

Assessing and monitoring the performance of health information systems: metrics and models

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Acronyms and abbreviations

ANC	antenatal care	IHP+	International Health Partnership Plus
ARI	acute respiratory infections	IHR	International Health Regulations
ARV	antiretroviral therapy	INDEPTH	International Network for the Demographic Evaluation of Populations and Their Health in Developing Countries
AusAID	Australian Agency for International Development	IMF	International Monetary Fund
CDC	Centers for Disease Control and Prevention	ITN	insecticide-treated nets
CRVS	civil registration and vital statistics	LSMS	Living Standards Measurement Surveys
CSM	country support methodology	MDG	Millennium Development Goals
DHS	Demographic and Health Surveys	MICS	Multiple Indicator Cluster Surveys
DQA	Data Quality Audit	NGO	non-government organisation
DQAF	Data Quality Assurance Framework	NHA	national health accounts
DQS	Data Quality Self-Assessment	OBAT	organizational and behavioural assessment tool
DTP	diphtheria, tetanus and pertussis immunisation	OECD	Organisation for Economic Cooperation and Development
FAO	Food and Agriculture Organization	ORT	oral rehydration therapy
GDSS	General Data Dissemination Strategy	PAPCHILD	Pan Arab Project for Child Development
GFATM	Global Fund to fight AIDS, Tuberculosis and Malaria	PAPFAM	Pan Arab Project for Family Health
GTT	Global Tracking Tool	PARIS21	Partnership in Statistics for Development in the 21 st Century
HDSS	health and demographic surveillance sites	PEPFAR	President's Emergency Plan for AIDS Relief
HIS	health information system(s)	PHIN	Pacific Health Information Network
HISHub	Health Information Systems Knowledge Hub	PRISM	Performance of Routine Information System Management
HISPIX	health information systems performance index	PTT	Progress Tracking Tool
HIV	human immunodeficiency virus	QI	quality of the system index
HMIS	health management information system	RDQA	Routine Data Quality Assessment/Audit
HMN	Health Metrics Network	RHINO	Routine Health Information Network
HSAA	Health Systems Assessment Approach	RHIS	Routine Health Information System
ICD	International Statistical Classification of Diseases and Related Health Conditions		
IDA	International Development Association		

RBM	Roll Back Malaria
SAVVY	Sample Vital Registration with Verbal Autopsy
SCBI	Statistical Capacity Building Indicator(s)
SD	standard deviation
STATCAP	Statistical Capacity Building
UHC	universal health coverage
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDESA	United Nations Department of Economic and Social Affairs
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Summary

We live in an information age. Never before has so much information—numerical and descriptive—been available and accessible to so many people. But growth in the quantity of information has not necessarily been accompanied by improvements in quality. Much of the statistical information that we can access is of dubious reliability and accuracy. At the same time, demand for reliable data for program monitoring and evaluation and for tracking of progress towards goals and targets continues to grow. With the approach of the 2015 deadline for the Millennium Development Goals (MDGs), the world's attention is turning towards the challenges of the post-2015 health and development agendas. A central issue driving the debate is the availability and quality of the statistical information needed to determine priorities, track progress, and evaluate program effectiveness. In this paper, we address these issues from the perspective of health.

Recent global and country estimates of the evolving burden of disease have drawn attention to emerging health challenges. But they have also generated concerns about the quality of the underlying empirical data upon which they depend. The World Health Organization (WHO) has put forward the concept of universal health coverage (UHC) as a key response to meeting the health needs of the population. UHC is an engaging and seemingly simple concept, but it is highly data demanding. Its measurement requires the ability to identify, for each individual, what health services they needed at a point in time, whether they received them, and how much they had to pay out of pocket compared to their incomes. Demonstrating to what extent health improvements result from improved UHC is also important. Meanwhile, the health sector is facing structural changes that imply major increases in the need for information. Reform and decentralisation have brought about shifts in functions between the central and peripheral levels of the health sector and generated new information needs. Health sector reforms also magnify the need for standardisation and quality of information.

These developments call for well-performing country statistical and health information systems (HIS). In response, several initiatives in recent years have been established to support countries in producing accurate and reliable data. In 2000, the Partnership in Statistics for Development in the 21st Century (PARIS21) was established, with support from the World Bank and several bilateral donor agencies. Its goal is to support

the development of national strategies for statistical development with a focus on “statistically challenged” countries. The Routine Health Information Network (RHINO), founded in 2001 with support from the United States Agency for International Development (USAID), seeks to increase the use of information produced by high quality and sustainable routine health information systems. In 2005, the Health Metrics Network (HMN) was established with support from the Bill and Melinda Gates Foundation with the goal of supporting countries to improve the availability, quality and use of data to inform country policymaking and programming. In 2008, the Health Information Systems Knowledge Hub (HISHub) was set up at the University of Queensland with support from the Australian Agency for International Development (AusAID) aiming to facilitate the integration of HIS into agendas that strengthen overall health systems and to enhance local capacities for data collection, management, analysis and use. Other initiatives with a component of strengthening information systems include the USAID-supported Health Systems 20/20 initiative and the work of the International Health Partnership and WHO on monitoring health systems performance.

In this paper we draw upon the lessons learnt from these various initiatives in order to lay out the key attributes of health information systems in terms that are definable and measurable, thus permitting effective monitoring of progress. We revisit the HMN Framework and HIS assessment tool and make some suggestions for improvement. We discuss the goal of HIS and examine the technical, organisational and capacity requirements for a functional and useful system. In the light of a critical review of currently available tools and experiences in assessing statistical and health information systems, we propose a comprehensive strategy and methods for assessing and monitoring HIS performance. We define a parsimonious set of indicators for assessment of HIS products—the availability, quality and use of data for decision-making—and for monitoring the inputs and processes that characterise well-performing systems. The indicators proposed have been tested in different initiatives, but this is the first time they have been brought together in an integrated framework, with principles for implementation designed to build country capacities first and foremost.

This comprehensive framework requires strong institutional mechanisms for implementation. For the assessment of HIS products we propose that countries

set up an independent body, at “arm’s length” from government programs and ministries, mandated to provide technical appraisal of the availability, quality and use of the key products of a health information system. Such an independent body could harness expertise from academic institutions and public health institutes and could involve experts in technical subject matter and decision-makers who use health data in policy and practice. Figure 1 presents a conceptual scheme for the interlinked monitoring and

independent body tasked with the review of HIS products will be essential.

Regular assessment of the availability and quality of the statistical information generated through the HIS will become increasingly important. Health is a major sector of the economy and an important concern for individuals and communities. Resource allocation and decision-making will be increasingly driven by complex health indicators and the use of multifaceted metrics such as disability-adjusted life years and UHC. These

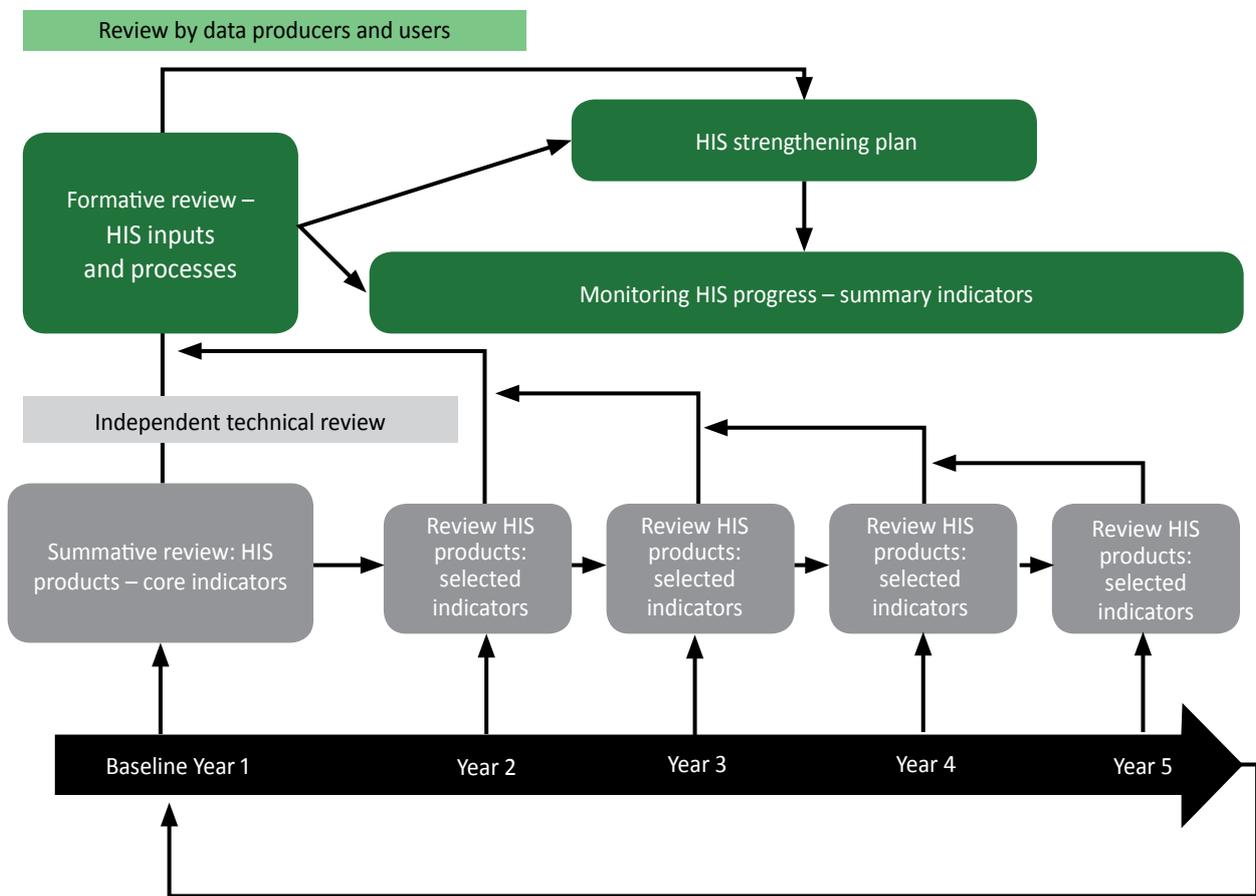


Figure 1 – Conceptual scheme for monitoring and evaluation of HIS performance

evaluation of the HIS. The evaluation of HIS products—the data generated by the system—is conducted by an independent body, possibly an academic institution in the country or an “arm’s length” quasi non-governmental agency. HIS inputs and processes should be assessed through all those working in the HIS and users of the data coming together to diagnose problems and identify interventions that can be included in a national HIS improvement plan. Collaboration with the

developments underline the need for a solid foundation of reliable and accurate health information and for the establishment of data quality assurance processes.

A prerequisite for success is government commitment, at the highest levels, to improve the functioning of the HIS and provide critical review and analysis of available information. This paper is intended as a first step in support of such a process.

The paper is in three parts:

Part I takes as its starting point the technical components of a HIS described in the HMN Framework and goes beyond this to describe the organisational and capacity requirements for a functional and useful system that delivers reliable policy- and program-relevant information.

