



# Improving the Structure and Performance of National Health Information Systems

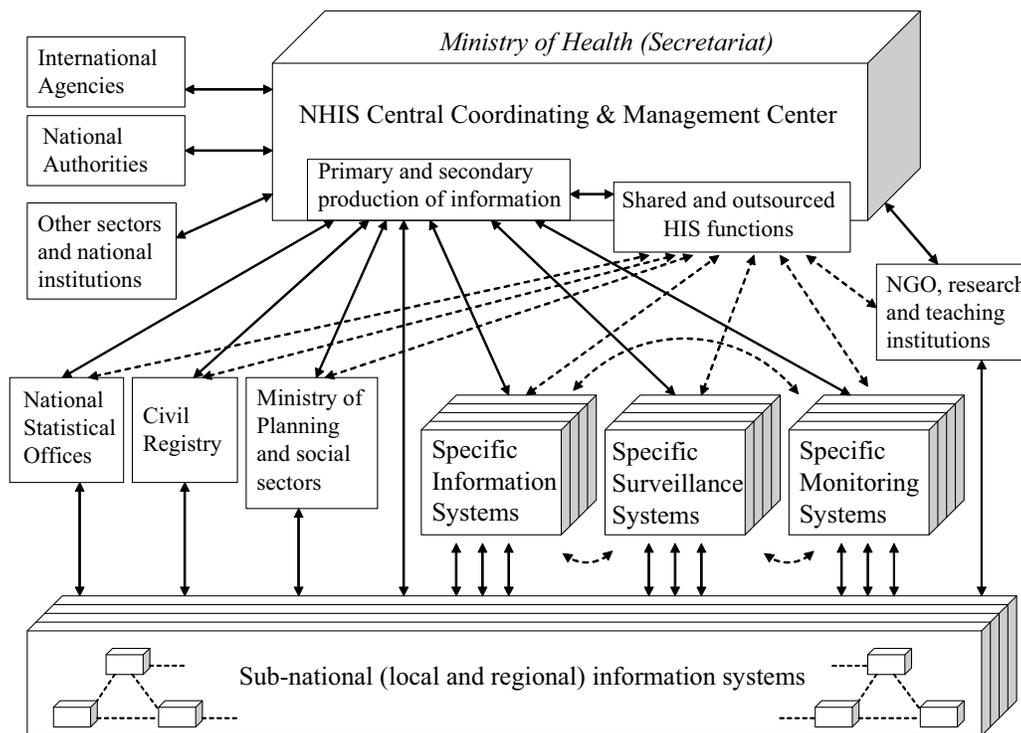
## Operational Approach and Strategic Recommendations





# Improving the Structure and Performance of National Health Information Systems

## *Operational Approach and Strategic Recommendations*



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*"There are a number of issues which confront national health administrations when they attempt to address problems with their health information systems. Strengthening health information systems is always a complicated process. National health information systems (NHIS) often comprise several sub-systems maintained by various programs, offices and institutions."*

*"Great prudence should be applied when changing the components of health information systems that are working fairly well. This particularly applies to the reporting systems of programs involving specialized services such as maternal and child health, family planning, or tuberculosis control."*

*"Avoiding overlap or gaps, and sharing information among programs, is difficult. Getting programs to agree on what type of data and processes is most necessary is even more difficult. The control of a reporting system and databases is not easily given up or shared. Coordination and partnership among systems is therefore very difficult."*

*"Each health administration must assess its needs for clinical and managerial information based on its mission, goals, priorities, core service responsibilities, levels and functions, models of service delivery, resources, and access to information technology. The health information system should be so designed that it does not exceed the capability of the administration to manage it."*

*"Strengthening the health information system at the various levels of service should be undertaken in support of efforts to develop health services and improve their performance."*

*"Any changes or developments to data recording and reporting should be made only to improve the provision of care at the patient and community level, particularly for those populations most in need."*

*Selected paragraphs of "WHO  
Cooperation in Strengthening NHIS"  
(WHO, 1997)*

## **Executive Summary**

In complement to existing technical literature, this document provides an operational approach and strategic recommendations to guide in the search for better National Health Information Systems (NHIS), through improving their structure and performance. The rationale for NHIS improvement is the needs for better availability, effectiveness and timeliness of information, in support of policy- and decision-making in the health sector. This document focuses on the identification, assessment, planning and improvement of the NHIS, including its components (institutional, technological and functional) and relevant elements (such as policies, standards, organization, resources, technology, processes and performance).

In operational terms, the NHIS can be assumed to be “the nationwide organized and integrated network of resources and processes that contribute to the overall production and communication of health-related information, composed by multiple specific information systems (maintained by various programs, offices and institutions) functionally interacting at different levels of a country. This network is coordinated by the national health authority, with the primary goal to support evidence-based decision and action in the health sector. The ultimate aim is to contribute to preserving and improving the health of the population”. The NHIS operational approach is described in chapter 2.

The preparation of plans and strategies aimed to improve the NHIS should take into account key issues such as: information needs, critical aspects and gaps of the NHIS structure and performance, as well as the feasibility and priorities for carrying out plans and projects for improvement.

Main stages of NHIS improvement are:

- NHIS assessment, aimed to provide descriptive diagnosis and gap analysis of the specific limitations, critical aspects and

recommendations for improvement (chapter 3)

- Development of plans or strategies aimed to improve the NHIS structure and performance (chapter 4).
- Improvement of the institutional (legal and administrative) component of the NHIS, through developing the necessary organization and institutional framework; this includes the redefinition of key information contents (chapter 5);
- Improvement of the technological component, by deploying the necessary and appropriate information and communication technology (i.e. hardware, software, connectivity) as the appropriate platform to support the production and sharing of information, including the corresponding staff training (chapter 6); and
- Improvement of the functional component (performance), i.e. all the interactive chain of processes involved in the production of information and management of information systems (chapter 7).

Main strategic recommendations focus on the following issues:

- Plans and processes aimed to improve the NHIS should involve actively all the stakeholders and pursue the development of common policy, criteria, standards and norms to produce harmonized information. This is because the NHIS is a complex nationwide network composed by multiple entities and specific information systems.
- To be effective, the NHIS should be user-oriented, with primary focus on those responsible for decision-making and action in health systems;
- Effective assessment, adequate national NHIS models and coherent design will provide the operational framework for

effective plans and projects to improving the NHIS structure and performance;

- Plans for NHIS improvement should take into account the necessary balance between information needs, gaps, expectations, affordability and cost benefit of the planned investment and efforts.
- The NHIS structure (institutional and technological components) provides the pre-conditions for performance. Actual improvement of the management and production of information implies to enhance all the interrelated chain of processes leading to appropriate information. Availability and training of the NHIS-related staff is the key factor for productive efficiency.

- Beyond the search for information technology as platform for improvement, this document suggests a more comprehensive approach, including the institutional and functional components, and the nationwide information network (even if the component to be improved is only a component or subsystem, or the overall improvement will be gradual).

The document also includes an operational glossary and annexes with principles to guide the development of the health information system, relevant contents of health information, and a list (menu) of potential core health indicators based on widely used core data sets.

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## 1. Introduction

*The rationale for embarking on NHIS improvement efforts is based on the high needs for effective information and better NHIS, in support of effective health action, and the frequent NHIS problems and limitations that are faced by countries at the moment of searching and planning better information systems. The chapter also describes the purpose and structure of the document.*

### 1.1. Needs for Effective Information and Better Health Information Systems

The basic rationale in the search for better systems is the improvement of availability, quality and effectiveness of information to better support health action towards the preservation and improvement of health conditions of the population.

#### *a) Health information as a key input for decision-making and action*

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

To ensure effectiveness, the production of appropriate information should be centered on the needs of the users of such information, acceptable to those who participate (producers and users of information), standardized to allow for consolidation and comparisons, and supported by national health and political authorities. Decisions for investing in the NHIS - to improve information - are justified by the high needs for information, when conditions for feasibility, readiness and cost benefit exist (Gattini, 2007).

Once the information has been produced by the NHIS, some information-based processes - such as analysis, monitoring, surveillance and evaluation - help information to become a meaningful input for action. Whilst information by itself has a great potential intrinsic value, the ultimate usefulness depends from the concrete use made by policy- and decision-makers, and the contribution made by those monitoring processes that use information to orient action. The NHIS is therefore responsible for the production of effective timely information,

but cannot be fully accountable for the actual use finally given to that information.

#### *b) The role of the NHIS for better health action*

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

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

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

Despite all efforts that could be made towards NHIS consolidation, the NHIS tend to face the

progressive risk of technical and functional obsolescence as well as lower responsiveness to the increasing demand for information (irrespective of the consolidation level reached at one point by the NHIS).

## **1.2. Frequent Limitations in NHIS Structure and Performance**

Besides the high potential use of information as a tool for action, its actual use for decision-making and health action could be quite limited, when lack of availability and effectiveness of information is related to frequent limitations in quality, completeness, accuracy, timeliness, meaningfulness and usefulness. Those limitations could be more frequent in developing countries and in those health systems with low level of development, so the NHIS generally have limited structure and performance to respond to the high demand of information.

The level of NHIS development varies among countries, with different causes leading to limitations in structure and performance. However, there are some systematic problems and limitations that could be found in NHIS, irrespective of the level of automation.

### *a) NHIS frequent challenges and limitations*

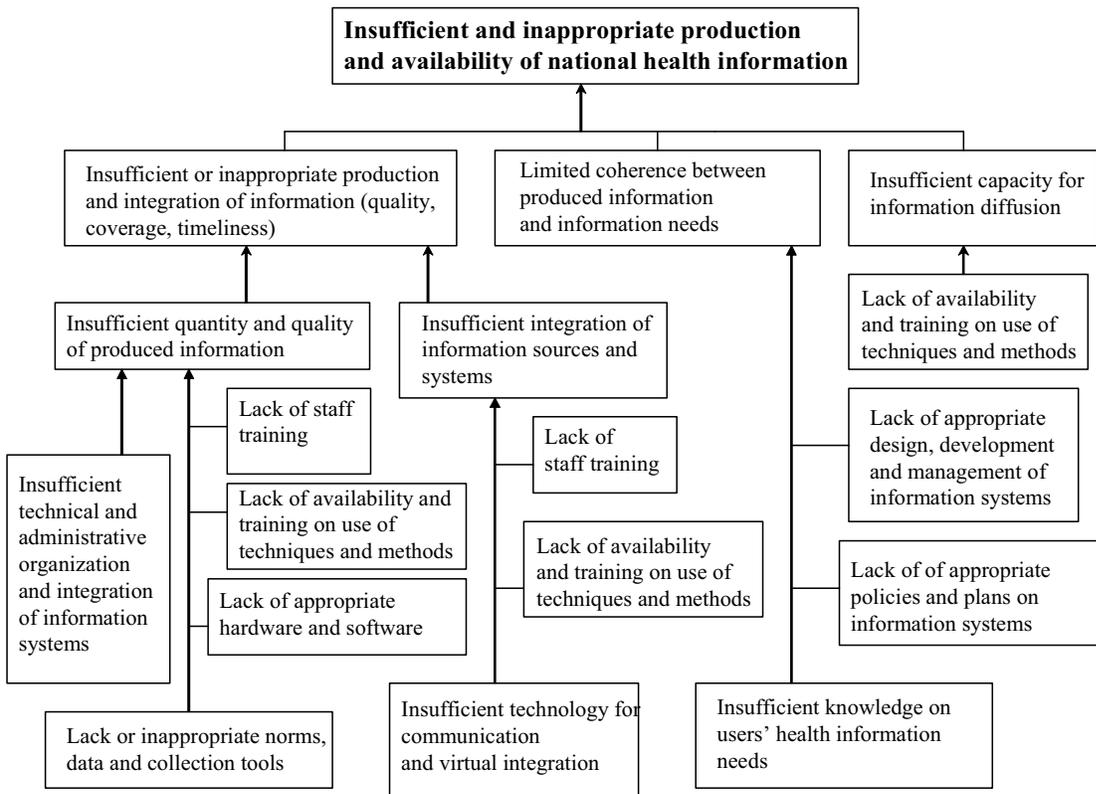
The main challenges and limitations faced by NHIS in countries are:

- lack of NHIS policy framework and its application to plans, projects and actions;
- relative NHIS weak structure and limited resources;
- limited NHIS performance with poor and limited availability of accurate, complete and timely information;
- limited skilled staff and training for information and technology management;
- health care staff overburdened by the collection of routine data with no corresponding benefit coming from the resulting information;

- low and delayed production, analysis, reporting, dissemination and use of information;
- statistical systems with low quality, integration and performance, limited training and high turnover of trainees;
- lack of effective communication between producers and users of information;
- limited institutional culture for demanding, integrating, analyzing and using information to support policy- and decision-making;
- long specification issues;
- NHIS isolated from policy- and decision making process and non responsive to information needs of decision-makers, thus isolated from health systems development and performance;
- turnover of decision-makers and other key users of information;
- fragmented and even overlapped specific information systems with lack of integration of specific and sub-national systems within a national HIS network;
- lack of coordination and communication between the stakeholders (offices, institutions, sectors) that should be involved in the production and sharing of information;
- New demands for information not responded by traditional NHIS, leading to irresponsible irrelevant information, despite the amount of data collected and overwhelming burden for participating (clinical and administrative) staff;
- Limited analysis and use of the information (WHO, 1997; Sauerborn and Lippeveld, 2000)

In general, those frequent limitations are usually taken into account in the tools for NHIS assessment, including the description, measurement and gap analysis of the limitations and problems probably to be found, so as to propose specific interventions for proper improvement (WHO, 1997, Sauerborn and Lippeveld, 2000; Sapirie, 2000; HMN, 2007).

**Figure 1.1 Critical aspects of information systems that limit the adequate production and dissemination of information**



The overall efficiency in the chain of processes leading to the production of information depends on the level of adequacy and integration of the institutional, technological and functional NHIS components; all this provides the framework or pre-conditions for efficiency. Figure 1.1 shows the types of factors that hinder the adequate production and dissemination of information (problem-tree based on discussions held by an inter-programmatic working group from HDP and HSP Divisions at PAHO, 1998).

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

*b) The institutional culture on information*

The institutional culture is an inherent component of the human component and organization of health services. The limitations and inconsistencies of the institutional culture can influence the function of the services, their management and also the production and use of information. In the specific case of the information, a deficient institutional culture can be an important contributing factor to:

- A lack of articulation of the different managerial processes, and between levels of management, as well as the quality and efficiency of the operation of health services. This prevents the information from being placed in an effective context.
- A lack of articulation and consistency between production, analysis, and use of information and management;
- A vision of data and information as passive input that is mostly found in historical reports, and not

as an essential input that should dynamically support decision-making processes;

- The assumption that decision-makers do not have time for reading or using information, so too concise summaries of information and routine reports could end up being too simple and useless;
- A tendency to disseminate information as a nice general product, with expensive reports, brochures and audiovisual documents that attract general attention, instead focusing on a solid and relevant content;
- Use of produced information as a way to get power or influence (illustrated despotism);
- Information used as an expensive issue instead being considered as a "public good" of the institution (open to all interested users);
- Putting excessive faith in technology as a solution and making investments in the area of information technology without taking into account the other NHIS components;
- Use of information technology and technical language in a way that is not in accordance with the institutional culture (mainly of those who take decisions);
- Use of information technologies by experts who are not sufficiently familiar with the fields of health and health systems (even though they could have been successful in applying informatics to other type of business).
- Promotion and sale of information products and services focused primarily on the providers' perspective (and self interest) and not on the persons who will use the information for decision-making;
- Lack of internal political will to assume the messages and implications for health action provided by information and evidence;
- Decision-making carried out on the basis of tradition, intuition (empirical knowledge) or predominant ideological models, disregarding available information and evidence.

*c) Limitations in the implementation of plans and projects on NHIS improvement*

Investing in better NHIS and ensuring their successful implementation and maintenance has been long term pursued by most countries. Based on existing manual statistical systems and records, the focus for development has been the progressive automation with the purpose of increasing capacity and accuracy in the production of information (Gattini, 2007).

National health authorities tend to embark on efforts to developing and improving NHIS given new requirements for information, perceived limitations in NHIS performance, and high expectations coming from features of modern information technology. However results of plans and projects aimed at improving systems have been heterogeneous, with a mixture of successes, limitations and failures, irrespective of the level of investment or automation involved.

Duplicated or inconsistent plans and projects are frequently carried out in countries to develop and strengthen specific information systems, especially if plans or projects depend from different initiatives and sources of financing.

Most plans and projects are technically sound; however their result can be very limited given some restricting factors, such as:

- plans and projects with too ambitious goals, beyond the country's feasibility and readiness to undertake improvement actions;
- difficulties in reaching and maintaining consensus and involvement of stakeholders from different offices, programs and institutions;
- low capacity to respond to new (and higher) requirement for health-related information, such as those coming from health sector reforms and development of surveillance, monitoring and evaluation systems;
- limited capacity to put in place and sustain, technologically-driven systems, with limited catching-up of changing technology,
- automation and technology applied to health information or statistical systems that are not

ready to absorb and use technology (given institutional, statistical or functional limitations);

- limited financing continuity after initial investment; and
- lack of useful lessons learned from past HIS-related experiences (that should include not only those projects who succeeded but also those who failed).

### 1.3 The Search for Better NHIS in Countries

Decisions for investing in NHIS are justified on a basis of the needs for information to support decision-making and action in the health sector, the feasibility and the cost benefit of the implementation and further maintenance. Estimating benefits from NHIS improvement should also take into account its contribution to a better knowledge of the factors having influence on health and on the quality of structure and performance of health systems and services.

Development, improvement and consolidation of the NHIS processes require an operational multi-component understanding, immersed in the wider health sector approach, culture, and need for information. Lessons learned and evidence-based opinions provided by HIS-related experts in countries are crucial in the search for feasible and successful improvement of the NHIS.

#### *a) Factors to ensure successful plans and projects on NHIS improvement*

Ensuring successful development and improvement depends on adequate NHIS policies, plans and projects, which should be in line with local, sub-national and national strategic health plans.

Expectations and plans for implementing and improving the NHIS should consider economic and political feasibility, cost benefit (showing expected return), adoption of appropriate technology, sustainability (after initial investment), and that the resulting better performance and usefulness could be the adequate solution to better support evidence-based policy- and decision-making.

The NHIS should be centered on information needs of the users, acceptable to those who will participate in the NHIS (both producers and users of information) and supported by national health and political authorities. The NHIS should not be a system owned by and limited to a ministry of health; however that entity should have a leading, coordinating and managerial role within the nationwide NHIS

The Health Metrics Network (HMN) initiative (2007) emphasizes the focus on country needs, priorities, capacity building, and multi-sector involvement. HMN proposes a set of principles to guide the NHIS development:

- countries should be empowered to undertake strengthening activities, with national capacity, leadership and ownership;
- the NHIS development should be responsive to country needs and demands;
- the improvement process should build upon existing initiatives, systems and knowledge;
- it is necessary building broad-based consensus and stakeholder involvement; and
- developing and strengthening the NHIS should be a gradual an incremental process

External technical assistance and the mobilization of resources are important, especially if regular budgets assigned to health information systems are limited and cannot support investments toward better information systems. Management of improved NHIS is facilitated if the system has been well designed in accordance with information needs. Planning and improvement of NHIS should consider national capacity of NHIS management and sustainability after the initial plans have been implemented. It is also important to adopt and keep clear rules, responsibilities, criteria and standards for the health information system (PAHO, 1999; Kleinau, 2000).

#### *b) The needs to improve multiple components and levels of the NHIS*

The NHIS is usually a very complex nationwide system with an extensive multiplicity of elements, components, processes and stakeholders. As such,

the NHIS has usually heterogeneous development of different specific systems and components (irrespective of the degree of technology applied). Given the complexity of NHIS, it is usually recommended that the improvement and development processes should be gradually implemented, with priority to start improving those components that are more feasible to improve and the efforts have greater cost benefit (HMN, 2007).

Implementing and improving the NHIS structure and performance involves developing and integrating the administrative, technological and functional components. The NHIS administrative improvement includes strengthening or establishing the legal and administrative framework, with related policies, norms, regulations, organization and management of resources and processes. Application of information and communication technology (hardware, software, connectivity) provides the structural platform, supported by the relevant training of staff who manages the system. Functional improvement seeks to increase the quality and efficiency of the whole productive process (including the organization and operation of statistical systems).

Specific information systems usually developed in countries include, for instance, vital and health statistics systems, epidemiological and surveillance systems, environmental information and surveillance systems, hospital information systems, monitoring systems, etc. The specific information systems can have different nature and organization, but they pursue a common primary goal: to produce health information to support policy- and decision-making in the health sector, with main focus on development, management and operation of health systems and services.

The contents of information needed for a comprehensive overview of health and the health sector cover diverse specific information coming from multiple sources. Key contents refer to health conditions (including determinants related to population, socio-economic, environmental and lifestyle related factors), the resources and processes carried out in health systems and services, and the outcome of those services. National health information merely based on the ministerial information system could be very incomplete and disarticulated, leaving out key

processes and contents of information from other information systems and sectors (such as the private sector and armed forces' health services).

Technology plays a potentially key role in increasing the capacity and speed of the deposit, process transmission, processing, analysis and dissemination of information. This potential has raised high expectations about the benefits coming from automated information systems. These expectations could motivate countries to embark on relatively large investments in implementing new automated and networked information systems, irrespective of the readiness of countries for dealing with informatics. Thus, adequate NHIS assessment, policies and plans are therefore needed before the application of technology.

*c) Key areas for NHIS improvement*

Main strategic recommendations to approach the NHIS improvement process are focused on the following areas:

- Identification of specific areas for improvement though adequate NHIS assessment, aimed to provide descriptive diagnosis and gap analysis of the specific limitations, critical aspects and recommendations for improvement;
- Development of plans and strategies aimed to improve the NHIS structure and performance;
- Improvement of the institutional (legal and administrative) component of the NHIS, through developing the necessary organization and institutional framework;
- Improvement of the technological component by deploying the necessary and appropriate information and communication technology (i.e. hardware, software, connectivity) as the platform to support the production and sharing of information; and
- Improvement of the functional component, i.e. all the interactive chain of processes involved in the production of information and management of information systems.

Given the magnitude and complexity of NHIS, usual recommendations indicate a step by step improvement, concentrated on some components

or specific systems, even implementing some pilot areas. Plans with excessive design are the common cause of failure in NHIS improvement efforts (Lippeveld and Sapirie, 2000).

#### **1.4. Purpose of the Document and Intended Audience**

Current literature already provides a wide range of technical and administrative documents dealing with the design, development, and operation of information systems (WHO, 1997; PAHO, 1999; HMN, 2007). The purpose of this document is to complement the state of the art published in technical literature with an operational approach (practical and problem-oriented).

The document aims to provide an operational basis to facilitate the identification and assessment of elements of specific and national health information systems (such as resources, processes, sources, organization) and consequently to guide the policies, plans and projects aimed at developing, consolidating and improving such systems, in line with the information needs of those responsible for decision-making in the health sector.

This document addresses a potentially wide target audience. However, the staff who produces and those who analyze and use information to make policies and decisions in the health sector constitute the primary and main target audience. Strengthening the NHIS should be done through a multi-disciplinary approach, thus this document addresses different types of disciplines involved either in the production or use of information for decision-making at all levels within the health sector. The wider audience of the document could include other entities and sectors that need health-related information (such as political, economic or social authorities, universities, research centers and national and international agencies).

#### **1.5. Structure of the Document**

Chapter 1 describes the needs for health information and better NHIS, and the frequent challenges faced by countries embarking on NHIS improvement. It also describes the purpose and structure of the document. Chapter 2 presents the operational approach as the background for systematic NHIS assessment, planning and improvement.

Chapter 3 presents the assessment approach, including the development of references for assessment (model and benchmark), the steps and the components to be evaluated. Chapter 4 discusses strategic recommendations for the main stages of planning the NHIS improvement.

Chapter 5 focuses on the NHIS institutional component, with the development of regulations, criteria, standards and norms, as well as the preparation and implementation of policies, plans and projects on NHIS improvement. Redefinition of key information contents is also emphasized. Chapter 6 focuses on improving the technological aspect of information systems, with emphasis on the search for appropriate solutions and recommendations for progressive implementation and improvement. Improving the NHIS performance is described in Chapter 7, starting with the pre-conditions for effective performance, identification of information needs and selection of contents and sources of information. Improving the production process involves the functional aspects ranging from the selection, collection, analysis, production and dissemination of data and routine information.

Annex 1 contains some WHO's principles to guide the development of NHIS. Annex 2 presents a list of relevant issues in the content of information, while Annex 3 contains a list (menu) with some of the most used health- and health sector-related indicators. Annex 4 contains a list of more specific data and indicators to support local health care management, and Annex 5 shows, as an example for basic set and readiness of indicators, the core health data elements proposed for the US.



## 2. The Operational Approach

*This chapter addresses the NHIS operational framework with focus on the definitions, goals, structure and functioning of health information systems in general, and the NHIS in particular. The description of main NHIS components and elements include the organization, resources, technology, management, production and dissemination of information, contents of information and main specific information systems.*

### 2.1. A Systemic Approach

The operational approach is based on some complementary concepts that are commonly used in current technical literature on information systems. Those specific concepts have been integrated through a systemic overview. Isolated concepts - from a specific discipline - can lead to bias in the approach to NHIS understanding and further improvement. Thus, a coherent framework is needed to facilitate proper understanding, evaluation and analysis of the NHIS, to ensure effectiveness of plans and projects on NHIS improvement.

This general framework is also aimed to provide an orientation for further design of a more refined NHIS model, at country level. A national model could become a more precise reference to guide the NHIS assessment, development and improvement. The design of a NHIS model is facilitated when some relevant national health-related factors are also taken into account, such as national health plans, the structure and performance of health systems and services, the national context for health action, the needs and priorities for information, and the prevailing culture on information and decision-making.

#### *a) General view of a health information system as a “system”*

Based on the very broad general definition of a system as “a set of elements interrelated around a goal”, a health information system could be essentially understood as “a set of inter-related elements with the goal of producing health-related information”.

According to Sauerborn and Lippeveld (2000), despite lack of clear consensus on the concept, a health information system can be described as “a system (namely, a set of elements that interact with each other to achieve a common objective) that

provides information (collection of facts or data that make sense) for the specific processes of decision-making at every level of an organization”.

This general approach is applicable to what a health information system is, despite the quite diverse nature, organization, structure and functioning of existing health information systems. There is a wide range of potential use and users from the information produced by the NHIS; however there is a prevailing assumption that the NHIS goal is primarily focused on the support to health systems (Sauerborn and Lippeveld, 2000, HMN, 2007); as well as PAHO and WHO strategies objectives for their strategic plans.

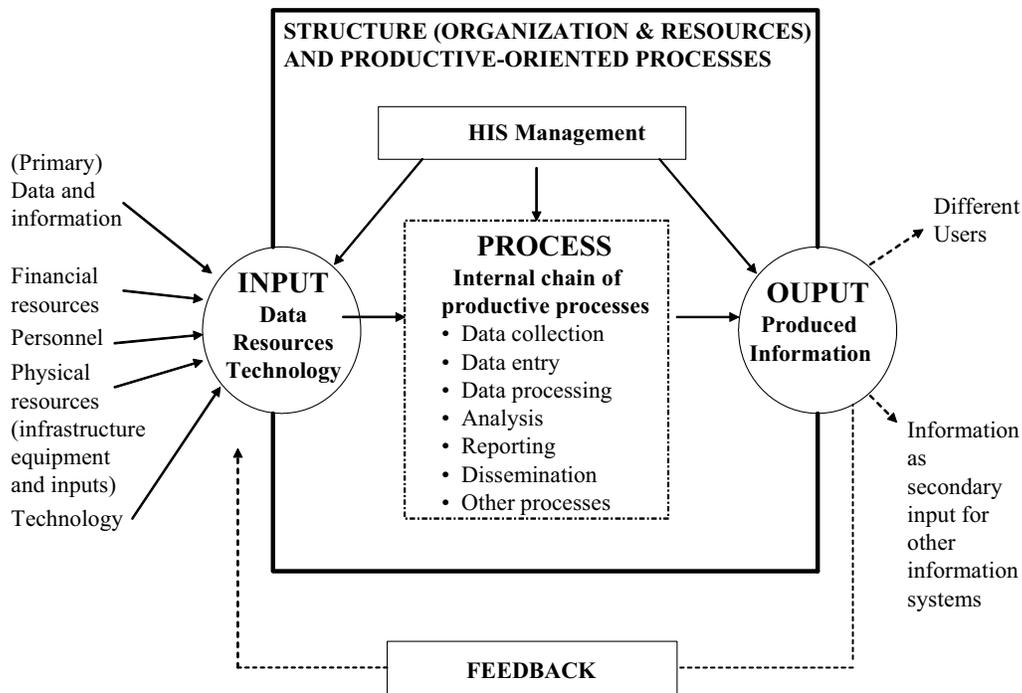
#### *b) Specific definitions, depending from the prevailing focus on different NHIS components*

There is a lack of consensus on the concept of health information system, given conceptual differences in the main focus used to define it. Some of the concepts used to describe information systems are:

- A set of elements (resources, technology, organization and processes) aimed at producing information on health and the health sector (focus on the goal);
- A set of uses, standards, responsibilities, procedures, resources, and purposes that have been determined legally, normatively, or administratively to produce information (focus on the normative framework);
- A technical-administrative unit (an entity, office or program) depending on an administrative or health authority that is responsible for the management, collection, production, analysis and dissemination of information (focus on the institutional organization);

- A set of processes that enable the productive process of collection, integration, processing, analysis and dissemination of data and information (focus on the functional component);
- A technological platform (hardware, software, connectivity) that can be used to collect, add, analyze, and produce appropriate information for various users, especially those who use such information to make decisions (focus on technological component);
- A technologically-based system based on specific software programs which support database management, information reporting and analysis, as a tool for decision-making in management, in response to routine and non-routine management information needs (focus on managerial support);
- A functional set of resources and processes belonging to different programs, offices and agencies which are secondarily integrated to produce information in support of the management, operation or evaluation of the health systems (focus on network of different specific information systems); and
- A functional component - aimed at producing the necessary dynamic information - within wider information and evidence-based action oriented systems (focus on systems dealing with "information for action" systems, such as monitoring and surveillance).

