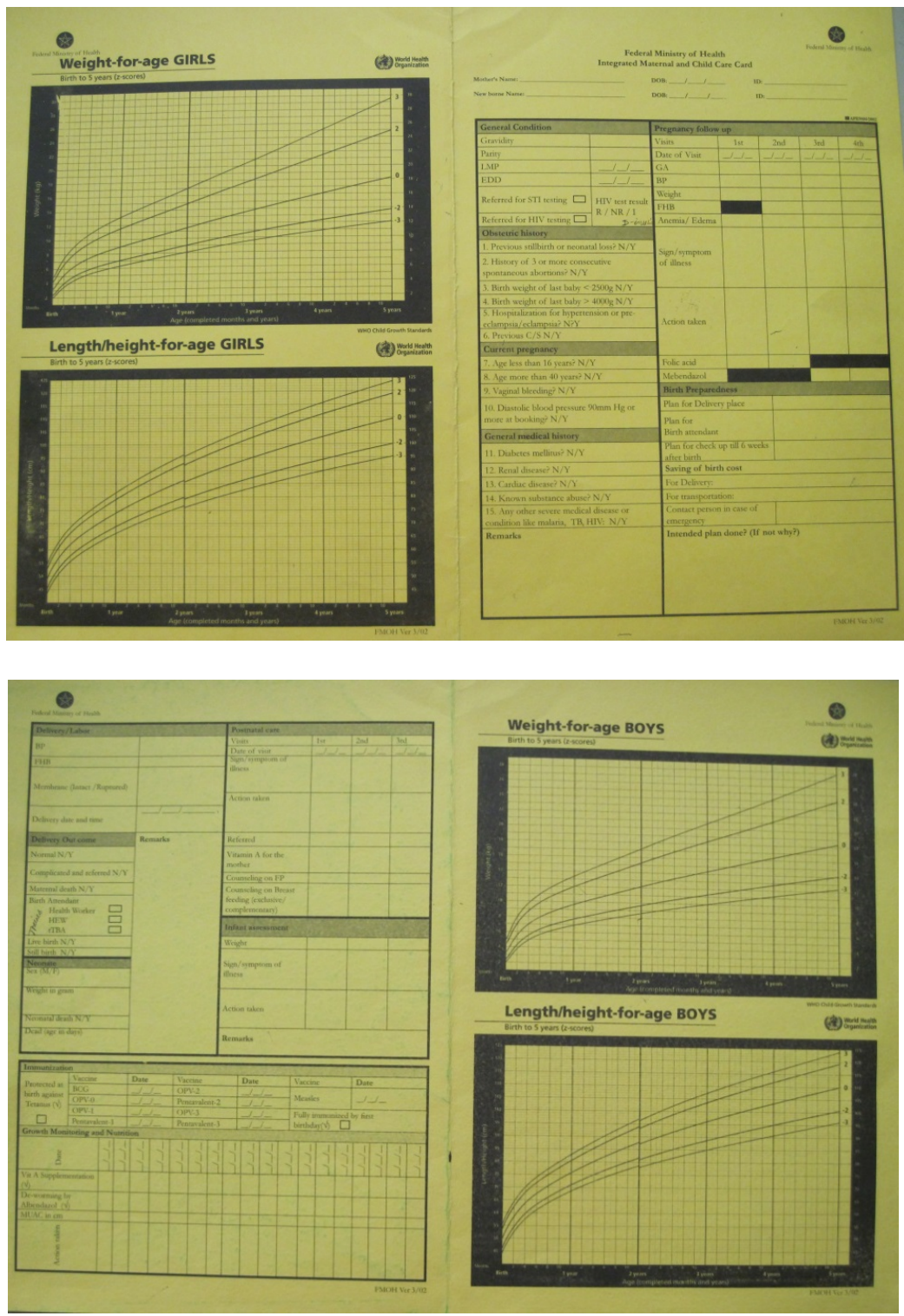


Figure 5. Representative patient-held card, Ethiopia Integrated MCH Card.

Tuberculosis Programme Form 4

Tuberculosis Identity Card

Name _____ BMU TB Register No. _____ Appointment dates: _____

Address _____ Date of registration: _____

Sex: M F Age _____ Date treatment start _____

Health facility: _____

Supporter (name and address) _____

Sputum smear microscopy				Weight (kg)
Month	Date	Lab No.	Result	
U				

Disease site (check one)
 Pulmonary Extrapulmonary, specify _____

Type of patient (check one)
 New Treatment after default
 Relapse Treatment after failure
 Transfer in Other specify _____

I. INITIAL PHASE
 CAI (I, II, III): (RHZE) S Other

Drugs and dosage:

II. CONTINUATION PHASE
 (RH) (RHE) Other

Drugs and dosage:

REMEMBER

Figure 6. Representative patient-held card, the TB Identity Card.²²

TICKLER FILE SYSTEM

Tickler file systems are a paper-based equivalent for managing patients' appointments and ensuring quality of care. For the most part, the system requires just two appointment boxes — one for months and one for days. A patient card is filed in the section for the next appointment due — the card is re-filed to the next appointment if the patient comes as planned, and if not the card remains, indicating the need for follow-up (e.g., a home visit or other contact). When electronic patient records are used, similar functionality should be available and are proving increasingly useful for programs that require continuity of care.

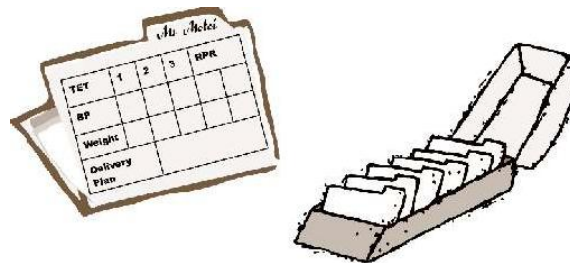


Figure 7. Tickler file system.

ELECTRONIC HEALTH RECORDS

RHIS in most low- and middle-income countries will be using paper-based systems for the foreseeable future, but the use of electronic health records (EHRs) for beneficiary data collection will become

²² World Health Organization (WHO). *Tuberculosis: The Revised TB Recording and Reporting Forms, Version 2006*. Geneva, Switzerland: WHO; nd. Available at http://www.who.int/tb/dots/r_and_r_forms/en/.

increasingly common over the next few years as technology improves and computers become increasingly available. Clinical care providers will increasingly collect beneficiary data using computers, mobile phones, and tablets to record data electronically. There are many potential advantages, provided the necessary resources and skills are available:

- Data is entered only once, saving staff much time and trouble.
- Such systems can help ensure continuity of care and can be used to remind clients and service providers to follow up.
- Electronic systems can improve quality of care by building in diagnostic algorithms and service provider support.
- Communication can be facilitated between different medical and administrative units.
- Coordination can be facilitated between clinical provider, pharmacies, and laboratory so that requests from clinicians can be acted on quickly and results can be fed back immediately.
- Electronic systems can provide health education to clients.
- Clinical care workers can enter diagnoses immediately, particularly for inpatients and when the diagnosis has been made at the hospital.
- Reduce the burden to health workers of completing data collection forms.
- Facilitate and speed up reporting processes for facility and system management.
- Directly link administrative functions such as billing and stock control to client care.

Assessing the Process of Designing and Implementing Electronic Health Records in a State-Wide Public Health System: the Case of Colima, Mexico

A case study assessed the design and implementation of an EHR in the Colima, Mexico, public health system, its perceived benefits and limitations, and recommendations for improving the implementation process. In-depth interviews and focus group discussions examined the experience of stakeholders participating in the EHR design and implementation. The program's main driving force was to improve reporting to two of the main government health and social development programs. Significant challenges included resistance by physicians to use the ICD-10 to code diagnoses; insufficient attention to recurrent resources needed to maintain the system; and pressure from federal programs to establish parallel information systems. The conclusion was that operating funds and, more importantly, political commitment would be required to ensure EHR sustainability in Colima.²³

However, EHRs still require advanced technology and networking skills and sophisticated management processes and maintenance that are often unavailable at remote facilities in developing countries. There is also the challenge of understanding and using the data collected, often worsened by the temptation to

²³ Hernández-Ávila JE, Palacio-Mejía LS, Lara-Esqueda A, Silvestre E, Agudelo-Botero M, Diana ML, Hotchkiss DR, Plaza B, Sanchez Parbul A. Case report: assessing the process of designing and implementing electronic health records in a statewide public health system: the case of Colima, Mexico. *J Am Med Info Assoc*. 2013. 20(2). Doi:10.1136/amiajn1-2012-000907.

increase the data volume and complexity collected electronically. Implementing EHRs requires skilled staff and resources for their training.

Facility Record Systems

REGISTERS

Registers are records of data that requires continuity, as for conditions that need follow-up over long periods, such as immunization, family planning (FP), ANC, TB, or chronic illnesses. The details kept in the registers are the minimum required to provide a summary of the care provided to the patient and to ensure follow-up (e.g., immunizations given, FP method administered, or TB or HIV treatment given). The register also facilitates compilation of indicators for periodic reporting: Data managers need only to flip through the register to aggregate services provided to clients, rather than accessing individual patient records.

(EHRs, where they are used, obviate the need for paper registers, as they can produce the same information contained in the register using only the individual patient records.)

Continuity is vitally involved with quality of care—far more than just the number of services provided might indicate. Most priority program areas require continuity and, for that reason, registers should be maintained so that a nurse can see at a glance which patients have attended clinics as expected and which need follow-up or tracing in the community. Regular review of registers facilitates identification of patients who must be actively pursued to ensure completion of immunization, timely continuation of contraception, full treatment of TB, or regular monitoring and control of blood pressure. The register below shows how continuity of care can be followed for a pregnant woman through ANC. Though paper registers are very helpful toward this end and for reporting, they are costly to produce and require effort to maintain effectively.

The FP register allows tracking continuity of clients even when using different contraceptives.

Serial No	Client No	Name	Parish	Phone No.	Age	ANC Visit (Circle)	Gravidity / Parity	Gestation age (w/ks)	EDD	Wt	Blood pressure	PMTCT Code		DIAGNOSIS /WHO STAGE/CD4 #	ARVs	Infant feeding option	TB status	Hb	Syp		Family Planning	T.T	IPT	ITN	Mebendazole	Iron / Folic acid		Other treatments	Referral in/out	Complications/ Risk Factors						
			Village	Alternate Phone No.								W	P						W	P						Fe	Folic									
						1.2.3.4+																														
						1.2.3.4+																														
						1.2.3.4+																														
						1.2.3.4+																														
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						1.2.3.4+																														

Figure 8. Uganda ANC register.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
CLIENT INFORMATION						AMOUNT OF CONTRACEPTIVE DISPENSED							OTHER FAMILY PLANING METHODS						OTHER SERVICES						
SERIAL NO.	CLIENT NO.	NEW USER	RE-ATT	FIRST VISIT OF THE YEAR	AGE	Lofemina	Overrette	Microgynon	Other Oral	Condom	IUD	Injectable	Other	Natural	vasectomy	Tubal Ligation	Implant New Users	Implant Revisits	Implant Removals	FP Counseling	HCT Code	ARVS	Cancer Cervix/Breast screening	Other services offered	Referral

Figure 9. Uganda family planning register.

TICK REGISTERS

Tick registers are an easy form of register in which predetermined columns assist health workers to mark important data items. PHC tick registers have been used successfully in South Africa and elsewhere for many years. In a tick register the health worker records the provision of service (e.g. a vaccination) by checking a predefined box in the appropriate space of the register to show one instance of the service being delivered.

A problem with most tick registers is that recording minor ailments wastes a great deal of space on the register. These are better recorded in a simple notebook or a tally sheet specifically for “minor ailments.”

TALLY SHEETS

Tally sheets are a middle ground between a case-based register and an aggregate reporting form and are an easy way of counting (tallying) data on conditions that do not require follow-up, such as head counts, minor ailments, children weighed, and the like. These data are collected to understand the frequency of a condition, the quantity of services provided, and are useful for planning.

Good computer software (e.g., the DHIS) can create customized tally sheets to enable easy capture of each service category listed on the monthly report. These automatically adjust the range of choices for services provided under each category based on a facility's usual service load (calculated by the computer from monthly reports for the previous year). Additionally, the tally sheet can be customized to contain only categories seen by a clinician providing a certain type of service.

Clinic managers should define tally sheets customized for the service mix and work patterns of their own clinics to make data capture easier, quicker, and more accurate.

Daily Tally Sheet

For recording immunization and children protected at birth against neonatal tetanus

Health center: _____ Date: _____

	Children under one year of age	TOTAL	Children over one year of age	TOTAL
BCG				
OPV 0				
OPV 1				
OPV 2				
OPV 3				
DPT 1				
DPT 2				
DPT 3				
Measles				
Hib 1				
Hib 2				
Hib 3				
Hep 1				
Hep 2				
Hep 3				
Women of childbearing age				
	Pregnant	Total	Non-pregnant	Total
TT1				
TT2				
TT3				
TT4				
TT5				
Children protected at birth against neonatal tetanus All children who receive DPT 1 should be assessed for protection at birth against neonatal tetanus.				
	Child IS protected against neonatal tetanus at birth	Total	Child is NOT protected against neonatal tetanus at birth	Total

Figure 10. Representative tally sheet.²⁴

Community Recording Systems

The strategy for primary health care adopted by most of the world’s governments calls for reorganization of the traditional health services system, adapting health care delivery to the needs and limitations at community level and involving and empowering the community to plan and manage local health services.

²⁴ Department of Immunization, Vaccines and Biologicals, World Health Organization, *Immunization in Practice: A Guide for Health Workers* [updated edition]. Geneva, Switzerland: World Health Organization; 2004.

This strategy includes restructuring HIS to give health care managers and providers a better understanding of community needs and to increase community involvement in the generation and use of information. Ministries of health and nongovernmental organizations have expanded the classic health unit data collection methods to include community data collection for a number of purposes:

- To monitor health activities performed in the community.
- To obtain more representative data on the health status and living environment of the communities served,^{25,26} including data on births and deaths in the community.
- To assist in planning for health services that are more accessible to the community.

COMMUNITY ROLE IN HEALTH INFORMATION SYSTEMS

Considering and recording the community's health needs is often neglected in the design and funding of interventions and in the development and management of the HIS, where there is no provision for reporting community information or action. Even when community-level indicators are included, most community data collection systems are managed by health care professionals at district or health unit level as an extension of the RHIS—and not by the community itself.

Community data collection systems managed by members of the community themselves are uncommon, although the rationale for such systems is obvious: If communities need to be involved in planning and management of services for PHC, they need information to carry out their functions and to make appropriate decisions.²⁷ The challenge is how to develop community-based systems and how to link them to health unit-based systems.

Although information management skills (i.e., for data collection compilation, and accounting) are available in most communities among merchants, teachers, and other professionals, these individuals could use assistance from professional health staff in determining what information they will need for decision making. But health professionals themselves are often not adequately skilled to offer this support.

This can be changed with certain provisos:

- Appropriate feedback must be given to communities—“appropriate” meaning easily understood and using formats developed in collaboration with community workers.

²⁵ Das Gupta M, Aaby P, Garenne M, Pison G, eds. *Prospective Community Studies in Developing Countries*. New York: Oxford University Press;1998.

²⁶ Green A. *An Introduction to Health Planning for Developing Health Systems*. New York: Oxford University Press; 1994.

²⁷ UN Centre for Human Settlements (Habitat). *Community-Based Environmental Management Information System (CEMIS) Module No. 4, Guidelines for Assessing Effecting Demand of Communities for Environmental Infrastructure*. Nairobi, Kenya: United Nations Centre for Human Settlements; 1995.

- Community information guidelines and appropriate indicators for monitoring community programs must be developed and used to compare with facility-based data.
- Meetings must be conducted with the community to discuss community data and understand the community perspective.