Part II comprises a critical review of currently available tools and experiences in assessing statistical systems and HIS.

Part III proposes criteria and methods for assessing and monitoring country HIS and puts forward a set of core indicators and associated measurement strategies.

Introduction

It has become a truism to assert that sound and reliable information is the foundation of all aspects of health system decision-making: policy development, program planning and implementation, governance and regulation, health research, human resources development, health education and training, service delivery and financing. Certainly, in recent years the impetus to strengthen country statistical systems, and health information systems (HIS) in particular, has increased. To a great extent, this impetus has arisen out of the growing demand for data to permit monitoring and evaluation and tracking of progress towards goals and targets such as the Millennium Development Goals (MDGs) and the post-2015 development agenda. In many countries, reform and decentralisation have brought about shifts in functions between the central and peripheral levels of the health sector, generating additional information needs and changing requirements for data collection, processing, analysis and dissemination. Health sector reforms also magnify the need for standardisation and quality of information.

The demand has fuelled the creation of regional and global initiatives with the remit to strengthen country statistical systems overall and sectoral information systems, including in health. In 2000, the Partnership in Statistics for Development in the 21st Century (PARIS21) was established, with support from the World Bank and several bilateral donor agencies. Its goal is to support the development of national strategies for statistical development with a focus on “statistically challenged” countries (PARIS21 Secretariat 2004). In health, the Routine Health Information Network (RHINO) was founded in 2001 with support from the United States Agency for International Development (USAID) (RHINO n.d.). RHINO seeks to increase the use of information produced by high quality and sustainable routine HIS. Its activities are focused on data generated through the activities of the health system itself—from health care centres, hospitals and associated administrative activities—also referred to as the health management

information system (HMIS)¹ (Lippeveld et al. 2000).

With the 2005 establishment of the Health Metrics Network (HMN), with support from the Bill and Melinda Gates Foundation, came a wider conceptualisation of the HIS within the statistical system more broadly. HMN’s scope of work extends beyond the health sector, as reflected by the composition of its governing board, which includes representatives from both the health information and statistical sectors. The HMN goal is to support countries in improving the availability, quality and use of data to inform country policymaking and programming (HMN 2008a). In 2008, the Health Information Systems Knowledge Hub (HISHub) was set up at the University of Queensland with support from the Australian Agency for International Development, AusAID (HISHub n.d.a). Like HMN, the HISHub adopts a broad view of health information as coming from both the health and statistical sectors. The goal of HISHub is to facilitate the development and integration of HIS into agendas that strengthen the overall health system; influence policy dialogue; and enhance local capacities for data collection, management, analysis and use. Its remit is largely centred on Asia and the Pacific region.

These examples relate to efforts to build stronger HIS as a whole. But the resources they have been able to mobilise pale in comparison with those invested in improving monitoring and evaluation capacity in disease-specific programs, driven by demands for performance- and results-based monitoring on the part of global health initiatives such as the GAVI Alliance, the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM), the (US) President’s Emergency Plan for AIDS Relief (PEPFAR), the (US) President’s Malaria Initiative, and the Roll Back Malaria (RBM) partnership. Through these well-endowed programs, considerable resources were directed to the development of innovative measurement approaches and country capacity building for disease-specific data collection, management and analysis.

1 Health service data sources have been variously equated with terms such as health management information system (HMIS), routine health information system (RHIS), management information systems (MIS) or Health Information Systems (HIS). In order to avoid confusion, the term “health service data sources” is used in the HMN Framework, while “HIS” is used exclusively to describe the total information system, incorporating both population-based and institution-based sources.

These initiatives share the goal of enhancing country capacities for the generation and use of empirical data and adopt a similar conceptual roadmap of how to reach that goal. The usual pathway is to start with a situation assessment, followed by the development and implementation of national improvement plans.² This approach presupposes a vision of what success would look like and how progress would be monitored. The most complete vision of what a health information system consists of is described in the *HMN Framework and Standards for Country Health Information Systems* (HMN 2008a) (hereafter ‘the HMN Framework’). The related *HMN Assessing the national health information system: an assessment tool* (HMN 2008b) (hereafter ‘the HMN Assessment tool’) is intended to provide a diagnosis of system strengths and limitations as the starting point for developing an improvement plan.

The HMN Framework has been acknowledged as a major step forward in understanding the functions and scope of a HIS. It has, however, been criticised as being pitched at a high technical level that fails to address the institutional and behavioural constraints to good information production and use (Aqil et al. 2007). Moreover, the related HMN Assessment tool, while useful for bringing country health and statistical stakeholders together, has proved too cumbersome to undertake on a regular basis and does not define specific HIS performance metrics.

A more operational and policy-relevant definition of the HIS is required, with measurable performance criteria, indicators, monitoring strategies and analytical techniques. To date, there is no consensus around any of these critical elements. However, since the HMN Framework was first published in 2005, considerable experience has been generated in countries on how to assess information systems and use the results for improvement plans. Work has continued on building an understanding of health systems, including HIS, in particular through the activities of the University of Queensland HISHub (HISHub n.d.a), the USAID-supported Health Systems 20/20 initiative (USAID n.d.), and the work of the International Health Partnership and WHO on monitoring health systems performance (WHO & IHP 2011a).

2 In this paper we address only those activities focusing specifically on improving country systems and do not refer to parallel activities to improve the estimation of indicators such as the Institute for Health Metrics and Evaluation.

Objectives of this working paper

Building on the aforementioned cumulative experience, in this paper we make the case for a minimum set of metrics, data sources and analytical and dissemination capacities that collectively compose a “good” HIS and enable regular monitoring of HIS performance. This framework could be used to guide HIS planning and resource mobilisation, evaluate the results of HIS investments, build confidence in the quality of available health information, and identify critical weaknesses in HIS for which additional investments are needed. In developing the framework, the following general underlying principles apply:

- The strategy is country-focused and designed to serve needs for accountability and evidence-based policy and planning.
- A systems-building approach is applied that fosters country capacity development.
- The unifying framework encompasses both the HIS as a whole and the multiple disease-specific monitoring and evaluation strategies.
- The approach enables both country and global monitoring of health system performance and tracking of burden of disease.

PART I: An emerging understanding of health information systems

Defining the boundaries

What constitutes a health information system is often in the eye of the beholder. In the view of many individuals and institutions working in health, a HIS is bounded by the health *care* system: the Health Management Information System (HMIS) compiles and reports the activities of the network of health care practitioners and facilities and the administrative and logistic information needed to sustain them. From the perspective of those engaged in disease surveillance and response, the boundaries of the health information system are defined by the combination of active and passive case finding of (and responses to) notifiable diseases and conditions and high priority risk factors and behaviours. The perspective of those working in disease-specific and categorical program areas is at once narrower and more extensive: information is gathered from both health and non-health sectors using multiple measurement approaches, but it is confined to a single entity such as human immunodeficiency virus (HIV) or child health. A broader view of the HIS extends well beyond the health care system, to include the information needed to understand and monitor the health of entire populations, not only the people using health care services but also, and more crucially, the people not using them.

The need for a coherent and unifying conceptualisation of the health information system has emerged in response to the perceived dysfunctionality and inefficiency of separate and often duplicative information systems. These are often driven by the demands of disease-focused programs, donor reporting requirements and international monitoring and evaluation initiatives focused on specific health topics. However, there is a broad consensus around the insight, first put forward by HMN, that the activities of a HIS cannot be limited to particular diseases or confined within specific kinds of data collection. Rather, the boundaries of the HIS extend

beyond the health sector to encompass all activities whose purpose is to generate information needed to measure the health of populations and the performance of health systems (HMN 2008a).

The HIS draws upon the activities and outputs of multiple systems and agencies, each of which needs to perform well within its own domain while collaborating with others to efficiently and effectively meet the demand for health-related statistics (Figure 2). In this view, health information is a series of interlinked systems cutting across sectoral boundaries and comprising not only the data generated directly through the health sector but also data of relevance to health produced by other agencies, such as the national statistics office, the census bureau, the civil registration authorities and other sectors (HMN 2008a). For example, data of critical importance to the health sector—such as births, deaths and sex and age patterns of mortality—are produced through the census, civil registration and national statistical systems. Health-related information may be produced by local and municipal authorities. Information on resources allocated and consumed for health derive from departments of finance and planning, and resource flows to the health sector can be extracted from national accounts. In many countries, national statistics offices conduct the censuses and household surveys which are the primary sources of population-based information on health outcomes, such as child mortality, and on the use of health care services or health-related behaviours. Poverty monitoring surveys, household budget surveys and household living standards surveys provide useful health-related data down to provincial level, but they are rarely carried out by the health sector. Health-related data are also generated by researchers evaluating the effectiveness of interventions, often in longitudinal health and demographic surveillance sites (HDSS).

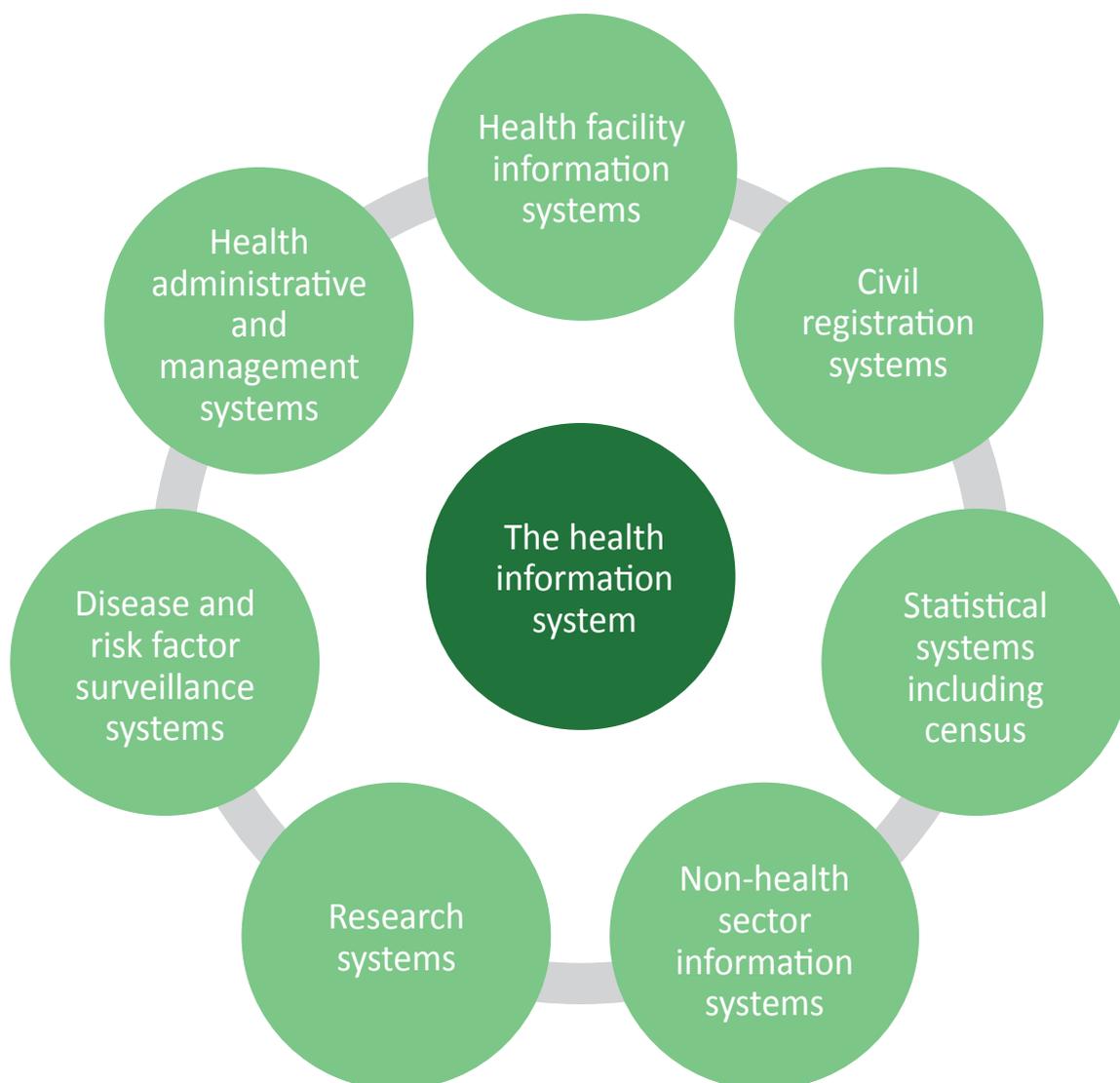


Figure 2 – The health information system draws upon many other systems and agencies