Figure 2.1 Structure and processes of a health information system (system approach)



c) General model of a health information system

A health information system includes structural and functional elements, as well as their relationships, as schematically described in the diagram of figure 2.1. The specific elements constitute input, processes and output. The ultimate goal pursued by information systems is

not represented in the diagram, given its abstract nature.

The *inputs* refer to all resources, technology and captured data and information. Resources include personnel, financial resources, equipment, technology, and primary or secondary data. The series of *productive processes* includes mainly data

collection, coding, data flow and communications, computational and statistical processing, statistical analysis, reporting and disseminating information. The *output* is the produced information. Produced information can become a secondary source of information (input) for other information systems. In complement to the direct HIS function, *outcome* is the direct or indirect impact of the HIS on the recipients of information and their actions, as well as on the HIS environment.

Finally, *dissemination of information and feedback* are crucial processes. Information systems are usually open systems, as they have dynamic change of information and many of their resources and processes are shared with other systems. For instance, clinical personnel who contribute to report primary data have other primary roles and functions within the health care system. As another example, information systems dealing with data on communicable diseases are usually included within a wider surveillance system.

The transmission of information among different specific information systems contributes to the configuration of information networks that could reach nationwide integrated coverage. All of this requires coordination, organization and administration at different levels. The productive process includes all the series of interlinked processes, such as data collection, data entry, data processing, analysis, reporting, dissemination, and some other processes that support the production of information.

The technological component provides the platform enabling the automated management and production of health-related information, as well as the efficient and integrated operation of the whole information system. In a strict sense, information technology is based on machines actively processing and communicating data. Automated information systems can use various types of computer programs with specific applications to process and distribute data, and establish automated database networks and information, based on standardized and compatible information (PAHO, 1999).

An information system does not need to be automated to exist. The level of automation could range from information systems which are based on a simple manual operation (for example,

manual statistical systems) to highly sophisticated computerized on-line systems. NHIS often have both automated and manual systems.

Data and information - as the inputs to be processed - can be entered directly to computers from events or reports (primary data), or constitute secondary data that have been already produced by other information systems (primary information sources).

The *content of information* refers to all matters which directly or indirectly relate to health, including the health of the population, conditioning factors, and the society's response to preserving and improving health, especially through the health sector. Information on the health sector covers such issues as physical, human and financial resources, technology, processes of production or delivery of services (individual and collective), the results or impact on health, and indicators of the quality and performance of health systems and services, including coverage, access and use, efficiency, efficacy, and equity.

### 2.2. Description of the NHIS as a Nationwide Integrated System

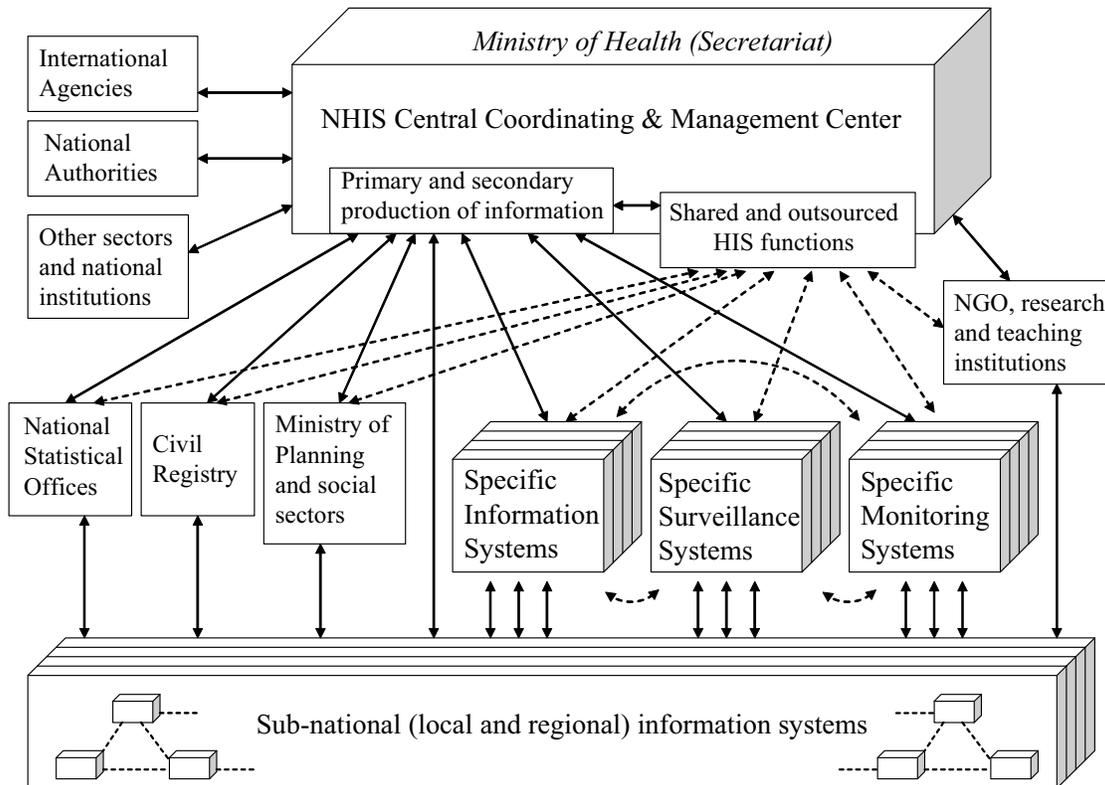
The operational concept of the NHIS - given it is a complex entity - covers some specific aspects that should be taken into account in its definition:

- It is a nationwide organized and networked set of resources and processes (it has a multi-office and multi-institutional nature);
- It is centrally coordinated and managed by the national health authority, but the overall organization involves multiple stakeholders and sectors;
- The formal organization implies an established administrative framework defining the NHIS goals, roles and responsibilities;
- It has the main direct purpose of producing useful and timely national and sub-national health-related information (output);
- The objective is to support evidence-based different decisions and actions in the health

sector as well as other sectors (in matters direct or indirectly related to health); and

- The ultimate aim is to contribute to preserving and improving the health of the population.

**Figure 2.2 The NHIS as a nationwide multi-level and multi-agency information network**



According to those concepts, the NHIS can be operationally described as:

*“the nationwide organized and integrated network of resources and processes that contribute to the overall production and communication of national health-related information, composed by multiple specific information systems (maintained by various programs, offices and institutions) functionally interacting at different levels of a country, that is coordinated by the national health authority, with the primary aim to support evidence-based decision and action in the health sector. The ultimate aim is to contribute to preserving and improving the health of the population”.*

The nationwide networked nature of the NHIS is very complex. As a didactic summary approach,

figure 2.2 shows the main stakeholders, levels and specific systems, including their complex interaction.

The NHIS is just one entity (system) that includes all the national relevant health-related information systems and information sources from different places, sectors and institutions, such as: health sector (public and private sector), other sectors, formal and informal organizations throughout the country.

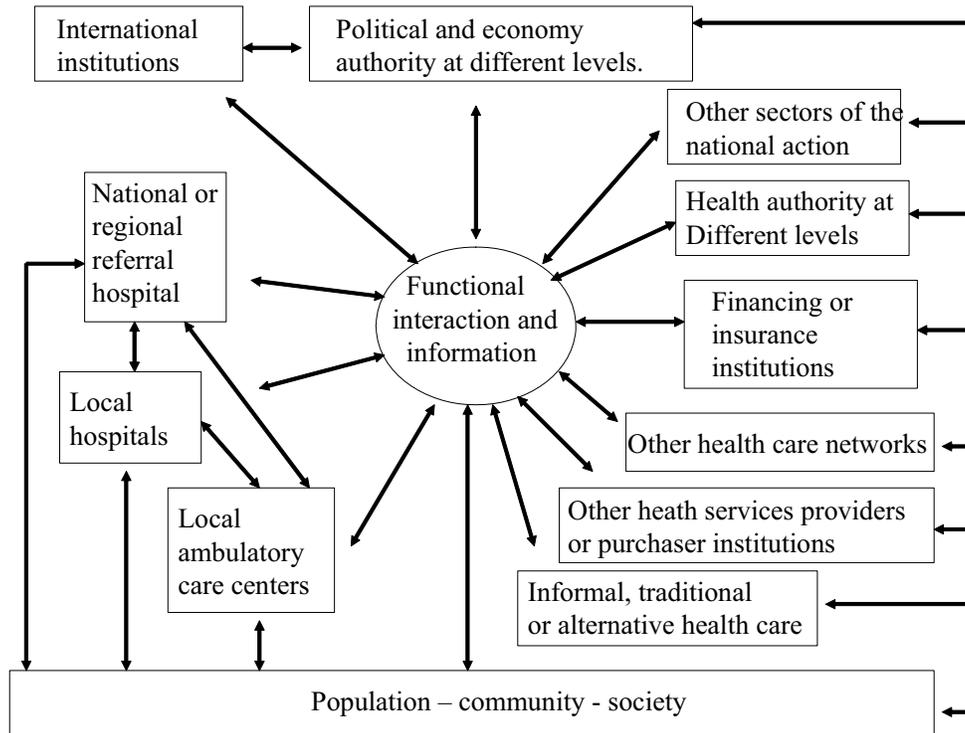
The functional coverage reached by the NHIS exceeds the boundaries and functions of a ministry of health, as the NHIS is not simply a ministry of health’s information system. Consolidation of the NHIS requires the effective functional integration of all specific information systems and levels; otherwise it would be a partial or incomplete NHIS

surrounded by a heterogeneous set of disarticulated and isolated specific systems.

The institutional agreements and negotiations to establish the network enable expedite and

coordinated financing flows and functional interaction. Figure 2.3 illustrates the two-way flow of institutional relationships and information between all key stakeholders involved (either formal or just functionally) in the NHS network.

**Figure 2.3** *Flow of interacting institutional relations, communication and information in the health sector*



At different offices and levels, the information can have a different degree of aggregation, depending on the decision-making level where it is generated, processed, analyzed or used. Individual data are collected at local level, whilst aggregated information according to an agreed set of data tends to be used at regional and national levels. Automated information systems can keep and share individual data even at national level; this facilitates the detailed analysis and reporting at all levels, such as in case of data from individual death certificates, hospital discharges and notification of communicable diseases.

The local level can collect and use disaggregated and aggregated information. This is the case of centers that need both individual patient-centered data and also aggregated statistics, such as at primary health care and ambulatory centers, internal productive units of hospitals (for instance laboratory or pharmacy), and health services that are organized on a multi-center health care network (with patient referral systems). The information produced should support the different managerial functions related to decision-making at every level of decision and operation of health systems.

Information systems at hospitals are often complex and multiple, given that hospitals can become sophisticated entities, especially those with large number of beds and complex specialties, with complex and dynamic provision of clinical care and numerous processes supporting clinical diagnosis and treatment, as well as billing and management of personnel. Furthermore, some hospital-based information often needs to be produced, reviewed and used immediately (such as on-line produced data in intensive care units), or at least during the period of hospitalization of a patient (to estimate individual costs and detailed billing).

**2.3. Co-existing Information, Statistical, Monitoring and Surveillance Systems**

The NHIS, as a nationwide integrated network, should be the main harmonized information source that is considered valid for the country (once approved by corresponding statistical and political authorities), even if there is originally coming from different primary sources (such as specific information, statistical, monitoring and surveillance systems).

The NHIS can be either a primary or secondary repository of information formally accepted as valid; otherwise information on same matters could be different between different sources leading to inconsistency and low validity (for instance, if the incidence rate of tuberculosis in a country is collected, processed and reported in parallel by surveillance and statistical systems).

The managerial and coordinating responsibility on information is under the coordinating national health authority, although the ownerships of information should belong to all stakeholders of the NHIS network. Within the NHIS, there is a functional and conceptual overlap between health-

related information, statistical, monitoring and surveillance systems.

Main difference is in the goal and the functional focus of each system: *information systems* are just aimed to produce information; *statistical systems* are aimed to provide data, indicators, analysis and reports that can summarize the measurement, variations, trends, evaluation and conclusions on a defined population or geographical area; *surveillance systems* are aimed to watch a defined situation and provide alert for opportune and effective action, if necessary. Surveillance systems are mainly focused on the population (population approach). *Monitoring systems* generally have action-oriented approach, similar to the approach and methods followed by surveillance systems, but are focused on projects, plans and performance of health systems (institutional approach).

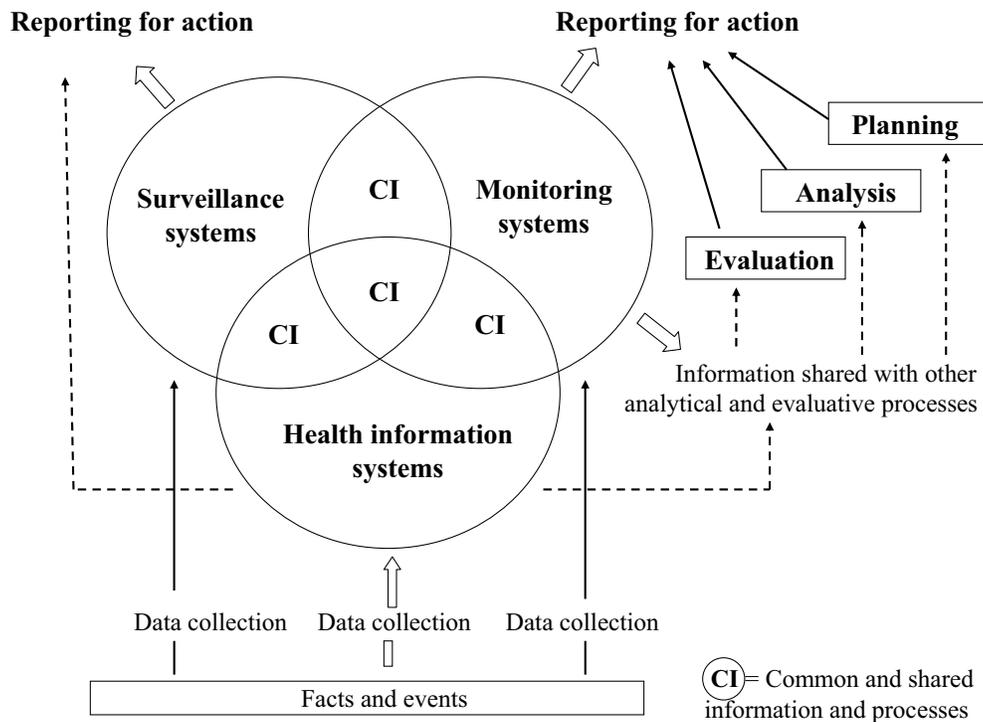
Beyond the NHIS, information and statistical systems are also essential part of information-based systems such as: monitoring, evaluation, surveillance, auditing, planning, physical resources' maintenance, and management of equipment, technology and inventories. Table 2.1 suggests the similarities and differences between information, statistical and surveillance systems.

**Table 2.1 Key elements of information systems within information, statistical and surveillance systems**

Information systems elements	Information-based System		
	Information	Statistics	Surveillance
Main outputs	Data and information	Statistical information; Measurement; Analysis and reports	Information for action; Observation, alert, relation to decisions; Analysis and updated reports
Main information inputs	Raw data; Individual and collective data; Automated data files; Secondary info and indicators	Raw data; Individual and collective data; Automated data files; Historical data bases; Secondary information and indicators	Raw data; Individual and collective data; Automated data files; Historical data bases; Secondary information and indicators
Key staff (management and coordinating center)	Information managers; Information technology professionals	Statisticians	Epidemiologists; Experts in area under surveillance
Other key staff	Management experts; Epidemiologists; Statisticians; Coders;	Inf. technology professionals; Coders Administrative	Statisticians ; Inf. technology professionals; Coders;

	Administrative support staff	support staff	Administrative support staff
Role of clinical and administrative staff in the health system	Filling administrative and clinical records, reports and forms; Data entry (if agreed); Analyze and use information if required by duty	Filling administrative and clinical records, reports and forms; Data entry (if agreed); Analyze and use information if required by duty	Report specific incidents under surveillance; Fill specific forms; Take actions if related to surveillance
Role of the NHIS	It provides common platform and network for all statistical, monitoring and surveillance systems	It provides common platform and network for all statistical, monitoring and surveillance systems	It provides common platform and network for all statistical, monitoring and surveillance systems

Figure 2.4 Functional overlapping between health information, monitoring and surveillance systems



In same line, figure 2.4 illustrates the functional overlap between information, surveillance and monitoring systems as tools of information for action. With proper integration and coordination, all systems contribute to produce information and support decision-making and action.

Whilst the NHIS is composed by structural and functional components; the United Nations (2001) focuses the definition of a *Vital Statistics System* rather from a functional point of view, as:

“...the total process of (1) collecting information by civil registration or enumeration on the frequency of occurrence of specified and defined vital events as well as relevant characteristics of the events themselves and of the person or persons concerned, and (2) of compiling, processing, analyzing, evaluating, presenting and disseminating these data in statistical form”.

Statistical systems, mainly those that have not yet been fully automated, tend to work mostly within specific centers, levels or health programs; then a few variables are consolidated and reported to

higher administrative levels. This could raise difficulties and delay for integration and completeness of information within the national statistical system. Ministries of health (at central level) usually have statistical systems based on aggregated data covering minimum data sets, but this is usually only a fraction (as the top of an iceberg) of all the information produced by information and statistical systems at different levels and offices. This should not be a major problem, if most collected and produced information is going to be mostly used at the same level of collection.

Multiple and sometimes incompatible statistics systems for same information can be found between private and public sectors, and different administrative levels. Lack of commonly accepted and used standards and criteria for data throughout a country limit quality and coverage of information.

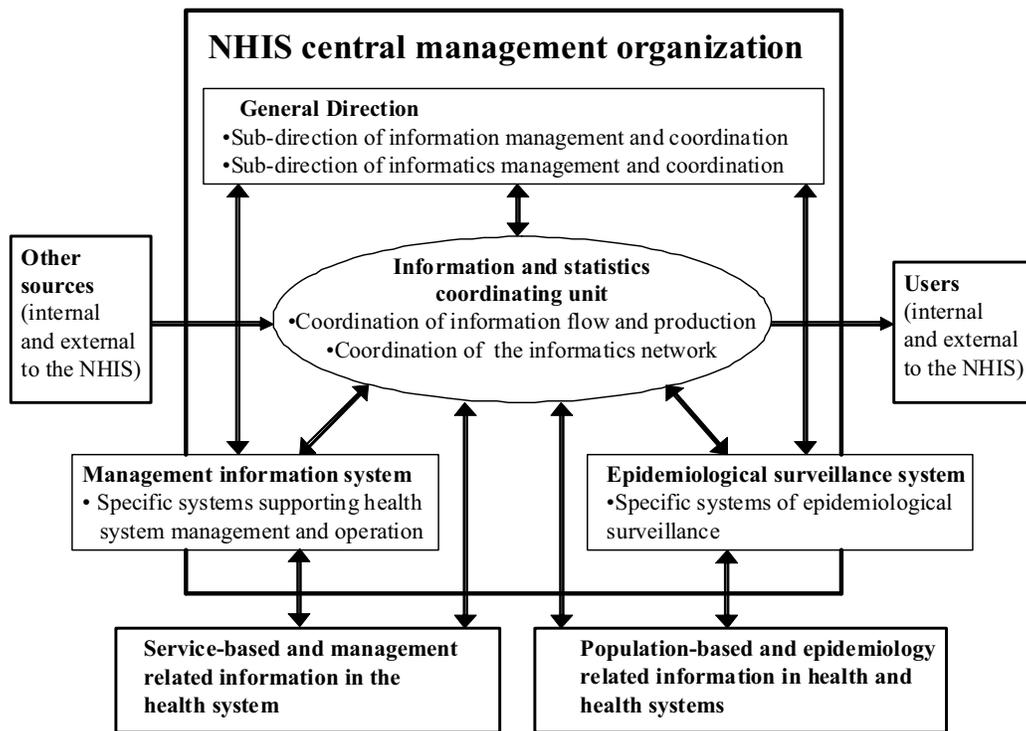
Information technology can provide automation with important improvement of nationwide manual statistical systems. The automation process is more

successful if it is applied to statistical systems that are already well functioning, at all levels of management and action.

Maintaining good performance of statistical systems generally require active and continuous training, control, supervision, audit, and provision of all manuals, forms and instructions in all the places where primary data will be collected. Data collection, flow and aggregation of data, production of information, analysis and reports should follow explicit and clear technical norms, and the country needs national capacity to manage, operate and strengthen the statistical system.

Figure 2.5 provides an example of central management of the NHIS that includes the involvement of key groups and users involved in statistics, epidemiology (epidemiologically-related surveillance), health systems management (especially for monitoring and evaluation) and informatics. This should also be reflected in an adequate organization of the sub-national level (if the NHIS has both central and decentralized functions).

Figure 2.5 A general model for the organization of the central level NHIS management



**2.4. The NHIS Components**

For analytical and planning purposes of this document, the NHIS is assumed to have three complementary components (table 2.2): institutional (the formal organization of policies, legal and administrative arrangements, the

organization of resources and processes dedicated to the production of information); technological (the equipment, software and connectivity used to support the production of information and facilitate communication); and functional (all of the inter-related processes involved in the production of information).

*Table 2.2 NHIS components*

Structure	Performance
<p><b>1. Institutional component</b></p> <ul style="list-style-type: none"> <li>• NHIS administrative framework</li> <li>• NHIS policies, plans, legal and administrative arrangements</li> <li>• Organization and administration</li> <li>• Information and decision-making culture</li> <li>• Defined and standardized information contents</li> <li>• Financial, and human and physical resources</li> </ul>	<p><b>3. Functional component</b></p> <ul style="list-style-type: none"> <li>• Production of data and information (collection, processing, analyzing, reporting)</li> <li>• Dissemination and sharing of data and information</li> <li>• Management of the information and information system</li> </ul>
<p><b>2. Technological component</b></p> <ul style="list-style-type: none"> <li>• Equipment (hardware)</li> <li>• Software</li> <li>• Connectivity structure and related services</li> </ul>	

*a) The institutional component*

The institutional or administrative component is the organizational framework establishing the formal existence of resources, organization, processes and the institutional environment of the NHIS. It includes the body of regulations, standards, and legal provisions that are related (direct or indirectly) to the collection, production and communication of data and information.

The set of laws, regulations, norms and standards defines:

- The institutional objectives;
- The participating entities responsible for the information system;
- The width of institutional scope;
- The regulation in effect to ensure that the production of information will be obtained in harmonized manner

Focused on its institutional component, the NHIS – under its institutional dimension - can be described as "the set of resources, standards, responsibilities, procedures, and users organized with the principal objective of producing and using information to support the processes of decision-making and action in the health sector, with emphasis on the role of the national health authority and of those responsible for health system performance to better respond to health needs of the population" (UN, 2001; M. Salud Colombia, 2002)

The NHIS components which are under the structure of a ministry of health can be identified within the ministry’s internal regulations and structure. However the identification of the institutional component existing in the nationwide information system could have a difficult and incomplete identification, as the overall NHIS universe involves different offices, units and

programs, within and outside the ministry of health, and even outside the health sector.

The coordinating role and responsibility of the ministry of health should be clearly defined, including its relationships with other entities and sectors (in regard to health information matters), as well as its responsibility for management and production of information. The participation of the various programs, offices and institutions, at different levels and sectors of the country needs to be reflected in the NHIS administrative framework.

The institutional component is also composed by all the financial, human and physical resources involved in the NHIS. However it is difficult to estimate the total amount of resources, given that the NHIS has a complex multi-institutional and multi-sector nature. Besides, some resources and staff are primarily part of other components of the health sector (such as clinical and administrative staff), but contribute to the information productive process, such as the original reporting and collection of primary data. The physical resources (mainly equipment) that are used to manage the information technology are usually considered within the technological component.

#### ***b) The technological component***

Information technology provides the platform to support the functioning of information systems. Through the computer-related equipment (hardware); programs (software) and communication (connectivity), the NHIS can have automated integration, flow, deposit, processing, and dissemination of information. Technology facilitates the virtual linking of different systems to constitute information networks. Information technology enables health systems to manage a high quantity and complexity of data and information that can only be obtained through computer technology. Technology can provide a wide range of services, beyond production and management of traditional data and information, enabling powerful worldwide communication and information and knowledge management (PAHO, 1999).

Nowadays, market options and technological solutions available provide multiple options for hardware or equipment, with many types of

processors and devices. Software can support functions in the administrative, financial and clinical areas, covering diverse aspects such as statistics, voice recognition, or diagnostic imaging.

*Appropriate technology* results from a balance between needs, expectations, national and sub-national goals in the acquisition and application of specific information and communication technology. The concept of appropriate technology is important, meaning that:

- The technology is manageable by the NHIS staff (coherent with national capacity for managing and using technology), and user friendly;
- The technology enables effective production of key necessary information, coherent with information needs, priorities and capacity to afford with proper funds and training;
- It is flexible enough to adapt to changing information needs;
- It has the best cost-benefit in relation to other alternatives;
- It has good technical support and flexible enough to allow for feasible updating;
- It could adapt to new software as needed by producers and users of information (for instance a new epidemiological software);
- The key hardware and software existing in all levels and components of the NHIS is compatible, enabling the configuration of effective and integrated information networks;
- The maintenance and management of technology is sustainable; and
- The automated reported information responds to needs and facilitates users to get access and use of that information.

Information technology requires the availability of adequately trained staff and computer programs to function. Staff training should be compatible with the relevant requirements for managing the technology. The use of standards and common technical criteria on equipment, programs, languages, communication, and contents is also

important. Given the type of information to be managed, it is important to ensure the security and confidentiality in access and use of information (PAHO, 1999).

Based on the NHIS design, there are different alternatives for implementation, from centralized computers leading the management and storage of information to be mostly centralized (with large computing equipment and national databases at central level) or decentralized through a wide linked network of processing and storage centers, to function as a single network, or integrating networks of specific information systems (PAHO, 1999; Wilson, 2000). In health systems composed by multiple institutions, the information network is the means to share information and business processes among suppliers, financiers, the government, patients and other stakeholders (PAHO, 1999).

In the last decades, WHO has been recommending the use of technology for the development and maintenance of health databases as well as the management of data and reporting. However, the computer perspective should neither dominate the selection of data and indicators, nor the design of registries and reports. Despite its importance, technology by itself cannot be the primary focus to meet information needs. Also, it cannot be independent of the global context of the NHIS and its existing structure (WHO, 1997).

### *c) The functional component*

The functional component involves the management, production and dissemination of data and information. Main phases of the productive process are:

- *Data and information collection:* Information can come directly from the measurement of elements or processes (primary data) and can be collected through individual contact with the users of the services. Alternatively, it can be collected directly in the community (such as in household surveys) as a non-routine activity. Both routine and non-routine data collection methods depend on the quantity and quality of the data to be collected. Secondary information can be collected from external sources such as education, municipalities, national census bureaus and statistical offices. For data collected

from other sources, it is important to bear in mind the original purpose for collecting the data (for example, to study household living conditions), in order to prevent bias in interpretation or use.

- *Information flow and transmission:* The flow of data and information allows data, as inputs, to follow the production process until the information is reported and disseminated as the output. The identification of all the pathways followed by the information flow is important for the assessment and further logical design of the productive process. According to the productive design, the flow of information can proceed within a defined information system (between different units or levels of aggregation of that system) or through different information systems.
- *Data processing:* Data processing can have a different technological substratum and the productive processes need to be coordinated around the end information products. To support this process, equipment and programs are required for processing and electronic communication (whether the system is partially or totally automated). Additionally, this process needs trained staff for its overall operation.
- *Data and information analysis:* Data processing can include statistical analysis (in order to review the quality of the information and determine if it meets the requirements with regard to coverage, opportunity, representation, and validity. Data processing can also include a statistical and technical analysis of the information related to its meaning as proxy for findings (for example, epidemiological description and analysis of communicable diseases).
- *Reporting, presentation and dissemination of information:* Production of information needs to properly reach main users through good quality and responsive reporting, with proper presentation and dissemination of information.
- *Feedback:* the diverse phases of the process and the final product need to be complemented by feedback, to the extent that users can evaluate the input and limitations (gaps in the information needs which are not covered) to provide

orientation for further development and strengthening of the information systems.

## 2.5. Specific Health Information Systems

The overall performance of the NHIS depends on the efficient and effective operation of each specific system as well as proper connectivity and coordination of systems within the nationwide information network. According to individual characteristics of specific information systems, these can be: formal, informal, simple, complex, manual, automated, specific, or general, or have a combination of these characteristics.

Each module or specific system covers different geographical levels within and outside the health sector. Specific information systems can be recognized by:

- the issue or content of information that they cover (e.g. mortality);

- the establishment or center where they are placed (e.g. hospital);
- the type of management that they support (e.g. management information system); or
- a combination of all of the above.

Table 2.3 describes main specific health information systems with their relevant sources of information (with inter-institutional information flow).