MOBILE TECHNOLOGY FOR THE COLLECTION OF COMMUNITY HEALTH DATA

Apart from improving communication across the miles, mobile phones, are in increasing use worldwide. With mobile phones:

- Community health workers can enter individual patient data directly into databases.
- Health facilities can report on notifiable diseases and other immediately reportable conditions.
- Management of public health logistics (e.g., essential medicines) and ordering critical supplies are facilitated.

Significant research and investment have addressed the use of mobile technology for public health, and this field will continue to grow. Mobile phone technology is making enormous strides in strengthening community data collection by putting state-of-the-art data collection tools into the hands of community health workers (CHWs). CHWs can report directly into the national database with detailed data on health conditions in households and the health status of individual community members.

GPS coordinates of reported data can be used to monitor activities of CHWs, to identify potential public health hazards, and even to pinpoint individual cases of communicable diseases. The rapid development of smart phones and tablet computers means that community HIS will be increasingly linked directly to facility information systems, and the invaluable contributions of community health workers can be increasingly recognized.

Data Reporting and Transmission

FACILITY SUMMARY REPORT FORMS

Summary reports are required to transmit aggregate information compiled from beneficiary cards, registers, and tally sheets at the health facility to the district level.

The design of these monthly, quarterly, or annual reporting forms is important; the forms should be as concise as possible while allowing sufficient space to record the necessary information. The forms should be easy to complete, so that the information can be reported in a timely manner.

Every report sent upwards should be complemented by feedback from the higher level.

Data transmission is becoming increasingly electronic in many countries, with data being computerized mainly at district level (although in some countries, data are being digitized at facility and even client level). Decentralization of electronic reporting brings with it the great advantage that data is entered at the “action” level (i.e., where it is used) and is therefore more readily available for use.

The ease with which data can be sent electronically increases the temptation to send *all* the data to higher levels, instead of prioritizing essential information for management decision making. The content of the periodic aggregate reports should be limited to priority indicators required for informed management at higher levels of the health system. Most of what is collected at facility level is relevant only to management and performance evaluation of the facility and its surrounding community.

The report’s content will likely depend on disease and service delivery priorities at a given time and place, but in general, what should be included are aggregate data on:

- Diagnosis (with ICD-10 coding as needed)—to track the burden of disease.
 - Inpatient data.
 - Outpatient data — on priority diseases.
 - Notifiable diseases — to control epidemics.
- Drug utilization—to ensure correct procurement and ordering.
- Laboratory and other diagnostic tests.

These routinely reported data should be analyzed and checked for quality before transmission. Every report transmitted upwards should be acknowledged by the level above, and each reporting site should receive written feedback showing that their submitted data have been analyzed and used at the higher level.

All staff need guidelines to clearly define exactly what data must be transmitted, when, to whom, and in what format. These guidelines should not only be written, printed, and distributed to all users but also made available by alternative mechanisms to increase access, such as:

- On the Web (in areas with Internet connectivity).
- On portable media such as flash drives.
- By telephone, when other means of transmission are unavailable.
- Distributed at regular staff meetings (or when staff collects their salary or the like).

Ethiopia RHIS Monthly Reporting Form

In Ethiopia, the monthly report form was redesigned so that each character that is to be filled in has its own box. In this way, the numbers on the form are easily readable both by district managers and at the regional office, where the monthly report forms can be scanned for automatic data entry.

Data Quality Assurance

Data quality is essential for its effective use in decision making: Quality is what engenders trust in data, and data perceived to be of poor quality are unlikely to be used. Moreover, managers require accurate, complete, and timely data in order to accurately target resources for effective management of the health system. Data quality involves a complex mosaic of issues relating to organizational procedures, processes, and institutional capacity, and cannot be assessed just by looking at one factor in isolation.

RHIS MANAGEMENT FACTORS FOR ASSURING DATA QUALITY

- Most data quality issues are related to organizational factors and management errors rather than data collection error. If data quality is poor, the following questions should be addressed: Is there a minimum data set that does not put excessive data collecting burden on staff?
- Are reporting protocols clear, defining who should report what data and when? Is staff informed of these protocols through guidelines, SOPs, and regular supervision?
- Are there clear definitions for each indicator and data element collected?
- Are the data collection tools (e.g., registers) and periodic reporting forms well designed, standardized, and consistently used? Are there sufficient blank copies of the tools and forms available?
- Has all staff responsible for data collection, indicator compilation, and reporting been appropriately trained?
- Do staff adequately understand the RHIS and have the necessary analysis and problem-solving skills?
- Are there logistical impediments to timely data transmission (e.g., lack of Internet connection, removable storage media, and/or vehicle to transport data)?
- Are resources (e.g., funds) available to maintain computer hardware/software and to ensure Internet connectivity?
- Are facilities meant to be providing the services they are not reporting on? Do they have the necessary capacity perform the services?

ESSENTIAL ELEMENTS OF DATA QUALITY

Data are considered to be of good quality if they are accurate, complete, timely, and consistent. These elements of data quality can be further defined as follows:

Accuracy

- Do data reflect what is actually happening at the facility?
- Are there data entry mistakes?
 - Are the correct values being recorded in the appropriate places?
 - If there are errors, are they systematic (i.e., the same error being made consistently, such as because the indicator definition has been misunderstood), are they accidental (i.e., random), or are they intentional?
- Are calculation errors being made when indicators are being compiled?

Completeness

- Are all facilities reporting, including the private sector and parastatals (e.g., military and prisons)?
- Of facilities reporting, are they transmitting all forms expected?
- In each report, are all required data elements reported? What is the percentage of “zero” reporting (i.e., for cells for which there is a true null value, reflective of no service delivery, there is a zero was recorded rather than a blank, which could be mistaken for a “missing” value)?

Timeliness

- Are facilities reporting by the reporting deadline established by the MOH? Are reporting periods standardized nationwide (i.e., starting and ending on the same dates in all facilities and districts)?

Consistency

- When compared to previous months, is the pattern consistent (i.e., with a similar distribution of cases of disease, or age/gender proportionality)?
- Do any facility or district indicator values differ strikingly from values for similar facilities or districts (i.e., are there outliers)?

DATA QUALITY CHECKS ON THE COMPUTER

Computer software applications used to enter, store, analyze, and transmit RHIS data can be utilized to perform data quality checks on the entered data, as well as to prevent erroneous values from being entered in the first place. For example, by:

- Prohibiting values outside a specified range for certain indicators—the software automatically informs the data clerk if values are outside the norm.
- Implementing validation rules—both common-sense rules (e.g., the number of babies weighed cannot exceed the number of babies born) and rules based on prior reporting patterns (i.e., prohibiting the entry of certain values markedly discrepant from historic values, for instance “low birth weight not permitted as a value for more than 10% of babies”).

- Building in trend analysis to identify outliers (e.g., District X reported a value for outpatient visits 50% higher than the average of the previous three quarters).

FALSIFICATION OF RESULTS

Poor data quality can result if data are falsified, perhaps due to pressures to achieve unrealistic targets or to gain resources. However, falsification is rare and often overestimated; it is more likely at middle management level rather than at data collection level, more likely in top-down, authoritarian RHIS rather than in decentralized systems, particularly when payments or bonuses are paid based on performance.

DATA QUALITY ASSESSMENTS AND AUDITS

A *data quality assessment* is an institutional process that involves regular review of RHIS performance as measured by the level of data quality and the use of data for decision making. A *data quality audit* is a more rigorous data quality evaluation mechanism, implemented less frequently, that usually involves an independent team of auditors (often from outside the country). Data quality assessments help improve data quality by uncovering hidden problems in data collection, aggregation, and transmission of priority indicator data. Knowing about these problems allows RHIS managers to develop data quality improvement interventions—for example, refresher training on indicator compilation or revision of data collection tools. If assessments are constructive, facilities and districts will begin demanding better data and will develop self-regulatory quality control mechanisms. Some data quality assurance best practices are as follows:

- Data quality assessments are decentralized as low in the system as possible—optimally at district and facility levels, where most data quality problems begin.
- As many stakeholders as possible are involved and engaged in improving data quality and thus invested in producing good-quality data.
- SOPs include clear actions to be taken when data quality is found to be poor.
- Results of assessments for priority indicators are recorded and monitored over time to follow trends in data quality performance indicators—such as for their completeness, accuracy, and timeliness—at both health facility and district levels.
- Assessments are integrated into routine supervision such that a data quality check (i.e., comparison of a reported indicator value with a recounted, or validated, value) is conducted for at least one priority indicator at each visit to a facility or district.
- A standardized tool is used to conduct assessments so that the results are comparable to results conducted in other facilities or districts. The choice of tool is somewhat arbitrary—some tools, such as the PRISM toolkit, are specific to RHIS and thus are highly appropriate for assessment of the RHIS; within this toolkit, the performance diagnostic tool can be used to perform routine data quality and data use assessments. Others, such as the MEASURE Evaluation Data Quality Audit Tool (DQA) and Routine Data Quality Assessment Tool (RDQA), use similar methods but were designed with donor-funded projects in mind. Among available tools are:

MEASURE Evaluation, PRISM: Performance of Routing Information System Management Framework

<http://www.cpc.unc.edu/measure/tools/monitoring-evaluation-systems/prism>

MEASURE Evaluation, Data Quality Assurance” suite of tools (the Data Quality Audit Tool (DQA) and the Routine Data Quality Assessment Tool (RDQA)

<http://www.cpc.unc.edu/measure/tools/monitoring-evaluation-systems/data-quality-assurance-tools>

Data quality should be assessed regularly—for example, during routine supervision or during quarterly review meetings conducted with health facility staff at the district level. Formal audits of data quality for high priority indicators should be conducted periodically but less frequently (e.g., every two years). Often, the frequency of assessment depends on the availability of human, financial, and material resources. Nevertheless, each level is ultimately responsible for sending only data of high quality to the next higher level.

Trouble-Shooting Data Quality Issues

(example SOP from India)²⁸

- Assess data quality using the district HIS assessment guide.
- Analyze reported data; identify data elements of poor quality, using validation checks and time trends.
- Discuss findings with program managers to get their opinion of what is wrong.
- Visit facilities and district offices to trace causes of quality issues.
- Plan remedial action based on one or more of the following:
 - Training for data collectors.
 - Support and supervision of indicator compilation and reporting.
 - Orders issued by district or higher authority.
 - Revision of the data collection tools.

Figure 11. Data quality assessment steps taken for India National Rural Health Mission (NHRM).

IMPROVING CIVIL REGISTRATION: LINE LISTING OF DEATHS

Vital statistics (i.e., registration of births and deaths) are commonly incomplete or inaccurate in developing countries, because many people are born or die far from the government infrastructure used to measure these events. The quality of death reporting can be easily improved by using line listing. In other words, instead of

²⁸ India National Rural Health Mission. <http://nrhm.gov.in/>

reporting zeroes, facilities report four data elements for each actual death in facilities (or in communities where this data is available).

- Probable cause of death (name and code, if possible).
- Age in years.
- Gender.
- Reference number in register, ID number or name (for follow-up if needed).

In order to reduce duplication of reported deaths, place of death is determined only by the reporting health facility. The data is then converted into aggregated data, with ICD-10 coding added when the data are computerized. The result is the number of deaths disaggregated by probable cause for the facility catchment area for the reporting period. Data can be followed up for completeness in districts that are underreporting (that is, reporting fewer deaths than would be expected), and data accuracy can be determined by comparing ICD-10 codes reported with those on record in the facility.

Data Storage

Health records, reports, registers and other data sources should be archived at health facilities after their use and preserved typically for five to ten years, depending on the policy established by the MOH. These data and records are useful for documenting medical histories, maintaining continuity of care, monitoring and evaluating service delivery, resolving legal disputes, and performing data quality assessments and audits.

Increasingly, programs are being audited to document a return on investment to investors (e.g., taxpayers). Data quality audits help develop confidence in the results reported by programs, and ensuring the availability of program documentation facilitates auditing. Historical records are also useful for resolving data quality problems that may be detected only after significant passage of time.

Archived data should be stored according to established policies on data security and confidentiality. Data can be stored as paper or electronically (and if electronically, on local computers or on servers).

PAPER STORAGE

Data storage begins with the decision as to whether to allow clients to keep their own record cards, as is done with child health cards, or whether to build and maintain appropriate facility filing and archiving systems.

Each protocol has its advantages and disadvantages:

- Client-held records are less problematic and enable clients to go to the facility of their choice without interruption of their care because of an absence of information on previous treatment.
- Storage systems at facilities need to be well designed and properly maintained, or patients will suffer enormous delays while records are retrieved.

ELECTRONIC STORAGE

Electronic data storage starts with the collection of individual EHRs and ranges from first-level storage on simple Excel spreadsheets through storage on standard servers and, beyond that, sophisticated servers in the cloud. Bear in mind:

- Electronic spreadsheets such as those in Microsoft Excel, although widely available and simple to use, are not suitable for continuous regular entry of data from multiple sources, because they lack such important data management capabilities as referential integrity²⁹. A proper database management software application such as Microsoft Access, Oracle, or MySQL, which obviate this problem, should be used.
- It is optimal to retain backup of forms, registers, summary reports, and the like, whose data have been manually entered, in case of computer failure and in the event that data needs to be further investigated.
- SOPs should include data and records policies that can be followed by every computer user. These policies should be readily available at facility level.
- A disaster recovery plan should be created and kept up to date.

Table 5. Advantages and Disadvantages of Patient-Retained Cards

ADVANTAGES OF PATIENT-RETAINED RECORDS	PROBLEMS WITH PATIENT-RETAINED RECORDS
<ul style="list-style-type: none"> • The time necessary to retrieve records in the facility can be used instead for service. • Patients have a personal health database they can present if they go to other units for service. • Village health workers can determine patients' follow-up health needs (immunizations, FP) during home visits. • Certain community-based health surveys are more easily conducted. • Patient-retained records can be used for patient education and to stimulate patients to take responsibility for their own health care. • Especially in large outpatient units such as in hospitals, it has been found that more records are lost by the clinic than by patients. • Hospital discharge information can be integrated into the patient-retained card, in order to provide information for follow-up outpatient care. 	<ul style="list-style-type: none"> • Patients lose cards, or forget to bring them when they visit a health facility. • Records get wet and deteriorate quickly. • Confusion arises when the color or the form of the record is changed. • Follow-up of chronic patients is more difficult, because there is no paper trace in the health facility.

²⁹ Wikipedia. Referential integrity [webpage]. Available at: http://en.wikipedia.org/wiki/Referential_integrity.

SERVER HOSTING

A server is a system comprising software and suitable computer hardware that responds to requests across a computer network to provide, or help to provide, a network service. Servers can be run on a dedicated computer, which is also often referred to as *the server*, but most networked computers are capable of hosting servers. In many cases, a single computer can provide several services and have several servers running.³⁰

Pros and Cons of Cloud Computing

Servers can also be *in the cloud*, where *cloud* is a metaphor for the Internet and *cloud computing* refers loosely to everything from virtual servers available over the Internet to commercial software-based services. If you are using cloud computing for your server, it may be located anywhere as long as you can connect to it over the Internet. Larger-scale electronic data storage is shifting rapidly from conventional servers to cloud servers.

When implementing Web-based systems, the server is critical, as the system optimally needs to be accessible 24/7. The new paradigm of Web-based systems breaks with the tradition of each organization having its own computer center and servers. Implementing a data warehouse *on the Web* means that it does not rely on any particular physical location for the server. In a modern cloud-based infrastructure, all the technical parts of managing and maintaining the servers are done by a professional hosting agency, either a government agency or a private concern. A professional hosting agency makes system management—that is, the setting up and maintaining of the system — easier and faster. At the same time, security, availability, scalability, and other general services are guaranteed.