Source: adapted from HMN 2008a

Problems can arise when different sectoral agencies have overlapping mandates and responsibilities for data collection, management, analysis and reporting. For example, the health sector may collect data on births and deaths occurring in health facilities independently from the activities of the national civil registration system. The resulting differences in key indicators cause confusion and may undermine the credibility and trustworthiness of the data. We return to this issue later.

While this way of defining a HIS acknowledges that it draws on multiple subsystems, it does not necessarily

imply any particular degree of formal integration, nor that any one institution or individual is in charge overall. Just as every country has a health system, however fragmented it may be among different organisations or however unsystematically it may seem to operate, so every country has a health information system that operates in more or less coherent ways. Integration and oversight do not determine the system, but they may greatly influence how well it performs.

Positioning health information within health systems

Evolving concepts of HIS have emphasised their centrality to public health decision-making and health systems performance. They have been variously described as:

Despite these declarations of ambition, in the general discourse on health systems, health information has occupied the role of Cinderella: much put upon and subject to neglect and mistreatment. The seminal *The world health report 2000* (WHO 2000) on health systems made no specific reference to the health information

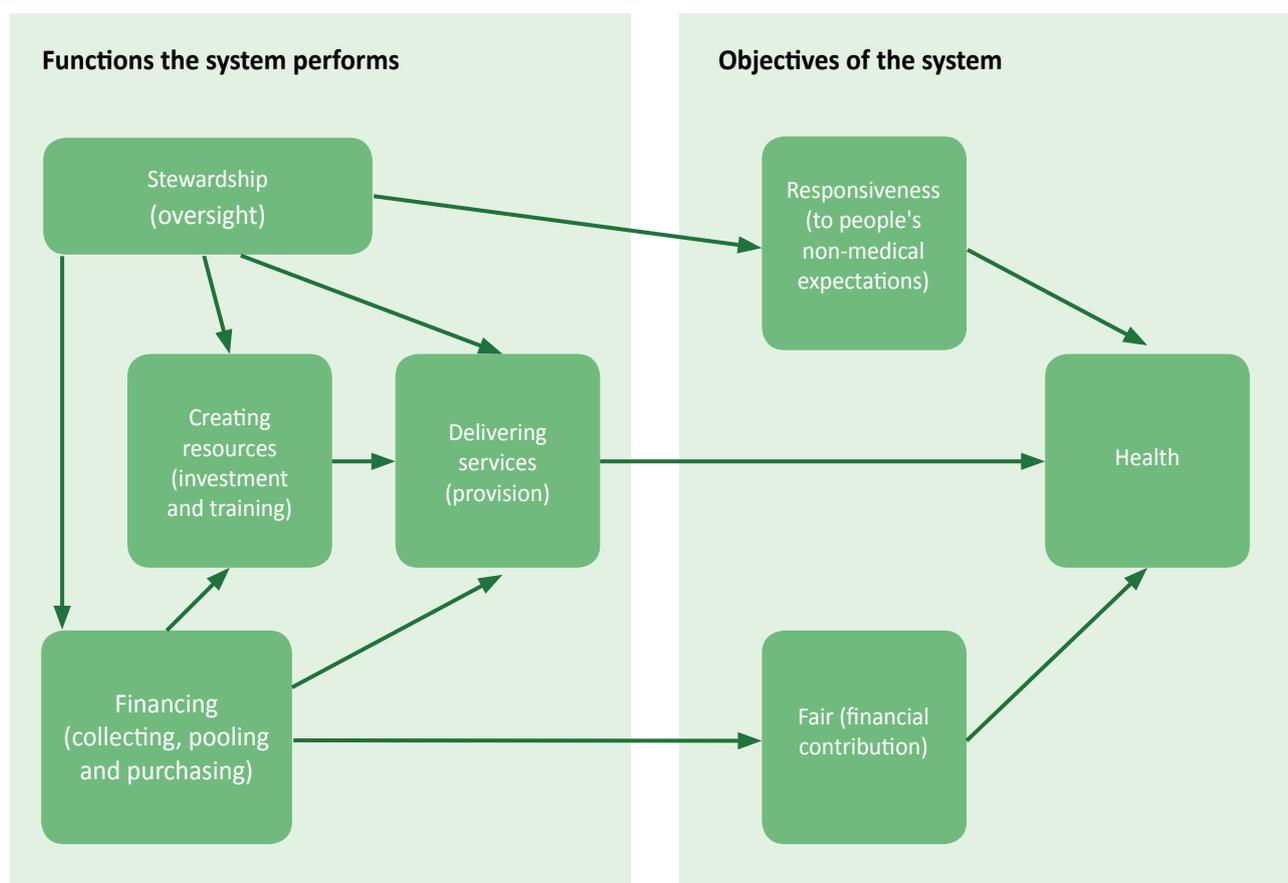


Figure 3 – Functions and objectives of the health system

Source: WHO 2000

“An integrated effort to collect, process, report and use health information and knowledge to influence policymaking, programme action and research” (Lippeveld et al. 2000)

a system that “ensures the production, analysis, dissemination and use of reliable and timely information on health determinants, health system performance and health status” (Aqil et al. 2009)

the “glue” holding the health system together (Lippeveld 2001).

system, the concept being subsumed under the general (and vague) concept of “stewardship” (Figure 3).

Subsequent iterations of the health system framework included health information as one of six “building blocks” (Figure 4) (WHO 2007a). While this positioning gave health information greater visibility, it reinforced a narrow conceptualisation of health information, confining it to the health sector and failing to acknowledge that much of the information needed by the HIS is generated in other sectors.

Another major weakness of the building blocks approach is its static nature; a pile of building blocks does not constitute a building. An analysis of any system has to take into account not only the raw material of which it is composed but also, and more importantly, the complex interactions and relationships between the different components (de

Savigny & Adam 2009). This is particularly important for the HIS whose function is to generate information about each individual “building block” as well as how they work together to improve health systems performance and contribute to the intended outcome of better health.

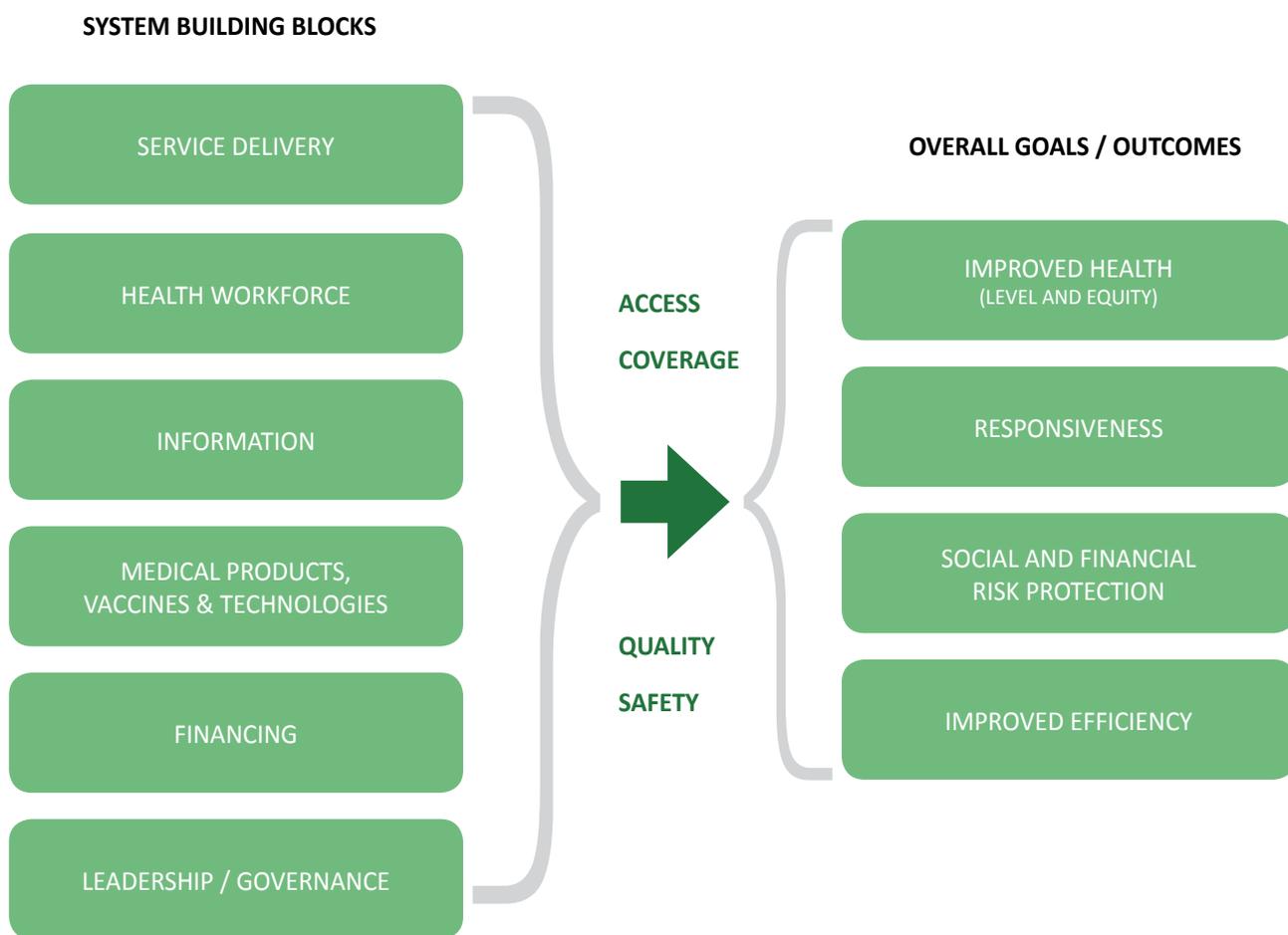


Figure 4 – WHO’s health system building blocks

Source: WHO 2007a

The HMN Framework: achievements and lessons learnt

The HMN Framework represented an important advance in the way that health information systems are conceptualised. The approach was widely welcomed and endorsed by countries at the World Health Assembly in 2007 (WHO 2007b). The HMN Framework has been hugely influential among development partners such as USAID's Health Systems 20/20 initiative (USAID n.d.) and has been integrated into the work of academic institutions seeking to strengthen HIS, such as the University of Queensland HISHub (HISHub n.d.b) and the Swiss Tropical Institute (Swiss TPH n.d.). More detail is provided about the HMN Framework in Annex I of this paper. Here we present the overall lessons learnt and identify new thinking about how to deal with complex systems that can help inform future efforts to strengthen health information systems.