Some sources provide routine information (such as epidemiological surveillance systems or health services-based statistics), some other provide non-routine information (e.g. nutritional surveys in the population and other sources provides secondary information collected from their primary sources (such as the case of national statistical offices and international agencies for estimate and projection of population structure).

**Table 2.3 Main specific health information systems and sources of information**

<b>Specific information systems</b>	<b>Main sources of information</b>
<b>1. Population-based information systems</b>	
Demographic and vital statistics	<ul style="list-style-type: none"> <li>• Census</li> <li>• Civil registry</li> <li>• Statistical national office</li> <li>• Ministry of health</li> <li>• Health services</li> <li>• Health and housing surveys</li> <li>• Community-based information</li> <li>• Ministry of economy</li> <li>• Ministry of education</li> <li>• Schools (records and statistics)</li> <li>• Research and tertiary teaching centers</li> <li>• Agriculture and commerce</li> <li>• Other sectors</li> <li>• International agencies and statistical entities</li> </ul>
Socio-economic or social statistics	
Health status (self-reported)	
Risk factors	
Morbidity (surveys, sentinel sites and services-based)	
Disability (surveys and services-based)	
Mortality (maternal, infant and other avoidable mortality)	
Food and nutrition	
<b>2. Surveillance-oriented information systems</b>	
Communicable diseases (including surveillance) population and services-based	<ul style="list-style-type: none"> <li>• Ministry of health</li> <li>• Health services</li> <li>• Epidemiological surveillance systems</li> <li>• Health surveys</li> <li>• Ministry of education</li> <li>• Schools (records and statistics)</li> </ul>
Chronic non-communicable diseases, mental health and injuries (including surveillance)	
Food and nutrition (including nutritional surveillance)	
Maternal and Child health (nutrition, morbidity, mortality, risk factors)	

	<ul style="list-style-type: none"> <li>• Research and tertiary teaching centers</li> </ul>
<b>3. Health system and services information systems</b>	
Health financing	<ul style="list-style-type: none"> <li>• Ministry of health</li> <li>• Health system and services</li> <li>• Health insurance institutions</li> <li>• Statistical national offices</li> <li>• Commerce and pharmaceutical institutions</li> <li>• Ministry of finance</li> <li>• Central bank</li> </ul>
Human resources	
Physical infrastructure	
Specific medical technology (medical equipment, laboratory, imagenology, pathology)	
Pharmaceutical drugs;	
Health care network (primary health care, hospital, referral system)	
National health programs (reproductive health, child health, adolescent health, ageing health)	
<b>4. Patient-centered information systems (health-services based)</b>	
Patient administrative and clinical data	<ul style="list-style-type: none"> <li>• Ministry of health</li> <li>• Health system and services</li> <li>• Health insurance institutions</li> </ul>
Electronic records databases	
<b>5. Environment health information systems (including surveillance)</b>	
Vector control (malaria, dengue, others)	<ul style="list-style-type: none"> <li>• Ministries of health and/or environment</li> <li>• Health and environmental services</li> <li>• Water and sanitation authorities</li> <li>• Municipalities</li> <li>• Ministry of labor</li> <li>• Industries</li> <li>• Research and tertiary teaching centers</li> <li>• International agencies and statistical entities</li> <li>• Health and housing surveys</li> <li>• Community-based information</li> </ul>
Water quality	
Food safety	
Waste management	
Occupational health	
<b>6. Virtual library and data warehouse</b>	
Virtual library	<ul style="list-style-type: none"> <li>• Libraries</li> <li>• Documentation centers</li> <li>• Research and tertiary teaching centers</li> <li>• Internet web-based community</li> </ul>
Data warehouse	

**2.5.1 Population-based Information Systems (overlapped with social and health statistical systems)**

Population data and vital statistics systems are usually produced and shared by entities such as the civil registry, national institutes of statistics, and ministries of health. In view of the fact that the definite data published is usually official (that is, backed by the governmental authority), formal inter-agency agreements on recording, data

management and quality control of the information are usually needed.

When information from these sources is incomplete, sometimes data can be collected from other alternative sources, such as verbal audit (oral autopsies) of maternal and infant deaths through periodical surveys in the community.

**2.5.2. Surveillance-oriented Information Systems**

Information systems included within surveillance systems use a combination of population-based data and clinical and administrative data recorded in health services.

Epidemiological surveillance has been traditionally focused on relevant communicable diseases (such as communicable, chronic, nutritional risks and diseases, mental health and injuries).

Mortality-related surveillance is focused on relevant and avoidable mortality, especially maternal and infant mortality. The Perinatal Information System (SIP) uses a PAHO developed tool that is aimed to capture and analyze information related to infant risks and key features around the perinatal period.

Public health surveillance, considered an essential public health function, should be composed by the integration of specific surveillance systems allowing for the comprehensive overview of health and determinant factors, analysis and forecasting in terms of information for action.

### **2.5.3. Health Systems Information Systems**

Specific information systems used in health systems can be are focused on:

- a) Resources: Health financing; Health insurance; Human resources; Physical infrastructure; Medical equipment & technology; and Pharmaceutical drugs;
- b) Health care delivery and national health programs: Health care delivery systems are mostly focused on activities provided to the population, through inpatient and outpatient care, as well as collective and community activities. National health programs include reproductive health, child health, adolescent health, ageing health.

Specific information systems can constitute a national network (e.g. national vaccination program at local regional and nation levels), or be located at specific level of the health care network: primary health care, secondary and tertiary care (inpatient and outpatient care).

### **2.5.4. Patient-centered Information Systems**

Patient-centered information systems are a subgroup of health services information systems characterized by the management of individual data collected in the contact between health care personnel and patients. Some specific systems use aggregate information aggregated statistics (e.g. length of stay at hospitals) and some others keep individual data to support analysis, monitoring and surveillance (e.g. follow-up of patients who are under treatment for tuberculosis, or patients waiting for kidney transplant).

Information systems supported by electronic records databases imply a more complex level of management of medical records as well of information technology.

### **2.5.5. Environmental Information Systems**

Environmental information systems usually manage different information contents, sources, flows and functional approach, given that information is mostly taken from the physical environment, through inspections, samples, use of special laboratory exams. The aim of environmental information systems is to support environmental epidemiology and solutions to problems in the environment, as well as the monitoring of national and sub-national environmental programs. All this requires inter-sector sharing of information and support to the diverse environment-related public and private entities.

Information systems on occupational health deals with information related to activities for prevention, monitoring and surveillance of avoidable events occurred as well as high risks in defined working places (either public or private).

### **2.5.6. Virtual Libraries and Data Warehouses**

Virtual libraries (containing formal and informal literature, reports and information on health and the health sector) have moved from traditional libraries with passive deposit of printed publication to documentation centers, with electronic support and then to information and knowledge management centers (linked to a very wide potential range of external information sources), and also provide information on Internet, with worldwide information.

Centers managing data warehouses are moving information in a way that traditional deposit of information has evolved towards functional effective information systems.

### 2.6. Local Health Information Systems

Local information systems should be in line and reflect the resources and processes involved in the routine operation of health service facilities. Local information systems, to ensure quality and completeness of data, should have clear standards,

criteria, manuals, definition of data and indicators, supervision and training.

Information systems are used in different setting of the local level: ambulatory centers, internal productive services of hospitals (intermediate or final), networks of delivery of health care (health services organized on a model of multiple centers), the community and the physical and social environment. At the same time, information should be viewed as one of the elements that help to the functional integration of the health care network.

Figure 2.6 Contents and flow of data and information in a health care center

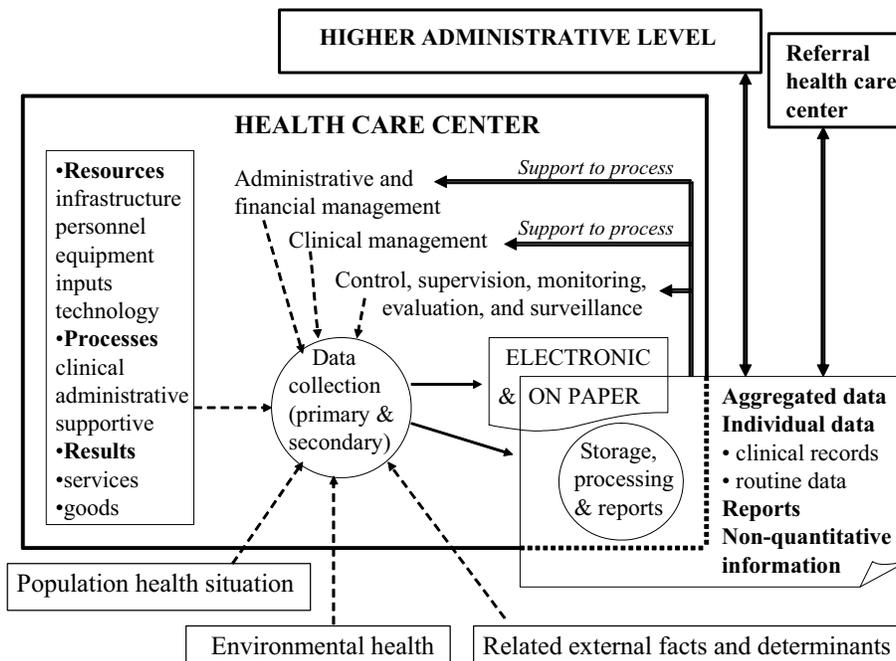


Figure 2.6 shows an example of relevant contents, flow and primary destination of local routine data in a health care center. Data storage, processing and preparing reports could be supported by an automated, manual or combined system, but the design, the criteria and information management is the same. That is why automated information systems have an increased probability of success if they are implemented when well performing statistical routine data systems have already been established.

#### 2.6.1. Hospital Information Systems

Hospitals are very complex institutions with many internal centers providing clinical and supporting care services, as well as performing all the administrative, financial and technical processes to run a non stopping critical center.

Given that complexity, the hospital information system is an integrated network of a general administrative and patient module that is connected to many specific information systems that support the hospital management and operation. Main hospital specific information systems (or modules) are described in table 2.4:

**Table 2.4 Hospital specific information systems**

<b>Group of information system</b>	<b>Specific information systems (modules)</b>
a. Patient management system	<ul style="list-style-type: none"> <li>• Patient management system</li> </ul>
b. Clinical data management	<ul style="list-style-type: none"> <li>• Medical records</li> <li>• Nursing care</li> <li>• Audits</li> </ul>
c. Diagnostic and therapeutic support	<ul style="list-style-type: none"> <li>• Clinical laboratory</li> <li>• Medical imaging</li> <li>• Radiation therapy</li> <li>• Pharmacy</li> <li>• Transfusion and blood bank</li> <li>• Dietary service</li> </ul>
d. Administrative systems	<ul style="list-style-type: none"> <li>• Finance management</li> <li>• Human resources</li> <li>• Performance monitoring</li> <li>• Hospital maintenance</li> <li>• Medical equipment maintenance</li> <li>• Material management</li> <li>• General services</li> <li>• Transportation services</li> </ul>
e. Other (primary health care and community-oriented)	<ul style="list-style-type: none"> <li>• Immunization</li> <li>• Epidemiological surveillance</li> <li>• National health programs</li> <li>• Environmental health</li> </ul>

Source: Based on "Setting up health Services Information Systems" (PAHO, 1999)

### **2.6.2. Primary Health Care (Community) Information Systems**

Specific information systems in primary health care (PHC) centers vary according to the clinical and administrative development achieved by each center and the link and support existing in relation to the health care network. Information systems in PHC centers could be very simple and manual, based on central-level developed forms, or become as complex as a hospital information system (as in table 2.3, with the exception of inpatient-related information). Besides, PHC centers manage information related to the public health issues of the target population, the development of national health programs applied to that population and referral systems (patient being referred to more complex health care centers).

### **2.7. The contents of information**

The contents of information cover by the NHIS include a wide range of key health-related issues

(summarized in Annex 2), such as: health conditions of the population; the government steering role (regulation, policies and plans, advocacy, information & research); health systems resources (policies, financing, human resources, physical resources, technology); health services delivery (health promotion; preventive-oriented services, curative-oriented services; rehabilitative services and palliative services) and environmental action (programs & control). Information includes description and measurement of health conditions (including determinants); resources (financial, human, physical and technological) processes (such as health system performance) and outcome of actions.

Given the complexity of institutions generally involved in the health sector (public and private entities) and the difficulty in establishing operational limits for national health systems, information becomes the input to understanding and describing the characteristics of health and health sector.

As a practical reference, Annex 3 presents a list with main information thematic contents that are most frequently utilized on health situation, determinant factors and health sector. Annex 4 also presents a list with information contents used in health care health centers.

### 2.7.1 Overview of Health Systems

The overview of health systems is based on textual, graphic and numeric information, consisting of a description to summarize the goals, organization, structure, functions, outputs and impact of their actions on the health of the population. Key issues to be covered are:

- Global health system, described as the prevalent model
- Normative organization of the system: legal regulatory framework and norms and regulations
- Financial model according to legal and economic framework and main financial flows
- Specific health systems, within the national health system, according to property (public, private), services provided and population covered for each system
- Stakeholders or main actors of the health sector, according to their role (regulation, financing, insurance, purchase, provision)
- Role and relevant functions of the State, with respect to the health sector
- Main determinants of the health system market
- Health financing and expenditure according to sources, funds and type of expenditure
- Health insurance system and main companies or agencies
- The public and private mix in the national health system
- Inter-sector action in health-related matters
- Community participation and its involvement in the health system

- Nongovernmental action in health
- International action in health-related matters
- Types and organization of health care delivery providers (public and private sectors)
- Administrative organization of health services
- Health care organization
- Health care network according to level of technological complexity
- Health services financing and financial flows, including outsourcing
- Legal and financial changes in health systems and services due to health sector reforms
- Changes in health systems functions following reforms (regulation, financing, purchase, provision)
- Changes in interactions between the different health system participating entities, mainly for regulation, financing, insurance and provision of health services
- Changes of roles in access and provision of care, related to health sector reforms

### 2.7.2 Sets of Data and Indicators

At country level, each country should critically assess the availability and readiness to produce a defined set of data and indicators, as well their use and contribution to health policy and multiple levels of health action. Each indicator should undergo a validation process. Confidentiality and ethical aspects should be considered in the development and use of data and indicators.

Types of indicators vary according to thematic areas and managerial processes supported:

#### a) Thematic issues:

- Indicators of population and bio-demographic characteristics
- Indicators of socio-economic circumstances

- Indicators of health situation (positive health, risk, morbidity, disability and mortality)
- b) *Indicators of health of systems (regulation, financing, insurance, provision of services)*
- Indicators of resources
  - Indicators of health care delivery services
  - Indicators of access and use of services
  - Indicators of health services coverage
- c) *Indicators of the health care productive process:*
- Indicators of structure
  - Indicators of process
  - Outcome indicators (immediate or 'outputs' and mediate or 'outcomes')
- d) *Indicators approaching needs, demand and use of health services:*
- Health indicators (as needs for health and health care),
  - Socioeconomic indicators (as needs for health care and determinants of access),
  - Perceived indicators of need for health care,
  - Indicators of demand,
  - Indicators of access and use of services
  - Indicators of access to services (geographical, economic, social and cultural)
- b) *Indicators to support management:*
- Indicators for planning (different length of periods and levels)
  - Indicators for programming (technical, administrative, financing)
  - Indicators for decision-making and routine management
  - Indicators for monitoring and surveillance (information for action)
  - Indicators for evaluation
- e) *Indicators to measure and assess overall quality of health systems and services*
- Indicators of efficiency (economic, managerial, distributive, social)
  - Indicators of effectiveness (attributable impact, at various levels)
  - Indicators of equity (access, use, impact)
  - Indicators of humanity and ethics of care, including satisfaction of personnel and users
  - Indicators of distribution of the resource and use (distributive efficiency and equity)

### 2.7.3. Indicators According to Specific Topics

There are some lists of indicator already widely used and promoted by international organizations, such as the Health For All indicators (HFA - European WHO) Core Health Data Initiative (PAHO/WHO), OECD indicators and WINSIG indicators (PAHO/WHO). Table 2.3 describes main types of indicators used according to the health-related issue they represent.

**Table 2.3** *Types of indicators according to health-related issue*

Issue	Specific types of indicators
Population Characteristics	<ul style="list-style-type: none"> <li>• Age and sex structure</li> <li>• Population growth</li> <li>• Urbanization and density</li> <li>• Indigenous populations</li> <li>• General mortality</li> </ul>
Socio-economic Context	<ul style="list-style-type: none"> <li>• Macro-economic level</li> <li>• Income and poverty</li> <li>• Employment</li> <li>• Education</li> <li>• Nutrition</li> <li>• Housing and sanitation</li> <li>• Physical environment</li> </ul>

	<ul style="list-style-type: none"><li>• Summary socio-economic development</li></ul>
Health Situation	<ul style="list-style-type: none"><li>a) Positive health status</li><li>b) Health risk<ul style="list-style-type: none"><li>• Maternal and child risks</li><li>• Lifestyle related risks</li><li>• Nutrition-related health risks</li></ul></li><li>c) Morbidity<ul style="list-style-type: none"><li>• Morbidity by communicable diseases</li><li>• Safety food-related morbidity</li><li>• Oral health-related morbidity</li><li>• Morbidity by cancer</li><li>• Morbidity by chronic diseases</li><li>• Injuries-related morbidity</li><li>• Morbidity by congenital causes</li></ul></li><li>d) Disability<ul style="list-style-type: none"><li>• Disability-related events</li></ul></li><li>e) Mortality<ul style="list-style-type: none"><li>• Specific life expectancy</li><li>• Child mortality</li><li>• Abortion</li><li>• Maternal mortality</li><li>• Mortality by communicable diseases</li><li>• Mortality by chronic diseases</li><li>• Mortality by cancer</li><li>• Mortality by external causes</li><li>• Mortality by iatrogenic causes</li><li>• Mortality by respiratory system causes</li><li>• Mortality by digestive system causes</li><li>• Mortality amenable to curative health care</li><li>• Mortality by endocrine system causes</li><li>• Mortality by diseases of the hematological system</li><li>• Mortality by mental and neurological causes</li><li>• Mortality by genitourinary system causes</li><li>• Mortality by ill-defined causes</li></ul></li></ul>
Social Protection	<ul style="list-style-type: none"><li>• Social security</li><li>• Health insurance coverage</li></ul>
Health System Resources	<ul style="list-style-type: none"><li>a) Financial resources</li><li>b) Human resources</li></ul>

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	c) Physical resources
	<ul style="list-style-type: none"><li>• Infrastructure</li><li>• Hospital beds</li><li>• Medical technology</li></ul>
Health Care Delivery	<ul style="list-style-type: none"><li>• Access to health services</li><li>• National health programs</li><li>• Ambulatory care</li><li>• Hospital performance</li><li>• Hospital use</li></ul>
More Detailed Data and Indicators to Support Local Health Care Management	a) Health care resources
	<ul style="list-style-type: none"><li>• Human resources</li><li>• Physical resources</li><li>• Financial resource and costs</li></ul>
	b) Economic and geographical access
	c) Health services delivery
	<ul style="list-style-type: none"><li>• Ambulatory care</li><li>• Inpatient care</li><li>• Clinical Support activities</li><li>• General services</li><li>• Administration, education and research</li></ul>
Patient-centered Information	<ul style="list-style-type: none"><li>• Identification</li><li>• Clinical history</li><li>• Contact with services</li><li>• Insurance and billing</li></ul>

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Internal productive units of health care facilities can operate with specific information systems focused on issues such as: admission, statistics, laboratory, diagnostic imaging, blood bank, pharmacy, dietary service, accounting, personnel, purchases, maintenance, and general services.

The information system of a health care center – such as a hospital - should include the integration

of all these subsystems, although they could have different degree of automation (many of them could be just manual) or there could be a few existing modules (such as admission, accounting, purchases, hospital discharges). The challenge is the progressive development of a system that could be able to integrate and produce the most relevant information for management and operation of a health center.

### 3. Assessing the NHIS

*Based on the NHIS model, appropriate assessment is an indispensable tool to guide the effective plan and implementation of the NHIS improvement. For each NHIS component (institutional, technological, functional), the chapter focuses on descriptive assessment, then the critical aspects to be assessed and the key questions to be considered in the preparation of questionnaires, interviews and analysis.*

#### 3.1. The Reference for Assessment: the Country Adopted Model and Benchmarks

The approach to NHIS assessment is facilitated when an operational model has been already developed at country level, and all the key stakeholders support its validity as the outline of the NHIS that is needed and feasible to achieve. The logical design of the model, as well as the physical design (technological part), provides a more detailed scenario for benchmarking.

The model provides the overall reference on what should be the desired fully structured and functioning system, once the NHIS has been improved and consolidated. Differences between the observed state of the NHIS (according to descriptive assessment) and the expected situation (the model) indicate the gaps for development and the need for improvement.

Recommendations coming from the NHIS assessment, especially gap analysis, could suggest some appropriate solutions for improvement, according to affordability, cost-benefit and priorities. However, importance should be given to the existing NHIS and its key specific information systems, as the baseline situation for improvement.

Benchmarking is the process of defining levels of reference or standards of excellence (gold standards) against which something can be measured or assessed.

National benchmarks provide the framework on the expected level of structure (institutional arrangements, resources and organization) and performance that the NHIS (or a specific information system) should achieve to fulfill appropriately its goals and be able to provide

effective and opportune information for action, once consolidated.

At national level, standards can be adopted according to:

a) ***International regulations and recommendations***, e.g.:

- Core health data that countries should produce;
- Cases of communicable disease that should be reported.

b) ***Normative reference*** (based on decisions adopted by the national health authority), e.g.:

- universal reporting of all deaths occurred;
- forms and variables that should be reported on administrative information;
- an estimated maximum time necessary to produce and report vital and health data.

c) ***Empirical reference*** (based on best structure and performance), e.g.:

- shortest time spent in the production and reporting of specific data or information (as found in systems with the best performance);
- quality and completeness of information that could be achieved, as already performed by a system with best performance

The normative reference can be adopted through combining international standards (if available) adapted to the national setting, with the best known practices (empirical reference) and experts' opinion. Within the NHIS, the standards for reference could be different for different levels and specific information systems.

The difference between a measured situation and the standard of reference provides the measurement of a gap. For instance, the reference

standard for the indicator *infant mortality rate* includes the following conditions: available, updated within a period of less than a year of produced each death, complete (cover all deaths)

and good quality. Possible categories for estimating gaps in this indicator are described in table 3.1 (based on HMN approach):

**Table 3.1 Example of a measurable level of appropriateness in the indicator “infant mortality rate”**

<b>Quality of the indicator</b>	<b>Appropriateness</b>
Availability	(3) Fully available – [Appropriate] (2) Mostly available (1) Mostly unavailable (0) Unavailable
Up-dated (after facts or events are produced and data are recorded)	(4) Less than 1 year [Appropriate] (3) 1 - 2 years (2) 2 - 3 years (1) More than 3 years (0) Unavailable
Completeness	(3) Complete – [Appropriate] (2) limited completeness but representative (1) very incomplete (0): no data
Overall quality	(3) Adequate – [Appropriate] (2) limited quality but acceptable indicator (1) very low quality (0): no data
Validity	(3) Valid – [Appropriate] (2) Limited by satisfactory validity (1) Unsatisfactory validity (0) Invalid

*Source = adapted from HMN situation analysis tool (Health Metrics Network, 2005b)*

### **3.2. The Assessment Method**

Given the complexity and diversity of the NHIS components within the health sector, a comprehensive assessment could not be always possible. According to the extension of the planned NHIS improvement, the assessment could cover the whole nationwide system or focus on its specific components (administrative, technological and functional), or some specific information systems (such as the environmental information system).

For each information system, the focus should be placed on the key components, relevant phases of the management and operation (specially the productive process). In case of a nationwide HIS covering different regions with similar structure and performance, then a geographical area can be

explored (a conventional samples); this option assumes that the NHIS has similar characteristics and critical problems in all areas of the country (Sapirie, 2000).

The assessment should be guided by its primary purpose: to provide a descriptive analysis of the level of organization, structure and performance of the NHIS, followed by the analysis of critical aspects, gaps and needs, to produce a diagnostic of the situation, with conclusions and recommendations aimed to orient the NHIS planning and improvement.

Publication of guidelines for integral NHIS assessment is not frequent in the literature, as the use of pre-defined methodologies and successful methods is not usually disseminated (Gissler et al, 2006). However starting in 2005, the Health

Metrics Network Initiative (HMN, WHO 2005) has been supporting countries with framework and analytical tools for NHIS broad assessment.

The preparation of the assessment includes the development of the methodology and tools (if no method is available), the plan and the necessary organization and training to carry out the assessment. The assessment should include a descriptive NHIS diagnostic, followed by the measurement on the availability and quality of organization, resources, processes and results. This will provide elements for the analysis, interpretation and recommendations.

Main phases of the assessment process are:

- Defining the NHIS components and specific elements or systems to be assessed;
- Planning and preparing the assessment, with the instruments for collecting and measuring information;
- Collecting the information:
  - Document and data collection
  - Observation
  - Fact finding interviews
  - Accreditation review (tracking)
  - Documenting clinical and administrative procedures
  - Information workflow guide;
- Gap analysis
- Overall analysis and interpretation;
- Consolidation and validation of initial conclusions and recommendations.
- Development of assessment report (M. Courmeene, 2007)

Some tools can be prepared and used (if available) to support the assessment:

- HMN situation analysis tool (HMN, 2005b) and document and data analysis guides (to explore state of HIS-related documents, data and sources of information);
- Interview templates (for fact finding);

- Use cases guide and workflow templates, for tracking clinical, administrative and documentation processes;

- Gap analysis guides and templates

Periodical repetition of the NHIS assessment will provide the basis for monitoring and evaluation, to ensure a successful improvement process.

Planning and preparing the assessment includes:

- Preparing the methods, guides and tools, through using, adapting or creating suitable assessment instruments;
- Defining the expected results or objectives, components to be assessed, resources, steps, budgets and timetable;
- Establishing the terms of reference of key participants and contracts (in case that hiring external support is needed);
- Defining the details of the process;
- Getting resources, financial, political and institutional support;
- Organizing and training the personnel who will participate.

Collecting information is a critical phase and depends from the structure and processes to be assessed. Instruments for collecting information could include templates, questionnaires (as based on the orienting questions suggested in this chapter), tables providing categorical values to critical aspects to be observed (such as a scale between 0 and 5 for the level of training observed in specific staff).

Collection of information could involve internal or external staff in places where data will be collected. Costs and efforts will depend on the extension of geographical areas, components and units that will be under assessment.

In the assessment of the functional component (management and production of information), it is important to involve key staff and representatives of the various groups of personnel participating in the management and production of information, at

different levels, offices and specific information systems. Also, it should be important to have the perspective of the users, specially the personnel in decision-making positions.

The analysis and interpretation of finding is supported by the material and information collected. Findings provided by the description and measurement of the NHIS components can be analyzed in terms of organization, structure, performance, gaps and needs for improvement. The answers to the orienting questions suggested below in this chapter should provide an analytical view of the NHIS and critical aspects to be developed or improved.

Final interpretation of results implies the comprehensive analysis of the NHIS findings, with plausible explanations for internal or external causes of limited development, performance or integration of the NHIS, including causes of gaps and needs detected.

Initial conclusions and recommendations, based on antecedents collected as well as observation and interviews, can be validated through consultative meetings to discuss initial report, with concurrence of all those who either provided key information or will apply the assessment recommendations to further NHIS improvement. It is important to have the feedback and opinion of decision-makers, as key users of information.

The conclusions, based on main findings, and the recommendations should become a practical orientation for planning, developing and improving the NHIS.

### **3.3. The Institutional Component**

#### ***a) Descriptive analysis***

Even if the NHIS development is going to be focused on specific internal components or systems, a general description of the NHIS and the institutional context of the health systems serve as a general background for the assessment.

For each component, the NHIS key aspects to focus on the general description are:

#### ***a.1) The NHIS within the health sector***

- The role, functions and responsibility of the national health authority;
- The nationwide (multi-sector) information system;
- The ministry of health's information system;
- Specific information systems;
- The integrated national health information network;
- Identification and clarification of the normative, administrative, and functional context of the organization and the functions of the health authority and the health sector (where the NHIS performs);
- Plans, projects and reforms of the health sector that could have implications for the organization and performance of the NHIS;
- Current existence and plans for development of specific information systems (such as epidemiological surveillance, and monitoring of programs);
- The technological and functional components, as well as the integrated information network at all levels and participant entities;
- The contents of information to be covered (such as population, the health situation and its conditioning factors, socio-economic aspects of resources and health assistance, insurance, financing, monitoring and surveillance), according to the levels of territorial aggregation;
- Principal types of users of information (internal and external to the national health authority and to the health sector);

#### ***a.2) Key elements of the institutional component:***

- The legal and administrative framework that supports the organization and operation of the NHIS (with the set of regulations, criteria, standards and norms);
- NHIS-related policies, plans and projects;

- The formal NHIS organization at nationwide level (what is stated in formal documents, with the role of the national health authority, the participant institutions and their complementary responsibility in relation to producing and sharing information and the inter-institutional flow of information);
- Roles and responsibilities formally assumed by the national health authority to coordinate and manage the NHIS (the nationwide system, different levels and specific information systems);
- Roles and responsibilities of other participating entities and sectors;
- If different, the organization of specific statistical systems (such as health, administrative and clinical statistics) and information systems; and
- The relationships and level of integration among all the specific information systems.