Many program and data managers are uneasy about offshore hosting, since it takes ultimate control of program data outside their country. But some countries have successfully used offshore application and data hosting, either temporarily or over a longer term:

- *Kenya*: The DHIS2 was initially implemented on a rented server in London because the MOH server and network were not working. The future strategy is to locate the server at a national hosting company or government agency.
- *Rwanda*: After initially using the cloud, Rwanda is planning to shift its data to the server of the national ICT ministry.

Although political arguments can be made for countries to remain in physical control of their data and the servers and although national concerns about security are understandable, it can also be argued that the

³⁰ Wikipedia. Server (computing) [webpage]. Available at [http://en.wikipedia.org/wiki/Server_\(computing\)](http://en.wikipedia.org/wiki/Server_(computing)).

primary task of a MOH is not to manage servers. If there are government hosting facilities or if there are local companies with hosting services, it makes sense to use them rather than for a MOH to maintain its own servers.

Table 6. Advantages and Disadvantages of Different Server Options

CLOUD COMPUTING		CONVENTIONAL SERVERS	
ADVANTAGES	DISADVANTAGES	ADVANTAGES	DISADVANTAGES
<ul style="list-style-type: none"> • Cost efficient. • Almost unlimited storage. • Backup and recovery. • Easy access to information. • Quick deployment. • Lower monthly costs. 	<ul style="list-style-type: none"> • Technical issues. • Security in the cloud. • Prone to attack. 	<ul style="list-style-type: none"> • High-end expensive dedicated servers perform better than most cloud servers. 	<ul style="list-style-type: none"> • If a dedicated server fails, you need to build a new server, reinstall the operating system, and restore data from backups. • Higher monthly costs.

Guidelines for Using Conventional Servers

MOHs preferring to maintain their own applications and data servers should institutionalize certain basic practices to ensure server reliability (figure 12):

- Human capacity for server administration and operation must be planned and budgeted for. Staff with skills in server administration and the specific technologies used for the application providing the services, such as Web servers and database management platforms, are essential.
- Reliable solutions are needed to automate backups. These should include local off-server and remote backups.
- Stable connectivity and high network bandwidth are necessary for traffic to and from the server.
- The power supply must be stable for both the server *and* the backup solution.
- The environment for the physical server must be secure, with controlled access and protection from theft and fire.
- A realistic disaster recovery plan must ensure that the service will suffer only brief down times in the event of hardware failure, network glitches, or other unforeseen circumstances.
- The hardware must be powerful, robust, and feasible to operate.

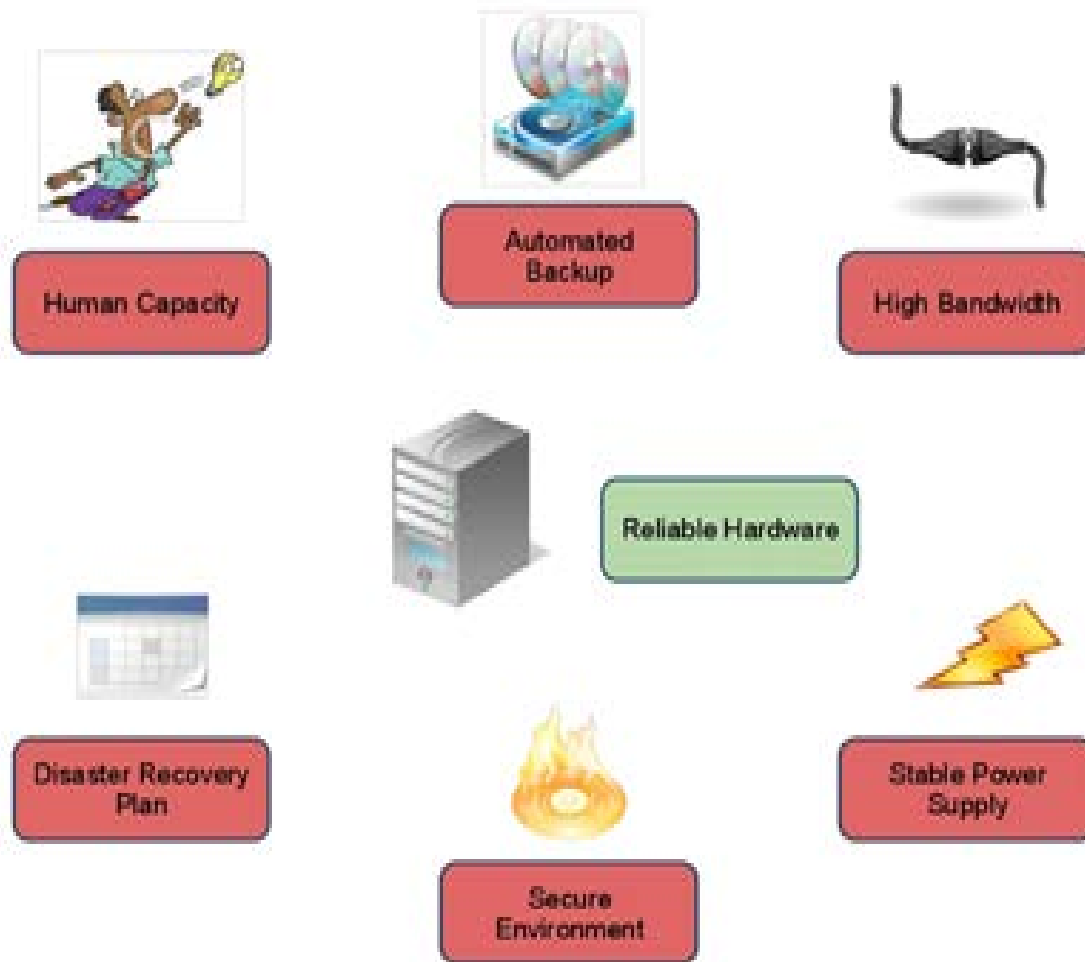


Figure 12. Seven requirements for reliable server hosting.

Data Confidentiality

Illness is often stigmatized: People fear getting sick and people suffering from communicable diseases are a potential source of infection. Thus, health data must be kept confidential at service delivery sites to ensure that sick people are treated fairly and with the respect they deserve. Ensuring data confidentiality should be prioritized when data are collected, transmitted and stored.

GUIDELINES

Clear guidelines and policies specific to each level should be observed, such as:

- Data are kept in a secure location—for paper records, a locked filing cabinet in a locked room.

- Access permissions must be controlled—only staff at a certain level have access to records.
- Where paper records can be taken must be limited. For example, rules should prescribe where they can be accessed and removing them from secure locations should be prohibited.
- Electronic records and files should be password protected—each file and each computer. Only specific cadres should be given access to passwords.
- Only aggregate data should be transmitted, since patient-level data serves little purpose at higher levels. In the context of health research, where patient-level data is needed, records must be well guarded and specific protocols maintained to ensure data confidentiality.
- A confidentiality agreement must be signed, and renewed annually, by all staff members requiring access to confidential records. The agreement should state the conditions under which records can be accessed.

Data Analysis

Data should be analyzed at the level of collection using RHIS data for program monitoring and planning, with indicators appropriate for the level. Local-level data analysis means that health workers are moving beyond mere reporting and are asking strategic questions such as:

- Who is doing what and where?
- Are programs making progress toward implementing plans?
- Are programs meeting their goals and targets?
- Are the indicators useful at local level?
- Are resources adequate to achieve program objectives?

TOOLS FOR DATA ANALYSIS OF ROUTINE HEALTH INFORMATION (TABLES, GRAPHS, AND MAPS)

Converting RHIS data into information can be facilitated by using appropriate tools for presentation and analysis. Data can be reported via:

- Tabular presentation (e.g., in summary tables and listing reports).
- Spatial presentation (e.g., in charts, graphs, and maps created using a GIS).
- Electronic analysis tools (e.g., with pivot tables).
- Decision support tools. (e.g. automated graphing and charting of indicator data based on parameters—such as period of analysis, geographic area, age group, and so on—supplied by the user).

DATA PRESENTATION AND ANALYSIS TOOLS

- Summary tables.
- Listing reports.
- Graphs.
- Geographic information systems.
- Pivot tables.
- Data warehousing.
- Decision support systems.

Summary Tables

Summary tables present data in a format that is similar to the monthly/quarterly report form. They allow for flexibility in the level of aggregation (facility, district, region, and nation) and periodicity (monthly, quarterly, and annually) and can include calculated population-based indicators.

Listing Reports

Listing reports group data by health program and include:

- Facility- or district-level detail, with district and regional subtotals and national totals.
- Presentation of monthly and quarterly details with annual totals.
- Indicators with denominators (e.g., coverage)—with numerators and denominators calculated separately, and then the indicator calculated for each level.

Data can also be exported in list format from the RHIS to an alternative data analysis software (e.g., SPSS or Microsoft Excel or Access) to allow users greater freedom of analysis.

Graphs

Graphs are tools for visualizing patterns in the data and include:

- Line graphs, to illustrate time trends.
- Bar graphs, to highlight categorical data, such as regional comparisons.
- Pie charts, for data that can be apportioned to a definitive number of categories, such that they total 100% (e.g., age groups, gender, and FP method).
- Box charts, spider graphs, bubble charts, and others.

Geographical Information Systems

A powerful tool, a GIS is generally a computer software application for displaying RHIS data geographically, such that differences in indicator values can be viewed spatially.

GIS Map Key Components: Key components of a GIS map include:

- Geographic features
 - *Areas:* Districts, towns, census tracts.
 - *Points:* Health facilities, doctors, cancer cases.
 - *Landscape Features:* Roads, rivers and lakes, mountains.
- Data with a geographic component—in other words, the data element is associated with a geographic attribute such as a village or district.

- GIS map layers, such as *shape files*, the map layers used in the GIS software *ArcGIS*.

GIS Functionality: A GIS can identify and select features; calculate and manipulate data and features; and display information in informative and compelling ways. A GIS can locate or select features based on their geographic relationship to other features, such as doctors within 10 miles of a hospital (point to point), census tracts within a district (area to area), clinics within certain census tracts (point to area), or roads that pass through a town (line to area). A GIS can also:

- Locate and select features based on their attributes, such as health facilities with beds, census tracts with one or more cases of cancer.
- Calculate and manipulate data.
- Assign and modify attributes based on geography. For instance, a GIS can add a census tract field to each physician record.
- Aggregate data based on geography. For instance, a GIS can combine population statistics by village within a health facility catchment area to calculate coverage; can count the number of physicians in each census tract and assign that data to the tract; and can multiply a grant amount for health centers in a district with more than 30 percent poverty.
- Aggregate features—for example, combining census tracts into a new hospital service area layer.
- Do geocoding (i.e., mark locations on a map based on geographic coordinates). As an example, a GIS can convert a list of physicians by address to a set of points by latitude and longitude.
- Calculate a buffer zone. For example, a GIS can create a layer of 5km buffer zones around health facilities and otherwise graphically depict features and data.
- Directly represent locations. For example, a GIS can show health centers as, say, stars, in relation to hospitals, which might be marked by crosses, and roads, identified by red lines.
- Represent locations thematically. For instance, a GIS can show districts in different colors based on ranges of a continuous variable (e.g., percent vaccination coverage); or health facilities as symbols sized proportionately using the value of an attribute variable (e.g., capacity, as measured by the number of beds); or health centers with a budget surplus as happy faces and those with a loss as unhappy faces; or districts with different colors based on percent vaccination coverage and scale the darkness of the color by population density (an example of a dual-theme GIS representation).

Availability: GIS software applications are readily available but their appropriate use requires training. Commercial GIS applications (e.g., ArcGIS by ESRI) have a wide range of functionality and are correspondingly expensive. Low-cost or free alternatives are also available, though with somewhat reduced functionality, including:

EpiInfo 7.0 with EpiMap, a freely available data management and statistical analysis software from the U.S. Centers for Disease Control and Prevention (CDC), which includes a GIS component

<http://wwwn.cdc.gov/epiinfo/7/index.htm>

Quantum GIS, a freely available, open-source GIS application with a wide range of functionality

<http://www.qgis.org/>

Microsoft Excel to Google Earth Thematic Mapping Tool (E2G), a tool developed to map administrative region data stored in Excel spreadsheets without the need for a GIS

<http://www.cpc.unc.edu/measure/tools/geographic-information-systems>

DECISION SUPPORT SYSTEMS

A *decision support system* (DSS) is a computerized application that allows health managers to visualize health indicators and data elements collected by the RHIS in graphical and geographical presentations. It differs from a data warehouse in that it provides automated analysis capability locally—typically drawing data only from a single database or computer. It is based on the principle that comparison is one of the most powerful analytical methods. Comparisons can include:

- Spatial comparisons—by health facility, district, province, or the like.
- Time comparisons—trends by week, month, year, and so on.
- Comparison of indicators—between inputs and outputs, for example.
- Benchmark comparisons—such as “expected versus achieved.”

A DSS is well suited for health managers at national, regional, and district levels in that it allows staff with limited data analysis skills to:

- Better interpret aggregate information from the RHIS.
- Rapidly and efficiently prepare their data for analysis and use it to inform decisions.
- Build capacity on how to use tools and interpret data.
- Link data from different programs.
- Improve data transparency—for instance, readily produce graphical information for use in advocacy or to share with the public, such as via the local newspaper.
- Create accountability incentives.
- Create feedback loops, especially for peer comparison.

A DSS is a highly useful, relatively low-cost analytical tool. It saves data users time in that it preprograms routine analyses, removing data management steps. The principal disadvantages of a DSS are that it requires custom programming to work with a given database and that the programming cannot foresee all analysis needs of a given user.

Data Dissemination

- Information produced by the RHIS should be *disseminated*, or shared, with all *stakeholders*, those who would use it to advance the mission of the health system. RHIS information should also be shared with, or *fed back to*, data producers at lower levels. Quality information products should be developed, including visual aids such as charts and maps, and mechanisms for dissemination, such as a Web portal.

STANDARD OPERATING PROCEDURES

Developing RHIS information products and disseminating them should be routine and standardized. SOPs should include:

- Routine procedures for dissemination and feedback (e.g., automated reports).
- Protocols for data reporting from lower to higher levels.
- Routines for dissemination and feedback of data from higher to lower levels.
- Description and promotion of routine production and dissemination of regular reports, such as:
 - monthly, quarterly and annual reports;
 - regular bulletins, disseminated at all levels, wherein data are analyzed and indicators used to monitor performance against targets; and
 - feedback reports containing analyzed data and information on performance specific to the facility or district (e.g., results of supervision visits and data quality issues uncovered at higher levels).

WEB PORTAL

A *Web portal* is a Web site that functions as a single point of access to information from the national data warehouse and other relevant sources. The Web portal's role is to make such data sources easily accessible in a structured, systematic way and is a potentially powerful tool for disseminating information and providing feedback to lower levels.

The portal can connect to the data warehouse Web interface and communicate with relevant resources such as maps, charts, reports, tables, and static documents. These data views can dynamically visualize aggregate data based on queries on the organization unit or indicator or period dimensions. The portal can add value to the information by making the data easy for inexperienced users to explore and structuring that information in a user-friendly way.

Considerations

When implementing a Web portal for dissemination of RHIS data:

- Engage stakeholders in defining information needs and the format for data presentation.

- Develop content appropriate to the stakeholder group—that is, the information itself and how it is presented should be customized to the user. For example, it might be simple and concise for politicians or the general public, but more detailed and more technical for RHIS managers.
- Strengthen visualization and analysis aspects of the portal to encourage use, including:
 - GIS functionality to enable spatial analysis and mapping; and
 - charts, graphs, and dashboards.
- Link the data warehouse with the portal so that the information is routinely up to date.