The HMN Framework achieved two important outcomes. First, it described the elements of a country health information system in terms of a logical results chain from the inputs and processes of the HIS (resources, indicators, data sources and data management) to the information products it is tasked to generate and their use for public health decision-making. It described the desirable standards to be attained when strengthening or establishing each HIS component, drawing upon work in both health and statistical agencies.

Second, having defined the contents or "hardware" of the HIS, the HMN Framework went on to describe the guiding principles and processes for implementation in countries, what could be termed the "software" enabling the framework to be implemented. The processes consist of three phases:

- a preliminary phase of leadership, coordination and political commitment leading to a detailed assessment of the current performance of the health information system
- a priority-setting phase and development of a country improvement plan
- an implementation phase with ongoing monitoring and evaluation of progress.

In tandem with the HMN Framework, the HMN developed an assessment tool designed to enable countries to understand the functioning of their systems

(HMN 2008b). With HMN funding and technical support, over 60 countries completed the assessment, going through the elaborate, multi-stakeholder process required. In 2009, an external evaluation of HMN concluded that the assessment tool offered a strong platform for a formal and structured process for identifying information issues and needs within a health system and a mechanism to highlight and direct a strategic process for improvement (Walker et al. 2009). However, from the perspective of country participants, the process was overly complex, too structured and prescriptive and resource and time hungry. It was phrased in very high level language and used technical concepts not readily accessible to data users such as senior administration or political staff, or to non-technical staff and mid-level officials. The evaluators suggested that a simplified version, appropriate in terminology for local translation, would offer more flexibility to accommodate local environments and context, thus enhancing local buy-in and ownership.

The HMN achievements in terms of analysis and assessment were not matched by useful guidance on how to develop feasible strategies for improvement. Although over 60 countries devoted the time, energy and resources to conduct the assessment, only a handful subsequently developed feasible improvement plans; there are few signs today of sustained action to address HIS comprehensively in the manner set out in the HMN Framework. The lesson is clear: overly complex assessments and lack of follow-up to the planning and implementation stage contribute to lack of country ownership and commitment and eventual slow death of well-intended initiatives.

Beyond HMN: systems thinking for health information systems

In 2012–13, several of the initiatives established for HIS strengthening—HMN, the USAID Health Systems 20/20 initiative and the University of Queensland HISHub—came to an end. Yet the demand for evidence and information on systems building, both in relation to health systems as a whole, and for health information systems in particular, continues to grow (HSR 2012). At this delicate juncture it is essential to avoid regressing into the strategies that failed in the past: limited, disease-focused projects aimed solely at supporting

better monitoring and evaluation. Indeed, a useful distinction can be made between supporting information systems and strengthening them (Chee et al. 2013). The former can include any activity that improves data availability, such as introducing a new data collection method or a new technology to assist data collection and compilation. Such activities have their place and can add value, but their long-term impact will be limited. Strengthening HIS can only be accomplished by more comprehensive changes to performance drivers such as policies and regulations, organisational structures, and relationships across the system to motivate changes in behaviour, build capacities to analyse and use data for policy and programs, and/or allow more effective use of resources.

Health information systems are complex, contextually driven, and contentious because they involve many actors, institutions and political agendas. Patience and long-term commitment are needed to achieve significant and sustainable change in such complex systems. Health information systems are, by definition, not stand-alone but must be integrated into operational health, statistical and governmental systems in each country. They must be enduring and stable, yet responsive to emerging needs in health information. In contrast with topic-specific programs, there is no clear end point; building better health information systems is an ongoing process requiring continuing commitment to data quality and use. This requires strong national integration and commitment, often in the face of acute resource shortages for health services as well as for health information. When there are competing demands, technocrats decide where to deploy limited resources for health data; they focus on disease-specific information needs and prioritise technological solutions, such as the introduction of new electronic methods of data collection and compilation. Less tractable issues such as coordination, capacity-building and strengthening analytical skills—perceived to be resource intensive and slow to deliver results—are neglected.

The importance of technical frameworks for strengthening HIS is undisputed. However, by itself, the technical content, even when buttressed by well-established standards and well-performing tools, is insufficient to bring about the needed change. To take up the analogy mentioned earlier, the HMN technical framework and roadmap address the “hardware” and “software” aspects of HIS. They do not address the “peopleware” aspect (DeMarco & Lister 1987). Yet

understanding how organisations and people—both producers and users of information—interact with the technical components of HIS is the key to success. Applying a “systems thinking” approach to health information shifts the focus to the relationships between the individual components and the synergies emerging from interactions among them. This approach involves addressing the technical components as well as the organisational, institutional and cultural context. In other words, alongside the technical and technological transformation of the health system, an important cultural change in its organisation needs to happen (HISHub & IHME 2009). Metrics for monitoring are needed across all aspects.

In the next section of this paper, we examine how these contextual, institutional and cultural issues can be integrated into a strategic framework and indicators for measuring and monitoring HIS performance. We take as given the goal, functions and scope of the HIS as initially defined in the HMN Framework. In Part II of this paper we summarise these with some updates and modifications to reflect lessons learnt in the six years since the HMN Framework was published.

Context, capacities and culture

Institutional and contextual issues

The way health information systems are organised and the institutional context within which they work greatly affect their ability to respond to the evolving demands of information users and to be flexible in light of changes in the external environment. Flexibility includes being able to receive and store data from many different sources and from multiple dimensions: from individual patient information to population-level time trends of morbidity; from storing only alphanumeric information to storing medical diagnostic images. Responsiveness implies giving greater consideration to the needs of health information users. This can happen at the individual level, for example by including patients and health care consumers in information sharing and dissemination. Enhancing flexibility and responsiveness requires shifting from a focus mainly on technical HIS problems to thinking in terms of strategic information management and greater transparency in data collecting, quality assurance, sharing and dissemination.

Although national organisational contexts differ in detail, responsibilities for overseeing HIS functioning and performance are generally divided among various sectors and agencies active in the generation, synthesis, analysis and use of data. Ministries of health are responsible for health management information systems and record the timeliness and quality of data reported through health services and disease surveillance systems. National statistics offices maintain information about the availability and quality of data generated through major data collection undertakings such as (usually) the decennial census, large-scale household surveys, and the civil registration system. As custodians of national official statistics, they often have explicit requirements for the way data are collected, compiled and shared, and adhere to the Fundamental Principles of Official Statistics (UN 1994). International agencies working in health also maintain information about the availability and quality of data on international health goals, including but not limited to the MDGs.

This division of responsibilities across different sectors can lead to duplication and uncertainty about responsibilities. This is further aggravated in settings where roles and responsibilities within the health sector are unclear or overlapping. In many countries the increase in 'vertical', disease-focused programs with their own funding streams and reporting requirements has led to the development of separate monitoring and evaluation strategies and data collection and analysis activities outside the routine health information system. Separate forms and reporting mechanisms have been introduced into health facility information systems, adding to the load of peripheral health care workers. Some programs have developed stand-alone data collection methods such as special household surveys, for example in relation to HIV/AIDS, malaria or risk factors for non-communicable diseases. While a case can be made for focused data collection activities, problems arise when these occur in an ad hoc way and when there

is no overall mechanism for ensuring data quality and for analysing the findings taking all data sources into account.

Capacities and skills

Nothing undermines the credibility of the HIS so much as a perception that the statistics produced are uncertain or subject to external or political manipulation. Capacities to review, analyse and interpret data and critically evaluate data quality are essential skills that are needed at all levels of the HIS, yet are rarely present in sufficient quantity and depth. Providing an assurance of data quality is particularly challenging when monitoring and evaluation responsibilities are distributed among multiple sectors and disease-focused programs. In the absence of an overarching policy and guidelines, establishing and enforcing uniform data quality criteria is difficult. Too often, there is reluctance from people working in health information to acknowledge data weaknesses, let alone address them. This generates a perverse cycle in which decision-makers reacting to the quality problems in the data exclude those data from their decision-making. In turn, providers of data choose not to invest in improvements because nobody is consuming their products (Ash et al. 2004).

Responsibility for data quality is shared across all levels and components of the HIS, from the initial point of data collection or record keeping, to the final data compilation and dissemination stage (Figure 5) (HMN 2008a). However, when responsibility is everyone's business it can easily end up being nobody's business. Moreover, there are powerful disincentives to transparency about data quality, especially when economic interests are concerned; many debates about quality of data are, in truth, about vested interests and integrity. Conflicts of interest can arise when people responsible for delivery of health services or attainment of health goals are also charged with measurement and monitoring of progress.