**b) Critical aspects and limitations to be reviewed by gap analysis**

Some critical issues are systematically described as institutional or normative limitations in the structuring, integration and performance of an NHIS (OMS, 1997; OPS, 2000; Sauerborn and Lippeveld, 2000). These include aspects such as the following:

- Lack of clarity and normative support for the global development of the NHIS;
- Obsolete existing regulations and standards with regard to the sector's operation or the information needs of those who make decisions;
- Lack of consistency among regulations and standards which are applied differently for the various specific information systems and do not support coherent or compatible integration. For the same nationwide information system, different regulations and standards could be found between different administrative levels, institutions or sectors;
- Existing laws, regulations, and standards are not accompanied by the necessary formal responsibilities, incentives, and sanctions that could enable the effective application of the legal framework;
- The existence of information systems that are intended to function independently (autonomously) or whose operation is not consistent or relevant to the overall NHIS, or to the management and operation of the health sector;
- The existence of information systems based on institutional models and logical designs that do not represent the perspective and needs of potential users (mostly reflecting the perspective of international donors or persons external to the health sector).

In general, these limitations could reflect the weaknesses and limitations of health systems (the NHIS immediate environment). Many information systems have not originally been developed to support planning and management of health systems, and this has limited NHIS improvement to become effective tools for management and action (Sauerborn and Lippeveld, 2000).

However managerial limitations in health systems can reduce effectiveness of information produced by NHIS. That is why the NHIS assessment should explore if the NHIS organization and performance is in line with the management and operation of health systems (PAHO, 2000).

**c) Key questions to guide the observation and preparation of interviews, measurement, analysis and evaluation**

- Are there regulations, institutional or legal documents supporting the formal existence of a NHIS?
- Are there regulations, institutional or legal documents supporting the formal existence of a NHIS at the Ministry of Health (or equivalent authority)?
- How many formal specific health information systems (including statistical, surveillance and monitoring systems) exist in the country?
- Which elements of the institutional component (legal and institutional documents, personnel,

financial, technological and other resources) are included in existing regulations, norms and decrees?

- Is there integration or functional articulation between the different specific information systems at the local, regional and national level?
- Are there formal mechanisms to support coordination, integration and feedback of the information among the various institutions involved in the NHIS?
- Is there a defined NHIS model? Is it complemented by a detailed design of the NHIS?
- Is the NHIS model (if existing) clear enough to help in the identification and assessment of the NHIS, at different levels of action and decision?
- Are there plans or projects in the health sector which have implication for the implementation or strengthening of the NHIS?
- What are the current priorities for developing specific information systems or modules of the NHIS (for example, a module on human resources);
- According to current legal and institutional framework, is it possible to recognize the main users of the information to be produced by the NHIS?
- What information contents should be covered by the NHIS or by specific information systems (such as population, bio-demography, socio-economic, resources and health assistance, insurance, financing, monitoring and surveillance)?

### **3.4. The Technological Component**

#### ***a) Descriptive analysis***

The description of the technological component of the NHIS is based on the identification of all the resources and conditions allowing functioning of information and communication technology, with emphasis on the computer and communication equipment, computer programs, languages, norms, criteria, and standards involved in the information

automated processing, with virtual communication among the different centers.

Key elements of the technological component to be included in the descriptive diagnostic are:

- The logical design of organization, resources, and activities that permit the operation of the technological component;
- The architecture and technological applications for the overall NHIS and for specific systems;
- The electronic platform of the virtual communication throughout different levels and specific information systems of the NHIS;
- The criteria, type of data and standards for each module or specific system that are used in the NHIS network; this involves broad commercial use, including aspects of computational language and interfaces between languages;
- The flow and exchange of virtual information between various levels, areas and institutions, and where and how data and information are stored (including safety copies);
- The written standards and criteria, as well as regulations to ensure quality, confidentiality, effective connectivity, safety and continuous functioning of the system. This includes information support and necessary maintenance to deal effectively with any emergency;
- The management of information technology, and the responsibilities and specific functions of all those who participate in the process of information production;
- Existence of mechanisms of evaluation and control of the technological resource and the quality of its operation.

#### ***b) Critical aspects and limitations to be covered by gap analysis***

By providing technological support, informatics offers possibilities for enhancing the production and usefulness of information systems. However, information technology alone cannot meet information needs. Information technology needs to be coherent and consistent with the global

context of information systems and their management.

Some critical aspects and limitations frequently affect the application and use of information technology, such as:

- Inconsistency between expectations, reality, and the feasibility of obtaining and improving the information technology over the short and medium term;
- A series of investments and projects on NHIS that are not always effective to improve responsiveness to information needs or no cost benefit is shown;
- The concept of appropriate technology is not always clear enough to those who will embark in plans and projects on information technology;
- The design of plans for investing and developing technology should be in line with the organization of the health system (the environment where important part of the NHIS is immersed). The resulting NHIS should facilitate the information, communication, management and operation of the national health system;
- Projects and investments are often driven by the perspective of donors or lenders of funds, rather than the information needs of those who have to make policies and decisions in the health sector.

***c) Key questions to guide the observation and preparation of interviews, measurement, analysis and evaluation***

- Is there a policy related to information technology (either exclusive or being part of a wider NHIS policy)?
- Is there an inventory of the technological infrastructure?
- Is there any updated diagnosis of the technological platform and the information network?
- Are there available criteria, standards and regulatory framework for information technology?

- What is the existing main infrastructure and computer-related equipment?
- What is the degree of obsolescence of the equipment and programs?
- What is the degree of articulation and coordination of the information network?
- Which is the degree of automation of different specific information systems;
- What specific software (supporting administrative, financial and clinical areas) is used in the NHIS at different centers and offices of the country?
- What are main languages used in the different components and units of the NHIS?
- How is the integration or linkage of the databases between the various offices and institutions participating in the information network?
- What problems are there with regard to property, usefulness, obsolescence, maintenance and management of technology?
- Have the technological applications been evaluated with regard to their management and usefulness?
- Is there financing and regular provision of inputs to support the operation of the technology?
- In the case of information systems comprising various sources and institutions, are there applicable norms, criteria, and common standards for the integration and transmission of data?
- Is there any updated information of the existing staff (formal or functionally ascribed) that is involved in the information technology component?
- Which is the availability and location of the existing staff that is involved in information technology (for procurement, application, development, maintenance, management and operation of informatics)?

- Which is the level of training for key personnel managing and operating information technology? Are there gaps between existing and required training in the key staff?

### **3.5. Functional Component**

#### ***a) Descriptive analysis***

The functional component of the NHIS refers to the performance of multiple specific information systems, at different administrative levels of the country. However specific information systems could have different processes and ways to produce information. In that case, individual assessment should be encouraged, by using the same NHIS assessment approach.

The description of the functional component (mainly the management and production of information) includes the following aspects:

- Type, quantity and characteristics of information are needed, degree of aggregation, administrative levels of collection, production and use, frequency;
- Limitations of quality and quantity of information;
- Use of non-routine information and surveys;
- Appropriateness of information and responsiveness to information needs;
- Timeliness of produced information;
- Sources of information;
- Accessibility to the information;
- Reliability of information;
- Usefulness for action;
- Relevancy for effective national surveillance and monitoring processes;
- Feasibility to produce and measure adequately the information;

- Quality conditions such as validity, consistency, reliability, ethics, representation and sensitivity;
- Produced information understandable by persons who make decisions and other actors directly or indirectly related to the health sector;
- Existence of statistical or epidemiological techniques and methods to support analysis and reporting of information;
- Availability of training for the management, production and analysis of information;
- Availability of training for reporting, presentation and dissemination of information;
- Capacity of users of information for analysis and use for decision-making;
- Limitations on the access and use of the information for decision-making and action

#### ***b) Critical aspects and limitations to be covered by gap analysis***

Critical aspects of the production of information that should be reviewed include: training of human resources, data sources, infrastructure, programs or computational communication, the existence of statistical tools, internal analyses of the production and dissemination of information (OPS, 1999; Sapirie, 2000).

#### *Data and information collection*

- Data collected within the service itself can have limitations in terms of quality, quantity, or opportunity. Lack of standards, criteria, guides, training, forms, and local registry clarity can lead to systematic shortcomings in the production of the information;
- Primary data can be collected following direct contact with users of health services, or in the community as an additional exercise subject to limitations. Supervision and training on data collection and entry represent an aspect that can often be deficient;
- Primary data routinely collected in the health services (for example, diagnostics in outpatient consultations) need to be reviewed, validated,

and assessed taking into account any limitations of quality and quantity with respect to the universe being measured;

- Information coming from external sources (such as education, municipalities, national centers of censuses or statistics), requires expedite inter-institutional flow. If such a flow is absent or limited, it can reduce the coverage or quantity and opportunity of information.
- Data collected from other sources can be very useful, but it is always worthwhile to consider the original purpose of collecting those data (for example, to know the degree of targeting of social programs). This is important to avoid biases in the analysis of data;
- Additional data collection in the community can be expensive or complex because of the demands on time, personnel, transportation, and other factors;
- The search for other routine and non-routine sources of necessary information could be difficult. Additionally, existing information may not be accessed due to ignorance of data availability or bureaucratic obstacles.

#### *Production and local analysis of information*

- There could be inadequate production and analysis of information, partly due to the lack of statistical or epidemiological techniques applied at the local level, and the lack of training of those responsible for the production and analysis of the information on the health situation and its conditioning factors;
- Limitations can be due to deficiencies in the availability and updating of equipment and computer programs used by those responsible for the production and analysis of information.

#### *Presentation and dissemination of the produced information*

- General limitations in obtaining equipment and computer programs to support effective strategies for the presentation and dissemination of information;

- Non availability of appropriate communication techniques at different levels. These include techniques to provide support for graphic, analytical and synthetic presentations.;
- Lack of training and inadequate capacity and strategies for the presentation and dissemination of produced information affect can limit proper sharing of information.

#### *Use of information produced in response to the needs of the users*

- Limitations faced by users (especially planners and managers) when using, analyzing and applying the information.
- Level of satisfaction of decision-makers with available information, in relation to their information needs.
- Limitations in capacity (including training) of the managers for using and applying the available information.
- Other limiting factors are the deficient integration of equipment and computer programs; and restrictive factors in the immediate environment (institutional). All of this converges to hinder the possibility of identifying and pursuing concrete alternatives for making decisions.

#### ***c) Key questions to guide the observation and preparation of interviews, measurement, analysis and evaluation***

- What type, quantity and characteristics of information is needed, with what degree of aggregation, and at what levels and how often?
- What are the available sources of information? Is the information easily accessible or is there a need for additional efforts to support its acquisition and integration?
- Is the available information adequate or should additional or more precise data be obtained from different sources through studies or special surveys?

#### *Information as a response to the needs of the users*

- Does the content of the available information meet existing needs, in order to support decisions or operate specific aspects of the services?
- Is it possible to get available up-to-date information according to needs?
- Is the content delivered in such a way that meets the needs of the users for analysis and decision-making?
- How effective is the interaction and understanding among information providers, especially those responsible for the management, delivery and dissemination of information?
- What proportion of the users' information needs should be met by routine information?
- How much of their information needs require special reports adapted to suit the mode and moment of decision-making?
- Has it participated or does it have periodic influence in order to improve the contents of information, or to cause that the content of the information is more consistent with its specific informative needs?
- In the case of information coming from diverse primary sources (internal and external to the health services), is there capacity to integrate and analyze heterogeneous information for decision-making?
- How reliable is the produced information, according to users?
- Can it be understood by persons who make decisions and other actors directly or indirectly related to the health sector?
- Does it meet conditions of ethical requirements?
- Does it have sufficient quality with regard to the situation or event that it intends to indicate?
- Has the quality of the original sources of the information been reviewed?
- Does it have sufficient quality, in order to enjoy credibility?
- In the case of quality limitations, is it possible to weigh the proportion of under-registration or bias at various levels of aggregation and geographical areas?
- Is it validated by another type of information or other sources?
- Is the information timely to support decision-making?
- Is it produced systematically? If so, does it include quality control and corrections?

*The process of production and dissemination of information*

*The information as product*

- Is the information useful for action?
- Is it relevant for effective national surveillance and programs?
- Is it easy to produce and measure, so that the process can be systematically repeated?
- Does it meet quality conditions such as validity, consistency, reliability, representation and sensitivity?
- With regard to community-based data and surveys, what is the quality and how representative is the information?
- In routine primary data of health services, how is the quality, quantity, and update?
- With regard to data from other sources: What is the quality in relation to biases, coverage? Is it representative (if based on surveys with samples)? What is the expected degree of updating? What are the characteristics of official data at various sources?
- What are the costs and efforts to acquiring the data (money, personnel, transportation, time and other factors)?
- In case of the reported information on health population, does the information only include

those persons who got access to services, or does it also include all the residents of a defined area?

- Is there proper management of the filling of information, flow, and information consolidation?
- Are there clear standards regarding the definition of indicators, the use of forms or data entry, etc.?
- Does training exist so that all who participate in the process and flow of information have common criteria?
- In the case of existing automated means, is there adequate management of data entry, computer connectivity, and management of files and databases?
- Is there regularity in the use of computer systems, including personnel for its maintenance, the backing up of the information, and the correction of deficiencies or anomalies that arise?
- Are there statistical or epidemiological techniques that are practical, useful, and applicable at local level that can be used for the adequate preparation of reports and analyses?
- Is training available to persons responsible for the production and analysis of information?
- Is training available to persons responsible for the presentation and dissemination of the information that is produced?

- Which is the degree of capacity (including training) for those who produce, analyze, disseminate or use the information?
- What is the capacity and motivation of those who make decisions when it comes to using the information?

### **3.6. Use Case and Workflow Exam in Support of Gap Analysis**

Information should reflect the administrative and clinical procedures performed in health care facilities. The quality of recording situations and events and entering data will help to improve health information, especially in case of individual patient-centered data that should be stored, processed and reported with opportunity and precision.

Use case refers to the sequential record of each health care or administrative task performed, step by step, and how the corresponding data and information is collected, analyzed, disseminated and use. Following this sequence, it is possible to detect bottlenecks, problems and opportunities uncovered, according to the processes tracked. Based on interviews to key actors responsible for those tasks, it is possible to know alternate course of events, take notes and suggestions for changes (M. Courneene, 2007).

Workflow is the graphical expression of the sequence of events and the record of those events, expressed in the responsible actors at each step and the time spent between one step of the task and the following step. Figure 3.2 shows an example of workflow template.

**Table 3.2 Example of a workflow template for the task of requesting lab exam and providing medicines**

Actor/ Unit	Time						
	Time 1	Time 2	Time 3	Time 4	Time 5	Time 6	Time 7
Physician	Request Lab exam					Write Prescription	
Record officer							
Nurse		Take sample for lab					
Laboratory Clerk			Record the request & receives sample		Write & Send results		
Laboratory technician				Perform Lab test			
Pharmacist							Provides medicines

The gap analysis can be facilitated by the used of a template as illustrated in table 3.3 (M. Courneene, 2007)

**Table 3.3 Gap Analysis Template**

Cause-And-Effect Analysis		Gap Analysis		Recommendations		
Problem or Opportunity	Cause and Effects	System Objective	System Constraints (e.g. challenges and resource needs)	Activities	Timeline	Person Responsible

The combination of use case, workflow and interviews provide the basis for the antecedents on bottlenecks limitations and opportunities, in terms of cause and effects.

The gap analysis, for each problem or opportunity detected, indicates the challenges and resources needs implying for improvement. This leads to recommendations according to activities to be undertaken, expected timeline and the responsible person.

### 3.7. The Assessment Report

The development of the assessment report is focused on the findings and recommendations and could include some steps:

- Development of the initial draft assessment report;
- The draft report could be submitted to internal validation with the stakeholders who provided opinions and inputs to support the findings;
- A discussion meeting on findings and recommendations with key stakeholders is important to support external validation for the

assessment and enrich the recommendations for NHIS improvement;

- Development of final NHIS assessment report

Given that the assessment is aimed to orient the NHIS improvement, the discussion will need to concentrate a multidisciplinary and multi-agency (from public and private sectors) group around the main implications of the assessment for detailed aspects of the NHIS improvement.

The preparation of the final report could include the NHIS description; the gaps in structure, organization, integration and performance; and the suggestions for plans and strategies to improve the NHIS

The contents covered by the Final Assessment Report could contain:

- The assessment objectives;
- The assessment method with main processes and tools;
- The NHIS model and standards for reference;
- The current situation of the NHIS according to descriptive analysis;
- The gaps, problems and limitations for better structure and performance;
- Recommendations.



## 4. Planning the NHIS Improvement

*The development of plans and strategies for improving the NHIS structure and performance faces some challenges and critical aspects that should be considered to ensuring successful results. Effective plans need to be supported by a coherent background, a refined NHIS design, clear goals and objectives, estimates of the required resource, timetable and the steps of the implementation process.*

### 4.1. Plans for NHIS Improvement

Plans and strategies to improving the NHIS should be in line with the overall NHIS model and coherent with the country's priorities, information needs (for policy- and decision-makers), technological needs, feasibility (including affordability) and expected time required for the improvement. Improvement is also assumed to be carried out within wider processes of health systems strengthening, health sector reform, or a wider government project for improvement of information and communication technology (ICT).

To be effective, the NHIS should be user-oriented, aimed to meet the information needs of all potential users, but mainly those who are responsible for policy- and decision-making in health systems, within the health sector. Usefulness to support policy- and decision-making is ensured when production of information is centered on information needs, acceptable to those who participate in production and use of information and it is supported by national health and political authorities.

The initial assessment and further monitoring are crucial processes to guide the design and planning of an effective NHIS, responsive to users' needs. Further NHIS changes and reforms should be oriented by information needs, and be supported by periodical assessment and monitoring. New changes should be based on the assessment of new needs and obstacles, as well as the existence of a wide range of appropriate options to embark in strengthening processes, according to national capacity and economic and institutional feasibility, cost benefit, adoption of appropriate technology, sustainability (after initial investment), effective performance.

The nationwide integration of the NHIS should include specific information systems, sources of information, and different participant offices,

administrative levels and geographic regions. The integration is facilitated by a clear design and plan, administrative arrangements and training (with technical norms and guidelines on the participants' responsibilities and procedures to follow), and the support of connectivity resources and services coming from the information and communication technological platform.

The plan should include:

- a) The background situation. It takes into account the needs for accurate and timely information to support health-related action; the needs and challenges to improve the production of information; and the challenges to improve the NHIS performance and the production of information
- b) The NHIS operational model and policies adopted by the country (as the normative background and general design)
- c) The objectives, including goal and purpose, specific objectives, and expected results and indicators
- d) Estimate of the needed resources: financial, human, information technology, and other NHIS-related resources and timetable.
- e) Steps of the implementation process are:
  - Establishment of NHIS steering committee and central management team;
  - NHIS assessment;
  - Improving the NHIS organization (institutional component);
  - Improving the technological infrastructure - including resources and technology - and integration of the NHI network;

- Improving the production and integration of information;
- Monitoring and evaluation of the improvement process

f) Timetable

#### **4.2. Options for Specific and Gradual NHIS Improvement**

In terms of priorities and feasibility, the NHIS improvement should be planned and implemented under a gradual approach (Lippeveld and Sapirie, 200; HMN, 2007). The decision on what part of the NHIS is possible to improve - through specific plans and projects - will depend on different gaps, priorities, feasibility, available resources and the specific objectives pursued in the plan.

Implementing specific information systems through specific plans and budgets could be successful as isolated actions. However the challenge is to implement a coordinated network of specific information systems to support different processes and levels of health systems and services. The complexity of health systems and services demand diverse type of information, produced through different processes. Producing information through specific systems or modules and then integrating the relevant produced information at national and regional level seems to be a practical solution for NHIS improvement.

It is expected that the momentum of strengthening NHIS will vary from country to country. In general, it is not possible to get integral improvement of the NHIS at once, despite the development of some very comprehensive NHIS plans that some countries develop.

The consolidation of the NHIS up to a stage of full responsive performance is usually an ongoing unfinished task, given complex and changing demand for information as well as difficulties for sustainability and risks of technological obsolescence.

Thus, improvement could be focused on some specific areas that could be planned as a

subcomponent for short term implementation, such as:

- Development of a NHIS policy;
- Establishment of a national management unit with trained personnel, replicated at other levels, as necessary;
- Developing and strengthening information systems for primary health care and specific national health programs;
- Automation and improvement of hospital information systems;
- Strengthening vital and health statistics with emphasis on the process training, quality and completeness of the production of core statistical data and indicators;
- Redefinition of information contents, including core health data sets;
- Gradual automation of those essential manual or semi-automated information systems (especially for information on deaths, communicable diseases and other events under surveillance, and health services-based statistics);
- Improvement of public health, epidemiological and environmental health surveillance;
- Development and strengthening of monitoring and evaluation systems for health systems and services;
- Development or improvement of a nationwide health information network, based on the integration of existing specific information systems and stakeholders; or
- Deploying information and communication technology, ICT (at least to support the production of basic information), with the corresponding staff training and establishment of mechanisms and standardization to ensure compatibility of information through the NHIS
- Improvement of NHIS performance through staffing and staff training, as well as better criteria, norms, standards and procedures to be

applied throughout the chain of processes leading to the production of information

The improvement process could be initially implemented as a pilot project, focused on some specific information systems, geographical areas or administrative units.

#### **4.3. The Conditions to Ensuring an Effective Plan**

A plan for NHIS improvement has higher possibilities of success when it is based on a solid and coherent background, with clear objectives on the specific NHIS component that will be subject to improvement, the specific needs and gaps implying for improvement, the cost benefit expected, and the challenges and opportunities for embarking on the plan.

There are several critical factors which must be considered within the background of the plan, in order to ensure success of the plan, such as:

- Possibility of further continuity of the human resources participating in the implementation, both at the national and sub-national level;
- The main responsible managers of the health sector understand and support the project as well as the resources and activities related to the plan;
- There is broad acceptability of the plan by suppliers, users and stakeholders;
- Implementation of the improvement will be gradual, with focus on key components and priority users;
- The plan is in line with the regular operation of the health sector in its decision-making, to support the production of information as a tool for action;
- The information contents are defined and accepted by all participants in the production of information
- The existing information culture is taking into account when choosing the indicators and ways of measuring, and in the managerial motivation to analyze and utilize the information effectively;

- The actual context of the health system is taken into account, including its political, legal and financial framework, its management, financing, assurance and healthcare practices and the way in which the health system is handled by the relevant health sector authorities;
- The interaction of the different actors involved in the information network allows expeditious communication, including adequate connectivity according to need;
- The various levels of the health system and various types of management have been taken into account.

For each area or subsystem to be improved, it is important to develop a team responsible for the development and implementation of the plan.

Redefining the information contents as well as estimating the readiness for the production of information is important in early stages. It includes to define data sets and how to produce appropriate information, completeness of information according to geographical or population coverage (in some cases, coverage of all the geographical sectors cannot be achieved, especially if they are rural and isolated).

#### **4.4. The Objectives**

The plan's goal and objectives focus on improving critical aspects of NHIS structure and performance to increase the availability, quality, effectiveness and timeliness of national health-related information to support priority decision-making, health action and monitoring of priority health action, finally aimed at preserving and improving health of the population.

Specific objectives could cover:

- Identifying and measuring the level of NHIS development, through assessment, with analysis of the structure and performance and recommendations for improvement;
- Developing NHIS policies covering regulation, data harmonization, criteria and standards;

- Defining the key information contents and datasets to be produced and used at different levels of decision-making and operation of the health system;
- Integrating different national NHIS specific plans and projects to improve the NHIS performance and production of information;
- Improving critical aspects of the NHIS technological platform (hardware, software, connectivity) necessary for the necessary automation and communication;
- Supporting national capacity building for information management and operation of the national NHIS (at least for some specific information systems and basic indicators);
- Creating the monitoring and evaluation mechanisms to ensure appropriate NHIS performance;
- Integrating the national health information network through improved communication and information sharing between all specific information systems.

#### **4.5 Resources and Timetable**

In general, different sources of funding and provision of resources will be needed, given the multi-institutional nature of the NHIS, and the combination of regular and extra budgetary resources to implement the plan. The NHIS improvement involves the necessary financial, human, physical and technological resources that have to be considered in the direct and indirect costs of the plan. It includes the resources and expenses to be covered during the plan period, as well as the resources needed to make the NHIS performance sustainable after the plans or projects on improvement have finished.

##### **a) *Financial resources***

The amount of resources required for the overall project will mainly depend from the components and levels that are going to be improved. Given the complex institutional nature of the NHIS, it is needed to clarify the extra resources that each office, institution and sector will need during and

after the implementation process, and what will be the sources for such extra resources.

The budget should be considered at three stages of the improvement process:

- Regular budget previous to the implementation of the plan;
- Budget and necessary extra funds needed at the time of development and implementation of the plan;
- Regular and extra budget, once the improvement plan has finished (to ensuring NHIS sustainability).

Financial resources should cover the incorporation and maintenance of new resources a technology, as well as processes and services performed during the planning and implementation process.

Funds needed for the implementation process of the plan include those necessary to cover the following actions:

- To carry out consultative meetings to refine the implementation of the NHIS;
- To carry out a consultative meeting on harmonization issues;
- Assessment of the applicability of available alternative options for software solutions;
- Exploring the feasibility of the patient unique identifier option;
- Technical and economic evaluation of plan;
- Search for solutions for information technology;
- Procurement and implementation of information technology infrastructure;
- Monitoring, evaluation, supervision and control of the implementation process;
- Operating costs will also include salaries, training, maintenance and upgrading of hardware and software, licenses fees, computer supplies, telecommunication services.

**b) Human resources**

The plan should consider the staff that will participate in all steps of the management and productive operation of the improved NHIS. It means administrative and clinical staff reporting and collecting information at the point that facts and events are recorded, staff working in the flow, processing, analysis, reporting and dissemination of information, as well as different types of NHIS managers.

Participation of staff in an improved NHIS can have different degree of involvement in the management or operation of the NHIS, according to the main responsibility of specific groups, such as:

- Administrative and clinical personnel primarily working in health care or administrative support;
- Staff primarily working for the NHIS, at any stage of the managerial or productive process: data collection, flow, processing, analysis, reporting, dissemination, management, information technology, training, monitoring and evaluation;
- Staff providing outsourced services (from external contract or agencies providing specific actions on the management, production or sharing of information);
- Staff working in other sectors that are not primarily aimed to produce health-related information (such as from the education sector).

**c) Physical resources and technology**

Financial resources need to be defined for the acquisition, maintenance and operation of ICT. Depending on economic and technical feasibility and cost-benefit evaluation, the ICT acquisition will be decided. It also includes ICT equipment and maintenance, software acquisition and licenses. Communication acquisition and services will be needed, such as telephone, internet, fax and videoconferencing

Necessary training will be needed to install, use and maintain the information and communication technology and resources at national and regional levels.

Specific costs involved in information technology will be decided after the search for options with the most appropriate, affordable and cost benefit options for ICT.

Some of the key resources and services usually needed are:

- Procurement and updating of hardware: computers, printers, screens
- Furniture and facilities to accommodate and protect the equipment
- Trained staff for ICT-related management and operation
- Supplies
- Software acquisition and licenses
- Telephone and telephone services
- Fax
- Internet services
- Video conference services
- Maintenance services

Necessary training will be needed to install, use and maintain the ICT and communication resources at national and regional levels.

For specific information systems, ICT structure should be located primarily in those units and centers where primary data is collected and the produced information is initially used (e.g. PHC centers and hospitals).

The possibility of implementing a patient-centered information system generally requires more sophisticated technology and management. In general, there is an explicit need for this type of information in countries, but the probability of a successful implementation of national patient-center information systems seems to be low in the short term in most countries with limited resources and capacity for managing ICT.

Estimating appropriate and realistic timetable is crucial to the successful implementation of the plan, given that the resource has to be applied to coordinated tasks and activities according to an agenda that allow to achieve one objective or stage

and then to continue with the following on time. Delayed steps of plans can lead to failure and limitations if resources start been running out before the expected partial results have been achieved.

#### **4.6. The Implementation Process**

The improvement in the NHIS institutional component involves:

- Identifying, analyzing and improving the establishment of the legal and administrative framework, with the development of regulations, criteria, standards and norms, as needed;
- Determining data requirements and clinical and administrative statistical systems to support the health systems, and developing the necessary regulations for the national application of data requirements and statistical systems;
- Developing and disseminating policies, plans and projects on the NHIS;
- Determining teams and responsibilities to manage different roles, levels and specific information systems

A NHIS steering committee is aimed to:

- Request and support the mobilization of resources for assessment of the NHIS (administrative, functional and technological components);
- Support the exploration, discussion and adoption of national policies, strategies, criteria, standards, definitions, data requirements, sources of information and information systems, including policies on compatible technology to ensure the integration of the information network;
- Take the lead in advocacy for the timely implementation of the plan and report to the political authority on the development of approved plans and strategies, as well as resources used and results achieved at each stage of the plan;

- Explore and support negotiations for external technical assistance and resource mobilization necessary to help the strengthening process.

The establishment or reinforcement of the NHIS central management unit, as needed, is aimed to:

- Be in charge of the initial assessment of the NHIS, and further monitoring;
- Explore and analyze gaps in functional, administrative and technological components, in the search for solutions aimed at achieving an adequate level for the NHIS at the national and sub-national level;
- Lead and manage the implementation, integration, management and coordination of the national network of specific health information systems.

Improving the technological component includes:

- Development of national policies and strategies on ICT;
- Selection and application of appropriate technology, exploring alternatives to deploy necessary hardware and adopt compatible software;
- Implementing, updating or integrating the automation of data to support the management, production and dissemination of information;
- Exploring and providing advice and support on specific software such as managerial information systems and other solutions;
- Exploring and providing advice and support on the choice of appropriate programs to be used at different levels of health systems and services;
- Exploring and supporting the application of reporting or analytical software, according to needs and requests;
- Development of electronic formats for health statistics and updated inventories. It includes the development of electronic templates for statistical reports and country health-related data; also, an automated inventory of the health sector's financial, physical, human and

technological resources (by facilities, level, region);

- Hardware and software procurement, according to needs and priorities, with emphasis on those information systems used in health care facilities (such as hospitals and primary health care centers) and those supporting monitoring health programs and epidemiological surveillance;
- Training personnel in the application and use of information and communication technology: providing guidelines, tools, workshops and direct training in information technology applications and their use, as requested; and training on management information systems, geographic information systems and analytical application software.