Linking to Other Sites and Other Systems

The Web portal can be connected to other relevant systems and Web sites through a Web application programming interface (API); an API specifies how some software components interact with one another. The portal can, for example, link to the WHO African Regional Office (AFRO) Observatory³¹ and such other relevant statistical sites as the World Bank General Data Dissemination System (GDDS)³² and the WHO.

Document Repository

The Web portal can also act as a document repository (content management system) and can include relevant documents such as SOPs and HIS and RHIS guidelines, policy documents, and situation analyses, indicator lists, metadata definitions, training materials, and the like.

Interaction with users can be enabled through an FAQ (frequently asked questions) module where questions and answers and other communication can be posted and managed for different target groups. This can make the portal a central point for document sharing and collaboration in the health domain.

Forum for Discussions

The portal can provide a forum for discussions between the country HIS teams and regional HIS structures. The forum can be used to disseminate reports and documents and to solicit feedback and for collaborative content editing.

³¹ Regional Office for Africa, World Health Organization. African Health Observatory & Knowledge Management (AHO), Overview [webpage]. Available at: http://www.afro.who.int/index.php?option=com_content&view=article&id=918&Itemid=1380.

³² The World Bank. The General Data Dissemination System, November 2003 [unpublished report]. Available at: http://siteresources.worldbank.org/SCBEXTERNAL/Resources/gdds_oct_2003.pdf.

For More Information

Michael Edwards and Theo Lippeveld, Decision Support Systems for Improving the Analytic Capacity of Decentralized Routine Health Information Systems in Developing Countries. In *Proceedings of the 37th Hawaii International Conference on System Sciences*, 2004.

<http://hmn-tsp.net/HCCDE02.PDF>

MEASURE Evaluation, Geographic Information Systems

<http://www.cpc.unc.edu/measure/our-work/gis>

Wikipedia, Web Portal

http://en.wikipedia.org/wiki/Web_portal

Chapter Summary

This chapter covered standards around data collection, processing, analysis, and dissemination:

DATA COLLECTION

- There are a variety of data collection tools, with various strengths, weaknesses, and purposes. It is important to select the tool carefully and to ensure that the RHIS relies on a variety of complementary tools. The tool, the data collector, and the data flow pattern should all be clearly articulated and understood.
- The selection of tools requires comprehensive stakeholder involvement from all actors in the system, including the community the health system serves.
- SOPs are critical so that staff can ensure that data are collected and compiled accurately and completely.

DATA ANALYSIS

- Facility summary reports should be sent to the next highest level and feedback should always be given back to the level that prepared the summary report. Routine data should be reported monthly.
- Analysis should be done at the local level before data is sent to the next level. A variety of data analysis tools are available; different tools are useful at different levels in the system. Data analysis should answer key questions related to health system performance and progress towards targets.
- All efforts must be made to ensure data quality. Reliability of data quality makes the data useful for decision making. Quality enables users to trust data and base decisions on it. Data quality is complex, relating to organizational procedures, processes, and institutional capacity; it cannot be assessed by looking at a single factor in isolation.

DATA STORAGE

- Data storage is an essential aspect of RHIS data management. Routine data records and reports are useful to ensure continuity of care to beneficiaries, to assess data quality, to study service delivery over time, and to resolve medical disputes. Data can be stored as paper and electronically; electronic storage includes both local and cloud-based servers.
- Ensuring data confidentiality is crucial, particularly in the collection and storage phases but also during transmission. Only aggregated data should be transmitted.

DATA REPORTING AND USE

- Reporting of data from lower to higher levels and the avenues for dissemination and feedback should be clearly articulated to encourage regular and routine sharing, production, and dissemination of information.
- The most visible outcome of a successful information culture is that available information is used at all levels to improve service delivery to clients and to strengthen facility management and management of systems at that level. Use of data close to its original source is the best way to validate it and the use of data is key to ensuring data quality throughout the system.

Chapter 3: Data Integration and Interoperability

This chapter looks at fragmentation of health information systems and how to overcome it through an integrated, user-centered approach to information system design.

We look first at the causes of fragmentation and outline basic principles for integration. We then give examples of best practices for integration at the three health system management levels. For example, how can we better integrate beneficiary paper and electronic records, based on standardized indicators? How can we improve system-level integration by developing an enterprise architecture or by building an integrated data warehouse?

You will learn about the following in this chapter:

- Causes of HIS fragmentation.
- Basic principles for data integration.
- Best practices for data integration—that is, integration of paper and electronic records.
- Key factors in beneficiary-level, facility-level, and system-level integration.
- An approach for developing a data warehouse that integrates business processes, data, and software.

Fragmentation and Integration

One of the main reasons for deficient and centralized information management has been fragmentation of HIS. National programs in many countries, often under donor pressure, have created separate *program information systems* tending to focus on a specific disease (e.g., diarrheal diseases), a specialized service (e.g., FP), or a management subsystem (e.g., drug management) instead of addressing management functions in a comprehensive way. These program information systems have existed side by side with the general RHIS, which may be considered insufficient and incapable of delivering the data needed for program management. Although these separate systems have the potential of providing real information support for programmatic decisions and the quality of information they generate tends to be better than that of the general information system,³³ redundancy in data collection, the presence of multiple report forms, and data transmission problems have made RHISs ever more chaotic and bothersome. Most of all, these systems, because of their disease-oriented approach, have further endangered the holistic perspective of individual and community health care.

³³ World Health Organization, 1994. Information support for new public health action at the district level. Report of a WHO Expert Committee: 1–31 (WHO Technical Report Series, No. 845) <http://www.who.int/bulletin/volumes/83/8/632.pdf>

Fragmentation of HIS refers to the absence, or underdevelopment, of connections among the data collected by the various systems and subsystems.

Increased *integration* is generally seen as the way to overcome fragmentation of country HIS. However, there is little shared understanding of what is meant by the term integration; what should be integrated, how integration may be achieved, and at what level.

WHAT IS INTEGRATION?

Definitions

A number of definitions that apply to integration:

- In engineering, system integration is the bringing together of the components into a single system and ensuring that subsystems function together as a unit.
- In information technology, systems integration is the process of linking together different computing systems and software applications physically or functionally, to act as a coordinated whole. The system integrator brings together discrete systems using techniques such as computer networking, enterprise application integration, business process management, and manual programming.

The Human Challenges

Yet HIS integration is usually more than IT systems integration or engineering. It is also a politically sensitive process that usually requires substantial change in how organizations operate. Key stakeholders at all levels need to be aware of (and promote) the benefits of integration and information sharing and actively participate in the change process. Only by long-term, high-level focus on good HIS governance, capacity building for data management and information use, and strong commitment to change by leadership across stakeholder groups, can an integrated HIS be achieved.

To move from a fragmented system toward an integrated approach, national HIS need to be strengthened to suit the needs of all stakeholders, and data collection systems across health programs require standardization and rationalization. The rationale behind an integrated HIS applies equally at all levels, and a technical solution such as an integrated data warehouse should be introduced at national and local levels, along with integrated organizational systems and long-term initiatives to address health worker behavior.

CAUSES OF FRAGMENTATION

The multiple causes of fragmentation have institutional, technical, and behavioral roots:

- Institutional—relating to poor governance, weak oversight and supervision, differing organizational and programmatic interests, political maneuvering, and/or geographic rivalry.
- Technical—reflecting poor HIS design, lack of technical interoperability among existing systems, and the absence of common metadata (i.e., data definitions, data sources, frequency of reporting, levels of use, targets, and other common interests).
- Behavioral—resulting from narrow programmatic interests, inadequate training, and the lack of appropriate HIS skills of health managers and providers.

Fragmentation Due to Institutional Complexity

In the interest of expediency (the need for data now), many countries have put in place *vertical* programs (parallel and distinct from the national HIS), each collecting information independently of the others, with little regard for supporting the overall HIS. These vertical programs are usually donor-driven and well-funded and therefore able to collect large volumes of good-quality data. However, sustainability is not prioritized, so the system is abandoned when donor funding ends as there is no institutional base. The end result is excessive data, with great overlaps—and large gaps where no data is collected. Data and indicators are poorly standardized and presented in incompatible formats, so that comparisons and analysis across programs are difficult. Some programs (e.g., for HIV and AIDS care, treatment, and prevention) are well resourced and collect volumes of quality routine data supported by regular surveys; other programs (e.g., for environmental health) are underfunded and collect data of poorer quality and less of it.

The way data is collected, reported, and used reflects the fragmented nature of funding agencies, implementing partners, and health programs. Each funding agency, partner, and health program requires its own reports; in the absence of other alternatives or strong MOH leadership and often lacking particular expertise in information system design and development, these organizations develop their own often-proprietary data reporting systems, typically using inappropriate technology (e.g., electronic spreadsheets). As the different health programs promote systems that are inefficient and do not satisfy integrated information needs, users tend to revert to developing their own individual systems and abandon integration efforts. In a vicious cycle, systems that do not interoperate (i.e., share data) continue to proliferate and thus lead to further fragmentation. As a result, many developing countries face a plethora of primitive, disease- or program-specific, spreadsheet-based reporting systems.

The example of INASA is typical: The official HIS is not able to satisfy the demand from health programs and partners, each of which then develops its own vertical data reporting silos. The vertical systems are technically deficient and cannot interoperate with other systems or satisfy the reporting needs of multiple health programs and the HIS.

Fragmentation of RHIS in Guinea Bissau

The Instituto Nacional de Saúde Pública (INASA), the official ministry of health HIS unit in Guinea Bissau, is nominally the focal point for data management and reporting and is meant to receive all data reported from health facilities via the regional health directorates. Officially, INASA manages the data and receives all requests for data. INASA has developed an integrated data collection tool that includes data across health programs in an effort to move toward an integrated reporting system. However, this form is not satisfying data requirements of certain health programs (e.g., for HIV and AIDS, TB, leprosy, community health, nutrition, and maternal health), all of which have defined their own data collection forms and reporting systems. Furthermore, data collection forms are sent directly to partners (e.g., those working in HIV and AIDS) without being processed at INASA. These systems undermine INASA's authority as the country's integrating HIS unit.

Fragmentation Due to Technical HIS Design Problems

In Data Collection Systems: When donor-funded, disease-specific programs or program-centric NGOs introduce proprietary data collection systems (because the RHIS does not collect exactly the data they need), data collection forms and reports proliferate. Multiple data collection forms (or multiple versions of the same form) at health facility level confuse and burden health care workers and compromise data quality. Data for the same program and indicators collected on different tools in different parts of the country are not always comparable and often cannot be aggregated at district or regional levels.

In Data Management Systems: The HMN's technical framework,³⁴ a standard for developing-country HIS, clearly states that a data warehouse should be the focal point in an integrated country HIS; the software application managing the HIS should be of professional quality and based on international standards governing such systems. Many countries experience fragmentation because the software at central level does not meet the needs of users, who then set up parallel systems, and integration efforts fail. Often, these user systems either do not work properly from the start or were created by software developers who did not receive comprehensive guidance on the information needs and business processes at issue. Then, after the product is developed, the software cannot be updated to meet new program requirements; often, too little internal capacity was developed to maintain and update the software.

³⁴ Health Metrics Network, 2008. Available at: http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf.

A Landscape of Fragmentation in Zambia³⁵

In 1996, the Danish International Development Agency (DANIDA) supported what was then a well-functioning computerized HIS in Zambia. The software for health data management was developed in Microsoft Access but although basically functional, it was plagued with technical problems. The MOH lacked expertise to adapt it to the health sector's changing requirements, so all programs developed their own reporting routines and technical solutions—which were not integrated with the official MOH HIS.

In 2006, a new Access-based system (DHIS1.4) was introduced, with 80 stand-alone installations all over the country. Each of these was modified locally; without time, skills, and resources, the central HIS unit could not manage the system. Individual systems were modified and the system became increasingly dysfunctional. Because it did not serve their needs, the various health programs devised other, separate software applications, creating a landscape of fragmentation.

Zambia is now trying a third approach, using a central Web-based server with districts logging on via the Internet.

Fragmentation Due to Behavioral Issues

The lack of appropriate skills among RHIS personnel can also lead to RHIS fragmentation. Donor-funded, disease-specific programs (e.g., those funded under the US President's Emergency Plan for AIDS Relief, or PEPFAR, and by the Global Fund to Fight AIDS, Tuberculosis and Malaria) have an immediate need for data to satisfy program management and evaluation needs, with particular regard to accountability and return on investment.

If the RHIS is weak, or even perceived to be weak, these donor-funded programs cannot rely on the RHIS and often introduce parallel, disease-specific systems to satisfy their own M&E needs. The perceived lack of competence within the national HIS leads to further RHIS fragmentation.

KEY PRINCIPLES FOR ACHIEVING HIS INTEGRATION

HIS integration can be achieved in many ways, and each should be tailored to the needs of the systems to be integrated. The approach should be multilayered and should focus on the common purpose: producing high-quality data for decision making.

The need for a more integrated approach to management and use of HIS data has been identified by the HMN Framework.

³⁵ Zambia HMIS Evaluation Report 2012. The European Union's EDF Program for Zambia. Heywood et al. June 2012.

Principles

The heart of an integrated HIS architecture is a standards-based data management system³⁶ that enables data to be integrated from divergent sources (e.g., individual records, service records, resource records, population surveys, civil registration, and census) and that makes this data available for analysis and use across stakeholder groups and through all levels of the health system. In developing such a system, four key processes must be considered and addressed both at national and subnational levels:

- Standardization of indicators and data collection systems across all HIS data sources (chapter 1).
- Advocacy and awareness-raising of the benefits of an integrated HIS by good governance and leadership.
- Long-term capacity building on data management and information use.
- Development of appropriate ICT-based solutions (e.g., a data warehouse) for an integrated HIS.

Interdependence of All Levels

Most key HIS data sources are at the health system's lower levels, and data collection, management, and use at local level determine data quality at national level. All levels of the information chain, from health facilities to national level, influence the quality of the data collected and all depend on integrated, high-quality information for decision making.

The community and health facility levels are crucial in terms of strengthening data collection at beneficiary level, ensuring data quality control, and promoting information use. Although most systems at this level are paper based, efforts to develop a computerized data repository that neglects the lower levels are highly unlikely to succeed.

The district is the first level where the important data sources for health system management come together and, as a result, forms a natural first level for the operation of an integrated computerized data repository. Although district data repositories might not contain all data sources, all data processing, or all technological tools, achieving a well-functioning, integrated HIS at the national level depends on these district repositories being well designed. More importantly, well-functioning district data repositories will have a real impact on capacity for making evidence-based decisions at lower levels.

³⁶ Health Metrics Network, 2008: Section 2.5, 37-41. Available at http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf.

BEST PRACTICES IN INTEGRATION

Integration is a complex, long-term process and requires locally appropriate solutions for success. Integration requires sustained vision by strong leadership at the highest level, able to make the right decisions; long-term good governance to create a positive environment for change; and SOPs that clearly set out roles and responsibilities.

Standard Indicators and Data Sets

Agreeing on and developing standard indicators and related data sets is an essential first step in developing an integrated HIS (chapter 1). These standards can be developed following a number of different approaches, as in Liberia, Ghana, and Burkina Faso:

- *Liberia:* Here, a compilation of agreed-upon data collection tools has been developed as a collaborative effort among all health programs and partners. All facility data is found in this compilation of about 20 forms in one consolidated “book” of forms.
- *Ghana:* The policy in Ghana is that all health programs should join forces in the new District Health Information Management System II (DHIMS II). All health programs include their data collection tools in the DHIMS II data warehouse. Data elements overlap among different program tools, but these data elements are defined only once in the data warehouse.
- *Burkina Faso:* This country’s national HIS unit encouraged all health programs to participate in a process to develop data sets for their program area in the new national data warehouse. Although the programs assisted the MOH in developing an integrated system, they continued using their proprietary systems, which had different reporting requirements.