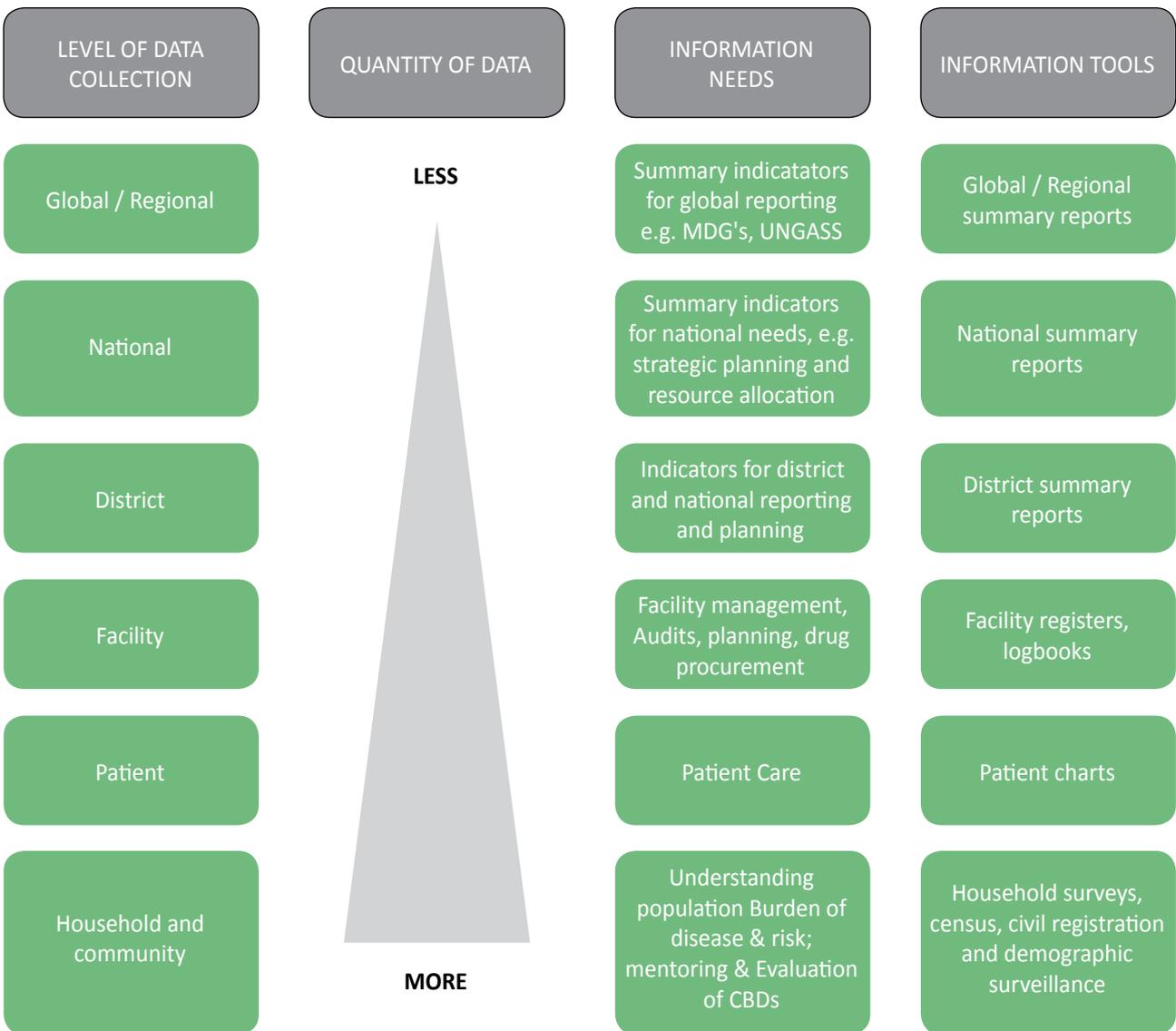


Figure 5 – Multiple levels of data collection, quality assurance and use

Source: HMN 2008a

An independent institution charged with data quality assurance for the HIS as a whole can counter such problems. Through such a mechanism, responsibility for data quality assurance is formalised, thus enhancing the confidence of users in the trustworthiness of the data the HIS produces.

Institutional mechanisms can take different forms, from an integral part of a ministry of health to an entirely separate private, non-profit organisation with independent funding. Whatever the form, it is important to maintain independence from program

implementation so as to maximise objectivity and minimise risks associated with vested interests.

National statistics offices that align their activities with the *Fundamental Principles of Official Statistics* (UN 1994) can make a significant contribution to data quality enhancement efforts. However, in many settings, statistical offices do not get heavily involved in health and social statistics, which are considered the responsibility of line ministries. Statistics offices tend to focus on household survey data, along with censuses and vital statistics. They are, however, potentially important

partners in data validation processes. A currently underutilised option is to forge closer links with academic, research and public health institutes, which may be well placed to support independent data quality assurance. We return to this issue later in the paper.

The key skills needed are those of analytics, adaptability, responsiveness and collaboration. This implies building interdisciplinary teams composed of:

- subject matter staff with knowledge of technical content, analytic methods, client needs and relevance
- methodologists with expertise in statistical methods and data quality trade-offs, especially with regard to accuracy, timeliness and cost
- operations experts who bring experience in operational methods, and concerns for practicality, efficiency, field staff and respondents
- systems experts bringing a systems view, and knowledge of technology standards and tools to the design of data collection and compilation activities
- writers and media analysts with the skills to interpret and understand data and convey the information in various formats to different target audiences.

Individual capacities are important, but there can be risks in relying on a few individuals alone. A systems thinking approach acknowledges the negative unintended consequences of overreliance on powerful individuals by carefully mapping the roles of individuals across the whole network of institutions, people and programs that contribute to the HIS. Network analysis can resolve some of the interpersonal issues as well as help bridge the gaps between assessment and action plan by identifying the multiple little fixes and actions that can help build synergies across components and activities.

Alongside building individual skills, it is equally important to develop institutional capacities. Few national health information systems have the full range of skills and expertise required across the spectrum of data collection, compilation, analysis and dissemination. However, demographic, statistical, epidemiological and communication expertise can be harnessed externally, for example from country institutions such as academia and medical training bodies, public health institutes, research groups, non-government organisations, foundations, donors and development partners. Capacity building efforts should draw upon such institutional

expertise to bolster the skills mix within the national HIS on an as-needed basis.

Many well-intentioned efforts to improve the performance of HIS have concentrated on the provision of external technical assistance. However, this is an expensive and not necessarily high quality or optimal solution. It does not foster country ownership and cannot replace the need for sustained domestic capacity for data collection, analysis and quality assurance. On the other hand, many countries have relatively strong research and academic institutions or maintain one or more demographic surveillance sites where there is considerable epidemiological and statistical capacity. Such institutions are often staffed by people with the skills needed for data quality assessment and enhancement and could provide critical contributions to independent institutional mechanisms for data quality assurance.

Culture

A culture of information exists when a country regularly uses data to describe problems and their solutions, seeks understanding of problems through the collection of data and information, establishes continuous quality learning processes, and empowers people through imparting information and knowledge. Creating a culture of information use starts at the basic level of data collection; for example, when health care providers use the data they collect to improve patient care, or when health facility data are aggregated and presented to identify data gaps, display trends and make comparisons across facilities or districts (Chee et al. 2013). A particularly powerful stimulus to a culture of information occurs when senior decision-makers demand the outputs of the HIS for use in policymaking and programming. For this to happen, it is not enough for data to be available and of good quality: they must be offered in a format that is intelligible, accessible and useful. If not, decision-makers will decline to use the information in their decisions, will not appreciate the utility of HIS and will be discouraged from investing in them in the future. Technical experts often have difficulties reaching senior decision-makers because they focus on prescriptive or normative approaches rather than taking a user perspective (Davies et al. 2011), identifying the information elements that are core and strategic for them (Whittaker & Buttsworth 2012).

Creating a culture of information use can be challenging in highly decentralised health systems where data collection functions and responsibilities are devolved to lower levels of government (provincial, regional or district). Where HIS components and subsystems are managed at the central level of government, it is relatively easy to ensure that uniform standards are applied throughout the system. However, some aspects of data collection and use will inevitably occur at the lowest levels of HIS where communities, individuals and health care workers interact.

Assessment versus performance

Much has been learnt in the past decade about the nature and functioning of health information systems. However, any effort to improve these complex systems has to grapple with the fact that the HIS is both the tool used for assessing health system performance and in this process is assessing its own performance. The data that indicate health system performance also indicate the level of HIS functioning; a functional HIS will generate the indicators required for monitoring health system performance. Countries want to know if they can rely on the indicators used to assess their health system

performance, so if the HIS produces accurate, complete and timely data on health system performance there is no need to assess the individual components of the HMN Framework.

This issue matters because the plethora of assessment tools available has led to a generalised assessment fatigue. Many countries are fully aware that their HIS are not able to produce high quality data on health system performance, but they do not want to spend inordinate amounts of time analysing all the details of their system. What they want is to focus on a limited set of indicators that are concise, align tightly with the HMN Framework, and are low-burden to collect. They have to find value in monitoring their HIS-strengthening processes in a development or sustainability framework and this has to be of clear value in addition to collecting the core health indicators themselves.

We will return to this issue in Part III of this document. Part II provides a review of experiences in assessing the performance of information and statistical systems developed in sectors other than health as well as in specific disease-focused aspects of the health system.

PART II: Experiences in assessing information system performance

Prior to reviewing the many tools and approaches for assessing health information systems, it is important to examine the standards and performance criteria and lessons learnt in assessing statistical systems in other economic and social sectors in addition to health.

Quality standards for statistical systems

The purpose of standards is to maximise the quality of the outputs of the information system. Standards for census and household survey data collection, management and analysis have been promulgated by the United Nations Statistics Division of the United Nations Department of Economic and Social Affairs (UNDESA). The principles, recommendations and manuals for population and housing censuses and household surveys are available from their website (UNDESA 2001, 2010).

For macroeconomic and financial statistics, considerable work has been done to define standards, guidelines and best practices for systems that generate data and information. While there are some differences in terminologies, overall there is a high degree of consistency in the various frameworks being used. One commonly used standards framework is provided by the UN *Fundamental Principles of Official Statistics* (UN 1994). Developed and endorsed by the United Nations Statistical Commission, this document describes the role of official statistics and lays out the criteria for a good system. It is often used as a general framework to assess the performance of national statistics offices (de Vries 1998).

Another widely used standards framework is the Data Quality Assurance Framework (DQAF) created by the International Monetary Fund (IMF) (IMF 2006). The DQAF is used for comprehensive assessments of countries' data quality and identifies quality-related features of governance of statistical systems, the institutional environment, statistical processes and products (IMF 2012). The framework comprises six quality dimensions:

1. prerequisites of quality: legal and institutional environment, relevance
2. assurances of integrity: professionalism, transparency, ethical standards
3. methodological soundness: use of internationally accepted standards, guidelines or good practices
4. accuracy and reliability: source data and statistical techniques are sound and statistical outputs sufficiently portray reality
5. serviceability: periodicity, timeliness, consistency; clear revision policy and practice
6. accessibility: data and metadata easily available.

The Organisation for Economic Cooperation and Development (OECD) has developed statistical standards, guidelines and best practices on development indicators (OECD 2003). Explanatory metadata are collected and published to accompany all data and thus enable users to evaluate data quality, that is, fitness for use. Based on these metadata, comparability across countries—an important aspect of data quality—can be assessed. The Food and Agriculture Organization (FAO) has developed a “Data Quality Stamp” that applies to statistical data that meet these quality criteria: “availability of appropriate metadata for all data series; use of international classifications; provision of update schedule to ensure timeliness; the data series provides global coverage information; the data series in the databases are integrated within a statistical framework; and the data series is up to date” (African Development Bank Group 2007 p. 33).

The IMF's General Data Dissemination Strategy (GDDS) is aligned with the DQAF but is more directed to quality ascertainment for the purposes of data dissemination. The GDDS provides a framework to evaluate needs for data improvement and priority setting. It also provides guidance in disseminating comprehensive, timely, accessible and reliable economic, financial and socio-demographic statistics to the public (EUROSTAT 2005).

Although there is wide agreement in the literature on what the components of data quality should be, there is no universal consensus on how to group them. Some authors have proposed headings covering accuracy, relevance, coherence and consistency, continuity, timeliness, accessibility and ability to be revised (Holt & Jones 1998). Others include coherence (especially comparability), availability and clarity (Elvers & Rosén 1997). A summary of commonly used data quality criteria is shown in Box 1. The extent to which statistics meet users' needs and expectations for statistical information is widely recognised to be of paramount importance. Producers of statistics provide neutral, descriptive information about all aspects of statistics to allow users to assess how well the statistics might meet their needs and expectations.