Developing and consolidating the national health information network includes:

- Exploring alternatives to get necessary hardware and compatible software according to national policies so as to ensure appropriate connectivity and communication;
- Getting communication services (telephone, internet) to support the network;
- Developing the electronic platform for the national health information network;
- Managing, supervising and providing training in the application and use of the health information network;
- Establishing virtual communication between all information participants and disseminate information to key users;
- Implementation of a national website on health and health sector-related matters.

Improving the management and production of information includes:

- Review of statistical systems, flow of information and production of information;
- Review of critical aspects implying limitations for the efficiency of appropriate and timely information;

- Review of the management and operation of general and specific health information systems;
- Staff training at different levels and stages of the information production process, according to needs;
- Implementation of methods, techniques and related software to support a better production, analysis and dissemination of information;
- Implementation of monitoring systems on the administrative and functional dimensions of producing information;
- Deploying the necessary hardware and technology for computing and communication, according to needs;
- Strengthening national capacity for communicating and disseminating information

#### **4.7. Monitoring and Evaluation of the Plan**

Since the early planning stages, the monitoring and evaluation of the plan should be developed, so as to ensure that the plan will be developed according to planned, or adapted to new situations that can influence the plan.

Key aspects related to the NHIS monitoring and evaluation are:

- Implementing a periodic follow-up assessment of the main indicators related to fulfillment of the plan at different stages;
- Assessing the overall result at the end of the plan and after the main stages (similar to the approach used for the initial assessment, so as to compare performance and impact of the plan);
- Applying more exhaustive evaluations in case the plan seems to be following a different path than originally planned;
- Making proposals for rearrangement of the plan, if necessary, to ensure the fulfillment of the main goals and results pursued in the plan.



## 5. Improving the NHIS Institutional Component

*The emphasis of the improvement of the NHIS institutional component is on the policies, the regulatory framework (the laws, regulations, standards and norms), the administrative organization - at national and sub-national levels, and the necessary resources to manage and operate the NHIS with efficiency, effectiveness and coordinated integration.*

### 5.1. The Legal and Administrative Framework

The NHIS policy provides the wide framework to develop specific rules, manuals, and formal agreements and ways of coordination. The policy is more applicable to the extent that there is effective political will and the necessary resources to ensure the application of the policy. Furthermore, the NHIS policy should be in consonance with informatics-related policies in effect in the country, as well as with the general policies of the health sector (PAHO, 1999).

The establishment of policies related to the various types of management and operation of health systems and services at various levels in the health sector, helps to clarify the needs of information and information systems, and represent opportunities for their development and strengthening.

From a normative standpoint, the NHIS is a transactional, functional and integrated multi-institutional system – coordinated by the national health authority - formally based on the interaction and agreements between the participant entities and groups organized around the goal of producing and sharing health-related information. Thus, the regulatory framework gives formal recognition to the complex network of participating entities and units as well as their responsibilities and rights.

The regulation with the normative framework should enable the NHIS to extend acknowledged coverage beyond a ministry of health (or the public health system) so that it can, systematically and expeditiously, obtain, handle, integrate, analyze and disseminate information coming from different sources (both inside and outside of the health sector) and at various levels of the administrative structure of the country.

The NHIS legal and administrative framework should be therefore consistent with the institutional structure of institutions or units where specific information systems are located, especially within the health sector. A coherent and comprehensive regulatory NHIS framework ensures the coordination, articulation and efficiency of the multi-institutional system. This, in turn, ensures quality in the management and production of information.

The normative component of the NHIS should provide the formal support to develop and manage the NHIS according to essential guiding principles:

- *Aimed to provide information for action.* The NHIS should ensure that information which is produced is a useful and timely management input for policy and decision-making within the health sector.
- *Effectiveness.* The NHIS should respond to the information needs of users by providing sufficient quality information, with universal coverage and opportune enough for effective use in decision-making at various levels of action and decision.
- *Efficiency.* The NHIS should have the necessary administrative conditions to support an efficient performance, in accordance with established criteria and technical and administrative requirements, so that the production process delivers information in a quantity which has a better cost benefit for use in health sector decision-making, considering the cost and use of resources, technology, time and opportunity.
- *Nationwide effective integration.* The organization and operation of levels and institutions in the NHIS network should be clear, including the description of the integrated in interactive networks coordinated by the national health authority, at the various levels of action

and decision. Key aspects of interaction within the network should be agreed by the diverse entities of the health sector and different management levels.

Administrative regulations and agreements should determine the particular responsibilities of the information system with regard to the processes of analysis, planning, surveillance, monitoring and evaluation.

The NHIS should be generally under the secretariat and coordinating role of the national health authority. At central level (usually at the ministry of health), it is possible to find or develop a formal NHIS office, department or unit, included in the formal organization of the ministry of health.

Some alternatives for the administrative location of a NHIS central coordinating and management entity (unit, office or department) are:

- NHIS general management office (with management and coordination roles);
- Health Information unit;
- Health statistics unit;
- Health informatics unit;
- Epidemiology unit; and/or
- Management information systems unit.

When applicable, the organization and interaction among the components of the NHIS at central level should also be replicated at different administrative levels and regions of the country, including the role of those responsible for information, statistics, monitoring and surveillance systems. This is facilitated when the organization of the health sector (or health system) at sub-national level is similar to central level. Some health sector reforms have promoted the decentralization of national health systems with the creation or strengthening of regional health authorities; proper alignment between regional and regional levels will facilitate proper performance of the NHIS and production of nationwide harmonized data and information.

## **5.2 The Development of Regulations, Criteria, Standards and Norms**

The NHIS administrative framework establishes the institutional and functional context of the regulation, and enables greater clarity and precision regarding the normative and technical aspects that will be covered. The regulation defines the expected contributions and responsibilities of the NHIS participants, especially those of the national health authority (generally the ministry of health), in relation to the NHIS development and operation. The regulation should define the role of the various participating actors and entities (in non-exclusive form) as: sources of information, producers and users of information, at different levels and regions.

Upon drafting the NHIS regulation and its most specific applications, the following issues should be taken into account:

- Legal framework;
- Formal NHIS objectives;
- Legal NHIS definition;
- Inclusion of relevant and specific definitions;
- Organizational structures of participating entities;
- Responsibilities, obligations and sanctions;
- Development and management of information technology;
- Contributions and responsibilities of participating entities in relation to the NHIS development and operation;
- Confidentiality, safety, quality of the produced information;
- Intellectual property of the information and the automated processes or computer programs that will be used in the system;
- Permanent and transitory features which allow the NHIS to be placed within the formal structure of the health sector.

This includes the explicit determination of the following issues:

- The concept and basic principles of the NHIS;
- The NHIS functions and objectives;

- The supporting laws and regulations to enforce NHIS participation and performance;
- The modes, variables and basic instruments of registry;
- The system's applications which are of specific use (e.g. information for managerial support, epidemiological surveillance and others);
- The rights to the information according to national and international criteria;
- The basis of the administrative system, administrative operation and the participation of entities which are components of the health system;
- The normative background that is directly or indirectly related to the creation and operation of the NHIS;
- The preparation of a controlled regulatory scheme in accordance with the principles, functions, objectives and institutional responsibilities defined as relevant;
- The drafting of the regulation
- Definition of the population that is assigned to different health insurance systems and health service institutions.

The list of main specific responsibilities of the NHIS stakeholders includes rights, obligations and sanctions such as:

- Responsibility for contributing information to the system, as stipulated by clear guidelines in adopted regulations;
- Responsibility for sharing information among the participants, communication with external users, and access to information according to type of users;
- Responsibility for ensuring that the information circulating in the NHIS has opportunity, quality and complies with definitions, norms, standards, normative criteria, modes of registry and flow of the information;

- Specific sanctions for non-compliance in relation to carrying out responsibilities and obligations determined in the NHIS regulations.

The regulation is also expected to address the development and organization of information technology (equipment, programs, virtual communication), as well as the management of information and information technology, including the setting of criteria, standards, norms, and the delimitation of responsibilities of persons involved in the management or application of the technology

Defining the necessary NHIS-related resources is important, such as human resources (according to categories and responsibilities), financing (both regular budget and investments), and the responsibility for costing, training, registration forms, computer programs, and investments.

The regulation should also cover the issues of confidentiality, safety, quality of the produced information, as well as the intellectual property of the information and the automated processes, or computer programs that will be used in the system.

The main strategies in the improvement of the NHIS institutional component focus on:

- Carrying out and maintaining a clear inventory of the normative body which lays the groundwork in order to recognize administratively the NHIS;
- Reviewing the body of laws, regulations, and standards which are translated into administrative structures and responsibilities that have been practically brought about;
- Proposing and developing a regulation for the NHIS to be applied to all the participant institutions;
- Evaluating the coherence between the current regulation and gaps in its application, and proposing and developing a coherent body of regulations, standards and criteria to ensure the development or strengthening of the NHIS;
- Involving in the NHIS to those persons responsible for the health sector, especially in decision-making positions, so that they can

apply their relevant experience and responsibilities to support the consolidation of the NHIS.

The preparation of the formal regulation is a multidisciplinary task which should be carried out at three complementary levels: technical working groups, specific support consultancies, and inter-institutional decision-making groups. In addition, diverse disciplinary areas such as information, informatics, epidemiology, administration, clinical sciences and economy, should be included, to ensure active multidisciplinary participation.

Given the complexity of information systems, the NHIS regulation cannot cover all details of the system. In practice, an intermediate regulation (not too detailed) is generally applied, which should be complemented by other more specific regulations (for example, a regulation on the hospital information system).

It is important to bear in mind that a regulation has to be consistent with other regulations which apply to institutions where the information system is placed. The regulation should also provide an adequate and coherent administrative basis to ensure that the management and production of information are reasonably possible to achieve in terms of coverage and quality, considering what is possible in the short, medium and long term with available resources or with specific investments. Transitory provisions, together with the progressive implementation of the global information system, should also be considered.

The proposal and preparation of regulations often face a challenge in the context of health sector reform, given that in general the NHIS itself should also be reformed to satisfy new demands emerging by health reforms.

The development of the format, the drafting and the legal requirements which are stipulated finally in a regulation are essential, but should be tied to the determination of the objectives, structure and contents of the regulation.

### **5.3 Institutional Arrangement for Proper Collection and Production of Information**

The collection, coding and production of data and information should be consistent with the standards, criteria, classifications, and modes of registries established at the national level. The use of standards and agreed upon criteria is very important, so that the information has a mode of uniform registry and can be added with similar language at various levels of action and decision, it is necessary to adopt standards and criteria that are followed by all who participate in the different levels of an information network (PAHO, 1999, 2001). In the decentralization process or in the development of local information, there exists the risk of developing information that then cannot be integrated in other levels or that is incompatible with criteria and standards adopted nationally.

In order to improve the information and information systems, it is necessary to know the standards and quality of practice for the range of participating personnel and the various processes that are carried out in the institution. In order to assure the quality of the information, it is necessary that those standards referred to in the classifications, codes, modes of registry, flows, equipment, and computer programs, exist and are disseminated at all levels (PAHO, 2001).

The adoption of standards and criteria in the following areas are of importance:

*a. Identification of users or beneficiaries, staff and provided services*

- Identification of the beneficiaries and users of the services
- Provided activities
- Type of personal provider of care
- Types of health programs

*b. Classifications and coding of clinical data and of the management and operation*

- Classification of causes of diseases
- Classification of procedures
- Classification of the personnel
- Classification of equipment and another physical resource
- Classification of budget and expenditure items

*c. Registration forms*

- Formats: textual registries, pre-coded, electronic

- Use of formats that permit easy and uniform data entry to computational data files
- Use of pre-established Codes that permit easy and uniform income to computational data files

*d. Flows of the information and modes of communication*

- Reference of information
- Feedback of the information
- Frequency and modes of shipment
- Intermediate and final processing centers

*e. Computational data processing*

- Identification of indicators and variables contained in databases
- Identification of secondary indicators generated in databases
- Guidelines of electronic communication, sending of information and files
- Compatible computational equipment in the informative network
- Compatible computer programs that permit transfer of common information (or effective programs of standardization of languages)

*f. Standards of health care*

- Categories of provided functions
- Expected performances
- Quality guidelines

#### **5.4. Defining the Information Contents**

In order to ensure that information will be responsive to and appropriate for meeting the needs of decision-makers, the process of determining information contents should follow some stages that include the assessment of information needs for each managerial process and level of decision-making.

##### **5.4.1. The Process of Content Selection**

Bodart and Shrestha (2000) emphasize two important phases in the identification of information needs: to carry out a functional analysis at each level of management of health systems and services; and to identify information needs to address the selection of those indicators that are feasible to be implemented.

Main stages of the content selection are:

- a) Functional analysis of the institutional background, management and processes (as a framework for information needs), and utilization and users of information;
- b) Identification of information needs, according to different participants;
- c) Review the feasibility of information to be collected and produced at different levels of administration (local, regional and national);
- d) Development of an initial selection of a potential set (menu) of data and indicators;
- e) Focusing the set of information through the collective analysis of needs versus feasibility (expectations, priorities, resources and limitations);
- f) Carrying out a multidisciplinary discussion between different stakeholders to look for consensus in agreed data elements;
- g) Reporting to national authorities on recommendable data indicators, their feasibility of being implemented and proposal for their normative existence; and
- h) Normative adoption of the final set of content of information and indicators, definitions, vocabulary and standards.

##### **5.4.2. Health sector functional analysis**

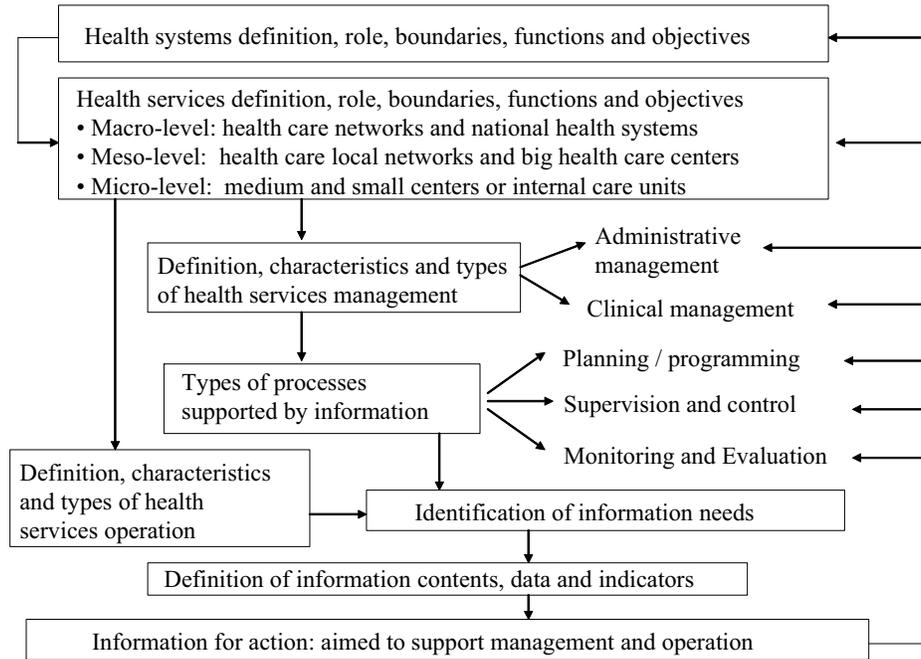
According to WHO (1997a), managers should evaluate their information needs, according to health services' mission, goals, priorities and responsibilities. Functional analysis covers issues such as institutional nature, role, functions and processes including services delivery, organization and management. Health sector reforms being carried out in many countries imply new challenges to the approach to health systems analysis, due to changes in the public and private mix, the relationships between stakeholders (many of them as a result of health sector reforms), and

the interaction between health systems and a more informed community.

Information in health services should reflect the health systems' functions, outputs, institutional

background and services in their real settings. It is also important to identify specific management-related processes such as planning, programming, operation, control, supervision and evaluation. This is summarized in figure 5.1.

**Figure 5.1** Health system functional analysis to defining information contents



According to the sequence of steps in the analysis, the study of health system management and operation at different administrative levels (local, regional, national) provides orientation for the definition of information needs, for each level and type of management and operation of health systems.

The analysis should take into account not only information needs and priorities but also readiness or feasibility for the production of such information. The analysis implies balancing expectations, priorities, resources and limitations. It is important that a multidisciplinary discussion on the proposed content selection could be carried out among professionals from the demand and supply side of information. Finally a normative decision on the content selection of the information and indicators should be adopted, as the selected set of data and indicators should be provided by all stakeholders of the NHIS.

### 5.4.3 Identifying Information Needs

Identification of information needs is frequently based on perceptions reported by key decision-makers, and needs are assumed to be the gap between the existing available information and the desired information which is feasible to get in the future. However identifying information needs is not a simple task, and even antecedents collected could be misleading, mainly if it only takes into account self-perceived needs from decision-makers and key staff.

Asking decision-makers about their information needs is not an easy process and could be very misleading. Sometimes information needs are based on self-reported gaps related to frequent use of information according to users, and sometimes needs are based on expert's opinion or following self-reported desired use of information. The question relies on what type and to what extent

decisions will be taken into practice by different managers and operators and thus, what is the evidence they will need to support their decision. This is a managerial issue that planners and developers of information systems cannot solve by just considering the information provider's perspective.

Diverse perceptions and approaches to identify needs can be adopted by different groups related to information, according to the role they adopted with regard to information:

- Personnel responsible for the management and operation of the services who take decisions based on received information, becoming the users;
- Analysts of management and operation of services and also health situation, that put in context all data and information received and provide reports and advice for decision-makers. During the analytical process, analyst can also provide insights on what are technical information needs;
- Managers of the information system with the responsibility on the production and dissemination of information, representing the providers of information and also becoming key interlocutors with the users of information;
- The personnel participating in the production of information, in all phases of collection, integration, flow, processing, analysis, preparation of reports, dissemination.

However participants often adopt more than one role in relation to information. A multidisciplinary perspective is more comprehensive, mainly if it integrates suppliers and users of information. Obstacles to the expected flow of information in the cycle of demand and supply of information can represent deficiencies, delays, inappropriateness or even information that is excessive and irrelevant (Sauerborn and Lippeveld, 2000).

#### 5.4.4 Selecting Data and Indicators

The indicator development should include phases in which the following aspects are determined:

- The area or problem that will be measured by the indicator;
- The relationship between determinants of health and health conditions that are influenced by socioeconomic characteristics, for instance poverty and risk of alcoholism and drug addiction;
- The phase of programming in which the indicator will be used: needs, risk factors, actions, results;
- The parameters that will be utilized, for instance obstetric deaths and annual live births as that basis for the indicator of maternal mortality.
- The type of statistical indicator, such as frequency or simple magnitude, rate, ratio, change of rates or composed indicator (e.g. Human Development Index).
- Universe and period covered by the denominators (period, included population at risk, level of geographical aggregation)
- Normative or empirical reference against which the indicators will be compared.
- Form in which the indicator will be presented (i.e. numerical statistics, graphic, map).
- Need for data, models and methods necessary for producing the indicator.
- When the indicator is new, it is important to prove it as a pilot project.

In this regard, the useful indicators in the management and operation of health services can be classified by the area or function for which are going to serve (Bodart and Shrestha, 2000):

- Areas of the management: planning indicators; programming; of clinical administrative management, financial; surveillance and monitoring; and of evaluation.
- Issues: indicators of population and socioeconomic conditioning factors; of system and service context; of organization; indicators of resources; of activities; and of use

- Aspects of the productive process: structure indicators, including organization and technology; of process (intermediate of support and the end); and of results, both those immediate (output) and the end (outcome).
- Aspects related to the use of services by the target population: health indicators; need for health care; demand; geographical, cultural, economic or functional access or use of services; and distribution of the resource and delivery of health care.
- Aspects related to the global quality of the services: indicators of efficiency; effectiveness; equity; humanity and ethics of health care.

A single indicator can serve various areas of management and users, which means that it is important to take into account, in the selection criteria, the indicators that will be the used in multiple managerial processes and diverse type of decision-making. Thus, it is important that the indicators could support different levels of management, through similar information (PAHO, 2000).

The use of a selected and reduced set of indicators is important in case of monitoring (process based on the use of a few proxy indicators). The appropriateness of indicators, in general, is clear in theory, but there are problems and limitations in their collection, production and availability. Also, there are difficulties in defining and adopting more precise indicators for what should be measured (for example, for mental health or equity). As a consequence, poor indicators or those of limited quality may be adopted under the expectation of having at least some usefulness, despite their limitations (Bodart and Shrestha, 2000)

A number of lists of data and indicators for health and health systems and services has been developed worldwide. Indicators used to develop the menu of indicators proposed in this document have been selected from initiatives and databases with broad national and international use. For the operational purpose of this document, a menu of relevant textual information and another one of quantitative indicators is proposed (Annex 2). For each type of specific information or indicator, the menu suggests the level of care where each indicator is more applicable. The levels are

classified operationally as: local health services (either of primary level or hospital); regional health services; and national health services. Same levels could be understood for health system or even the health sector. Annex 3 presents more specific data and indicators that support local health care management.

Concerning the character of the requested data, this will be determined by the national health authority in association with related institutions. Key consideration will be given to the specific criteria and definitions stipulated for each piece of data, as well as the procedures for their registry and transfer.

## **5.5 The Role of the National Health Authority**

With regard to the health authority's responsibility for the management of the NHIS, this should be explicitly indicated. Managing the system will be the responsibility of the health authority supported by operational manuals, established criteria, and modes of classification that facilitate a uniform and coherent operation where it is possible to relate and integrate information from different sources and specific information systems.

The health authority should identify and establish links between the various entities, people, and databases that will participate in the various phases of the general information process. The health authority's role is also to develop articulation and coordination mechanisms and guarantee that the operation of the information system is carried out in accordance with what is stipulated in the regulation.

The regulation should adapt to the degree of decentralization of the management of the health authority. The activities of the health authority will be understood in a network that includes the same responsibilities at the central and provincial levels.

With regard to the management of the health information network, the health authority has the responsibility for coordinating the flow of information within the national databases network, thereby guaranteeing that the network is developed and functions in accordance with the regulation in effect. To this end, the health authority has direct

responsibility for reviewing and correcting the quality and completeness of key information that will be official. Other competent entities in the health sector contributing with key information are also responsible for monitoring the quality, quantity, and opportunity of the information they provide.

With regard to the responsibility for planning and development of the NHIS, the health authority will have responsibility for promoting, monitoring and guaranteeing that the planning and development of the general system and specific systems are carried out in accordance with the regulation in effect and in coherence with the plans and policies of the specific information systems (for example, compatible with the requirements for the compulsory reporting of communicable diseases) and the regulation governing the health sector. Additionally, the health authority seeks to guarantee that the operation of the automated information network is carried out in accordance with current normative provisions.

The national health authority - in coordination with related institutions – can establish the issues and modes subject to compulsory notification and reporting. Concerning the flow of information, the health authority acting together with other competent institutions will determine the specific conditions for the collection, flow, integration, processing, analysis, and resulting dissemination of information. This includes administrative issues and the type of information technology that will be utilized to guarantee an efficient, timely, and coordinated flow of information, between different units and geographical levels, and also between institutions participating in this flow.

With regard to the dissemination of information, the health authority in coordination with other competent institutions will regulate the access to and dissemination of information and will stipulate the means, frequency, priority users in the management of the health sector and epidemiological surveillance. The health authority will also guarantee the quality, coverage, and confidentiality of the information.

The national health authority has also an important coordinating and leading role for the integration, harmonization and alignment of all external cooperation from different agencies, partners and

donors. NHIS assessment should include an inventory of all existing plans and projects based on external cooperation and loans, and seek for integration of all improvement efforts around the country NHIS model as well as the needs and priorities translated in the NHIS strategic plan for the short, intermediate and long term.

## **5.6. Institutional Arrangement for Resources and Technology**

### ***a) Financial resources***

Countries have NHIS with different level of development and need for improvement, so the necessary resource mobilization and establishment of financial mechanisms for NHIS improvement will be different for the implementation of the project in each country.

Resource mobilization and establishment of financial mechanisms will be necessary for the implementation and further management and sustainability of the NHIS. Coordinated funding from pooling or organized complement of different sources (regular budget, international agencies, banks and donors) will be needed. Given a frequent mismatch in the implementation between countries and diverse donors, agreements are needed to establish coordination mechanisms and integration of NHIS-related initiatives.

To ensure effective partnerships, it is recommended to develop partnership maps, leverage financing (use funding obtained from vertical programs in order to spread impact and gain across the health system) and use of regional approach to sourcing financing. A multi-donor program to support the NHIS plan as a coordinated joint venture will facilitate the use of potential funds on a more efficient and effective way.

External agencies and companies related to information technology need to be coordinated in order to support the design, procurement, training and implementation of the technological platform, including the connectivity network and services.

### ***b) Human resources***

The overall NHIS could be coordinated by a central management team (depending from the

national health authority). This should be multidisciplinary and open to communicate and link with those responsible for specific information systems, as well as regional and local information systems.

The project team will be needed throughout the period of implementation of plan, to support managerial, technical and administrative roles to manage and coordinate all the stages of the process, including the progressive integration of administrative levels and specific information systems.

The team profile could involve at least one HIS manager, one ICT specialist, one statistician and one administrative staff. Short term staff will be needed, such as an economist for three months to evaluate cost-benefit HIS options.

This will require costs for salaries and related benefits of the staff working in the plan at the local level (renting and maintaining offices, as well as buying or leasing office equipment and furniture).

The type of personnel, and main roles to be assumed by the staff of the NHIS central management team, are summarized in table 5.1.

This will require costs for salaries and related benefits, and expenses for site facilities (renting and maintaining offices, as well as buying or leasing office equipment and furniture). Short term staff will be needed, such as trainers to support improving production of information.

The NHIS in countries with small population size may not have enough trained staff or budget to maintain NHIS teams, so the establishment of a multi-country networked NHIS team could be an option (e.g. for the Eastern Caribbean countries).

**c) Physical Resources**

This is presented in chapter 6 – in relation to the technological component – given the importance of the equipment and software needed to enable the production of information and communication, based on sophisticated technology.

The prevalent focus given to information technology (computer hardware, software and connectivity) needs to be complemented by the focus on development and improvement of the institutional component (organization, policies, regulations, resources and processes) as well as the functional components of the NHIS.

**Table 5.1 Key staff and roles in the NHIS central coordination and management team**

Type of staff	Role
HIS manager	<ul style="list-style-type: none"> <li>• To lead and coordinate the implementation project</li> <li>• To lead the management team and coordinate with institutions and offices</li> <li>• To coordinate the HIS assessment</li> <li>• To coordinate interaction with all national HIS participants as well as sources and users of information</li> <li>• To coordinate the monitoring and evaluation of the HIS implementation and HIS operation</li> <li>• To coordinate the information reporting and dissemination</li> </ul>
Health system decision-makers	<ul style="list-style-type: none"> <li>• To advice on development of a more user-oriented NHIS (support to decision-making)</li> <li>• To advice on health systems information contents</li> <li>• To contribute to integration of health systems and services specific information systems</li> <li>• To support health systems-oriented analysis and report</li> <li>• To support use of information for monitoring and evaluation systems</li> </ul>
Statisticians	<ul style="list-style-type: none"> <li>• To advise and support the harmonization of data and information</li> <li>• The contribute to the refined design of the statistical component</li> <li>• To control and ensure the proper collection, flow, completeness and quality of data</li> </ul>

5. Improving the NHIS Institutional Component

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	<ul style="list-style-type: none"> <li>• To support statistical processes carried out</li> <li>• To provide training, if needed</li> <li>• To contribute to routine information reports</li> </ul>
Epidemiologists	<ul style="list-style-type: none"> <li>• To provide orientation on a population-based NHIS (support to epidemiology and surveillance)</li> <li>• To advice on health conditions information contents</li> <li>• To contribute to integration of statistical and epidemiological and surveillance systems</li> <li>• To support epidemiologically -oriented analysis and report</li> <li>• To support use of information for epidemiological analysis and surveillance</li> </ul>
Information technology specialists	<ul style="list-style-type: none"> <li>• To advise and support the assessment of IS/IT according to readiness for improving the NHIS</li> <li>• To assess options for IT</li> <li>• To contribute to the procurement and installation of IT</li> <li>• To support and control the IT functioning</li> </ul>
Administrative staff	<ul style="list-style-type: none"> <li>• To provide administrative support to the manager and technical staff</li> <li>• To ensure communication among all HIS participants</li> <li>• To support administrative control of documentation and information reported from sources and specific systems</li> </ul>



## 6. Improving the NHIS Technological Component

*The strategic approach to improving information and communication technology (ICT) is crucial to ensure that informatics – if appropriate to needs and affordability of the country - will provide the technological platform to proper NHIS performance. Relevant issues are the development of ICT-related national policies and strategies; the search, selection and application of ICT solutions at various levels and specific systems of the NHIS, and the consolidation of an effective NHI network through compatible sharing of information.*

### 6.1. The Search for ICT Solutions

Investing in better health information systems (HIS) and ensuring their successful implementation and maintenance has been long term pursued by countries of the region. However past experience has shown heterogeneous results, leading to a mixture of successes, limitations and failures.