To get health programs and partners to agree on indicators and data sets is difficult, and agreements can fall apart if solutions do not take each program’s needs into account.

BENEFICIARY-CENTERED INTEGRATION

Integration of Paper Records

A beneficiary- or client-centered integration starts at the client interface and promotes the use of integrated

SHARED STANDARDS

Shared standards for data and indicator sets represent a key prerequisite for successful integration.

- The MDG initiative and its indicators have enormous potential to motivate countries toward integration and to provide a center point around which integration can occur.
- Regional efforts to define a shared indicator set (e.g., within WAHO, to which most West African countries are compelled to report, provides a catalyzing influence.
- Country initiatives (e.g., the South African National Indicator and Data Set* and the Kenyan Integration Process†) have set examples for other countries to follow.

* <http://www.doh.gov.za/docs/policy/2012/dhmis.pdf>

† <http://www.afyainfo.org/index.php/features/the-afyainfo-project>

data collection tools, such as those described in chapter 2:

- Family health cards, such as the Ethiopian family card.
- Integrated registers for ANC, labor and delivery, and immunization that track the mother and child as an integrated unit, as in Rwanda and Malawi.
- HAST client cards that integrate HIV/AIDS, sexually transmitted infections (STIs), and TB, as in Lesotho and Nigeria.

The existence of integrated client cards alone is insufficient—the key to achieving effective facility-level integration is to promote integrated data use at local level. This can be done in many ways, among them:

- Using client data during clinical ward rounds.
- Promoting discussions about client and facility data during facility staff meetings.
- Displaying up-to-date graphs on the walls of facilities and offices.
- Involving health center committees and communities in understanding data use.

FACILITY-LEVEL INTEGRATION

Integrated client cards are still the exception rather than the rule, as most countries have not achieved beneficiary-level integration.

Many countries have yet to achieve facility-level integration, where the paper summary reports from different programs (e.g., for maternal health, growth monitoring, HIV and AIDS, malaria, and TB) are combined into one integrated monthly facility report, for which the officer in charge of the facility is responsible, rather than individual program coordinators.

This integrated facility report is sent by the facility in-charge to the district health management team (DHMT), rather than to the various district program managers and is entered into the integrated database by the district information officer (DIO). These routine data are turned into indicators, combined in the database with other data, such as for population, human resources, drugs and equipment—information that often comes from such other interoperable systems as those for census, logistics management, and human resource.

Graphs, GIS maps, reports, and other information products are produced for the HIS as a whole and used by the entire DHMT as well as by individual programs, for self-assessment, program monitoring, collective decision making, and providing feedback to data collectors and other stakeholders.

Integration of electronic medical records (EMR) is much easier than paper-based records. EMR can easily link the various health problems and services patients receive. For example, an HIV-positive woman under

follow-up who becomes pregnant will have her pregnancy follow up and HIV/AIDS treatment in the same record. Also, EMR from a woman can be linked easily to EMR of the neonate, etc. Unfortunately, the ICT context in most low income countries is not yet ready to implement EMR in primary care facilities.

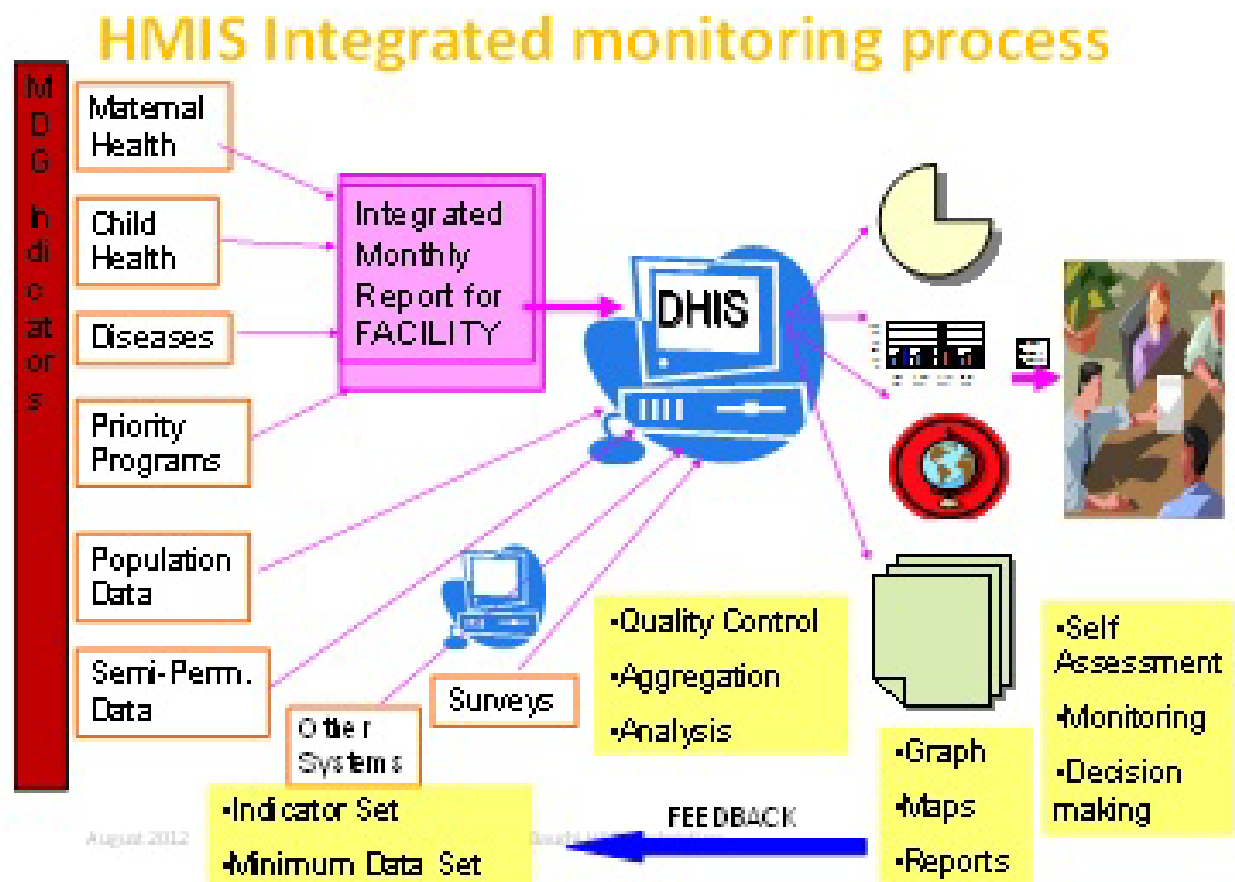


Figure 13. Integrated facility periodic report.

SYSTEM-LEVEL INTEGRATION

Integration of Electronic Records

A data warehouse can make a real difference in integrating the HIS, in terms of data storage, processing, analysis, visualization, transmission, dissemination, and strengthening of evidence-based decision making. Electronic transmission of data from a local data warehouse to the higher levels also improves the timeliness and quality of reporting.

Every system should produce precisely the results it is designed to produce.

However, the computerized solution will only be as good as the HIS it is meant to support, and the success of the HIS depends heavily on other processes, including metadata management, advocacy, and capacity development.

Integration of the RHIS

To summarize the challenge of integration and to better interpret the problems confronting the integration and standardization processes, the model shown in Figure 15, is useful.³⁷ This model helps describe integration as challenges along three dimensions.

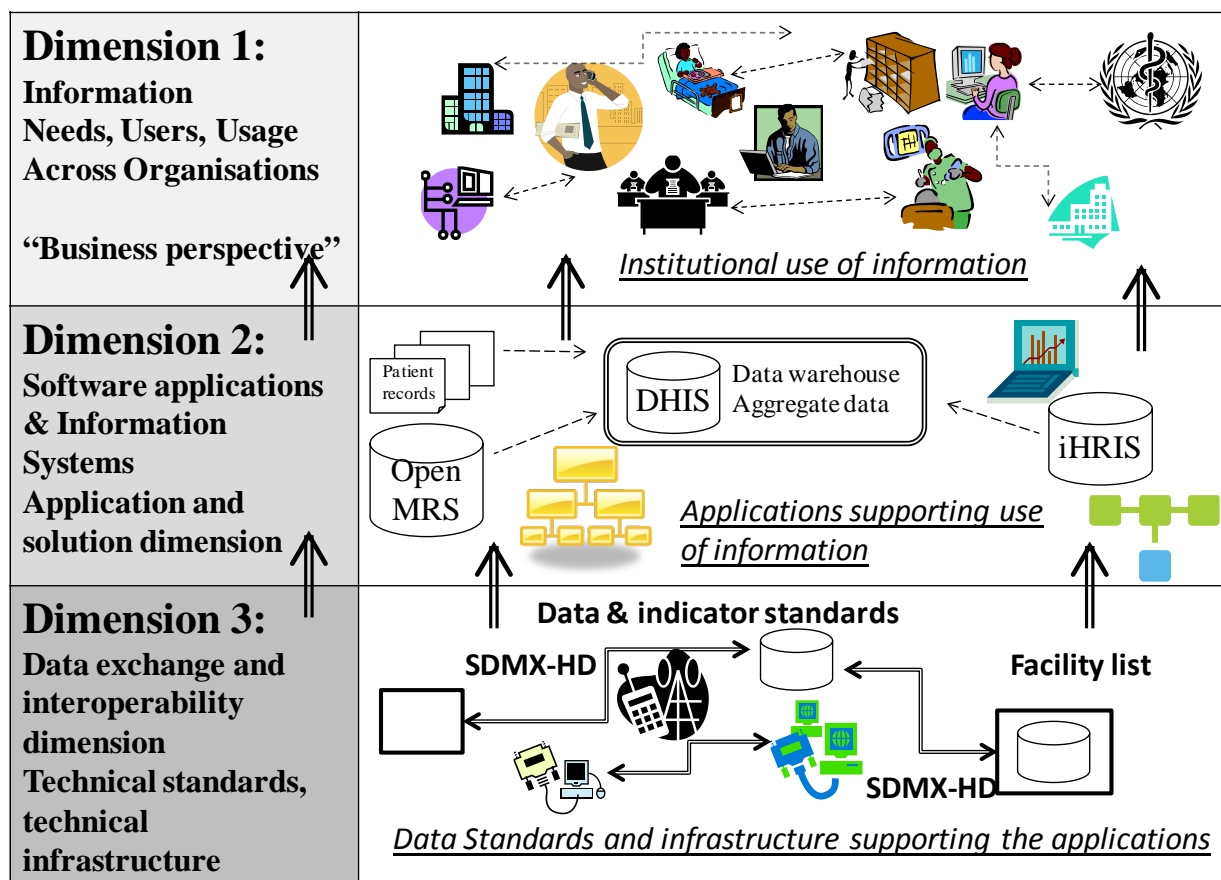


Figure 14. Dimensions of RHIS Integration.

³⁷ Thomson M, Mantilla G, Platzer B, Willingham AL, Sommerfeld J, Touré Y. *Assessment of Research Needs for Public Health Adaptation to Social, Environmental and Climate Change Impacts on Vector-Borne Diseases in Africa: An Informal Expert Consultation Convened by the Special Programme for Research and Training in Tropical Diseases, Addis Ababa, Ethiopia, February 27–29, 2012*. Geneva, Switzerland: World Health Organization; 2012. Available at: http://apps.who.int/iris/bitstream/10665/76282/1/9789241504669_eng.pdf.

According to this model, the problem of integration can be analyzed within a framework comprising three interconnected levels.

- *Organizational Dimension:* The organizational dimension, a combination of business and data architecture, is the key level where integration efforts should be focused: This is the decision-making and political level where consensus must be obtained to achieve integration. Leadership is needed to get different programs to agree on basics and to support the overall HIS, rather than their own vertical, program-focused systems. These agreements must address metadata such as facility lists, data elements and coding, indicators, data collection and reporting formats, locus of control and coordination, and reporting frequencies.
- *Application Dimension:* The application dimension (the application architecture, i.e. how the software applications work together to produce the desired outputs) involves developing appropriate database and software tools to manage the agreed-upon data and indicator standards with suitable database tools. Unless this dimension is well developed, fragmentation begins to proliferate again because the database does not yield results in line with agreed-upon indicators.
- *Technical Dimension:* In the technical arena—that is, with respect to the technical architecture—the different existing systems for PHC, hospital, human resources for health, logistics, pharmacy, and laboratories need to be functionally capable of interoperating with other systems using a standardized data exchange protocol, such as SDMX (statistical data and metadata exchange³⁸). Unless data can be shared in this way, the data warehouse will be incomplete and programs will continue to operate independent systems.

Integrated Data Warehouse

A data warehouse is a database used for reporting and data analysis, a central repository of data created by integrating data from one or more disparate sources. Data warehouses store current as well as historical data and are used to create trending reports for senior management, reporting such as annual and quarterly comparisons.³⁹

A data warehouse includes business intelligence tools that can provide users with dynamic multidimensional analysis capabilities, such as data triangulation, and is one of the main tools for data integration. It can extract, transform, and load data and be used to manage the data dictionary and metadata.

Capabilities: A data warehouse can:

- Congregate data from multiple sources into a single database so a single query engine can be used to present data.
- Maintain data history, even if source transaction systems do not.
- Integrate data from multiple source systems, enabling a central view across the enterprise (chapter 3).

³⁸ SMDX-HD (Health Domain) [webpage]. Available at: <http://www.sdmx-hd.org/>.

³⁹ Wikipedia. Data warehouse [webpage]. Available at: http://en.wikipedia.org/wiki/Data_warehouse.

- Improve data quality, by providing consistent codes and descriptions, flagging or fixing bad data.
- Present the organization's information consistently.
- Provide a single common data model for all data of interest regardless of the data's source.
- Restructure the data so that it makes sense to users.
- Restructure the data so that it delivers excellent query performance, even for complex analytic queries, without impacting the operational systems.

Requirements: A data warehouse requires extensive planning and highly developed information technology (IT) infrastructure. It also requires significant expenditures in IT hardware, software, and ongoing support. Data warehousing yields significant advantages in accessibility and data quality, but given the investment and required IT sophistication, it should not be undertaken without careful consideration of the IT readiness of the system, as well as the cost versus benefit.

The HMN process of country HIS assessment and strategic planning has created worldwide awareness of the need to strengthen and integrate countries' HIS and promotes the building of country data warehouses as a practical way forward. Thus many countries have either planned an integrated data warehouse, are in the process of implementation, or have already done so.

To gain the technical advantage of such a data warehouse, the Internet must be used and a modern server hosting strategy adopted. However, the Internet has limitations (e.g., not all health facilities are connected to it), and innovative solutions are required, such as using the cloud infrastructure, or hybrid online–offline solutions. Finding appropriate hosting strategies is a major—but solvable—technical challenge in implementation.

A Stepwise Prototyping Approach Toward a Data Warehouse

Developing an ICT-based solution to support an integrated data warehouse is complicated—and there are more examples of failure than success. Such system reform will have a better chance of success when attempted within a broader approach applying the key standards listed above, rather than conceived as a technological quick fix.

- Quickly develop an attractive prototype to show main stakeholders key benefits to get buy-in for the project.
- Anticipate future expansion needs, and adhere to global standards for future data transmission.
- Plan for a collaborative process with participation from a wide range of stakeholders at all levels.
- Be responsive to feedback by allowing for an iterative, flexible development process. Use the prototype actively in interaction with the users.
- Involve local staff in all phases of development, and emphasize learning by doing.
- Let organizational needs drive the process; the end goal is to strengthen information use at all levels and not necessarily devise an advanced technological solution.
- Don't reinvent the wheel—many data warehousing tools are available for customization and use.
- Keep it simple and sustainable. Scale up based on available local capacity and resources.
- Make sure the solution fits the context, both in terms of human capacity to use and maintain the data warehouse and in terms of the ICT infrastructure needed to run it.
- Give due emphasis to capacity development. Local knowledge about the importance of use benefits all levels through local interest in data quality. As user maturity increases, data quality will improve, and more functionality will be requested.