Quality standards for health information systems

In the area of health information, WHO and the US Centers for Disease Control and Prevention (CDC) have defined standards for disease surveillance (WHO n.d., WHO 1999; CDC n.d.). Standards for the statistical classification of causes of death have been defined by WHO (2010a). Disease-specific programs have also developed standards for program monitoring and evaluation, generally using multi-agency technical

reference groups to achieve consensus around indicators, measurement and analytical strategies (Roll Back Malaria n.d.). This has had the unintended and unfortunate effect of creating a series of vertical information systems and a cadre outside of the health management system to manage information systems. It has also caused a dichotomy between information system professionals (data people) and health systems managers (action people) who cannot understand each other's roles, responsibilities and the need to work together (Lind & Lind 2005).

By contrast, standards for HIS as a whole and criteria for assessing their performance were not defined until recently. Literature reviews have noted a serious scarcity of structured evaluations for best practices in health information systems (Mitchell & Sullivan 2001; Tomasi et al. 2004). There are very few papers in the international journals on information systems evaluation in developing countries. It has been suggested that lack of evaluation of district-level routine health information systems has been partly due to the lack of defined standards and criteria for evaluating information systems (Odhiambo-Otieno 2005a, 2005b). HMN was the first technical group to define the key components and standards of a country health information system in a comprehensive way (HMN 2008a).

Box 1 – Commonly used data-quality criteria

-
- **Relevance** – data meet the needs of users at different levels
 - **Accuracy** – data correctly estimate or describe the quantities or characteristics being measured; in other words, that the values obtained are close to the (unknown) true values
 - **Credibility** – users have confidence in the statistics and trust the objectivity of the data, which are perceived to be professionally produced in accordance with appropriate standards and transparent policies and practices
 - **Accessibility** – data can be readily located and accessed in multiple dissemination formats that incorporate information on the types of data and how they are collected
 - **Interpretability** – users can readily understand, use and analyse the data, assisted by clear definitions of concepts, target populations, variables and terminology, as well as by information describing the limitations of the data
 - **Coherence** – statistical definitions and methods are consistent, and any variations in methodology that might affect data values are made clear, for example, different household surveys using similar wording to generate data on the same indicators
 - **Timeliness** – delays between data collection and availability or publication are minimised, although not to the extent of compromising accuracy and reliability
 - **Periodicity** – vital statistics are shared regularly so that they serve the ongoing needs of policymakers for up-to-date information
 - **Representativeness** – data adequately represent the whole population and relevant sub-populations
 - **Disaggregation** – data can be stratified by sex, age and major geographical or administrative region
 - **Confidentiality** – data-management practices are aligned with established confidentiality standards for data storage, backup, transfer (especially over the internet) and retrieval.
-

In setting standards for health information systems it is important to recognise that compromises have to be struck: it is simply not possible to satisfy all standards and criteria all of the time. The goal of “perfect” data is unattainable; all datasets have weaknesses of one kind or another. In general, there is more scope for omissions and for transcription and computation errors in data generated at health facility level compared with data generated using standardised data collection methods, such as household surveys. During data aggregation to district and national levels, errors (over and under-reporting) may cancel each other out. However, incentives for data reporting may end up distorting the balance. In assessing HIS performance, it will be necessary to balance quality standards against the constraints of financial and human resources and consider opportunity costs and competing demands. There are inevitable trade-offs to be taken into account, for example, between accuracy and timeliness. In the final analysis, quality should reflect “fitness for use” of the data by the various users.

The key performance metrics for the HIS are the availability and quality of the data it generates. There are a number of dimensions to data quality, including timeliness, completeness and accuracy. The HIS should undertake regular assessments of each of these dimensions for core indicators. The aim is to make a judgement whether the level and trend for each indicator adequately reflects reality, or whether the level and trend is likely to be a data artefact and does not reflect reality due to poor data quality. In the latter case, adjustment of the data may be necessary to avoid misleading conclusions, or omission of that indicator may be required until the data quality is improved in future collection.

Completeness and timeliness of data require assessing the extent to which the universe of expected observations (for example, from all public and private facilities, or from all civil registration areas) is reporting regularly and for every reporting period; there are

no missing values; and data are available within a specified time frame. Assessing the accuracy of core indicators requires attention to both numerators and denominators. Accuracy in the numerator depends on complete reporting and absence of duplicates. Accuracy can be compromised by faulty aggregations of events up to the central level. Denominators used to calculate rates and ratios are usually derived from a different source than the numerator, for example, from the census or civil registration system. Denominators from the census are usually population projections based on estimates of natural growth and migration. The further in time after the date of the census, the more likely it is that the projection will not be accurate—especially in countries with high and undocumented levels of migration. Another potential issue with census data is whether the official estimates are for the *de jure* (where a person usually lives) or *de facto* (where the person was on census day) population, with the latter being more desirable. For small areas, the denominators may be very small, especially for sub-populations (e.g. infants, children, pregnant women), resulting in unstable indicator levels. “Catchment areas” may not be well defined or/and enumerated. Finally, for sub-national estimates there is almost always some degree of non-correspondence between the numerator and denominator; for example, when people in a given area access services (events) in a different area (denominators).

Accuracy of data from health facilities can also be assessed by internal comparisons across facilities or districts or by identifying outliers. Deviations from expected levels or trends should be identified and investigated. Multi-level record reviews, for example, of samples of reports, can be used to assess consistency and to verify aggregations. Accuracy can also be assessed through comparisons with external sources. Data collected routinely (from health facilities, financial tracking, vital registration data, commodity distributions, etc.) should be compared with data from other sources such as surveys, regional or global databases, special studies and modelled estimates. Discrepant comparisons should be flagged for further investigation. The plausibility of levels and trends should be assessed by making international comparisons, and also by examining sub-national estimates and equity of sub-groups. Again, implausible levels and trends should be flagged for investigation.

- For data generated through household surveys, the main quality issues relate to:
- the sample design, that is, to what extent and with what level of confidence can inferences be made to the population of interest
- the validity of the data, that is, to what extent does the questionnaire efficiently capture information to measure what it should be measuring
- the reliability of data, that is, to what extent were human errors in fieldwork and data management minimised so as to have reliable responses that were correctly recorded and captured electronically
- the treatment of missing values, that is, if and when to impute data, and how.

Apart from the standard quality criteria related to sound sampling and questionnaire design, it is important to harmonise sampling methods and questionnaire design across surveys, especially for ad hoc surveys, so that the resulting data are comparable across survey instruments and over time. Every country should develop a strategic plan that institutionalises periodic surveys (e.g. household, facility) using agreed standards and validated questions. Survey programs should also be designed to generate data needed to enhance or to help “validate” data from routinely reported sources. A review of these fundamental conditions, and others, should be made to determine to what extent they exist, and if they are adequate. Any shortcomings or barriers to obtaining these conditions—technical, political, financial or otherwise—need to be highlighted and addressed.

Data quality assurance approaches generally distinguish between assessment criteria for data outputs and assessment criteria that relate to the quality of institutional frameworks that are prerequisites for the generation of reliable data. Some of the quality frameworks are intended to be used to assess national level data, whereas others relate to the quality of data issued by international agencies such as the World Bank or the IMF. Indicators of country health information system performance can be grouped into two broad types, namely:

- indicators related to data generation using core sources and methods (health surveys, civil registration, census, facility reporting, health system resource tracking)
- indicators related to country capacities for synthesis, analysis and validation of data.

Indicators of data generation reflect country capacity to collect relevant data at appropriate intervals and using the most appropriate data sources. Benchmarks include periodicity, timeliness, contents of data collection efforts and availability of data on key indicators. Indicators of country capacity measure key dimensions of the institutional frameworks needed to ensure data quality, including independence, transparency and access. Benchmarks include the availability of independent coordination mechanisms and the availability of microdata and metadata (WHO & HMN in collaboration with Global Fund, GAVI & World Bank 2009).

Typology of assessment methodologies

In this section we examine previous efforts to assess country statistical health information systems, examining tools that have tackled HIS as a whole as well as those that have been confined to certain components such as RHIS or HMIS, or which address major disease-specific information systems. Three main approaches have been used for assessment:

- independent (often external) expert evaluation with priority given to objectively measurable indicators of performance, usually in terms of system outputs and products
- self-assessment through the application of a standardised tool by country stakeholders, with attention to system prerequisites and processes as well as system products
- a combination of external and self-assessment methods, combining objective measures of outputs and subjective assessments of processes.

Independent assessment is generally perceived to be more objective, with self-assessment obviously being more subjective in nature. The distinction, however, is not absolute. Self-assessment approaches can include objectively verifiable indicators, and independent

assessment tools may include subjective metrics. Each approach has strengths and limitations. In order to minimise the reporting burden on countries, independent assessment tends to be based on existing sources that can be readily accessed, including country health and statistical information websites and databases of international agencies. The disadvantage of having an external agency do the assessment is that countries may not agree with the findings and therefore not use the results to develop an improvement strategy. This risk is lessened when the external review is commissioned by the country authorities themselves, as opposed to a development partner or donor. Some national statistics offices have commissioned external “peer” reviews of performance to identify strengths and weaknesses and make recommendations for improvement. This approach has proved promising and has indeed been adopted by some developed country statistics offices (Fellegi & Ryten 2000).

The major advantage of self-assessment is the degree of country ownership generated, especially when multiple stakeholders are involved in completing the assessment. This consensus-based approach enables the assessment to serve as the basis for the development of a plan for improvement. However, self-assessment approaches are time consuming and complex to implement, require strong leadership and consensus-building skills, and are less likely to generate results that can be compared over time or between countries. Experience has shown a general tendency to positive bias, and there is no question that there is a conflict of interest in conducting self-evaluations of performance (HMN 2007). Self-assessment approaches are most useful in the initial phase of a project or program, primarily with a diagnostic objective of identifying weaknesses in the current system. They are less suitable for monitoring purposes that require comparability over time, across regions within a country and across countries. Table 1 offers a summary of the different assessment approaches.

Table 1 – Matrix of assessment tools and approaches

Area	Self-assessment	External assessment	Mixed methods
Statistical system assessment	General Data Dissemination Strategy (GDDS)	World Bank Statistical Capacity-Building Score	-
	PARIS21 Statistical Capacity Building Indicators (SCBI)	-	-
Comprehensive HIS assessment	HMN assessment tool	HIS performance index (HISPIX)	MEASURE Evaluation HIS Indicators
Assessments of HIS components	RHINO: PRISM tools	-	-
	HMN civil registration assessment tools (rapid and comprehensive)	-	-
	WHO HMIS data quality report card	-	-
Disease-specific information system assessment	Routine data quality assessment (RDQA)	GAVI Data Quality Audit (DQA)	Global Fund Routine Data Quality Audit (RDQA)
	Immunisation Data Quality Self-Assessment (DQS) tool	-	-

Source: adapted and updated from WHO 2007a.