To increase possibilities of success, the implementation plan should consider that:

- the produced information will be responsive to information needs raised at regional level;
- the implementation approach should be compatible, acceptable and applicable to all countries of the region;
- it should take advantage of existing national HIS structures;
- it should be embedded in the operational experiences of policy- and decision-making in the region;
- it should support management of patient-centered information;
- it should be tested and proved to be effective; and
- it should be planned and show return in terms of cost benefit as well as sustainability

Ensuring successful implementation depends on adequate NHIS plans and projects, which should be in line with local, sub-national and national health plans. Expectations and plans to implement ICT - as part of NHIS improvement - should consider feasibility, cost benefit, the adoption of

appropriate technology, sustainability after the initial investment finishes, expected usefulness to support evidence-based policy- and decision-making in health action, and acceptability by those who participate in HIS (producers and users of information) and also by national health and political authorities.

The procurement and use of ICT requires careful decisions taking into account adequacy to local needs and capacity for managing ICT. It should allow the NHIS to be sustainable and modifiable according to changing needs for information. Decisions on the safety and confidentiality of information are important with regard to commercial programs being utilized. Equally important are decisions on the deposit and backing up of the information (PAHO, 1999).

Some governments have developed government information systems (GIS) based on common criteria, standards, policies and features for all sectors. The procurement and use of ICT requires careful decisions taking into account adequacy to local needs and capacity for managing ICT. It should allow the NHIS to be sustainable and modifiable according to changing needs for information. Decisions on the safety and confidentiality of information are important with regard to commercial programs being utilized. Equally important are decisions on the deposit and backing up of the information (PAHO, 1999).

NHIS in developing countries are generally limited in development, resources, budget and performance. These restrictions, plus the relatively high cost of hardware, software and telecommunication services, strongly reduce the possible options in the search for appropriate and affordable technological solutions. For that reason, the search for appropriate technology includes exploring on those HIS technological solutions

used in other developing countries (mainly in the governmental and public sector settings), that could be potentially applicable to a defined country.

The search for ICT solutions could be focused on those NHIS that:

- have been successfully applied to health care settings (either primary health care, hospital care or specific sub-systems);
- are reliable;
- do not demand expensive and sophisticated hardware;
- allow for integration of information from different sub-systems (software compatibility);
- produced information that can support statistics, surveillance, monitoring and evaluation;
- are relatively user friendly;

- they are either public dominion (with no license or property right costs) or have affordable costs
- have no strong technical dependency from owning the companies, but have access to upgrades;
- are relatively recent in vintage; and
- training requirements on the new software are not too extensive for information technology staff in countries.

Given that the NHIS is composed of networked multiple specific information systems, the appropriate ICT options for the NHIS depend primarily from each type of specific information system, and then the necessary technology to ensure integration and data and information within the nationwide NHIS.

Main specific information systems are described in table 6.1.

**Table 6.1 ICT types of solutions required by NHIS specific information systems**

Specific information systems	ICT types of software
<p><b>Population-based information systems</b></p> <ul style="list-style-type: none"> <li>• Demographic, vital statistics</li> <li>• Socio-economic, social statistics</li> <li>• Health status (surveys)</li> <li>• Risk factors (surveys)</li> <li>• Morbidity (surveys, sentinel sites or services-based)</li> <li>• Disability (surveys or services-based)</li> <li>• Mortality (including surveillance)</li> <li>• Food and nutrition (surveys or services-based)</li> </ul>	<ul style="list-style-type: none"> <li>• Population estimates usually come from other sector and international organizations, based on census projections</li> <li>• Vital statistics systems can have information systems shared among civil registry, statistical offices and ministries of health: agencies can have different ICT platform but data and information should be compatible</li> <li>• Needs for quick information is usually slower than for other topics (with the exception of some critical surveillance).</li> <li>• Most information used in population surveys is non-routine generated. Surveys generally do not require sophisticated ICT.</li> <li>• EpiInfo (CDC) has a module to support surveillance on nutrition</li> </ul>
<p><b>Surveillance-oriented information systems</b></p> <ul style="list-style-type: none"> <li>• Communicable diseases (including surveillance, population and services-based)</li> <li>• Chronic non-communicable diseases, mental health, injuries (including surveillance, population and services-based)</li> <li>• Food and nutrition (including surveillance)</li> <li>• Maternal and Child health</li> </ul>	<ul style="list-style-type: none"> <li>• Many countries and agencies have developed software to support surveillance. CDC has developed user friendly program Epi Info supporting databases management and reporting</li> <li>• HIV/AIDS national and international programs have developed several specific HIS</li> <li>• PAHO/WHO has developed an Perinatal Information System (SIP)</li> </ul>
<p><b>Health system and services information</b></p>	<ul style="list-style-type: none"> <li>• Manual information and statistical systems dealing with</li> </ul>

<p><b>systems</b></p> <ul style="list-style-type: none"> <li>• Health financing</li> <li>• Human resources</li> <li>• Physical infrastructure</li> <li>• Specific medical technology (medical equipment, laboratory, imagenology, pathology)</li> <li>• Pharmaceutical drugs</li> <li>• Health care network (primary health care, hospital, referral system)</li> <li>• National health programs (reproductive health, child health, adolescent health, ageing health)</li> </ul>	<p>aggregated data at different national levels can be easily automated with no need of sophisticated ICT.</p> <ul style="list-style-type: none"> <li>• Many ICT vendor companies can provide packages of software to manage health care resources (financial, physical, human), as well as administrative and clinical data</li> <li>• Specific software programs can be developed to manage information on health care cost or productive centers that need daily and on-line information, such as laboratory, pharmacy, imagenology, pathology and billing. Those programs can be integrated as clinical and administrative modules of a unique hospital information system</li> </ul>
<p><b>Patient-centered information systems</b></p> <ul style="list-style-type: none"> <li>• Patient administrative and clinical data</li> <li>• Electronic records databases</li> </ul>	<ul style="list-style-type: none"> <li>• Many ICT vendor companies can provide packages of software to manage individual data such as electronic medical health records. This requires most complex ICT</li> <li>• Patient administration systems are the basic module in the integrated patient-centered information systems</li> </ul>
<p><b>Environment health information systems (including surveillance)</b></p> <ul style="list-style-type: none"> <li>• Vector control</li> <li>• Water quality</li> <li>• Food safety</li> <li>• Waste management</li> <li>• Occupational health</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental information and surveillance systems generally do not need sophisticated automation. Manual information systems can be automated according to main data contained in forms, variables and reports.</li> <li>• Most information used in environment-related surveys is non-routine generated. Surveys do not need use of sophisticated HIS, and rather use a research approach</li> <li>• Occupational health (information and surveillance) could have a routine information system using several sources, and a patient-centered system can be necessary.</li> </ul>
<p><b>Virtual library and data warehouse</b></p> <ul style="list-style-type: none"> <li>• Virtual library</li> <li>• Data warehouse</li> </ul>	<ul style="list-style-type: none"> <li>• Software used in virtual libraries (information and knowledge management centers) is usually user-friendly despite complexity of ICT and extensive information managed.</li> </ul>

## 6.2. Development of ICT-Related Policies

Policies on ICT are important to ensure coherence in the procurement, development, implementation, and operation of ICT as the platform for health information systems. The policies on ICT should be coherent with those of the overall NHIS and the health sector.

Mechanisms should be sought to ensure and define linkages, standards, and common procedures that apply to the different entities participating in the NHIS (PAHO, 1999).

Interdisciplinary work in inter-institutional committees is important for the development of ICT policies as well as to ensuring compliance with the policies and strategies of the NHIS. Although the subject of technology is quite specialized, working groups which advise and

decide on ICT development or improvement should include users and producers of information at all levels, and a wide range of personnel, such as statisticians, epidemiologists, demographers, economists, sociologists, administrators, planners, community representatives, engineers, system analysts and informatics specialists.

The national ICT policies should include key elements such as:

- The specific benefits expected from the technology;
- Technological norms and standards (hardware and software);
- Sets of data and dictionaries based on registries and predetermined forms, coding for main key variables such as diseases and clinical procedures;

- Processes, data flow, and communication standards between different sites and computer systems;
- Measures and standards to ensure reliability, privacy, and safety of the data;
- Policies for development, allocation, and utilization of human resources;
- Financial requirements; and
- Plans for training and development of personnel (PAHO, 1999)

### **6.3 ICT Implementation and Improvement**

As indicated in chapters 3 and 4, the first phases of a plan for implementing and improving ICT include an assessment to provide the institutional diagnosis and supporting institutional documentation; the proposal and decisions for strategic IT solutions, and the development and implementation of an ICT implementation plan (PAHO, 1999).

The outline of the ICT expected architecture includes the equipment, computer programs, and the methods being utilized for the development of applications and communication protocols. The applications should be defined in relation to priorities for development. It is also necessary to define the lines of responsibility and how human, financial and material resources are going to be allocated.

The relevant aspects of ICT development and improvement are:

- Completion of an inventory and a situational diagnosis of the technology in the network of the information system.
- Development of the general design or redesign, through identifying the information architecture and technological applications that will support such architecture and permit the management and global production of information;
- Identification of administrative processes and financial assistance that will be supported by the technology;

- Determine the set of specific systems that will share the automated part of the network of the National Information System;
- Determine the specific information, including criteria, type of data and standards per each module or specific system that will be utilized in the whole network of the system. The use of criteria and broad use commercial standards are important, among them are aspects of the computer language and the interfaces between languages;
- Determine how the flow and exchange of information will take place between various levels, areas and institutions, and where and how such information will be stored (including safety copies);
- Determine the features of quality, confidentiality, connectivity, and safety that are required to ensure that the technology will function adequately and continuously, including the back up of information and necessary maintenance to confront any emergency effectively;
- Estimate, at various levels and areas, the gaps and development priorities between the existing information system and the technology being used, and what is expected from a logical design as a reference for development or enhancement;
- Determine the mode of administration of the global information system and the specific management of the technology, and how they will be the responsibilities and specific functions of those participating in the process of information production;
- Establish mechanisms for evaluation and permanent control of the technological resource and the quality of its operation.
- Determine the mode, frequency, and presentation relating to the delivery of information to users. It includes determining who will have access to the information and to the use of the technology.
- Determine what type of solutions will be included - among different alternatives - to improve existing NHIS, by developing new or

incorporating technological solutions already existing on the market.

- Determine the costs of different alternatives to develop or improve existing information technology, the kind of investments that will be undertaken, and the specification of equipment, software and connectivity to be utilized.

The technological component implies costs and investments that are relatively high, generally speaking, compared with other expenditures incurred by the health system. These costs are not only estimated to design and initial implementation, but also cover maintenance, updating and replenishment.

Personnel who implement and maintain the technology represent costs – both direct and indirect - that usually are not considered in the traditional costing of regular staff. For example, extra time could be needed from the ICT staff for the dynamic and continuous monitoring of the operation of internal networks or the permanent connection to other entities, and sudden calls to face emergencies caused by computer viruses, faults, and the daily need for safe storage of a large quantity of data on back-up files.

The diverse complexity of units, offices and programs in the health sector, and their different use of information technology, has an impact on the selection and implementation of appropriate technology. There is usually a combination of technologies with a variable degree of complexity, depending on the level of action and decision where the data are going to be processed and the information provided.

#### **6.4 Elements and Options for Progressive Automation**

ICT can support all phases of the production of information, starting with the collection of primary data (data entry), but there are two stages on which the computer infrastructure mainly concentrates: data processing and the transmission of information (Wilson, 2000).

According to the existing development of a specific HIS, there are different options or steps

for automation (non-exclusive) in support of each phase of the production of information:

- Development of a manual information (or statistical) system
- Improvement or consolidation of such manual system, to perform effectively
- Development of progressive automation to support some aspects of production (such as data transmission and processing, and reporting)
- Increase of degree of automation, up to full automation
- Automation of information transmission of data and information to other information systems within the NHIS network
- Development of virtual communication

The factors to be considered for final choice depend on the feasibility, needs for and cost-benefits of improving the technology. Often, it is sufficient to improve a manual information system, or to maintain a hybrid (which is a combination of a manual and an automated system), using relatively basic technology. In such a case, consideration should be given to the conditions and capacities of the personnel who will have to handle the applied technology. The volume of managed data is also important. It is worth distinguishing the volume that is really needed to be handled and the unnecessary overload of data that often bear the information systems, especially those of health services.

In small health care centers with little technology and no informatics, it is worth analyzing the cost benefit of computation, especially if good manual information systems are in operation and budgets are limited. The dilemma focuses on what to put under computation, the correct technological level to develop, if improving the manual system is not preferable in the first instance (Wilson, 2000).

There are multiple options for the application of equipment, programs and computational connectivity but decisions regarding adoption should include the opinion of all the types of personnel since they all will participate in the information system in some way or another.

Specific hardware and software decisions for deployment and application refer mainly to:

- Computational processors;
- Devices for the storage of information, hard disks;
- Video screens: use of data or graphs environments;
- Multimedia;
- Personal identification devices: readers of cards with magnetic bands, cards with microcircuits or intelligent cards;
- Connectivity equipment: central connection points, directions, and integral parts of communications equipment;
- Other entry/exit devices: printers, fax machines, scanners;
- Programming languages: languages and techniques which cause the equipment and networking technology to function, as well as integrate different applications and databases;
- Operating systems programs;
- Program activators: database management, safety systems, interfaces, messaging systems, and intermediate programs;
- Communications programs, programs developed for Internet, HTML, web browsers, and others;
- Software: administrative, financial and clinical.

In the health sector, hospitals have needs for complex ICT, especially those with big size, multiple production centers and sophisticated specialization. Hospitals can become complex provider centers that require wide range of detailed information.

Sometimes, immediate production (on-line) of information is required, as is the case with intensive care units, and the management of detailed individual data is frequently needed (as in case of medical records). For that reason, national health authorities generally provide high priority to the development of automated hospital information systems, with greater investments in ICT, in order

to support administrative, financing and clinical functions.

Existing information technology in hospitals tends to be quite varied, since they generally have a mixed automated system (combined with manual systems, and with a different degree of computational sophistication. The automation of clinical services is frequently regarded as insufficient or difficult to implement. Starting with isolated specific information systems (such as billing, laboratory, pharmacy), ICT steps for improvement can include the development of an integrated hospital information system based on effective communication of data between all networked units or subsets of a hospital, and also among the clinical services, administrative services, and technical and logistical support services. Furthermore, it is important to consider the rapid obsolescence of ICT, where rapid growth and technological advances together contrast with early aging that characterizes most of existing systems. It is therefore important that users should be very cautious in order to avoid investing in systems prone to the early obsolescence (PAHO, 1999).

It is necessary to have personnel who are IT experts for the design and selection, development or application of the technology, for the maintenance of equipment and programs, computer management and output, in accordance with the global management of the National Health Information System. Technological management includes training, monitoring, and evaluation of the operation (often solving problems and operational emergencies with the equipment and programs).

In the case of institutions which develop own software programs or applications, an issue which should be resolved in each context is whether external programs should be purchased or a mixed option should be adopted. Each option has advantages and disadvantages, coming from issues such as the intellectual property, possibilities of updating or the capacity to make changes whenever the managers need different reporting, so the program needs to be adapted to satisfy the new requirements of information, in support of health care production processes.

Powerful commercial database management systems (programs of third and fourth

technological generation) are currently available for microcomputers and even personal computers that require technicians to have a different degree of training in programming.

Database management systems can be complemented with programs that permit, in a relatively straightforward way, the capacity to obtain consultation reports and to write reports based on results. This is also a feature of some analysis programs, such as EpiInfo ® and SPSS ®.

However, in some less sophisticated centers and for management and public health purposes, it is also possible to use simpler quite friendly equipment and computer programs that can be handled by personnel who are not experts in

informatics. Those programs can have anyway high processing capacity and technological sophistication, accessible at offices at different levels of the health sector and. Such is the case, for example, with many programs run under the Windows Operating System® which are widely used at offices and even at home (such as those of Microsoft Office®), that can be integrated into local or distance networks (via Internet). Microsoft Office®, which is worldwide used, comprises word processors, graphics programs, electronic tables, databases and Internet connection. There are some other available statistical programs, or programs facilitating epidemiological analysis (such as EpiInfo ® or SPSS ®) or geographic information systems (GIS), which are user-friendly.



## 7. Improving the NHIS Performance

*The strategic recommendations to improve the NHIS performance focus on those critical aspects that enable proper management and production of information. Improvement of the institutional and technological components (as presented in previous chapters) provide the pre-conditions for performance, whilst improving the management and operation of all intermediate and final productive processes improve the NHIS performance - to provide the necessary effective information - as pursued in the NHIS main goal.*

### 7.1. Pre-Conditions for Effective Performance

Adequate organization and structure of the NHIS (the institutional component) is the main pre-condition for effective performance in the production of information.

Efforts made to improve the performance – to be successful – should consider national capacity and feasibility to enhancing critical aspects (such as staff training, methods, resources, technology, information flow) that can limit the quantity, quality, and coverage of information).

Effective implementation of pre-conditions will depend from national and multi-sector capacities to produce information, the adoption of policies and common criteria, standards and compatible databases, a multi-sector and multi-agency support, economic and political support, the necessary financial, human and technological resources, as well as establishment of a technical national group (with a steering and management role) to implement and manage the system.

Table 7.1 summarizes the relevant critical-preconditions needed to support adequate performance (i.e. efficient and effective NHIS productive function), which have been already described in previous chapters.

*Table 7.1 Relevant pre-conditions for effective NHIS performance*

Institutional component and elements	NHIS Conditions
NHIS administrative framework	<ul style="list-style-type: none"> <li>• An appropriate NHIS model and logical design has been developed, including specific information systems</li> <li>• A coherent multi-agency and multi-sector organization has been already consolidated</li> </ul>
<ul style="list-style-type: none"> <li>• NHIS policies, plans, legal and administrative arrangements</li> </ul>	<ul style="list-style-type: none"> <li>• There is consensual adoption of policies, criteria, standards, norms, sources of information and information systems</li> <li>• Existing information and statistical systems have clear and disseminated rules and norms, as well as measures for proper procedures, control and monitoring</li> <li>• A nationwide integrated health information network has been consolidated – supported by formal agreements – that facilitates and reflects the relationships and communication between all stakeholders of the whole health sector.</li> </ul>
<ul style="list-style-type: none"> <li>• Organization and administration</li> </ul>	<ul style="list-style-type: none"> <li>• There are clear roles and responsibilities from different stakeholders, with clear defined management at all levels</li> <li>• There is a clear and disseminated design of the information productive process, including the collection, flow, processing, reporting and dissemination of information, as well as feedback</li> <li>• Plans have been implemented for improving and maintaining the production and dissemination of information, including staff training and support with techniques, methods, norms, control and supervision</li> <li>• A monitoring and evaluation has been implemented, to ensure future</li> </ul>

	sustainability and continued appropriate performance.
<ul style="list-style-type: none"> <li>• Defined and standardized information contents</li> </ul>	<ul style="list-style-type: none"> <li>• There is a definition – properly disseminated - of data requirements, data sets, data sources and specifications and development of a database model</li> </ul>
<ul style="list-style-type: none"> <li>• Financial resources</li> </ul>	<ul style="list-style-type: none"> <li>• The NHIS has the necessary financial sources, for improvement and maintenance, including direct and indirect costs</li> <li>• There are regular budgets and extra funds ensuring financial sustainability of the NHIS</li> </ul>
<ul style="list-style-type: none"> <li>• Human resources</li> </ul>	<ul style="list-style-type: none"> <li>• There is available and trained staff, as necessary, to manage the system, and development of technical norms and protocols to ensure that procedures will be properly followed.</li> <li>• There are regular budgets and extra funds to ensuring financial sustainability of the NHIS</li> </ul>
<ul style="list-style-type: none"> <li>• Physical resources</li> </ul>	<ul style="list-style-type: none"> <li>• There are the necessary facilities and equipment to perform management and production of information</li> <li>• There are regular budgets and extra funds to ensuring the sustainability of the necessary facilities, equipment and related resources and services</li> </ul>
<b>Technological component</b>	<ul style="list-style-type: none"> <li>• The technology has resulted from appropriate search for alternatives of solutions (hardware and software), followed by the procurement and implementation of information technology infrastructure;</li> <li>• The deployment and strengthening information and communication technology takes into account the existing structure, feasibility and national capacities to manage information</li> </ul>
<ul style="list-style-type: none"> <li>• Equipment (hardware)</li> </ul>	<ul style="list-style-type: none"> <li>• The equipment is updated and compatible to perform the necessary productive functions, according to needs and feasibility</li> <li>• The equipment is properly maintained with security measures to ensuring continuous production and the necessary backup of information</li> </ul>
<ul style="list-style-type: none"> <li>• Software</li> </ul>	<ul style="list-style-type: none"> <li>• There is appropriate and compatible software to allow for processing, communication and integration of all relevant data and information</li> <li>• Maintenance and updating of the software is affordable (including license and technical support costs) and properly managed by the NHIS staff</li> </ul>
<ul style="list-style-type: none"> <li>• Connectivity structure and related services</li> </ul>	<ul style="list-style-type: none"> <li>• The connectivity equipment and the services provided support proper communication of data and information</li> </ul>

The production of information is influenced by (and should be adapted to) the characteristics of the health sector, including the administrative and functional communication between different programs, offices and sectors. It means that:

- The information has to be consistent with the specific needs of managerial processes and operations.
- In the improvement process, a reasonable balance is needed between needs, expectations, availability, and the expected use of information.
- Information to be produced should be primarily problem solving-oriented, aimed to supporting practical decision-making.

- Information is an essential input for management, but is not sufficient to ensure effective decision-making.
- Information has different expressions (not only indicators), and makes sense to the extent that it approaches the reality in a credible way.
- Information needs to be consistent with the structural and operational characteristics of the health sector and its changes (such as reforms).
- It is necessary to define, give priority and select some contents of the wide range of information, and the corresponding productive processes necessary to producing it.

- There is need for monitoring and evaluation of production and quality of outputs, based on an initial assessment.

## 7.2. Improving the Management of the NHIS

Improvement in the management of information is aimed to reaching the administrative and managerial conditions to ensure that the available NHIS resource and inputs - at all levels of the system - will be used in the most efficient and effective way to facilitate all the chain of intermediate and final processes leading to the production of complete, accurate and timely information. It also includes the control as well as the ongoing monitoring and evaluation of the NHIS, at all levels, so as to apply the opportunely necessary corrections, to ensure that the processes will be carried out according to the expected plans and goals.

Relevant aspects for potential improvement of managerial capacity help to:

- Leading and coordinating the different offices, entities and sectors participating in the NHIS;
- Administrating the systems according to plans and programs, with proper communication to all stakeholders and NHIS staff;
- Keep an ongoing dialogue with information users and focus the planning and production of information oriented to the information needs of users, mainly to policy-and decision-makers and those who use information for the operation of health systems;
- Keep effective control, monitoring and evaluation systems with periodical reports to the steering committee, national health authorities and stakeholders;
- Managing the financial resources and budget according to planned and resolve problems;
- Management of the NHIS staff at all levels, as well as personal who contributes to different stages of the process, such as in data reporting and collection;
- Managing, maintaining and deploying technological equipment according to planned,

as well as services provided from external entities (including outsourcing);

- Implementing and applying training programs to the staff and ensuring that the key staff has the necessary training

The production of information needs to be supported by effective management and coordination, adequate computational resources (based on appropriate technology for every context), trained staff, use of techniques and methodologies for the transmission, processing, and analysis of data and the dynamic integration of the network into the information, institutional, and technological areas. .

Management and national coordination are crucial for the good operation of the information production process. This requirement should be similarly replicated in all levels and types of specific systems that participate in the national health information system.

Staff training should be specifically geared to supporting important functions related to the production of information, and should be assisted by courses or training activities, educational material, and continuous supervision.

The technology, with its equipment and programs, is required to be appropriate to the needs and possibilities of acquisition, maintenance, management and functions in accordance with national policies and criteria. In the case of donations or different or obsolete equipment which is remaining, it is worth analyzing maintenance or renewal alternatives.

Generally speaking, a network based on this infrastructure is enough to take care of information systems, and specific monitoring surveillance at the local, regional and even national level. If 50 thousand deaths occur annually in a given country and each death certificate has eight relevant variables, for examples, it represents a fairly low burden of requirement for management processing and computational analysis. If there are 400 thousand annual hospital discharges, for example, and eight variables are registered in computation, it is also quite a manageable volume to the extent that the registry is decentralized, the data is processed and analyzed at each level and is

transmitted for more comprehensive processing at a geographical level. This makes it possible to have individual data even at the national level.

Relevant additional problems, such as the need for coding the leading cause of hospitalization, should not be confused with technological limitations or occasional excessive workload in the information network.

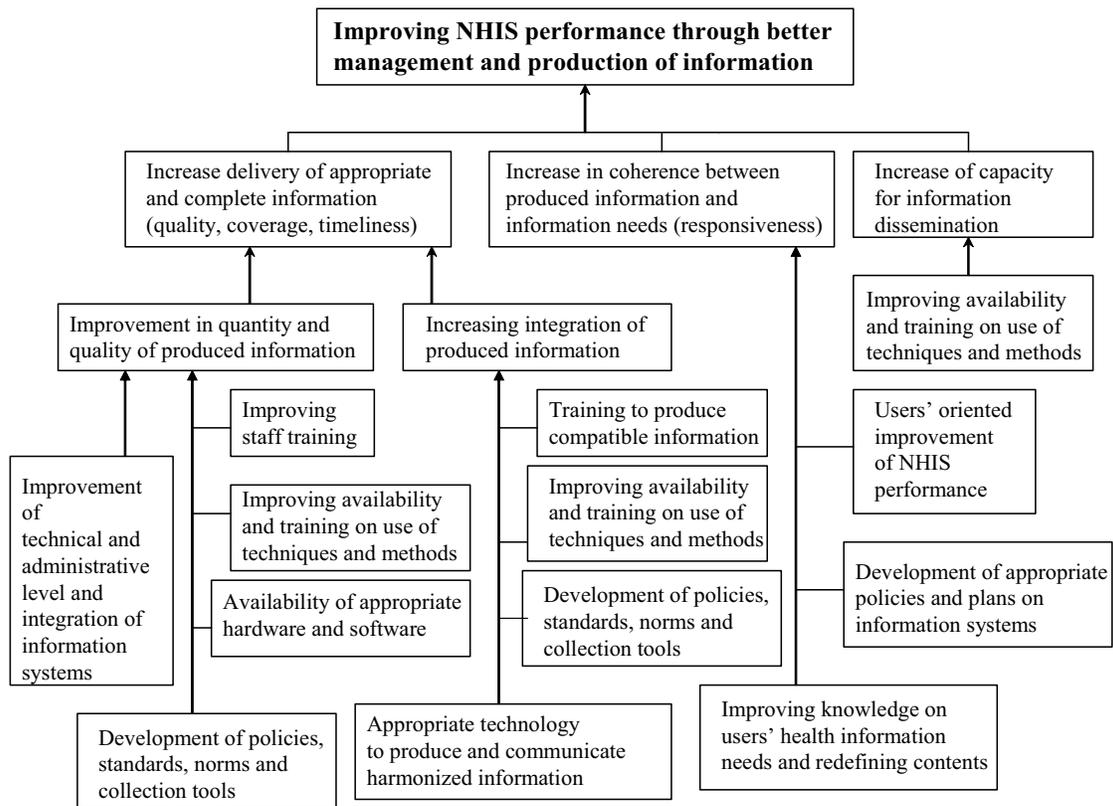
Inefficiency in the information technology infrastructure is reflected in a low level of administrative development in such key areas as the registry, processing, and use of information. (Take the case of a hospital which purchases an external system with nine administrative and

clinical modules but only develops two). Generally speaking, this situation reflects a problem of efficiency of management of health care centers and not inherent limitations in the technology.

### 7.3. Improving the production of information

Strategies for enhancing the quality, production, and use of information are described in figure 7.1, reflecting a “solution tree” of cause and effect, in line with main critical issues describe in the “solution problem” described in figure 1.1 of Chapter 1.

Figure 7.1 Strategies for enhancing the quality, production, and use of the information



Under proper management and based on the appropriate resources and technology, each productive line of specific data and information should proceed with the interrelated processes of:

- Data collection;
- Data entry (for computerized systems);
- Data transmission, with storage at different levels;
- Data processing (at different levels, if not central level of processing is decided);

- Analysis (statistical, analysis of quality of such information, and direct interpretation or meaning of the produced information);
- Reporting (predefined, following routine, or ad-hoc reports);
- Dissemination, either by oral, printed or electronic means;
- Feedback

Improvement in production and analysis of information is subject to monitoring and evaluation of the key processes involved (at different level and specific information systems) with emphasis on the gaps and bottlenecks limiting availability, opportunity and quality of information, as well as the enabling factors that are necessary to ensure better production of information.

**a. Data and information collection.**

In order to assure consistent quality of registered data, it is necessary to develop standards, criteria, guides, and adequate forms to be distributed to all the entities, offices and programs responsible for the collection of data. It is important that that material is sufficiently widespread and readily available to staff who need it for their collection tasks. It is important to develop and maintain staff training that collects or records data, followed by supervision and training of staff.

There is need to develop and maintain a system of review and validation of the information, with continuous supervision of the process of collection.

There is need to ensure that there is effective inter-institutional interaction, with harmonized understanding of the information contents and the modes of registry, in order to permit the flow of

data and information which are from sources outside of the health sector (such as education, municipalities, national centers of censuses or statistics), as well as inside the national health system.

In the case of secondary sources contributing data, it is worth considering the original objective of the collection of this data, to avoid bias in its application or interpretation (for instance, data on housing conditions, primarily collected through a household survey aimed at assessing targeting of social programs).