Enterprise Architecture

Enterprise architecture is a vision for change in a system, incorporating the environment, principal components and their interrelationships, and the guiding principles of its design and evolution. It is a well-described methodology for aligning information systems with an organization's mission, goals, and objectives. As computer systems become more widespread and independent applications multiply, there is increasing need for overall information system architecture. The question is, "What kind of architecture?"

Purpose and Benefits

The purpose of enterprise architecture is to optimize, across the enterprise, an often-fragmented legacy of processes (both manual and automated) into an integrated environment that is responsive to change and supportive of the delivery of the business strategy. Effective management and exploitation of information through IT is a key factor to business success and an indispensable means to achieving competitive advantage. An enterprise architecture addresses this need by providing a strategic context for the evolution of the IT system in response to the constantly changing needs of the business environment. Furthermore, a good enterprise architecture enables you to achieve the right balance between IT efficiency and business innovation. It allows individual business units to innovate safely in their pursuit of competitive advantage. At the same time, it ensures that the needs of the organization as a whole for an integrated IT strategy are met, permitting the closest possible synergy across the extended enterprise.⁴⁰

Important organizational benefits accrue from good enterprise architecture—benefits that are clearly felt in the enhanced efficiency and productivity:

- A more efficient business operation.
- A more efficient IT operation.
- Better return on existing investment, reduced risk for future investment.
- Faster, simpler, and cheaper procurement.

Four Architecture Domains

These are commonly accepted as subsets of an overall enterprise architecture:

- *Business Architecture*: This defines the business strategy, governance, organization, and key business processes.
- *Data Architecture*: This describes the structure of an organization's logical and physical data assets and data management resources.
- *Application Architecture*: This blueprint guides individual applications to be deployed, their interactions, and their relationships to the core business processes of the organization.
- *Technology Architecture*: This describes the logical software and hardware capabilities required to support the deployment of business, data, and application services—IT infrastructure, middleware, networks, communications, processing, standards, and so on.

⁴⁰ The Open Group. Architecture forum [webpage]. Available at: <http://www.opengroup.org/togaf/>.

For More Information

Sally Stansfield, Nosa Orobato, David Luinski, Steven Uggowitz, Henry Mwanika, *The Case for a National Health Information System Architecture; A Missing Link to Guiding National Development and Implementation* (Geneva: World Health Organization, 2008)

http://www.who.int/healthmetrics/tools/1HMN_Architecture_for_National_HIS_20080620.pdf

Health Metrics Network, *Framework and Standards for Country Health Information Systems*, 2nd ed. (Geneva: World Health Organization, 2008)

http://www.who.int/healthmetrics/documents/hmn_framework200803.pdf

Oracle 9i Data Warehousing Guide, Release 2 (9.2), Part Number A96520-01 (Database Online Documentation)

http://docs.oracle.com/cd/B10501_01/server.920/a96520/concept.htm

The Open Group, “Architecture Forum,” (*enterprise architecture*)

<http://www.opengroup.org/togaf/>

Chapter Summary

This chapter covered themes around data integration and interoperability of information:

- Standardization of indicators and data collection systems across HIS data sources.
- Advocacy and awareness-raising of the benefits of an integrated HIS by good governance and leadership—a culture of information.
- The role of community and health facility levels in strengthening client-level data collection, ensuring data quality control, and promoting information use.
- The district as the first level of where important data sources for health system management meet and the natural first level for an integrated computerized data repository.
- Development of appropriate ICT-based solutions (data warehouse) for an integrated HIS.
- Looking forward—developing HIS based on enterprise architecture.

BASIC STANDARDS

- In system design: Focus on the end user.
- Understand the horizontal and vertical information needs between and among programs.
- Ensure that architecture provides for quality and coverage adequate to create trust in data.

- Respect local autonomy. Managers should be able to define their own data needs and use data locally, as long as basic conditions are met:
 - Interoperability with other systems.
 - The data elements required for the level above are collected.
 - Data definitions and data quality standards are adhered to.
 - Each data element is entered only once onto one data screen.
- Data warehouse approach means that all data is available in an integrated way at one point as a portal (gateway) for access to data.
- Be prepared to redesign work flow and processes as the system evolves.

Chapter 4. Governance of RHIS Data Management

Data management governance is at the core of all information systems and is crucial for the functioning of an RHIS. This chapter defines RHIS governance, provides an overview of governance of RHIS, and proposes standards for data management governance which, when applied, can strengthen RHIS performance. We first look at formal governance structures such as SOPs and strategic planning and financial systems, as well as oversight mechanisms such as technical working groups (TWG). We then look at workforce development, training, and supervision to identify best practices pertaining to RHIS staffing. Policies and procedures for data management are discussed next, with particular regard to data and metadata stewardship. The following section looks at RHIS assessment, starting with general assessment questions and then exploring the Performance of Routine Information Systems (PRISM) model⁴¹ to see how RHIS converts inputs into appropriate outputs by influencing determinants of health outputs (organizational, behavioral, and technical) and their influence on overall health system performance. The final section discusses ways to promote a culture of information use.

You will learn about the following in this chapter:

- Formal structures for effective RHIS governance and management.
- Staffing and workforce development.
- ICT infrastructure.
- Policies and procedures for data management.
- Monitoring and evaluation of RHIS.

Governance Defined (in the Context of Data Management)

Governance in data management can be defined as:

The development and implementation of administrative policies, procedures, and processes that define workflow, program inputs and outputs, management structure and oversight functions, and the methods and frequency of performance evaluation.

Data management governance dictates how the different components of the RHIS, at the same or different levels of the health system, work together to achieve a common goal—quality health data for decision making.

⁴¹ MEASURE Evaluation. PRISM: Performance of Routine Information System Management Framework [webpage]. Available at: <http://www.cpc.unc.edu/measure/tools/monitoring-evaluation-systems/prism>.

For the purposes of this set of best practices, governance is applied largely to RHIS and is seen as a core function of management—that is, to monitor, assess, and strengthen these systems to facilitate improvements in service delivery.

Data management governance ensures that data is of high quality—reliable, consistent, and complete—as well as readily available to stakeholders (i.e., consumers, or those who require health information to inform decision making). In practical terms, that means putting personnel, policies, procedures, and organizational structures in place to ensure that data is accurate, consistent, secure, and available.

The process of data management governance should foster cross-organizational collaboration, facilitate structured policy making, and balance ad hoc or narrow information needs with the organizational interest. Interventions to improve governance should address the institutional, behavioral, and technical determinants of RHIS performance and focus on improving the desired RHIS output of good-quality data that is regularly used to improve service delivery.



Figure 15. Schematic for governance of RHIS data management.

Formal Governance Structures

RHIS governance is the oversight and monitoring function necessary to ensure that the RHIS functions as designed. Adequate governance allows the system to identify threats to performance and make necessary corrections, as well as to find opportunities to improve RHIS and advance the aims of the system. Governance structures are the formal mechanisms through which this oversight takes place, including organizational frameworks, TWG, and boards of directors. Management structures are the mechanisms through which the RHIS is administered—including personnel for monitoring and implementation and its functions for strategic and financial planning, administrative and financial management, and supply chain and logistics. Governance structures oversee the management functions and inputs to ensure optimal system functioning.

This chapter explores standards for governance structures as well as for the management structures and functions monitored as part of governance of the RHIS.

MISSION STATEMENT

A mission statement is a formal expression of the purpose of the organization and its reason for being. The mission statement guides organizational actions and decision making. A good mission statement clearly states the reason for the organization's existence and often includes goals, names primary stakeholders, and articulates how the organization provides value to stakeholders.

Mission statements help maintain focus by reminding stakeholders of the primary purpose of the organization and thereby simplifies the process of determining which potential objectives or courses of action are extraneous.

That said, a mission statement should be broad enough to permit innovation and experimentation. The mission statement can also be used as a barometer to judge current efforts and output.⁴²

The Uganda HMIS mission statement is a representative example:

“Provide quality and timely health-related data and information to all stakeholders.”⁴³

⁴² Hill CWL, Jones GR. *Strategic Management: An Integrated Approach*, 8th ed. Boston, MA: Houghton Mifflin Company; 2008.

⁴³ HMIS Resource Centre, Uganda Ministry of Health. The Resource Centre [webpage]. Available at: http://www.health.go.ug/hmis/index.php/info/resource_centre.

ORGANIZATIONAL CHART

An organizational chart is a diagram used to depict the organization’s structure and personnel. It identifies the hierarchical relationships among and between entities, positions, and personnel and serves as a map of the structure and positions within the organization. It helps organize personnel by identifying management control within the organization.

An organizational chart is useful for planning, resolving disputes, and managing change. It can be used as a baseline for planning, budgeting, and workforce modeling as it gives a succinct overview of the organization.

An organizational chart should be easy to update, should be kept current, and should be made available to all stakeholders—for example, accessible on the internet.^{44,45}

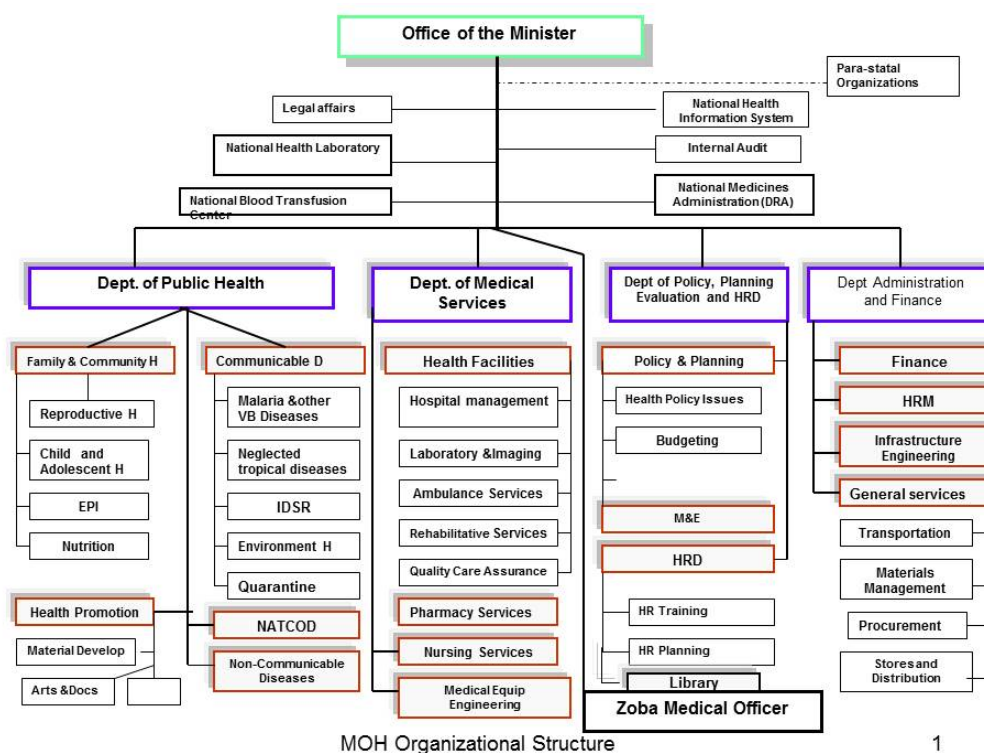


Figure 15. Representative organizational chart within Eritrea Ministry of Health.

⁴⁴ Wikipedia. Organizational chart [webpage]. Available at: http://en.wikipedia.org/wiki/Organizational_chart.

⁴⁵ Orgchart.net. Main page [webpage]. Available at: http://www.orgchart.net/wiki/Main_Page.

STANDARD OPERATING PROCEDURES

Human beings are at the center of all health systems, and their governance roles and responsibilities need to be clearly defined in a set of SOPs that form part of the organizational culture of the RHIS. SOPs should describe clearly who should do what, when, and with what resources, in order to manage and maintain the RHIS.

An SOP is a written document or instruction detailing all relevant steps and activities of a process or procedure: “detailed, written instructions to achieve uniformity of the performance of a specific function.”⁴⁶

SOPs should provide employees with a reference to common business practices, activities, or tasks. For an RHIS, SOPs need to be specific to:

- The level of the health service management—that is, the client, facility, or system as a whole.
- The type of health worker (e.g., community health worker, clinical health professional, information officer, or DHMT member).

SOPs should be written in easily understandable language (and translated into the local language if necessary) and should be widely available in electronic and hard copy throughout the organization, forming the basis of pre-service and in-service training of all cadres of staff. The SOPs should also be the focus of supervision.

Local staff needs to buy into these SOPs, and their development should be a consultative and participatory process that is repeated at regular intervals to keep the SOPs from becoming outdated.⁴⁷

⁴⁶ See <http://www.merriam-webster.com/dictionary/standard%20operating%20procedure>.

⁴⁷ International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use. Efficacy single, good clinical practice E6(R1) [webpage]. Available at: <http://www.ich.org/products/guidelines/efficacy/efficacy-single/article/good-clinical-practice.html>.

2.3.2 Reporting HMIS Data

All health data should be reported using the standard HMIS tools developed and produced by the Ministry of Health. This should be done in the stipulated time to ensure timely decision making.

Please refer to the HMIS procedure manuals for the deadlines for the different datasets for reporting.

Steps involved in HMIS reporting include;

- Step 1: Using the daily summary tables compile the weekly and monthly reports.
- Step 2: Using the monthly summary tables compile the quarterly and annual reports
- Step 3: The health unit in-charge should cross check the HMIS reports for errors before submission to the next level
- Step 4: Submit the respective HMIS form to the next level e.g. HMIS 105 from the health unit to the Health Sub-District (HSD)
- Step 5: The summary tables should be retained and regularly up-dated in the health facility/HSD/District databases.

Figure 16. Representative standard operating procedures for RHIS.⁴⁸

REPORTING STRUCTURES

In the field of RHIS, data and information begin at the periphery (i.e., the service delivery point, which can be either a facility or the community) and then flow toward the center (i.e., the national level); it must also be shared horizontally (e.g., with stakeholders at each level of the health system). Consequently, the reporting structure is critical to ensure that relevant information based on quality data is available to those who need it in timely fashion.

Reporting structures include directives from RHIS management at national level, which state who reports what and to whom, when reports are due, and in what format and by which mechanisms.

In the context of RHIS, reporting structures clearly define:

- The source document for reporting—that is, the individual client record (e.g., the medical record or client encounter form).
- The standardized, aggregate, periodic indicator report for reporting to the next level (e.g., the monthly or quarterly report).
- Reporting deadlines—the date reports of various types are due to the next level.

⁴⁸ Uganda Ministry of Health. *Standard Operating Procedures for Health Information*. Kampala, Uganda: Ministry of Health; 2011. Available at: <http://www.health.go.ug/hmis/public/files/sop.pdf>.

- Procedures for indicator calculation and compilation, and completing the forms—what values to count in the register or how to deal with missing values, where the reports should be sent and by what mechanism.
- Procedures for sending the data to the next level. For paper systems, should that be by registered mail or courier? Is it acceptable to hand the report to a passing taxi driver going to the district seat? For electronic systems, should a report be sent as an email attachment, using a specific file transfer protocol (FTP) or downloaded to external media and sent by courier?
- Procedures for data quality review. Who is responsible for data quality review prior to submission, and upon receipt of a report at the next level? What is the procedure in the event a data quality issue arises or an incomplete and/or late report is received? Is a phone call made to solicit a missing report or amend an error in the report?
- Sanctions (if any) for failure to meet reporting obligations.
- Policies and procedures for obtaining standardized reported data from private providers and institutions.
- Which staff member or members monitors the reporting of performance and compliance? How are these standards enforced? For example, is there a standardized monitoring tool?