Self-assessment approaches

The General Data Dissemination Strategy

The IMF/World Bank General Data Dissemination Strategy (GDDS) originated in the aftermath of the 1994–95 international financial crisis and was designed to bolster confidence in economic and financial data. The principal goal of the GDDS is to improve data quality, which relates both to the data and to the statistical system overall; in other words, it addresses both outputs and processes (IMF 2007). The approach consists of an

externally facilitated self-assessment of the products of a statistical system, covering mainly economic and financial data but also relevant to data generated through sectoral line ministries, including health. The GDDS is designed to help countries assess and document their statistical practices and procedures and compile metadata. It also supports countries in developing and implementing plans for improvement in different areas of statistics. The process engages both data producers and data users and seeks to bring about more effective communication among both national statistical agencies and the user community.

The GDDS addresses three key areas: the quality of data, development plans for statistical systems, and the dissemination of data. Together, these three priority areas constitute a solid base on which to formulate long-term policies for statistical development. The *GDDS Guide for Participants and Users* (IMF 2007) sets out objectives for data compilation and dissemination that relate to the following four properties (“dimensions”) of statistical systems.

The first dimension covers the economic, financial and socio-demographic *data* that the GDDS recommends be produced and disseminated by member countries. It is a basic tenet of the GDDS that dissemination of such data is essential to the formulation of macroeconomic policies and to the effectiveness and transparency of economic management.

Quality of the data constitutes the second dimension of the GDDS. This dimension covers information that is available to help users assess the quality of the data covered by the system. Specifically, the GDDS calls for (i) dissemination of documentation on methodology and data sources, and (ii) dissemination of component detail, reconciliations with related data, and statistical frameworks.

Since it is essential that the user community has confidence in the data produced by statistical systems, the third dimension covers the *integrity* of the data. The objectivity and professionalism of the agency producing the statistics, as manifested in the transparency of its practices and procedures, are key determinants of user confidence. Within this dimension, the system identifies four key elements: (i) dissemination of the terms and conditions under which official statistics are produced; (ii) identification of internal government access to data before their release; (iii) identification of ministerial commentary on the occasion of statistical releases; and (iv) provision of information about revisions and advance notice of major methodological changes.

The nature of official statistics as a public good presupposes their dissemination to users in an accessible and equitable manner, and for this reason the fourth dimension of the GDDS is *access* by the public. Two elements of access receive special attention in the GDDS: (i) dissemination of advance-release calendars; and (ii) simultaneous release to all interested parties.

The GDDS implementation strategy involves providing short-term technical assistance to countries to engage in a systematic review comparing existing statistics to international standards. Participation in the GDDS is voluntary, but interested countries are required to commit to using the GDDS as a framework to develop their systems for compiling and disseminating economic, financial and socio-demographic data. They are also required to designate a country coordinator to work with IMF staff and to prepare metadata on current statistical compilation and dissemination practices and plans. The GDDS does not issue country reports as such, but participation in the GDDS is publicly recognised by the IMF through the posting of the member country's metadata. Based on the result of the assessment, countries develop a comprehensive improvement plan for the statistical system. The GDDS has been used as the basis for the preparation of National Strategies for the Development of Statistics (PARIS21 Secretariat 2004).

World Bank/PARIS21 Statistical capacity building indicators

Noting that the absence of an overall framework to assess statistical capacity made it almost impossible at the international level to monitor progress over time and to identify and change priorities, in May 2001 the PARIS21 consortium set up a Task Team on Statistical Capacity Building Indicators (SCBI). The task team, led by the IMF, proposed 16 quantitative indicators and 18 qualitative indicators (Laliberté 2002). While generally applicable to countries in all stages of statistical development, the SCBI are targeted to “statistically challenged” countries. By providing a snapshot reading of these countries' statistical circumstances, the SCBI were intended to help them identify strengths and weaknesses, plan toward specific goals, and monitor the activities leading to these goals. The SCBI can also facilitate communication and coordination among the organisations involved in technical assistance. At the same time, they were intended to present a comparative view of statistical capacity building across countries and to enable tracking of statistical development over time, thus providing the donor community with an additional means to account for its technical assistance.

The SCBI are of two kinds: quantitative indicators that can be objectively measured and qualitative indicators that require more subjective assessment. The *quantitative* indicators cover resources (domestically and externally funded annual budget, staff and equipment), inputs (surveys and administrative sources) and statistical products. They are intended to enable assessment of the extent to which a statistical agency has delivered its products. The resource indicators show the extent of success in obtaining funding both from government and external donors, the strengths of data sources, and availability and capacities of human resources. These quantitative indicators provide a rough idea of the depth and breadth of statistical activities. However, the 10-year evaluation of PARIS21 noted that the usefulness of the quantitative indicators is limited because there are no benchmarks against which to evaluate their performance (PARIS21 Consortium 2009). Further, the output indicators do not measure effectiveness, since they do not show to what extent the statistics are effectively used. Nor do the resource indicators measure efficiency, because the amount of resources used cannot be readily related to all required characteristics of the statistical outputs. Thus, the quantitative indicators need to be viewed within the context of how the statistical activities are carried out, as measured by the qualitative indicators.

The *qualitative* indicators cover relevant aspects of the statistical environment (legal, institutional and organisational), of core statistical processes and of statistical products. They measure efficiency and effectiveness of statistical production. They are intended to measure the extent to which the legal and institutional environment facilitates the production of the statistics; the resources are sufficient; the statistical culture is amenable to quality work; integrity and professionalism are protected and transparency measures are in place; core statistical processes are performed according to methodological requirements, the source data are available and techniques used are adequate; measures are in place to maintain the relevance of the products; and the characteristics of the statistics produced fit users' needs. Each indicator is evaluated against a four-scale assessment level, to which are attached benchmark descriptions or vignettes.

The SCBI come in the form of a questionnaire to be completed by data producers. The questionnaire is made up of a table that contains the indicators, along with

the relevant instructions for providing the information. The table was designed to serve both as a collection and dissemination device, with minimal editing required between these two functions.

The SCBI were the first systematic approach at the international level to help shed light on the statistical circumstances of countries, provide a means to share results systematically, and present a comparative view of statistical capacity building across countries. In practice, however, the full set of indicators proved too burdensome to administer widely, both for countries and international agencies (HMN 2006). However, some of the measures and principles continue to be used in the DQAF and in monitoring projects supported by STATCAP loans from the World Bank. Furthermore, some of the concepts have been built into the World Bank's statistical capacity score indicator described later in this paper.

The HMN health information system assessment

The HMN Assessment tool brings together country users and producers of health data to conduct a self-assessment—usually, though not always, externally facilitated—of the strengths and weaknesses of the national HIS (HMN 2006). Like the GDDS and the SCBI, the assessment is intended to guide countries' efforts to strengthen their HIS through conducting a baseline analysis then identifying areas for improvement and donor support for such improvement.

The HMN Assessment tool uses a cascading structure that flows from five main dimensions of data quality: integrity, methodological soundness, accuracy and reliability, serviceability, and accessibility. For each of these interrelated dimensions, the framework identifies pointers, or observable features, that can be used to assess quality. In addition to these five dimensions of data quality, the tool describes prerequisites for assessing system functioning. The tool thus comprises 197 coded (closed) questions covering the six HIS categories: HIS resources, core indicators, data sources, data management, information products, and data dissemination and use. For each item, scenarios or vignettes are proposed and respondents select the scenario that most closely resembles their perceived situation. Each question can be rated by multiple respondents and the average scores are automatically calculated and converted into percentages. Depending on the responses, scores for each question can vary

between 0 and 3. The total scores for each component are grouped into categories: highly adequate (score $\geq 75\%$), adequate (score 50–74%), present but not adequate (score 25–49%), or not adequate ($<25\%$). By engaging all stakeholders, the tool fosters consensus around HIS strengths and limitations, leading to a shared vision of a more coherent, integrated, efficient and useful system.

In 2007 and again in 2012, HMN conducted a review of the lessons learnt from the assessments based on reports submitted by 61 countries (Figure 6) (Wyatt & Liu 2002; Bunge 2012). Overall, the self-assessment approach appears to have worked well in generating a broad understanding of the HMN concept of a health information system, cutting across both disease-based and source-based information silos. The tool resulted in enhanced collaboration among various stakeholders

assessments, donor agencies and development partners were only marginally involved in conducting the assessment despite their roles as funders or technical partners in monitoring and evaluation. In general, stakeholder involvement was found to be the most problematic part of the whole process, with particular difficulties in terms of ensuring the participation of high level policymakers.

Concerns have also been expressed in relation to the objectivity of the respondents and possible conflicts of interest that arise when subjects evaluate themselves. In several reports, the assessment generated high scores for information products even in countries with acknowledged deficiencies in the ability of the HIS to generate reliable data on indicators such as child and maternal mortality, raising issues of the objectivity and validity of the self-assessment.

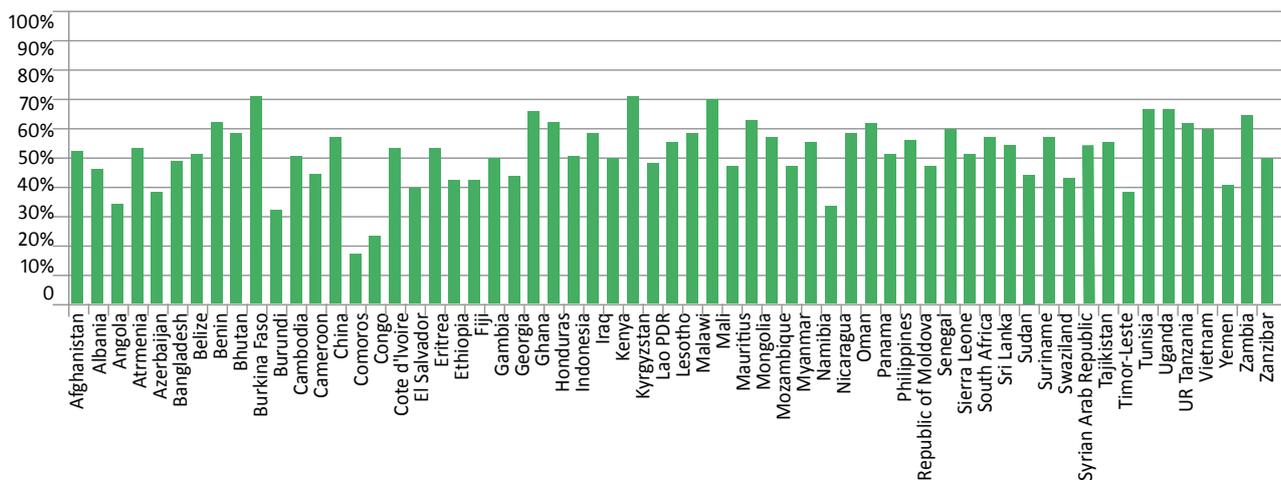


Figure 6 – Overall HIS assessment scores in 61 countries, 2005–2011

Source: Bunge 2012

in health information, particularly between health and statistical constituencies. However, the degree of stakeholder involvement necessitated a complex and time consuming process and was not always successful. Although representatives of ministries of health and national statistics offices were generally active in the assessment, this was not the case with other important stakeholders such as academia, research institutions, NGOs, and disease surveillance and categorical, issue-focused programs such as HIV/AIDS. In most

A general conclusion was that a self-assessment approach is not well suited to enabling comparisons between countries and over time because of the variability in completion methodologies used in different countries; variations in the number, levels and expertise of participants; and the high degree of subjectivity in the reporting. The assessment operates at a high level, generating a broadbrush picture of the health information system's overall functioning rather than a detailed assessment of specific components.