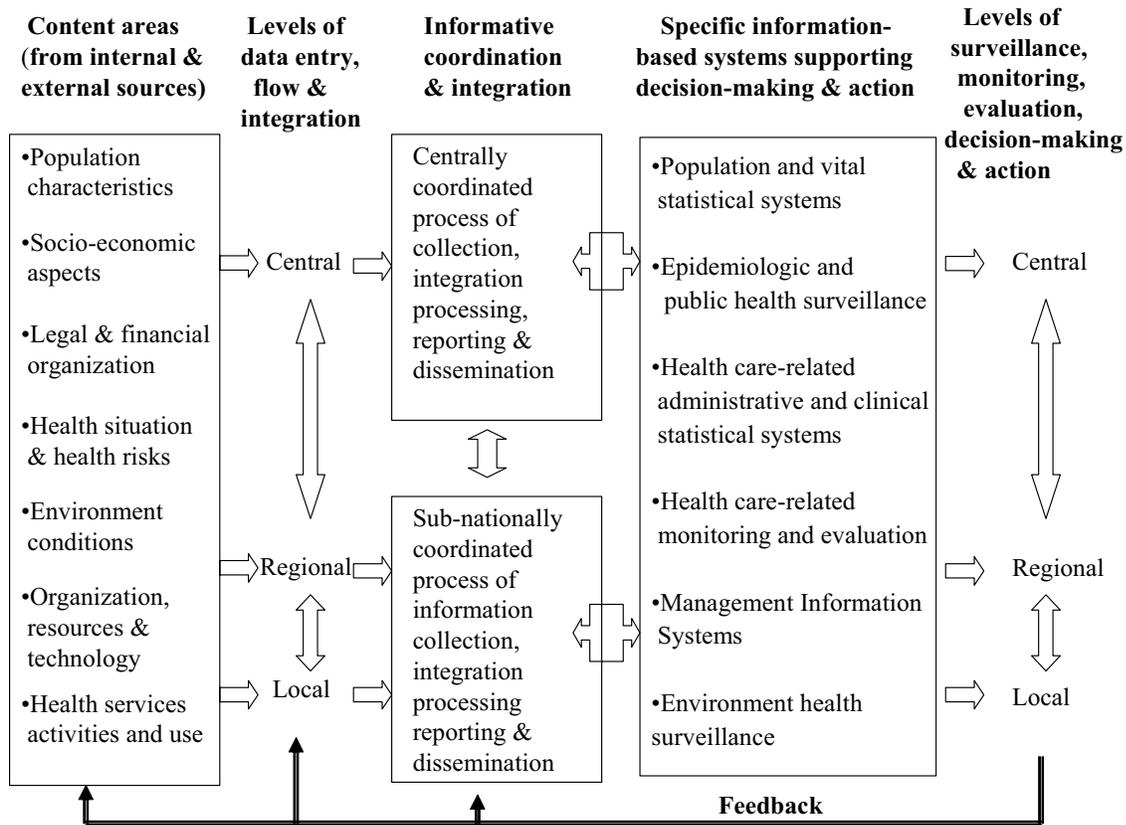
It is important to consider the possible cost-benefit of obtaining additional information to what already exists, to avoid the setting up of new areas of information which could overload the system or complicate the process without corresponding benefits. The estimate of cost can be both direct and indirect (time, personnel, transportation, time and other factors).

For the purpose of ensuring proper access to information from different sources inside and outside of the health sector, it is advisable to ensure the existence of a regulatory framework, exchange agreements, and the exploration of strategies to integrate other actors and sectors that represent useful sources of information for the health information system.

**b. Information processing and analysis.**

Improvement in the processing of information should be primarily focused on each specific line of information to be produced, within each specific information system. However the NHIS, given its complex nature, is a sophisticated multiple nationwide setting where the processing and communication of data and information is usually performed at different levels of a country. This is reflected in the diagram of figure 7.2

**Figure 7.2** Multiple levels and specific systems involved in information processing and communication, within the nationwide NHIS



The configuration and operation of specific information system networks should be geared to promote maximum coverage, efficiency and quality in the production process that result in information which is thorough, valid and reliable.

This is the responsibility of the central and sub-national management team. This approach is favored to the extent that it follows established criteria and standards and is under the effective coordination and supervision of the team responsible for the National Health Information System.

It is currently possible to have equipment and computer programs with high capacity and technological sophistication that are within the reach of different levels of the entities in the health sector and can be handled, in quite a friendly way, by personnel who are not experts in informatics. Such is the case, for example, with the use of personal computers which are IBM compatible and

which utilize the Windows ® Operating System, that can function in isolation, or can be integrated into local or distance networks (through Internet or another type of connection).

The analysis of information usually is performed by sophisticated software; however analysis of key information can be supported by user friendly programs for statistical analysis (such as EpiInfo ® or SPSS ®) or geographic information systems. In same line, Microsoft Office® offers some very useful tools for the analysis of data, such as the spreadsheet program (Excel®), (Access®) for databases and (Powerpoint®) for presentations. In addition, such programs facilitate the import and export of data and tables from other programs or from electronic reports of more complex databases.

**c. Presentation and dissemination of the produced information.**

It is useful to be able to have communication techniques which are appropriate at different levels, including graphic and analytical support, and synthetic presentation that today are relatively within access of the local level of health services. It is useful to have equipment and computer programs to support strategies involving the presentation and dissemination of information that have a different degree of cost and sophistication. It was already indicated that widely used programs such as Microsoft Office satisfy the majority of requirements for the presentation of the information.

Today, technological resources and strategies for the dissemination of information are supported preferably by the use of Internet sites that have user friendly programs in order to prepare information for presentation and dissemination. However, it is worth analyzing the costs, benefits, the objective of the audience, and the concrete goals that hopefully be reached since, on one hand, there is potentially a massive amount of information for presentation, and there is a tendency to utilize these sites more for the publicity of groups and achievements instead of genuine information at the service of the target audience.

Strategies and activities that could be effective:

- Establishing formal mechanisms for sharing information among offices and institutions (such as agreements between the ministry of health, national institute of statistics and civil registry office, for production and reporting of vital statistics);
- Training on reporting and presentation of information and reports;
- Promoting institutional virtual health libraries with electronic reports and key databases
- Promoting and extending the type of PAHO core health data reporting and table generator;
- Application of techniques and computers programs for editing and publishing data and information, both in printing as well as virtually;

- Use of information and knowledge management as well as information sharing approaches and electronic tools;
- Promoting dialogue between managers of health systems and services - as potential users of specific information for decision making - and those responsible for the planning, management and production of information.

Best use of communication strategies and techniques is relevant for proper dissemination and sharing of information, especially if supported by integrated health information networks. This includes the application of techniques of presentation and modern dissemination of information, with Internet support and modes of reports readable and adapted to easier understanding managers (OPS, 1999).

Access to information needs proper information supply and the proper mechanisms to get opportune and expedite access to different sources. The search for proper information has a wide range of potential sources, including routine health information systems, published formal and informal research, surveys, libraries, data warehouses, administrative, clinical and statistical data and reports. Information technology and capacity for storing and sharing huge amount on information, even open to the public, facilitates access to health-related information.

#### *d. Use of the information*

The use of information is not an internal factor of production, but is relevant for its justification and reorientation. The use of information should be centered on specific needs for it, who are the users and what processes of what is the action or decision to be supported.

The improvement of access and use of information by decision-makers can be focused on the some aspects that make can be effective in the search for better access and use of information – by the managers – in the process of decision-making:

- Improving availability and quality of information, mainly through better performance of national and sub-national health information systems;

- Improving dissemination, sharing and access to information; and
- Improving managerial capacity for analysis and use of information

The use of information should be a factor that is permanently subject to monitoring and evaluation, in order to adapt the production of information. The monitoring gap between needs, production, and the use of information is relevant in order to continually gear needs for development and strengthening of information systems.

*e. Advocacy for the support and use of information in the institutional culture*

Advocacy that seeks to promote political and institutional support for information and information systems is facilitated when users perceive that information respond to their needs. Evidence is presented showing that it is possible to improve responsiveness, regarding information needs of decision-makers.

User feedback about subsequent development and strengthening of information systems becomes a process and a relevant strategy which also determines whether strengthening (the type of information needs that should be met as a priority) should be emphasized.

The processes of operational evaluation and its multidisciplinary and inter-institutional analysis can contribute to the advocacy process through the adequate development of information systems and the use of the resulting information.

To the extent that there is transparency in the actions of management and the processes of decision-making, good management of the health sector (or of its specific components) will favor the definition of needs. It will also allow better clarification of the precise function that corresponds to information systems within the health sector.

**7.4. Improving the Integration of the Nationwide Information Network**

Effective integration the nationwide NHIS is facilitated by the coordination of all the multi-

agency and multi-initiative strategies and plans aimed to improve the production of information, at least to agree on the key compatible information to be produced, under similar standards and criteria.

Based on proper structural pre-conditions for NHIS performance, it is necessary to proceed continuously with the proper collection, communication, sharing and integration of data and information throughout all the nationwide NHIS network, so as the information could be as complete as possible, at national and sub-national levels. Monitoring, evaluation and feedback information become crucial to ensure opportunity and completeness of information at all levels and participating institutions.

To avoid duplications, gaps and overlaps in information, the national health authority should assume an effective leading and managerial role, with the necessary capacity to approach national needs, priorities, interests and feasibility for implementation of plans and investments, as well as monitoring and evaluation with the corresponding correction, when needed.

The role of an effective NHIS steering committee is essential. If possible, the country should have a multi-sector wide approach for the NHIS, including information and statistics assessment, analysis and the corresponding development and implementation of plans.

Harmonization and alignment of similar initiatives, to better support standardized and homogeneous information, should be focused on:

- Multi-sector integrated ownership and support to national capacity for assessment and planning;
- Organization of a multi-donor and multi-initiative coordinating group;
- Support to establishing harmonized legislative framework among different agencies and sectors, to ensure proper collection and production of data;
- Training and skills enhancement of producers and users of information and statistics, including policy and decision makers;

- Use of available NHIS and statistics-related frameworks, methods and instruments;
- To promote multi-institution and multi-sector plans for NHIS and statistics improvement;
- Integration or complement of national plans based on external funds and technical cooperation;
- Integrated or common NHIS performance assessment and monitoring;
- Information and data sharing;
- Establishing a common database of plans, information and data among different entities dealing with similar information;
- National coordination between plans and implementation process that are carried out in different entities and for different specific information systems (if possible, also pooling of funds);
- Monitoring and evaluating the harmonized multi-agency and multi-sector management and production of information, as well as individual initiatives taken by different entities to improve health information systems.

#### **7.5. Ensuring the Value of Information as a Tool for Action**

In order to become an effective decision-making tool, information should fulfill some requirements and characteristics. Information should be:

Responsive to:

- specific information needs to support evidence-based decision-making, in an opportune and effective way;
- specific routine and non-routine requests from different managers at different levels and responsibilities; and
- new requests coming from changes in information needs under dynamic management.

Coherent with:

- the institutional and managerial culture;
- the content that is expected to cover;
- the type of analysis and decisions that are to be made; and
- the amount of information that is required for analysis and decision-making, at different moments and processes.

A piece of evidence to support decision-making, through:

- reflecting – at least partly and indirectly – the situation that is assumed to indicate (health systems and services);
- following agreed and clear standards and assumptions on each data and indicator;
- known quality, completeness and credibility of available information; and
- the balance between official (historical) information and draft (provisory) updated information.

The information needs to be coherent to reflect the structural and functional characteristics of health systems and services, and sensitive to detect changes in structure or performance of health systems.

Frequently, there is a consensus on the necessity and usefulness of information; however more clarification is needed in regard to more detailed information contents and use. Perceived information needs from those who are responsible for management could be different to what is actually needed so support effective evidence-based decisions.

Value and usefulness of information contents and information needs for decision-making should be periodically reviewed, so as to adapt to changing demands for effective and responsive information. Appropriate procedures for the acquisition and production of information should be based on practical and relatively low cost methods to produce timely practical and useful information, avoiding the unnecessary use of complex methodologies.

It is often necessary to utilize timely unconfirmed information to support decision-making, instead waiting for formal or official (definitive) information. A reasonable balance should be sought between using unconfirmed provisional information (unofficial) that still is subject to corrections, and information that has been established and disseminated officially. Both products are important but there could be a great cost difference if time is spent waiting for official information.

In general, the same information could be used to support multiple users and managerial processes, at different levels of health systems and services. The management of health services includes a series of related processes, such as planning, programming, decision-making, control, and evaluation.

The information requirements vary according to the different types and specific levels of management, at different levels of health systems and services. However, multiple users can use same information for different processes. This requires proper distribution of information that can be used as suitable input for different processes, users, and types of management.

Information, although an essential pillar for management and action, it is not sufficient to ensure an appropriate and effective decision-making process. There are factors depending on the decision-making capacities that could facilitate or hinder the use of information, as is the case of managerial training. Information can be more effective for decision-making when management is more effective and managers know how to analyze and use the available information (Sauerborn, 2000).

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## **Operational Glossary**

Database	A database is a file or a set of them who contains data that form a given structure. The terms data and information are, often, utilized as synonyms, but its precise definition is derived from the distinction between form and content.
Reference standard	Pre-established pattern as level desired in light of which what is found, that can be set as predefined objective (normative standard) or built with indicators already existing previously or in various places (empirical standard).
Evaluation	<p>Process that attempts to determine, in such a systematic and objective way as whether it is possible, the importance, effectiveness, efficiency and impact of activities in light of given objectives.</p> <p>Study of certain aspects of structure, process, or outcomes of a program or service, destined to contribute an operational knowledge in order to orient to whom plan or take decisions.</p>
Evaluating	Grant value to something, Compare an observed situation with an expected or desired situation
Management	Process of management of an institution based on a set of rules, procedures and operational methods as planning, programming, organization, motivation, control, supervision, and evaluation, with the objective that the organization carries out the achievement of the objectives, functions, and institutional goals.
Indicator	<p>Quantitative synthetic, qualitative, textual or graphic expression, that presents in a summarized way (directly or indirectly) an aspect of the reality to be described or evaluated.</p> <p>Variable that has mainly the objective of measuring a given situation or changes (directly or indirectly), and that should orient, as much as possible, to the action.</p>
Health indicator	Every susceptible variable to be measured directly and that reflects the state of health of the community
Monitoring	Systematic knowledge of aspects of a program, project, or strategy, that tries to establish the extension in which the delivery of goods and services are occurring in accordance with what is planned, so that appropriate measures to correct detected deficiencies can be adopted.
Productive process	Organized set of activities and systematized and interrelated procedures aimed at providing intermediate or final products that make it possible to provide specific health services to the user population.
Health services	Institution or network of institutions whose essential objective is to provide personal health services, either of curative or preventive orientation, and collective services that bear a relation to the health of the people.

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	<p>Any intervention or service aimed to improve health or support the diagnostic, treatment or rehabilitation of sick people (and not necessarily medical or clinical care). It also includes activities of intervention collective or on the conditions of the environment (adapted of Euro WHO, 1997).</p>
Information System	<p>Organized set of resources, technology, and processes around the objective of producing information. It can be organized formally or functionally, and it is part of the institution where it provides informative inputs or to constitute a specific component of a supplier information network.</p> <p>An ordered and integrated set of data, and their relations, that make it possible to contribute information for decision-making</p> <p>A solution based on use of the computation and technology, in order to respond to the information needs</p> <p>The same technology of computation (hardware, software) and connectivity that is used in health institutions</p> <p>A specific software program (as the executive systems of management)</p> <p>A company or entity organized at formal or informal level (including resources and interrelated processes) around the objective to produce information.</p>
Health System	<p>Organized set of all the resources and processes that have as purpose to influence the health of the population.</p> <p>Institution or group of institutions defined by legal, financial, or agreed framework that has the functions to provide health services to the population, as well as to ensure the resource and operation of the services and the access of the population to its use.</p>
Management Information System	<p>An executive information system is a system on the basis of computer program that makes it possible for the executives (managers) to dispose of information for fast information, decision-making analysis, and support. Example is the Program Winsig.</p>
National health information system	
* operational concept	<p>Interrelated set of multiple sources, resources and processes (run in various programs, offices and institutions) that form operationally a national network integrated of specific information systems, that is organized and coordinated by the health authority, around the end to produce information in directly or indirectly health-related matters and the health sector, for the purpose of supporting the different decisions and // sector actions of health and of other sectors, that in total help to preserve and improve the health of the population.</p>
* normative or administrative	

concept	Set of users, standards, responsibilities, procedures, and resources organized with the principal object to provide production and use of information in order to orient the processes of decision-making and action of the health sector, with emphasis on the health authority and those responsible for providing health services to the target population.
* Technological concept (Informatics)	A productive information system that is sustained in an automated network of databases, made up of a set of subsystems with infrastructure of equipment, criteria, standards, programs and processes that make it possible to obtain, process and to transmit data in order to produce information on health.
Public health surveillance	Process of observation of demographic characteristics that are relevant in public health and subject to control, with the objective of reporting in a timely fashion and dynamic in order to orient the consequent action of the services and health programs.

## **Annex 1. Principles to guide the development of the national health information system**

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1. The strengthening of the health information system at the different levels of the service should be carried out in support of the services development activities of health and improvement of its operation.
2. All the data that have to be registered at any level of the service should have a clearly identified use (for the decision or action) in regard to the case management or to the community action by the personnel or the members of the community in this level.
3. Any change or modification of the registry and the report of data should only be carried out in order to improve care at the level of the patients and the community, in particular in the neediest populations. A result of this principle is that countries, municipalities, or regions should not be encouraged to change their information system primarily to provide data for central level and international reporting purposes.
4. Each health administrator should evaluate its clinical information needs and of management being based on its mission and its goals, priorities, responsibilities with regard to basic services, levels, and functions, models of delivery of services, resources, and access to the information technology. The health information system should be designed so that it does not surpass the capacity for administration in order to arrange for it.
5. It should be acted with great caution upon doing changes of the components of the health information systems that work reasonably well. This is in particular applied for the systems of specialized program notification, like that of `maternal and child` health, family planning, or fight against tuberculosis. The global review of the registry and report of the health services should rarely be undertaken. The changes of the system should try to integrate progressively the registry and report system in the local levels
6. Efforts should be made to make better use of existing data at all levels through practical analysis, improved data presentation and the enhancement of the flow and sharing of data between systems and services
7. There should be promoted and be supported the practical utilization of the informatics for the database maintenance and the preparation of reports.
8. There is recommended the selection and definition of a manageable set of essential health indicators as solid activity to undertake the examination and strengthening of the health information systems and to establish the national practical capability of surveillance in health and the health services. There should be elected essential indicators for the use give the levels national, provincial and district, taking into account the following criteria:
  - A. Usefulness for action
  - B. Relevance for national and program monitoring
  - C. Facility for production and coherent, reliable, representative, and sensitive measurement
  - D. Valid,
  - E. Understandable
  - F. Ethical

It is necessary sometimes to select analogous indicators that are of difficult or impossible direct measurement.

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Source: WHO (1997): Cooperation of WHO for the strengthening of the national health information systems. Instruction note for representatives of WHO in the countries and Ministries of Health. Working document HST/96.4 WHO: Geneva

## **Annex 2. Contents of health information**

List A2.1, describes the content of information most frequently utilized to indicate the level and characteristics of the health situation in a defined population, the conditioning factors and the health sector.

### **List A2.1 Relevant information on health situation, determinant factors and the health sector**

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- *Macro context of the health situation, its conditioning factors and the health sector*
  - General context (historical and geographical)
  - Political dimension
  - Economic dimension
  - Social dimension
- *Population and health conditions*
  - Bio-demographic dimension
  - Dimension geographical distribution
  - Socioeconomic dimension
  - Dimension of health situation
  - Conditions of the environment of importance in health
  - Dimension health insurance and beneficiary condition
- *Health System*
  - Global health system according to prevalent normative model
  - Normative organization of the system: legal regulatory framework
  - Models according to the context and financial flows
  - Specific health systems, according to property and coverage of population
  - Participating institutions of the health sector according to role (regulation, financing, insurance, purchase, provision)
  - Role and relevant functions of the State, with respect to the health sector
  - Role and determinants of the markets on the health system
  - Financing and health expenditure
  - Agents of insurance related with health care
  - Mix public private of foresight, financing and health care
  - Inter-sector action in matter related to health
  - Community participation
  - Nongovernmental action in health
  - International action in health
- Health services.
  - *Organization*
  - Types, according to public/private sector
  - Administrative organization
  - Assistance organization
  - Levels of complexity
  - Financing and financial flows

- *Resources*
    - Assistance human resources
    - Equipment and assistance infrastructure
    - Drugs and other assistance inputs
    - Technology
  - *Activities*
    - Preventive-oriented ambulatory activities
    - Curative-oriented ambulatory activities
    - Hospital activities (curative-oriented)
    - Collective activities of promotion and prevention
  - *Access and use of services.*
    - Perception of needs
    - Effective use of services
    - Coverage of programs
    - Epidemiological estimates of potential demand on services
  - *Processes of development and reforms of health services.*
    - Legal and financial changes
    - Asunción of functions (regulation, financing, purchase, provision)
    - Interaction between entities of regulation, financing, insurers and health service providers
    - Changes of roles in assistance
    - Implications of the sector health reforms.
    - Interaction between growths and national and sector health crises.
- 

In each one of these areas of content, arise informative sources from institutions and groups that should be part - either informally or functionally - of the network that integrates, it analyzes and it disseminates related information to the sector and its reforms.

## **List A2.2 Relevant information in health care health centers (especially hospitals)**

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The aspects of information according to the administrative and clinical dimension from health care centers as hospitals can be synthesized in the following list of groups of relevant functional modules (OPS, 1999):

- a. Logistics of Patient Care
    - Registry
    - External admission
    - Admission of hospitalization, discharge and transfer
    - Management of services and appointments
    - Orders
  - b. Clinical Data Management
    - Medical records
    - Nursing care
    - Clinical audit
  - c. Operation of diagnostic technical support services and therapeutic
    - Clinical laboratory
    - Medical diagnostic imaging of diagnosis and intervention
    - `Radiation Therapy`
    - Pharmacy
    - Transfusion and blood bank
    - Dietary service
    - Other services
  - d. Operation of technical support services for the population and conditions of the environment
    - Health of the environment
    - Immunization
    - Clinical surveillance and databases
  - e. Administrative management and of the resource
    - Financial management
    - Payments, accounts to receive
    - Accounts payable
    - General accounting of accounts
    - Accounting of costs
    - General accounting
    - Management of Human Resources
    - Lists of salaries
    - Management of human resources
    - Personnel
    - Benefits
    - Management of materials
    - Purchases
    - Control of inventories
    - Management of fixed assets
    - Medical equipment maintenance
    - Physical equipment maintenance
    - Services of laundry
    - Services of transportation
    - Budget and executive support
-

The internal productive centers can generate specific information systems as: admission, statistics, laboratory, diagnostic imaging, blood bank, pharmacy, dietary service, accounting, personnel, purchases, maintenance, and general services. The information system of a health care center as a hospital, should include the integration of all these subsystems, although they tend to have different degree of automation (many of them tend not to be automated) what limits the global system, or else this only consists in a few modules (as admission, accounting, purchases, hospital discharges).

Source: Pan American Health Organization (1999) Setting up Healthcare Services Information Systems. PAHO/WHO: Washington DC



### Annex 3. Menu of health- and health sector-related indicators and level of management or operation where each indicator is applicable

Document originally included in the working document “Información para la Gestión y Operación de Servicios de Salud”, prepared by C. Gattini for PAHO/WHO, HSP/HZO, in May 2002.

This annex includes a menu (list) of indicators that could be collected, produced or disseminated through health information systems at different levels of administrative integration within the health sector. The menu is based on four international sources of widely used indicators: PAHO Core Health Data Initiative (PAHO, 1998); Health For All Indicators (WHO, 1998), OECD database (OECD, 1999) and WINSIG indicators (PAHO, 1999).

The table includes proposed levels of management or operation where each specific indicator could have higher applicability: national health system (NHS), regional health system (RHS), local health system (LHS), local hospital, mainly inpatient functions (HOS), and local ambulatory care center, including Primary Health Care (AMB). Bold text indicates most used indicators.

No	Topic	Indicator	Level of management or operation with higher applicability of indicator					
<b>1</b>	<b>Population characteristics</b>	<b>Total mid-year population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	<b>HOS</b>	<b>AMB</b>	
1.1	Age and sex structure	Male population	NHS	RHS	LHS		AMB	
		Female population	NHS	RHS	LHS		AMB	
		Masculinity index	NHS	RHS	LHS		AMB	
		<b>Population 0-14 years</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>		<b>AMB</b>	
		<b>Population 65 and more years</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>		<b>AMB</b>	
		<b>Population of women 15 to 49 years</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>		<b>AMB</b>	
		Dependency ratio	NHS	RHS	LHS		AMB	
		Number of annual births	NHS	RHS	LHS		AMB	
		<b>Crude birth rate (live births per 1,000 population)</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>		<b>AMB</b>	
		Total fertility rate	NHS	RHS	LHS		AMB	
		Annual population growth rate (%)	NHS	RHS	LHS		AMB	
		International immigration rate	NHS	RHS	LHS		AMB	
1.2	Population growth							

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1.3	Urbanization and density	International emigration rate	NHS	RHS	LHS	AMB
		Proportion of urban population (%)	NHS	RHS	LHS	AMB
		<b>Rurality</b>	NHS	RHS	LHS	AMB
		Population density	NHS	RHS	LHS	AMB
1.4	Indigenous population	Proportion of indigenous population	NHS	RHS	LHS	AMB
1.5	General mortality	Number of annual deaths	NHS	RHS	LHS	AMB
		<b>Crude death rate (per 1,000 population)</b>	NHS	RHS	LHS	AMB
		<b>Life expectancy at birth (years)</b>	NHS	RHS	LHS	AMB
		Life expectancy at birth, men (years)	NHS	RHS	LHS	AMB
		Life expectancy at birth, women (years)	NHS	RHS	LHS	AMB
<b>2</b>	<b>Socio-economic context</b>					
2.1	Macro-economic level	<b>Gross national product, US\$ per capita</b>	NHS			
		Gross domestic product, US\$ per capita	NHS			
		Real gross domestic product, PPP\$ per capita	NHS			
		Annual average rate of inflation (%)	NHS			
2.2	Income and poverty	<b>Average per capita monthly income</b>	NHS	RHS	LHS	AMB
		Ratio of 20% highest / 20% lowest income	NHS	RHS	LHS	AMB
		Percent of population living under the national line of poverty	NHS	RHS	LHS	AMB
		<b>Percent of population living under the international line of poverty</b>	NHS	RHS	LHS	AMB
		Percent of population living under the international line of extreme poverty (indigence)	NHS	RHS	LHS	AMB
2.3	Employment	<b>Unemployment rate (%)</b>	NHS	RHS	LHS	AMB
		Total employment (%)	NHS	RHS	LHS	AMB
		Labor force (% of population)	NHS	RHS	LHS	AMB
2.4	Education	<b>Literacy rate (%) in population aged 15 and more</b>	NHS	RHS	LHS	AMB
		Literacy rate (%) in men aged 15 and more	NHS	RHS	LHS	AMB
		Literacy rate (%) in women aged 15 and more	NHS	RHS	LHS	AMB
		<b>Average years of schooling in the population</b>	NHS	RHS	LHS	AMB
2.5	Nutrition	Average number of calories available per person per day (kcal)	NHS	RHS	LHS	AMB
		% of total energy available from fat	NHS	RHS	LHS	AMB
		% of total energy available from proteins	NHS	RHS	LHS	AMB
2.6	Housing and	Average number of persons per room, in households	NHS	RHS	LHS	AMB

sanitation	% of population whose homes are connected to water supply system	NHS	RHS	LHS	AMB
	Percent of urban population with potable water through house connections	NHS	RHS	LHS	AMB
	Percent of urban population with reasonable access to public sources of potable water	NHS	RHS	LHS	AMB
	Percent of rural population with reasonable access to potable water	NHS	RHS	LHS	AMB
	Percent of urban population with house connection to public sewer systems	NHS	RHS	LHS	AMB
	% population having access to sewage system, septic tank or other hygienic sewage disposal	NHS	RHS	LHS	AMB
	Percent of urban population served by individual systems of excreta disposal	NHS	RHS	LHS	AMB
	Percent of rural population having adequate sanitary means of excreta disposal	NHS	RHS	LHS	AMB
	Percent of population with access to disinfected water supplies	NHS	RHS	LHS	AMB
	Percent of urban population with regular collection of solid waste	NHS	RHS	LHS	AMB
2.7 Physical environment	Sulphur dioxide emissions from fossil fuel combustion, kg per capita per year	NHS	RHS	LHS	AMB
	Index of air pollution (Sulphur dioxide particles)	NHS	RHS	LHS	AMB
	Index of water pollution (Escherichia coli)	NHS	RHS	LHS	AMB
	Proportion of dwellings in low sanitary condition	NHS	RHS	LHS	AMB
2.8 Summary socio-econ. development	Human Development Index (UNDP)	NHS	RHS	LHS	AMB
<b>3 Health situation</b>					
3.1 <b>Positive health status</b>		NHS	RHS	LHS	HOS
3.1.1 Perceived health status	Proportion of population reporting self-assessment of health as good	NHS	RHS	LHS	HOS
	Proportion of male population reporting self-assessment of health as regular	NHS	RHS	LHS	HOS
	Proportion of female population reporting self-assessment of health as bad	NHS	RHS	LHS	HOS
3.2 <b>Health risk</b>					
3.2.1 Maternal and child risks	Proportion of women of childbearing age living with risk factors	NHS	RHS	LHS	AMB
	Proportion of all live births to mothers aged under 20	NHS	RHS	LHS	AMB