MASTER FACILITIES LIST

A master facilities list is a complete listing of all unique public, private, and faith-based health service delivery sites in a country, with information about capacity and services available. It is usually a searchable, referential, electronic database maintained at a central location (e.g., the national-level offices of the RHIS within the MOH). It is dynamic and should be kept up to date as facilities are added or subtracted from the system. A master facilities list should have two components:

- The signature domain—a set of identifiers that permit the unique identification of a given health facility.
- The service domain—the available services and capacity of each health facility, information that is essential for health system planning and management, and resource allocation.

A master facilities list improves record keeping by improving transparency and reporting efficiency—it minimizes duplicate reporting. The list can facilitate effective sampling for health facility assessments and service availability mapping. Finally, it helps promote better analysis and synthesis of data to improve decision making and health system functioning.⁴⁹

PLANNING STRUCTURES

Planning is critical to ensure that RHIS resources are targeted efficiently and according to need, so that maximal benefit is achieved from RHIS investments. Planning *structures* refers to mechanisms for planning,

⁴⁹ World Health Organization. *Creating a Master Health Facility List, Draft*. Geneva, Switzerland: World Health Organization; 2012. Available at: http://www.who.int/healthinfo/systems/WHO_CreatingMFL_draft.pdf.

such as periodic program reviews and needs assessments, combined with financial reviews and budgeting. Setting targets and situational analyses are also aspects of regular planning.

Annual and Five-Year Strategic Planning Structures

A strategic plan is a tool that guides efforts to fulfill a mission with efficiency and maximum impact. Strategic planning allows RHIS managers to articulate goals and to list the steps required to achieve them. It will outline the resources required and the necessary staffing. The strategic plan states what will be done, and with what personnel and resources for the future. Ideally, strategic planning should be conducted every five years and the plan updated to meet changing needs and goals. The strategic plan should include a budget and M&E plan to monitor performance toward established targets, both long- and short-term targets. The M&E plan should have indicators to monitor performance, with indicators linked to activities, and activities linked to objectives and goals.

The strategic plan should be reviewed annually, with specific tasks for the year outlined and budgeted. The annual plan, or operational plan, will guide yearly activities and ensure the project is on track to meet stated goals and objectives. Targets for indicators should be updated with current information to ensure they are grounded in reality.

Target Setting

Setting a target for a given health activity is akin to setting a goal. For each indicator, a target is set—for example, a given district will HIV-test 1,000 pregnant women during ANC in the next quarter. The program's performance is monitored against this target. If the target is valid and is attained, you can be reasonably assured that the program is functioning as designed.

Setting appropriate targets requires advance knowledge of the disease or health priority in question. A baseline value for the target is required to know the current status of the problem before it is known how well the program has performed. Baseline values can be taken from surveys or from historical data if it is of good quality. If baseline and historical data are lacking, a baseline survey should be scheduled at program startup in order to set the standard by which the program's effectiveness will be judged.

Targets should be realistic and based upon past experience—that is, on historical trends that show the pattern of change observed over time.

Stakeholder expectations of progress achievement should also be considered when setting targets. Expectations of program managers or implementers may be useful to provide a realistic idea of what can be

achieved. Expert judgment, the accomplishments of similar programs (with high performance), and research findings can also be used (and should be).⁵⁰

Regular Situational Analysis Reporting

A situation analysis is a method for managers to analyze the internal and external environments in an organization to understand the organization’s own capabilities, strengths, weaknesses, and opportunities for improvement. It often includes an analysis of past and present data to understand trends that can influence performance.

A *SWOT analysis*, which looks at strengths, weaknesses, opportunities, and threats, is a type of situational analysis reporting that can be used to assess an organization’s present situation and to improve future realities. Such an analysis can build on strengths and reduce weaknesses and can lead to improved planning to strengthen the organization’s position for the future.

Table 7. Representative SWOT analysis.⁵¹

	STRENGTHS	WEAKNESSES
INTERNAL	Efforts which are currently being made by the FMOH to reform the HMIS of the country.	The legal and regulatory framework of HIS is not strong.
	Good collaboration/coordination between MOH and the Central Statistics Agency (CSA).	HIS development across the country is unbalanced; greater support is required in regions where there is poor infrastructure.
	The CSA has accumulated ample experience in conducting a nationwide census.	Lack of adequate and skilled human resources leads to poor data quality. Attrition rate of skilled human resources is high.
	OPPORTUNITIES	THREATS
EXTERNAL	Government interest by the FMOH and CSA is strong to strengthen the Ethiopian HIS.	Financial resources are inadequate: Ethiopia is a country with many problems. It cannot cover the expenses required to put in place the anticipated HIS and ensure sustainability.
	There is a National Advisory Committee (NAC) that could take on a leader role in bringing together all stakeholders to create consensus.	Some stakeholders are suspicious as to whether the present assessment tool results in identifying the most important areas that would help to use health information effectively. This view was reflected during the Adama HIS assessment workshop.

⁵⁰ U.S. Agency for International Development (USAID). Establishing Performance Targets. In: *Performance Monitoring and Evaluation TIPS*, no. 8. Washington, DC: USAID; 1996. Available at: http://pdf.usaid.gov/pdf_docs/PDABQ856.pdf.

⁵¹ Federal Democratic Republic of Ethiopia Ministry of Health and Worth Health Organization, Ethiopia. *Assessment of the Ethiopian National Health Information System: Final Report*. Addis Ababa, Ethiopia: Ministry of Health; 2007:37-38. Available at: http://www.who.int/healthmetrics/library/countries/HMN_ETH_Assess_Final_2007_10_en.pdf.

Mechanism for Upgrading Facilities and Equipment and for Acquiring New Staff

A standard mechanism should be established to requisition new equipment, or make physical upgrades to facilities, district management offices, and other RHIS workplaces. Potentially, such a system will be part of other government systems for making capital improvements to government infrastructure. Likewise, a standardized system should be in place for requisitioning new staff. Upgrading facilities and augmenting staff should be based on the results of needs assessments or other forecasting.

FINANCIAL PLANS AND MECHANISMS

RHIS management and its oversight by governance structures require financial resources, which most often derive from the public coffers. Sound, transparent management of these funds is critical to maintaining public trust in the RHIS and its information products. To promote transparency, periodic financial reporting should be conducted—perhaps annually—to ensure that RHIS stakeholders and other interested parties are assured that public finances are used judiciously. To ensure the most efficient use of public funds, forecasting and needs assessment should be conducted regularly. Forecasting is the act of predicting, in a systematic way, RHIS financial needs. Increasingly, RHIS financing is being used to improve performance by linking information to resource allocation. Many countries have:

- Introduced schemes for performance-based financing of health facilities and services, using data directly for budget allocation.
- Established insurance schemes or are exploring the option—insurance that is paid out based on data, an important area for RHIS strengthening. Insurance information systems must be well integrated with the RHIS to achieve mutual benefits between RHIS and the insurance payments.

Adequate Staffing and Workforce Planning and Development

People are the lifeblood of RHIS, and it would generate no information products without the combined efforts of all RHIS staff. It is critical that RHIS staff have the training they need to perform the tasks expected and to produce the data and information necessary to adequately monitor the health system. Adequate numbers of staff is also necessary. How many staff are enough? Having a staff that is too small risks underperformance, while a staff that is too large risks wastage of precious RHIS resources. The staff and its training should be organized, efficient and of high quality. Certain standard elements of RHIS staffing and training help ensure high quality output from the workforce while avoiding redundancy or wastage.

TRAINING INFRASTRUCTURE

Training is critical to provide the core competencies required to complete the tasks to achieve program goals and objectives. The RHIS should have the necessary training infrastructure to ensure that training is comprehensive and high quality. Training infrastructure includes:

A Training Plan

A training plan explicitly maps out who is to be trained for what and when (and how often). The plan should be based on a needs assessment to identify gaps in workforce capacity and should be updated periodically so that it is always current. The plan should cover the range of training needs for the entire workforce, including pre-service and in-service training, and should specifically address requirements for each level of the health system—since training needs will be different at service-delivery level than at district level and higher.

Standardized Training Curriculum/Materials

A standardized curriculum ensures that competencies learned in one part of the country are the same as those learned everywhere else. Since the tasks performed are the same in every district, training for those tasks should also be the same in every district. The curriculum should be pilot tested to gauge its effectiveness at building competence, and for trainee perception of its acceptability and usability.

The curriculum should be easily updated and available from a central repository (e.g., on the Internet), so that updates to the curriculum can be accessed readily and remotely. Accessibility will help ensure that the latest materials are used for training nationwide.

Training Institutions

Training institutions, including universities and training hospitals, need to include RHIS modules in their programs and to be supported to implement standardized RHIS training curricula. They need to collaborate with RHIS capacity-building partners to participate actively in the development of the RHIS curriculum and to form an RHIS capacity development network.

Training Database

A database that documents who was trained in what domain or skill set, where, and when will help identify institutional and individual training needs by geographical subunit within the country. A database will also permit monitoring of the effectiveness of the training plan by facilitating analysis of training data. The

training database should be available to stakeholders when needed—and integrated into the larger electronic information system for the RHIS—so that training needs are considered when conducting overall strategic planning and budgeting for the RHIS.

SUPPORTIVE SUPERVISION AND MENTORING:

Supervision is critical for cementing gains made in capacity development during training. Following up after training ensures that health workers can implement the skills they have learned during the training. Supervision should be focused on the conditions required for proper functioning of the system—that is, the SOPs. Supervisors should be asking: “Are all the key elements present? Are the functions being performed adequately?” Effective supervision should include joint observation of the tasks performed, followed by discussion of strengths and weaknesses and direct problem solving. Best practices for supervision include:

Availability of Guidelines for Standardized, Effective Supervision

Supervision, like training, should also be standardized across the program, so that RHIS workers receive the same support everywhere. Guidelines on effective supervision techniques should be prepared and distributed with training to staff conducting supervisory visits. The guideline describes step by step what should be done before, during, and after each supervisory visit.

Standardized Supervisory Checklists

A standardized checklist should be used while conducting supervisory visits. The most important tasks, such as an indicator compilation, should be reviewed with RHIS staff and their performance assessed. A checklist will help ensure that the most important elements are reviewed, while reducing the burden on supervisors and those being supervised. Also, a checklist will permit the comparison of performance across facilities and districts.

Feedback

The results of supervisory visits should be communicated to the staff members being supervised so that they are aware of their own performance and areas of strength and weakness. Individual counseling (mentoring) should be conducted during the supervisory visit, while a compiled report should be shared with the unit shortly thereafter.

Standardized Supervision Reports—Tracking Results and Monitoring Trends

A standard report of the results of supervision should be prepared and submitted to the RHIS management at higher levels, so that the information can inform the planning process. Data from supervision should be used to gauge whether RHIS staff are improving over time, or not. RHIS management should react to problems uncovered during supervision and make plans to address them during the planning process.

Schedule of Supervisory Visits

Supervision should be conducted regularly, on a set schedule, depending on available resources. Not every health facility needs to be visited every quarter, but efforts should be made to visit each facility at least once per year—problem sites more often.

Data Quality Checks

Data accuracy should be assessed for one or two priority indicators when performing supervisory visits to health facilities. The indicator value for the latest reporting period should be recalculated using the register or other source document and the value compared to the reported value for the same period. The results of these checks should be monitored for the same indicator over time to gauge the trend in reporting accuracy.

Information and Communication Technology Infrastructure

ICT are electronic tools used for managing and transmitting data and information, such as computers (hardware and software), networks, tablets, personal data assistants (PDAs), flash media, and communication tools, such as cell phones, modems, e-mail, instant messaging, and social networking.

ICT are playing an increasingly important role in innovation for data generation, analysis, interpretation, and use—allowing data products to be produced at ever lower levels and decision support systems to be decentralized to the lowest levels. ICT is also revolutionizing information dissemination and exchange, with interoperable databases and locally adapted dashboards at all levels of the system. Good computer software enables higher levels to see raw data disaggregated to the facility-level place of collection, giving *granularity*, or detail, to data.

MOH RHIS management should research ICT needs and invest in the tools that reduce workload, improve data quality and availability, and expand the knowledge base of the health workforce. Not all ICT are necessary, and investment in ICT is expensive. Investments should be made wisely, according to needs assessment and cost/benefit analysis. ICT that are put to use for RHIS should be well maintained and

supported, with funds and dedicated personnel. The ICT infrastructure should be monitored and its use evaluated periodically for effectiveness.

A policy framework should be developed by the MOH to manage ICT resources in the system. What resources to acquire, how they should be used and by whom, when they should be upgraded or replaced, and how they are maintained should all be codified into the framework to ensure efficient stewardship of RHIS resources.

Because RHIS personnel should not be expected to have knowledge of maintenance and repair of ICT hardware and software, outside resources can be utilized. Reputable, licensed computer hardware and software vendors and repair firms can be contracted to maintain the ICT resources in the HMIS, reducing the burden on HMIS personnel and allowing them to focus on data collection, analysis, and use for planning and management.

Policies and Procedures for Data Management Governance

The management of RHIS data should be standardized such that the steps performed in turning data into information are the same throughout the system—the same from one district or facility to another. These steps and processes should be well defined, detailed, written down, and made accessible to all staff and other stakeholders in the data management process. Processes should be supported by policies that are well known and enforced, so that standards are applied uniformly across the system. The following are standards and best practices for data management policies and procedures:

REGULATORY AUTHORITY

Governments use their authority to safeguard the public's health in many ways. They use their control over public finances to set disease control priorities and allocate resources to public health entities at national and subnational levels. The government also uses its inherent powers to protect public health by enacting and enforcing safety and sanitary codes, conducting inspections, mandating the reporting of specific epidemic diseases, compelling isolation and quarantine, and licensing health care workers and facilities.

For an RHIS to function effectively, all public and private facilities should routinely report, using standard mechanisms, to the RHIS. To efficiently target resources for disease control and prevention, RHIS managers need to understand where disease is occurring in the population and where services are being utilized. Without accurate targeting based on complete, reliable data, resources can be wasted by sending too much to areas that do not need it or too little to areas that do.

Regulatory authority often takes the form of public institutions empowered to regulate public health practice according to government imposed standards, for example the Nigerian government set up the National Agency for Food and Drug Administration and Control (NAFDAC) to regulate the production and sale of prescription drugs. In Nigeria, the Health Records Officers Registration Board is responsible for maintaining the licensure of health record practitioners.⁵²

Regulatory authority is necessary to ensure complete reporting from all sources of health service delivery, both public and private. The MOH can compel health facilities that are publicly owned to report health data by creating incentives or penalties for compliance and noncompliance—threats to withhold salaries or other incentives can be a particularly effective motivator for health facilities. However, the MOH has no formal influence over private providers to ensure reporting, other than the regulatory authority provided through government. Thus, regulatory authority to compel reporting, particularly from the private sector, is essential for the timeliness and completeness of health data.

EXAMPLE

National Monitoring and Evaluation Policy—Republic of Kenya **Ministry of State for Planning, National Development and Vision 2030 (2012)**⁵³ *Reporting Structures*

The National Monitoring and Evaluation Policy will enhance implementation of the National Integrated Monitoring and Evaluation System (NIMES), enabling all sectors to undertake M&E activities and submit reports as the policy requires. Each ministry's Ministerial Monitoring and Evaluation Committee (MMEC), in conjunction with the Central Planning and Project Monitoring Unit (CPPMU), will prepare quarterly and annual M&E reports, including amalgamated reports from all stakeholders that will be submitted by line ministries' principal secretaries to the Monitoring and Evaluation Directorate (MED).

The national M&E policy will facilitate reporting and engagements that are both vertical (from subcounty to county to national levels) and horizontal (between and among state and nonstate actors). Line ministries' departments at the devolved level will provide timely and qualitative management reports to headquarters through the vertical reporting system.

At a minimum, the private sector should: report all epidemic disease as it is diagnosed, either in case report form or via phone calls for such high-priority epidemic diseases as cholera; report service utilization statistics as defined by the MOH; and maintain an archive of health records for a duration specified by the MOH.

⁵² Lister SA. *An Overview of the U.S. Public Health System in the Context of Emergency Preparedness, CRS Report for Congress RL31719*. Washington, DC: Congressional Research Service, The Library of Congress; 2005. Available at: <http://www.fas.org/sgp/crs/homsec/RL31719.pdf>.

⁵³ National Monitoring and Evaluation Policy. Republic of Kenya, Ministry of State for Planning, National Development and Vision 2030. March 2012.

WRITTEN INSTITUTIONAL DATA GOVERNANCE PLAN BASED ON BEST INTERNATIONAL PRACTICES

An RHIS governance plan refers to roles and processes in an enterprise that serve as a guideline for fulfilling, sustaining, and extending RHIS planning. A governance plan crosses all organizational layers, including stakeholders, administration, maintenance, strategy, policy, and support.⁵⁴

An RHIS governance plan defines oversight roles and responsibilities and the relationships among entities within RHIS management. The plan should clearly state who does what, when, and how with regard to RHIS management, to management of data and information, and to decision making. A governance plan is useful in times of transition or change in the RHIS, since it provides a reference tool to clarify roles and settle disputes.

A FUNCTIONAL DATA GOVERNANCE COUNCIL WITH DEFINED RESPONSIBILITIES AT ALL LEVELS

RHIS oversight committees should be formed at each level of the system—that is, in each district or region—to monitor system performance. The oversight committee should be made up of RHIS stakeholders from health care institutions, implementing partners, local governments, and, where possible, the private sector. These committees should facilitate the RHIS stated mission in their area of influence by monitoring performance, alerting RHIS management to strengths and weaknesses, and facilitating capacity building.

ESTABLISHED DATA STANDARDIZATION POLICIES, FRAMEWORK, AND PROCEDURES

Most countries still lack policies that bring together the various components of RHIS under a single unifying framework and that provide clear lines of responsibility and functionality. RHIS management structures should be strengthened centrally and resources and authority decentralized to serve the specific needs of the people involved in implementing RHIS, particularly at the periphery.

The RHIS framework in both national health policies and strategic plans should encapsulate an integrated RHIS as part of overall health systems strengthening and governance reform, with buy-in to the plan from political authorities, the MOH, and donors. The framework should recommend the pooling of RHIS expertise and resources into “one plan, one framework and one funding mechanism.”⁵⁵

⁵⁴ Technopedia. Governance plan [webpage]. Available at: <http://www.techopedia.com/definition/2910/governance-plan>.

⁵⁵ Paris Declaration on Aid Effectiveness: Ownership Harmonization, Alignment, Results and Mutual Accountability. In *The Paris Declaration on Aid Effectiveness and the Accra Agenda for Action*. Paris, France: Organization for Economic Co-operation and Development; nd:4-13. Available at: <http://www.oecd.org/dac/effectiveness/34428351.pdf>.

Countries also need a practical RHIS operational plan wherein all RHIS activities within the MOH are centrally guided, with clear lines of decentralized responsibilities in the spirit of administrative, financial, and operational decentralization toward states/provinces and districts.

As defined in the RHIS framework, institutionalized mechanisms should be developed for integrated RHIS data quality assurance (as measured by its completeness, accuracy, timeliness, and consistency), with validation rules for electronic systems and a team approach to data quality. In addition, these policies should:

- Specify interoperability of RHIS subsystems.
- Define human resource needs and capacity strengthening requirements.
- Define responsibilities for data collection, information flow, and use.

National policies should provide for a balanced, limited set of national indicators, which are regularly reviewed in a participative manner, with clearly defined numerators and denominators, data sources, baselines, and national targets. There should be an annual indicator review process in which program and subnational managers participate to ensure that the existing indicator set fulfills their needs.

Most countries have policies, laws, and regulations governing health services that, if applied, would greatly improve health system functioning. Too often inadequate resources or a lack of incentives mean that these policies are not enforced. Their implementation could be strengthened by the application of SOPs.

METADATA STEWARDSHIP

In RHIS, *stewardship of metadata*, or responsible planning and management of data about data, is needed to foster consistent use of data management resources and facilitate data mapping among computer systems. A data steward holds responsibility for maintaining a data element in a metadata registry. Data stewardship roles are common when organizations need to exchange data precisely and consistently among computer systems and to reuse data-related resources. A data steward ensures that each assigned data element:

- Has a clear and unambiguous definition.
- Does not conflict with other data elements in the metadata registry.
- Is being used and is being used consistently in all interlinked computer systems; unused data elements are removed.
- Has adequate documentation on appropriate usage and notes.
- Is documented with regard to its origin and sources of authority.

Assignment of data elements to an individual promotes trust in systems where users can contact a specific staff member with questions on specific data elements.

DATA QUALITY ASSESSMENT AND AUDITING

Data quality should be assessed periodically to enhance confidence in the data and promote the use of the data for decision making. Data quality should be assessed routinely for high-priority indicators as a part of regular supervision, and less often, although periodically, for other indicators. A periodic assessment of RHIS performance—for example, via PRISM—should include a data quality assessment.

Monitoring and Evaluation

MAINTAINING RHIS QUALITY

According to the PRISM framework, technical, organizational, and behavioral factors are crucial to converting RHIS functions into the key outputs in the form of quality data that is regularly used so as to improve health system performance.

Technical Factors

These are related to the specialized know-how and technology to develop, manage, and improve RHIS processes and performance. Affecting RHIS performance both directly and via behavioral factors, they include: RHIS design, computer software, and the complexity of information technology and of reporting forms and procedures.

Organizational Factors

Factors relating to organizational structure, resources, procedures, support services, and culture promote a “culture of information”—the capacity and control to promote values and beliefs within the organization by collecting, analyzing, and using information to achieve the organization’s goal and mission. Organizational factors include: governance, planning, resource availability, training and capacity development, supervision, finances, information distribution, and the culture of information.

Behavioral Factors

These include: the RHIS users’ demand for data, data quality checking skills, competence and problem-solving skills for RHIS tasks, confidence levels in their ability to perform RHIS tasks, and motivation to perform at peak ability. These behavioral factors are influenced by both technical and organizational determinants (above).

Looking at Performance

A major test of the effectiveness of RHIS governance is regular participatory assessment to see whether it is improving health program outputs and health impacts. Yet, surprisingly, this aspect of performance is rarely formally evaluated.

RHIS impacts on health programs can be measured by four simple questions:

- Is the information relevant?
- Is the information of good quality? (Is it timely, consistent, complete, and accurate?)
- Is the information presented in a user-friendly way? (Is it easy to access and easy to interpret?)
- Is there capacity to act on the information provided?

The answers to these questions need to be approached in a way that addresses the health systems framework by looking at technical, organizational, and behavioral determinants and should be further elaborated by asking:

- Has the RHIS been decentralized, and have lower-level program managers contributed to decision making?
- Have the systems been integrated and contributed to broader program integration?
- Has RHIS contributed to evidence-based decision making and more effective health outcomes?

ASSESSING RHIS FUNCTIONALITY

There are many established ways to assess RHIS functionality, including:

Self-Assessment

To strengthen data management, countries should institutionalize regular self-assessment data use meetings, particularly at facility and district levels. Self-assessment should use local data to calculate indicators in order to review performance against targets for client, facility, and system indicators and to compare the results to those of similar institutions, other geographic areas, and national norms. Self-assessment meetings should be conducted at least quarterly and should be made part of routine SOPs for work and management procedures.

Health Metrics Network Assessment Framework

This comprehensive assessment framework, considered the gold standard for HIS assessment, asks stakeholders approximately 200 questions regarding all six HIS components—HIS resources, indicators, data sources, data management, information products, and data dissemination and use—and scores the

answers electronically, producing a series of graphs for each component.⁵⁶ As the HMN framework deals with the holistic HIS (the RHIS being just one aspect of which), it is not discussed further here, but constitutes a valuable tool for evaluating HIS functionality, in which RHIS plays a significant role.

The PRISM Framework

The PRISM framework and toolkit takes a holistic approach to RHIS monitoring and evaluation, seeking to assess system performance by investigating RHIS performance determinants (the technical, organizational, and behavioral factors described above). Performance, as assessed by the PRISM methodology, is measured by the level of data quality, the extent of data use for decision making, and the management capacity. The output of the assessment toolkit is measured against a pre-set standard according to the Lot Quality Assurance Sampling (LQAS)⁵⁷ technique employed by the methodology. In this way, performance can be measured nationally, as well as subnationally, using a relatively small sample of health facilities.

PRISM assessments can be used to establish a baseline measurement of performance and can then be repeated after RHIS interventions to gauge their effectiveness. PRISM tools can also be used for routine monitoring of RHIS performance (such as conducting data quality checks as part of routine supervision).

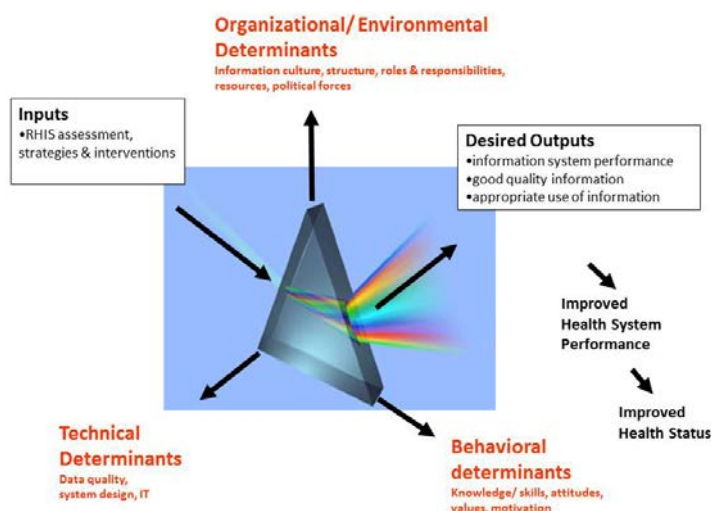


Figure 17. The PRISM framework.

⁵⁶ Health Metrics Network, *Framework and Standards for Country Health Information Systems*, http://www.who.int/healthmetrics/documents/Components_of_a_strong_HIS.pdf.

⁵⁷ <http://www.cpc.unc.edu/measure/training/materials/outcome-monitoring-and-evaluation-using-lqas>

PRISM Tool Kit: In order to measure RHIS performance, processes, and determinants and their relationships described under the PRISM framework, four tools have been developed and standardized that use interviews, observations, and pencil-and-paper tests to collect data. Information obtained through the PRISM tools provides a comprehensive picture of the RHIS, creating opportunities for intervention and system strengthening.

- *RHIS Performance Diagnostic Tool:* This tool determines the overall level of RHIS performance, looking separately at data quality and data use. The tool specifically measures: RHIS performance; status of RHIS processes; the promotion of a culture of information; supervision quality; and technical determinants. The tool provides opportunities to compare RHIS performance with status of RHIS processes and other determinants as well as to identify strengths and gaps for appropriate actions and interventions.
- *RHIS Overview Tool:* The mapping section of the RHIS overview provides information on all existing routine information systems, their interaction, and their overlaps. Thus, it identifies redundancies, workload, and levels of fragmentation and integration, which create demand for integrated information systems development. The review also provides information on the complexity and user-friendliness of registers and forms. Lastly, a flow chart provides information about horizontal and vertical transmission and decision-making nodal points. The office/facility checklist assesses resource availability at facility and higher levels. A comparison of resources availability (human, equipment, logistics) with RHIS performance provides information as to whether resources are appropriate.
- *RHIS Management Assessment Tool (MAT):* This tool is designed to rapidly take stock of RHIS management practices such as governance; planning; training; supervision; use of performance improvement tools; and finances. The tool provides information on the level of RHIS management functions and indirectly reveals senior management’s commitment to an efficient and effective RHIS.
- *RHIS Organizational and Behavioral Assessment Tool (OBAT):* This tool identifies organizational and behavioral factors that affect RHIS performance, such as motivation, confidence levels, demand for data, task competence, and problem-solving skills—the organizational variables explore promotion of a culture of information and rewards. OBAT compares RHIS knowledge, skills, and motivation with actual performance and identifies the strengths and weaknesses of behavioral factors. Similarly, it is possible to determine to what extent organizational factors influence performance, directly or indirectly, through behavioral factors.
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For More Information

World Health Organization, “Health Financing for Universal Coverage,” 2013

http://www.who.int/health_financing/en/

World Health Organization, “Health Financing for Universal Coverage: SimIns Health Finance Policy Tool,” 2013

http://www.who.int/health_financing/tools/simins/en/index.html

Jurien Toonen, Ann Canavan, Petra Vergeer, and Riku Elovainio, Learning Lessons on Implementing Performance Based Financing, from a Multi-Country Evaluation: A Synthesis Report Drawing on Lessons from Country Study Reports Cordaid/HealthNet TPO Experiences in PBF Pilot Projects in Democratic Republic of Congo, Tanzania, Zambia, Burundi, Rwanda National PBF (Retrospective Study) (Amsterdam: Development Policy & Practice Amsterdam, n.d.)

http://www.who.int/health_financing/documents/performance_based_financing_synthesis_report/en/

Paul Jacob Robyn, Rainer Sauerborn, and Till Bärnighausen, “Provider Payment in Community-Based Health Insurance Schemes in Developing Countries: A Systematic Review,” Health Policy and Planning 28, no. 2 (March 2013), for linking RHIS to health insurance schemes

[doi:10.1093/heapol/czs034](https://doi.org/10.1093/heapol/czs034)

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Chapter Summary

This chapter discussed the following standards around data management and governance:

THE IMPORTANCE OF CLEAR MANAGEMENT STRUCTURES

- Clearly defined reporting structures.
- Standard Operating Procedures.
- Strategic and financial planning mechanisms.
- The need for a master facility list with attribute data and a way of keeping the list current.
- The importance of targets, annual plans, internal and external reviews, and planning structures.
- A regulatory body to oversee the RHIS.
- Appropriate planning for RHIS upkeep and improvement, including finances, equipment, personnel, training and capacity building, audits, etc.

STANDARDS RELATING TO STAFFING AND WORKFORCE PLANNING AND DEVELOPMENT

- Training infrastructure, including planning, standardized curricula, and data on training.
- Supervision and mentoring, with standard procedures, checklists and reports, data quality checks, and feedback.

STANDARDS RELATING TO APPROPRIATE, UPDATED, AND WELL MAINTAINED ICT INFRASTRUCTURE

- Need for ICT policy.
- Need for maintenance and troubleshooting services (eventually outsourced).

IMPORTANCE OF POLICIES AND PROCEDURES FOR DATA MANAGEMENT

- Sufficient regulatory authority.
- Written governance plans.
- Governing councils to monitor, support, and react to RHIS performance.
- Data standardization policies, framework, and procedures.
- Adequate management of metadata.
- Policies to ensure contributions to the RHIS from the private sector.

MONITORING AND EVALUATION

- Regular performance assessment using standard tools.
- Appropriate action planning.

MEASURE Evaluation

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400 Meadowmont Village Circle, 3rd Floor
Chapel Hill, NC 27517

<http://www.cpc.unc.edu/measure/>