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		NHS	RHS	LHS	AMB
	<b>Proportion of all live births to mothers age 35</b>	NHS	RHS	LHS	AMB
	Adolescent fertility rate	NHS	RHS	LHS	AMB
	Percent of infants exclusively breastfed through 120 days of age	NHS	RHS	LHS	AMB
3.2. 2	Lifestyle related risks	NHS	RHS	LHS	AMB
	Proportion of regular daily smokers in the population, age 15+ years	NHS	RHS	LHS	AMB
	Number of cigarettes consumed per person per year	NHS	RHS	LHS	AMB
	Proportion of 15-19 years of age who smoke	NHS	RHS	LHS	AMB
	Annual alcohol consumption, in liters per person	NHS	RHS	LHS	AMB
	<b>Prevalence of alcoholism (% of total population)</b>	NHS	RHS	LHS	AMB
	Road traffic accidents involving alcohol per 100,000 population	NHS	RHS	LHS	AMB
	First admissions to drug treatment centers per 100,000 population	NHS	RHS	LHS	AMB
3.2. 3	Nutrition-related health risks	NHS	RHS	LHS	AMB
	<b>Percent of live births weighting less than 2.500 grams</b>	NHS	RHS	LHS	AMB
	<b>Proportion of children &lt; 5 years weight/age less than 2SD from WHO reference median</b>	NHS	RHS	LHS	AMB
	<b>Prevalence of overweight among adults (20-74 years)</b>	NHS	RHS	LHS	AMB
	Prevalence of obese among adults (20-74 years)	NHS	RHS	LHS	AMB
3.3	<b>Morbidity</b>				
3.3. 1	Morbidity by communicable diseases	NHS	RHS	LHS	AMB
	Number of annual cases of tuberculosis (registered)	NHS	RHS	LHS	AMB
	<b>New diagnosed tuberculosis cases per 100,000 population, all forms</b>	NHS	RHS	LHS	AMB
	Viral hepatitis incidence per 100,000 population	NHS	RHS	LHS	AMB
	Viral hepatitis A incidence per 100,000 population	NHS	RHS	LHS	AMB
	Viral hepatitis B incidence per 100,000 population	NHS	RHS	LHS	AMB
	Number of annual cases of yellow fever (registered)	NHS	RHS	LHS	AMB
	Number of annual cases of plague (registered)	NHS	RHS	LHS	AMB
	Number of annual cases of dengue (registered)	NHS	RHS	LHS	AMB
	Malaria annual parasite index	NHS	RHS	LHS	AMB
	Number of annual cases of human rabies (registered)	NHS	RHS	LHS	AMB
	Number of annual cases of congenital syphilis (registered)	NHS	RHS	LHS	AMB
	Number of annual cases of syphilis (registered)	NHS	RHS	LHS	AMB
	Syphilis incidence per 100,000 population	NHS	RHS	LHS	AMB
	Gonococcal infection incidence per 100,000 population	NHS	RHS	LHS	AMB
	Pertussis incidence per 100,000 population	NHS	RHS	LHS	AMB
	<b>Measles incidence per 100,000 population</b>	NHS	RHS	LHS	AMB
	<b>New cases of malaria per 100,000 population</b>	NHS	RHS	LHS	AMB
	Diphtheria incidence per 100,000 population	NHS	RHS	LHS	AMB

		Tetanus incidence per 100,000 population	NHS	RHS	LHS	AMB
		Number of annual cases of tetanus neonatorum (registered)	NHS	RHS	LHS	AMB
		Acute poliomyelitis incidence per 100,000 population	NHS	RHS	LHS	AMB
		Congenital syphilis incidence per 100,000 population	NHS	RHS	LHS	AMB
		Congenital rubella incidence per 100,000 population	NHS	RHS	LHS	AMB
		New cases of neonatal tetanus per 100,000 population	NHS	RHS	LHS	AMB
		Rubella incidence per 100,000 population	NHS	RHS	LHS	AMB
		Mumps incidence per 100,000 population	NHS	RHS	LHS	AMB
		<b>Clinically diagnosed HIV+ incidence per 100,000 population</b>	NHS	RHS	LHS	AMB
		<b>Clinically diagnosed AIDS incidence per 100,000 population</b>	NHS	RHS	LHS	AMB
		Prevalence of leprosy	NHS	RHS	LHS	AMB
3.3.	Safety food related	Microbiological foodborne diseases, total number of outbreaks	NHS	RHS	LHS	AMB
2	morbidity	Microbiological foodborne diseases per 100,000 population	NHS	RHS	LHS	AMB
3.3.	Oral health-related	<b>Decayed, missing or filled teeth at age 12 (DMFT-12 index)</b>	NHS	RHS	LHS	
4	morbidity	Average number of missing teeth, age 35-44 years	NHS	RHS	LHS	
		% of totally toothless, age 65-74	NHS	RHS	LHS	
3.3.	Morbidity by cancer	New cases of cancer, all sites per 100,000 population	NHS	RHS	LHS	
4		Proportion of every type of cancer (%)	NHS	RHS	LHS	
		New cases of colon cancer per 100,000 population	NHS	RHS	LHS	
		<b>New cases of prostate cancer per 100,000 population</b>	NHS	RHS	LHS	
		New cases of trachea, bronchus and lung cancer per 100,000 population	NHS	RHS	LHS	
		<b>New cases of female breast cancer incidence per 100,000 population</b>	NHS	RHS	LHS	
		<b>New cases of cervix uteri cancer incidence per 100,000 population</b>	NHS	RHS	LHS	
		Incidence of malignant neoplasm of the stomach	NHS	RHS	LHS	
3.3.	Morbidity by	<b>Prevalence of hypertension</b>	NHS	RHS	LHS	
5	chronic diseases	<b>Prevalence of diabetes mellitus type 2</b>	NHS	RHS	LHS	
		Proportion of types of diabetes mellitus (%)	NHS	RHS	LHS	
		New cases of mental disorders per 100,000 population	NHS	RHS	LHS	
		New cases of alcoholic psychosis per 100,000 population	NHS	RHS	LHS	
		Proportion of main types of mental disorders (%)	NHS	RHS	LHS	



	Estimated deaths rate among children < 5 years of age, acute respiratory infections	NHS	RHS	LHS	
	Number of registered deaths due to tetanus neonatorum	NHS	RHS	LHS	
	<b>Neonatal mortality rate per 1,000 live births</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	Early neonatal mortality rate per 1,000 live births	NHS	RHS	LHS	
	Late neonatal mortality rate per 1,000 live births	NHS	RHS	LHS	
	<b>Postneonatal mortality rate per 1,000 live births</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	Still birth rate per 1,000 births	NHS	RHS	LHS	
	Perinatal mortality rate, per 1,000 births	NHS	RHS	LHS	
	Percent of deaths < 1 year of age due to conditions originated in the perinatal period	NHS	RHS	LHS	
3.3	Abortion	NHS	RHS	LHS	
	Number of annual abortions	NHS	RHS	LHS	
	<b>Abortions ratio per 1,000 live births</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	Abortions ratio per 1,000 live births, in mothers under 20 years of age	NHS	RHS	LHS	
	Abortions ratio per 1,000 live births, in mothers aged 35 and more	NHS	RHS	LHS	
3.4	Maternal mortality	NHS	RHS	LHS	
	<b>Maternal deaths ratio, all causes per 100,000 live births</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	<b>Maternal deaths due to abortion ratio, per 100,000 live births</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	Maternal deaths due to hemorrhage per 100,000 live births	NHS	RHS	LHS	
	Maternal deaths due to toxemia of pregnancy per 100,000 live births	NHS	RHS	LHS	
	Maternal deaths in the puerperium period per 100,000 live births	NHS	RHS	LHS	
	Maternal deaths due to other direct obstetric per 100,000 live births	NHS	RHS	LHS	
	Maternal deaths due to other indirect obstetric per 100,000 live births	NHS	RHS	LHS	
3.5	Mortality by communicable diseases	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	<b>Mortality due to infectious and parasitic disease, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	Number of annual deaths from tuberculosis for the year	NHS	RHS	LHS	
	Number of annual deaths from AIDS for the year	NHS	RHS	LHS	
3.6	Mortality by chronic diseases	NHS	RHS	LHS	
	Mortality by diseases of circulatory system, 0-64, per 100,000 population	NHS	RHS	LHS	
	<b>Mortality by diseases of circulatory system, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	
	Mortality by ischemic heart disease, 0-64, per 100,000 population	NHS	RHS	LHS	
	<b>Mortality by ischemic heart disease, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>	

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		Mortality by cerebrovascular diseases, 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by cerebrovascular diseases, all ages, per 100,000 population	NHS	RHS	LHS
		Mortality by other circulatory system diseases, 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by other circulatory system diseases, all ages, per 100,000 population	NHS	RHS	LHS
3.7	Mortality by cancer	Mortality by malignant neoplasm, age 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by malignant neoplasm, all ages, per 100,000 population	NHS	RHS	LHS
		Mortality by trachea/bronchus/lung cancer, 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by trachea/bronchus/lung cancer, all ages, per 100,000 population	NHS	RHS	LHS
		Mortality by cancer of the cervix, 0-64, per 100,000 population	NHS	RHS	LHS
		<b>Mortality by cancer of the cervix, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>
		Mortality by malignant neoplasm female breast, 0-64, per 100,000 population	NHS	RHS	LHS
		<b>Mortality by malignant neoplasm female breast, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>
3.8	Mortality by external causes	Estimated annual deaths rates due to malignant neoplasm of the stomach	NHS	RHS	LHS
		Mortality by external cause injury and poison, 0-64, per 100,000 population	NHS	RHS	LHS
		<b>Mortality by external cause injury and poison, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>
		Mortality by motor vehicle traffic accidents, 0-64, per 100,000 population	NHS	RHS	LHS
		<b>Mortality by motor vehicle traffic accidents, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>
		Mortality by other external causes, 0-64, per 100,000 population	NHS	RHS	LHS
		Estimated annual deaths rates due to accidents, excluding transport	NHS	RHS	LHS
		Mortality by other external causes, all ages, per 100,000 population	NHS	RHS	LHS
		Mortality by suicide and self-inflicted injury, 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by suicide and self-inflicted injury, all ages, per 100,000 population	NHS	RHS	LHS
		<b>Mortality by suicide and self-inflicted injury, age 15 and over, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>

		<b>Mortality by homicide and purposeful injury, 0-64, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>
		Mortality by all causes, all ages, per 100,000 population	NHS	RHS	LHS
		Mortality due to work-related accidents per 100,000 population	NHS	RHS	LHS
3.9	Mortality by iatrogenic causes	Mortality by adverse effects of therapeutic agents, 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by adverse effects of therapeutic agents, all ages, per 100,000 population	NHS	RHS	LHS
3.10	Mortality by respiratory system causes	<b>Mortality by diseases of the respiratory system, all ages, per 100,000 population</b>	<b>NHS</b>	<b>RHS</b>	<b>LHS</b>
		Mortality by bronchitis/emphysema/asthma, all ages, per 100,000 population	NHS	RHS	LHS
3.11	Mortality by digestive system causes	Mortality by diseases of the digestive system, all ages, per 100,000 population	NHS	RHS	LHS
		Mortality by chronic liver disease and cirrhosis, all ages, per 100,000 population	NHS	RHS	LHS
3.12	Mortality amenable to curative health care	Mortality by appendicitis, 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by appendicitis, all ages, per 100,000 population	NHS	RHS	LHS
		Mortality by hernia and intestinal obstruction, 0-64, per 100,000 population	NHS	RHS	LHS
		Mortality by hernia and intestinal obstruction, all ages, per 100,000 population	NHS	RHS	LHS
3.13	Mortality by endocrine system causes	Mortality by endocrine, nutrition and metabolic disease and disorders involving immune mechanism, all age, 100,0000 pop.	NHS	RHS	LHS
		Mortality by diabetes mellitus, all ages, per 100,000 population	NHS	RHS	LHS
3.14	Mortality by hemato-logical system causes	Mortality by disease of the blood and blood-forming organs, all ages, per 100,000 population	NHS	RHS	LHS
3.15	Mortality by mental & neurological causes	Mortality by mental disorder & disease of nervous system & sense organ, all ages per 100,000 population	NHS	RHS	LHS

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3.1	Mortality by genitourinary system causes	Mortality by disease of the genitourinary system, all ages, per 100,000 population	NHS	RHS	LHS	
3.1	Mortality by ill-defined causes	Mortality by symptoms, signs and ill-define conditions, all ages, per 100,000 population	NHS	RHS	LHS	
4	<b>Social protection</b>					
4.1	Social security	Total coverage of social welfare	NHS	RHS	LHS	HOS AMB
		Population coverage given by social security	NHS	RHS	LHS	HOS AMB
4.2	Health insurance coverage	<b>Population excluded from health security or insurance coverage</b>	NHS	RHS	LHS	HOS AMB
		Health insurance cover for comprehensive health care delivery (% population)	NHS	RHS	LHS	HOS AMB
		Health insurance cover for hospital care (% of population)	NHS	RHS	LHS	HOS AMB
		Health insurance cover for primary health care (% of population)	NHS	RHS	LHS	HOS AMB
		Health insurance cover for drugs (% of population)	NHS	RHS	LHS	HOS AMB
5	<b>Health system resources</b>					
5.1	<b>Financial resource</b>					
5.1.1	Expenditure in health	<b>National health expenditure as percent of GNP</b>	NHS	RHS		
		Public hospital expenditures as percent of government health expenditure	NHS	RHS		
		Government health expenditure as percent of national health expenditure	NHS	RHS		
		Total health expenditure as % of gross national product	NHS	RHS		
		Total health expenditure as % of gross domestic product	NHS	RHS		
		Total health expenditure in PPP\$ per capita	NHS	RHS		
		Public health expenditure as % of total health expenditure	NHS	RHS		
		Total inpatient expenditure as % of total health expenditure	NHS	RHS		
		Expenditure on inpatient care, PPP\$ per capita	NHS	RHS		
		Public inpatient expenditure as % of total inpatient expenditure	NHS	RHS		
		Total pharmaceutical expenditure as % of total health expenditure	NHS	RHS		
		Pharmaceutical expenditure, PPP\$ per capita	NHS	RHS		
		Public pharmaceutical expenditure as % of total pharmaceutical expenditure	NHS	RHS		
		Total capital investment expenditure on medical facilities as % of total health expenditure	NHS	RHS		
		Salaries as % of total public health expenditure	NHS	RHS		
5.2	<b>Human resources</b>					

Human resources	Total health employment	NHS	RHS	LHS	
	Total hospital employment	NHS	RHS	LHS	
	Number of physicians per 100,000 population	NHS	RHS	LHS	
	Number of graduates in medicine	NHS	RHS	LHS	
	Proportion (in %) of physicians working in hospitals	NHS	RHS	LHS	
	Number of general practitioners in primary health care (PHC) per 1,000 population	NHS	RHS	LHS	
	Number of dentists per 100,000 population	NHS	RHS	LHS	
	Number of pharmacists per 100,000 population	NHS	RHS	LHS	
	Number of nurses per 100,000 population	NHS	RHS	LHS	
	Number of university graduates in professional nursing	NHS	RHS	LHS	
	Proportion (in %) of nurses working in hospitals	NHS	RHS	LHS	
	Auxiliary nursing staff per 100,000 population	NHS	RHS	LHS	
	Number of midwives per 100,000 population	NHS	RHS	LHS	
	Number of physicians graduated per 100,000 population	NHS	RHS	LHS	
	Number of nurses graduated per 100,000 population	NHS	RHS	LHS	
	Number of midwives graduated per 100,000 population	NHS	RHS	LHS	
Number of pharmacists graduated per 100,000 population	NHS	RHS	LHS		
Number of dentists graduated per 100,000 population	NHS	RHS	LHS		
<b>5.3 Physical resources</b>					
5.3.1	Infrastructure	NHS	RHS	LHS	
	Number of hospitals per 100,000 population	NHS	RHS	LHS	
	Number of acute care (short-stay) hospitals per 100,000 population	NHS	RHS	LHS	
	Number of ambulatory care facilities	NHS	RHS	LHS	
5.3.2	Number of primary health care units per 100,000 population	NHS	RHS	LHS	
	Number of hospital beds per 100,000 population	NHS	RHS	LHS	
	Hospital beds in acute hospitals per 100,000 population	NHS	RHS	LHS	
	Psychiatric hospital beds per 100,000 population	NHS	RHS	LHS	
	Beds in nursing and elderly homes per 100,000	NHS	RHS	LHS	
5.3.3	Private in-patient hospital beds as % of all beds	NHS	RHS	LHS	
	Computed Tomography Scanners per 100,000 population	NHS	RHS	LHS	

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3		Magnetic Resonance Imaging Units per 100,000 population	NHS	RHS	LHS	
		Radiation therapy equipment per 100,000 population	NHS	RHS	LHS	
		Lithotriptors per 100,000 population	NHS	RHS	LHS	
		Mammographs per 100,000 population	NHS	RHS	LHS	
<b>6</b>	<b>Health care delivery</b>					
6.1	Access to health services	Percent of population with access to health services	NHS	RHS	LHS	AMB
		Under-registration of births (%)	NHS	RHS	LHS	AMB
		Percent of birth registrations which are for children under 1 year old at time of registration	NHS	RHS	LHS	AMB
		Under-registration of mortality (%)	NHS	RHS	LHS	AMB
		Deaths with medical care as % of registered deaths	NHS	RHS	LHS	AMB
		Deaths due to signs, symptoms and ill-defined conditions as % of registered deaths	NHS	RHS	LHS	AMB
		Autopsy rate (in %) for all deaths	NHS	RHS	LHS	AMB
6.2	Maternal and child programs	<b>% of infants immunized against tuberculosis</b>	NHS	RHS	LHS	AMB
		<b>% of infants immunized against diphtheria</b>	NHS	RHS	LHS	AMB
		<b>% of infants immunized against tetanus</b>	NHS	RHS	LHS	AMB
		<b>% of infants immunized against pertussis</b>	NHS	RHS	LHS	AMB
		<b>% of children immunized against measles</b>	NHS	RHS	LHS	AMB
		% of infants immunized against poliomyelitis	NHS	RHS	LHS	AMB
		% immunized against influenza	NHS	RHS	LHS	AMB
		% of infants breastfed at 3 months of age	NHS	RHS	LHS	AMB
		% of infants breastfed at 6 months of age	NHS	RHS	LHS	AMB
		Percent of children under 1 year attended by trained personnel	NHS	RHS	LHS	AMB
		<b>Percent of pregnant women attended by trained personnel during pregnancy</b>	NHS	RHS	LHS	<b>HOS</b>
		Percent of pregnant women attended by trained personnel during first trimester pregnancy	NHS	RHS	LHS	HOS
		Percent of deliveries attended by trained personnel	NHS	RHS	LHS	HOS
		Caesarean sections per 1,000 live births	NHS	RHS	LHS	HOS
6.3	Ambulatory care	<b>Ambulatory care consultations (any type) per inhabitant per year</b>	NHS	RHS	LHS	<b>AMB</b>
		<b>Doctors' consultations per inhabitant per year</b>	NHS	RHS	LHS	<b>AMB</b>
		<b>Number of outpatient contacts per person per year</b>	NHS	RHS	LHS	<b>AMB</b>

		NHS	RHS	LHS	AMB	
6.4	Hospital activity	<b>Dentists' consultations per inhabitant per year</b>				
		Average length of stay (ALOS), all hospitals	NHS	RHS	LHS	HOS
		Average length of stay, acute care hospitals only	NHS	RHS	LHS	HOS
		Bed occupancy rate in %	NHS	RHS	LHS	HOS
		Bed occupancy rate in %, acute care hospitals only	NHS	RHS	LHS	HOS
		Autopsy rate (in %) for hospital deaths	NHS	RHS	LHS	HOS
		Surgical wound infection rate (in %), all operations	NHS	RHS	LHS	HOS
		In-patient care admissions per 100 population	NHS	RHS	LHS	HOS
		Acute care hospital admissions per 100 population	NHS	RHS	LHS	HOS
		Hospital discharges: infectious and parasitic diseases per 100,000 population	NHS	RHS	LHS	HOS
		Hospital discharges: all cancers, per 100,000 population	NHS	RHS	LHS	HOS
		Number of mental patients in hospitals, 365 days per 100,000 population	NHS	RHS	LHS	HOS
6.5	Hospital use	Hospital discharges: diseases of the circulatory system per 100,000 population				
		Hospital discharges: ischemic heart disease per 100,000 population	NHS	RHS	LHS	HOS
		Hospital discharges: cerebrovascular disease per 100,000 population	NHS	RHS	LHS	HOS
		Hospital discharges: diseases of the respiratory system per 100,000 population	NHS	RHS	LHS	HOS
		Hospital discharges: diseases of the digestive system per 100,000 population	NHS	RHS	LHS	HOS
		Hospital discharges: diseases of the musculoskeletal system and connective tissue per 100,000 pop.	NHS	RHS	LHS	HOS
		Hospital discharges: injury and poisoning per 100,000 population	NHS	RHS	LHS	HOS
		Hospital discharges: injury and poisoning per 100,000 population				
		Hospital discharges: injury and poisoning per 100,000 population				
		Hospital discharges: injury and poisoning per 100,000 population				

## Annex 4. More specific data and indicators to support local health care management

1	Economic and geographical access	
1.1	Health insurance coverage	Total health insurance cover (% of population) Health insurance cover (% of population) for comprehensive health care Health insurance cover (% of population) for primary health care Health insurance cover (% of population) for hospital care
1.2	Distance	Percent of target population living less than 1 hour from center Distance (km) to a referral hospital (if not being one) Distance (km) to specialties (if not having ones)
2	Health care resources	
2.1	Human resources	Number of physician hours contracted Number of general practitioner hours Number of specialist doctor hours (per specialty) Number of dentist hours Number of pharmacist hours Number of nurse hours Auxiliary nursing hours Administrative personnel hours General services staff hours Number of physician hours for inpatient care Number of general practitioner hours for inpatient care Number of specialist doctor hours (per specialty) inpatient care Number of nurse hours for inpatient care Auxiliary nursing hours for inpatient care Number of physician hours contracted per 1,000 population Number of general practitioner hours per 1,000 population Number of specialist doctor hours per 1,000 population Number of dentist hours per 1,000 population Number of pharmacist hours per 1,000 population Number of nurse hours per 1,000 population Auxiliary nursing hours per 1,000 population Administrative personnel hours per 1,000 population General services staff hours per 1,000 population
2.2 2.2.1	Physical resource Equipment	Number of Beds Operating rooms (theater) equipment Child delivery room equipment Clinical Laboratory equipment X-ray equipment Sonography equipment Electroencephalography equipment Electrocardiography equipment Blood Transfusions equipment Dental care equipment Rehabilitation equipment

		Vaccination equipment Cattery equipment Sterilization equipment Laundry equipment Maintenance equipment
2.2.2	Medical inputs	Provision of drugs and disposable medical inputs Provision of described drugs Provision of drugs sold over the counter Provision of disposable medical inputs Provision of therapeutic equipment and non disposable medical inputs Provision of glasses and other vision products Provision of equipment and orthopedic prosthesis Provision of audiphones Provision of equipment and medical equipment, including wheelchairs Provision of other non disposable medical input
<b>2.3</b>	<b>Financial resource</b>	
2.3.1	Expenditure and costs	Total expenditure of health care delivery Total expenditure in staff costs Total expenditure in salaries Total expenditure in drugs and other medical inputs Unitary cost of consultation Unitary cost of the hospitalization Total direct service cost (in percent) Total indirect service cost (in percent) Total cost in drugs per consultation Total cost in drugs per hospitalization Total cost in surgical material per surgical operation
<b>3</b>	<b>Health services delivery</b>	
<b>3.1</b>	<b>Ambulatory care</b>	
3.1.1	Provision of curative-oriented services	Doctor consultations General doctor consultations Specialty doctor consultations Dental consultation and control Prescriptions per consultation Treatment of Physiology/Physiatrics per Consultation Rehabilitation activities
3.1.2	Preventive-oriented services	Vaccination doses against tuberculosis Vaccination doses against diphtheria Vaccination dosis against tetanus Vaccination doses against pertussis Vaccination dosesd against measles Vaccination doses against poliomyelitis Vaccination doses against influenza Children under 1 year attended by trained personnel Pregnant women attended by trained personnel

		<p>Pregnant women attended by trained personnel (first trimester)</p> <p>Nutritionist consultations and controls</p> <p>Nursing consultation controls</p> <p>Midwifery consultation controls</p> <p>Health education sessions</p>
3.1.3	Community-oriented Coverage	<p>School controls</p> <p>School vaccination doses</p> <p>Massive vaccination campaigns doses</p> <p>Domicile curative care</p> <p>Domicile rehabilitation services</p> <p>Domicile chronic care nursing services</p>
<b>3.2</b>	<b>Inpatient care</b>	
3.1.4	Inpatient activities	<p>Discharges</p> <p>Concentration Index</p> <p>Occupational Index</p> <p>Average Days Stay</p> <p>Turnover Rate</p> <p>Substitution Interval</p> <p>Intensive Care Transfers by Discharge</p> <p>Special Care Transfers by Discharge</p> <p>Surgical Interventions by Discharge</p> <p>Treatment of Physiology/Physiatrics by Discharge</p>
3.3	Clinical supportive activities	<p>Clinical laboratory</p> <p>Diagnostic imagenology</p> <p>Patients transport and emergency rescue</p> <p>Other services supporting health care</p> <p>Clinical Laboratory Examinations per Consultation</p> <p>X-ray Studies per Consultation</p> <p>Sonographies per Consultation</p> <p>Electroencephalographies per Consultation</p> <p>Electrocardiographies per Consultation</p> <p>Blood Transfusions per Consultation</p>
3.4	Administrative supportive activities	<p>Computers</p> <p>Existence of Local Area Network</p> <p>Mail boxes connected to internet per 100 staff</p>
3.5	General services	<p>Patient rations per day</p> <p>Sterilization activities per day</p> <p>Washed clothes (kg) per day</p> <p>Maintenance activities per day</p>
3.6	Administration and other activities	<p>Time (hours) dedicated to clinical management</p> <p>Time (hours) dedicated to administrative and financial management</p> <p>Control and supervision (hours)</p> <p>Education and training in health personnel (hours)</p> <p>Research and development in health (hours)</p>

3	Patient-centered information	
1.1	Identification	Patient identification Address Age Sex Nationality Ethnical group (if relevant at local level) Insurance health system
1.2	Clinical history	Family health antecedents and risk predisposition Health-related lifestyle and risks Relevant past health events Relevant past health care ambulatory and inpatient events Vaccinations Communicable diseases history Gynecological and reproductive-related history Chronic risks and diseases Elderly-related problems
1.2	Contact with services	Medical record Cause of consultation Maternal or child controls Chronic disease programmed controls Hospital admission cause Surgical operation Clinical relevant procedure Radiotherapy Laboratory exams Imaging exams Pharmaceutical drugs and other medical products provided Blood transfusion Diet consultation Physical medicine and rehabilitation procedures
	Insurance and billing	Insurance coverage at moment of use Cost of services provided

## **Annex 5 Core Health Data Elements proposed for the US**

<b>Indicator</b>	<b>Readiness for Implementation</b>
1 Personal/Unique Identifier	Need study/evaluation
2 Date of Birth	Ready
3 Gender	Ready
4 Race and Ethnicity	Ready
5 Residence	Ready
6 Marital Status	Ready
7 Living/Residential Arrangement	Some work needed
8 Self-Reported Health Status	Need study/evaluation
9 Functional Status	Need study/evaluation
10 Years of Schooling	Ready
11 Patient's Relationship to Subscriber/Person Eligible for Entitlement	Ready
12 Current or Most Recent Occupation and Industry	Need study/evaluation
13 Type of Encounter	Need study/evaluation
14 Admission Date (inpatient)	Ready
15 Discharge Date (inpatient)	Ready
16 Date of Encounter (outpatient and physician services)	Ready
17 Facility Identification	Some work needed
18 Type of Facility/PAMBe of Encounter	Some work needed
19 Health Care Practitioner Identification (outpatient)	Some work needed
20 Provider Location or Address of Encounter (outpatient)	Ready
21 Attending Physician Identification (inpatient)	Some work needed
22 Operating Clinician identification	Some work needed
23 Health Care Practitioner Specialty	Some work needed
24 Principal Diagnosis (inpatient)	Ready
25 Primary Diagnosis (inpatient)	Ready
26 Other Diagnoses (inpatient)	Ready
27 Qualifier for Other Diagnoses (inpatient)	Ready
28 Patient's Stated Reason for Visit or Chief Complaint (outpatient)	Need study/evaluation
29 Diagnosis Chiefly Responsible for Services Provided (outpatient)	Ready
30 Other Diagnoses (outpatient)	Ready
31 External Cause of Injury	Ready
32 Birth Weight of Newborn	Ready
33 Principal Procedure (inpatient)	Ready
34 Other Procedures (inpatient)	Ready
35 Dates of Procedures (inpatient)	Ready
36 Procedures and Services (outpatient)	Ready
37 Medications Prescribed	Ready
38 Disposition of Patient (inpatient)	Some work needed
39 Disposition (outpatient)	Ready
40 Patient's Expected Sources of Payment	Some work needed
41 Injury Related to Employment	Ready
42 Total Billed Charges	Some work needed

Source = Department of Human and Health Services, US. (1996), 'Core Health Data Elements. Report of the National Committee on Vital and Health Statistics'. Washington DC: August 1996.





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