With hindsight, it seems clear that the assessment tool has taken a producer perspective on health information, with insufficient attention to user needs, that is, what policymakers and planners need in terms of health information and the capacity or otherwise of the health information system to respond.

Tools for assessment of civil registration and vital statistics systems

The tools developed for assessing the performance of civil registration and vital statistics (CRVS) systems by the University of Queensland HISHub in collaboration with WHO and HMN focus on births, deaths and causes of death but do not address other aspects of civil registration and vital statistics systems such as marriages and divorces. They were developed through close collaboration between country and technical partners, and are designed to be self-assessments completed by a suitably broad group of local stakeholders—with technical support if needed. The assessment tools come in two variants:

- a rapid assessment tool that generates a series of numerical scores reflecting the strengths and weaknesses of the current systems, and one overall score for classifying systems into one of four categories; this tool is primarily aimed at raising awareness and preparing the way for a more comprehensive review (WHO & HISHub 2010a)
- a comprehensive assessment tool that compares the current systems with the CRVS standards developed by the United Nations Statistics Division and WHO. This detailed assessment aims to produce the evidence needed to prioritise improvement activities and to develop an improvement plan (WHO & HISHub 2010b).

The rapid assessment tool consists of 25 questions on the functioning of CRVS systems grouped into the following 11 component areas:

- legal framework for CRVS
- registration infrastructure and resources
- organisation and functioning of the vital statistics system
- coverage of birth and death registration
- data storage and transmission
- ICD-compliant practices and certification within and outside hospitals
- practices affecting the quality of cause of death data
- ICD coding practices
- coder qualification and training, and quality of coding
- data quality and plausibility checks
- data access, dissemination and use.

The assessment should be conducted by a group of knowledgeable individuals with responsibilities for various aspects of CRVS systems. Question responses should be agreed upon and selected following thorough group discussion. For each of the 25 questions, respondents select from one of four possible scenarios, choosing the one they consider most closely reflects the country situation. A numerical value (0–3) is assigned to each scenario to indicate how well this aspect of the system functions. Adding together the numerical scores for each of the 25 questions reveals the total score. The rapid assessment can be completed by the major stakeholders in less than a day. By 2012 it had been conducted in more than 30 countries, mainly in the Asia-Pacific region. Based on the results, a typology has been developed that classifies country CRVS systems into four groups: dysfunctional, weak, functional but inadequate, and satisfactory. An example of the output of the rapid assessment across the 11 component areas is shown in Figure 7.

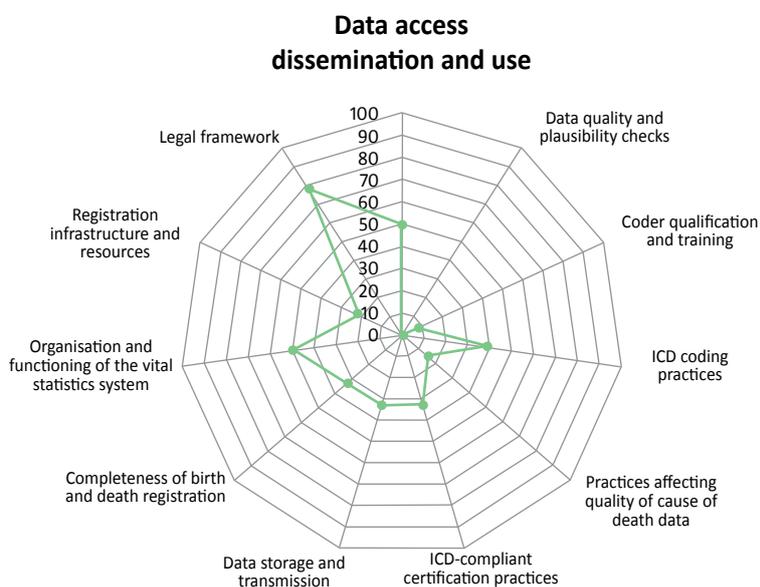


Figure 7 – Typical summary output chart of the CRVS rapid assessment

The comprehensive assessment requires more time and involves more participants, but yields a much more detailed diagnosis of the problems and provides clearer guidance on the priority actions required. The comprehensive assessment tool is structured around the inputs, processes and outputs of CRVS systems and consists of five key components:

- **INPUTS**
 - Legislative and regulatory frameworks supporting the existence and operation of CRVS and financial, human and technological resources required for proper functioning of CRVS
- **PROCESSES**
 - Processes required for obtaining and compiling information such as birth and death registration and cause of death certification practices
 - Forms, classifications and coding practices used in gathering and compiling information on births, deaths and causes of death
 - Procedures for the management, storage, compilation and transmission of data
- **OUTPUTS**
 - Type and quality of statistics produced, and methods for disseminating, accessing and using the resulting vital statistics.

Each component consists of several elements and may include up to 100 detailed questions on different aspects of how the system functions. The comprehensive assessment has been conducted in several countries and has led directly to the development of national improvement plans for CRVS.

The Performance of Routine Information System Management (PRISM)

The PRISM framework was developed through the USAID-supported MEASURE Evaluation RHINO initiative. The PRISM framework assumes that RHIS performance is affected by RHIS processes, which in turn are affected by technical, behavioural and organisational determinants; it outlines the direct and indirect impacts of these determinants on RHIS processes and performance. For example, the complexity of data collection forms (technical) could affect performance by lowering motivation. The PRISM framework also measures the relative importance of the determinants on RHIS performance and opens opportunities for assessing the relationships among RHIS performance, health system performance and health status. Through broader analysis of organisational information needs, it also overcomes silo problems in the existing RHIS and promotes a more integrated approach to information system development.

Implementation of the PRISM framework is through the application of four standardised tools:

- The RHIS performance diagnostic tool determines the overall level of RHIS performance, looking separately at quality of data and use of information. Specifically, the tool measures RHIS performance, status of RHIS processes, the promotion of a culture of information, supervision quality, and technical determinants. The tool collects data based on records observation.
- The RHIS overview provides information on existing routine information systems, their interaction and overlaps. It identifies redundancies, workload, fragmentation and level of integration, which create demand for integrated information systems development. The review also provides information on the complexity and user friendliness of the registers and forms. An information flow chart provides information about horizontal and vertical transmission and decision-making nodal points.
- The RHIS management assessment tool is designed to rapidly take stock of RHIS management practices with regard to functions such as governance, planning, training, supervision, use of performance improvement tools, and finances. The tool collects data based on records observations. Besides providing information on the level of RHIS management functions, it indirectly shows senior management's commitment to an efficient and effective RHIS.
- The RHIS organisational and behavioural assessment tool (OBAT) identifies organisational and behavioural factors that affect RHIS performance. It measures the level and role of behavioural factors such as motivation, confidence levels, demand for data, task competence and problem-solving skills, while organisational variables include promotion of a culture of information and rewards. The tool is self-administered and uses a paper and pencil test. OBAT compares RHIS knowledge, skills and motivation with actual performance, and identifies the strengths and weaknesses of these behavioural factors. Similarly, it is possible to determine to what extent organisational factors influence performance directly or indirectly through behavioural factors.

Information obtained through the PRISM tools provides a comprehensive picture of the given RHIS, creating opportunities for intervention. However, successful application of the tool requires an attitude of sharing

responsibility for RHIS weaknesses as opposed to blame avoidance, a shift that is not always easy to manage in health systems that are strongly hierarchical. The PRISM framework application requires considerable skills in performance improvement tools, communication and advocacy, and its comprehensive and time-consuming nature means it is not something to be undertaken lightly or frequently.

WHO HMIS Data Quality Report Card

A recent approach developed by WHO and partners aims to take the self-assessment process to a new level by introducing more objective methods and verifiable indicators into assessment of health facility data quality (WHO 2010b).

The impetus to improve the quality of health facility data comes from the annual, or more frequent, demand for health data. Population surveys are conducted only at occasional intervals (between three and five years), whereas health facility data are collected and aggregated continually and thus can present a timely picture of population health. In practice, HMIS data have a number of limitations and quality problems, such as missing values, bias and computation errors. Furthermore, when HMIS data are used to estimate population coverage rates, assumptions have to be made about the relevant denominators or target populations. These assumptions are often prone to errors. A strategy for assessment and adjustment would enable health facility data to meet the demand for annual reporting on key indicators.

The Data Quality Report Card approach starts from the premise that almost no health data can be considered perfect. Data quality assessment is therefore needed to understand how much confidence can be put in the health facility data, and to understand where problems lie. The notion of adjusting raw data is widely accepted in relation to censuses and population-based surveys, where standard methods are used to assess and adjust data, with documentation of changes made and rigorous quality control mechanisms. In contrast, data quality assessment and adjustment methods for health facility data are still in development stages and have not previously been documented in standard guidelines.

Health facility data are defined as health information collected when a patient comes for a consultation at health service points (both public and private), such as health posts, health facilities, clinics and hospitals.

These data are processed at the health facility and then sent to the appropriate administrative authority. Data from all reporting health facilities and administrative authorities are compiled and summarised.

The assessment of HMIS data quality focuses on three dimensions: completeness, accuracy and consistency, and validation against independent external sources of data. Within each dimension, several indicators are used to track progress, as shown in Table 2 (WHO 2011a).

Table 2 HMIS data quality criteria

Indicator		Definition
COMPLETENESS		
1	Completeness of district reporting	% of expected monthly district reports received
2	Completeness of facility reporting	% of expected monthly facility reports received
3	Comprehensiveness of district reporting (zero/missing values)	% of monthly district reports that are not zero/missing values (average for 4 indicators: first antenatal care visit [ANC1], diphtheria, tetanus and pertussis immunisation [DTP3], deliveries)
ACCURACY and CONSISTENCY		
4	Accuracy of event reporting: outliers in the current year	% of district values that are moderate/extreme outliers (2 SD / 3 SD or more from mean) (average for 4 indicators)
5	Accuracy of event reporting: monthly and annual differences	% difference between monthly reports and end-of-year report (average for 4 indicators)
6	Verification of consistency	% of agreement between data in sampled facility records and national records for the same facilities for 3 core indicators
7	Consistency over time	% deviation from the average of previous 3 years (average for 4 indicators)
8	Internal consistency between indicators	DTP 1(3) coverage based on facility reports divided by ANC1 coverage based on facility reports
9	Consistency of population projection (UN)	National statistics office projected number of live births divided by UN projected number of live births
EXTERNAL COMPARISON		
10	External comparison: of ANC1	ANC1 coverage based on facility reports divided by survey coverage rate
11	External comparison: DTP3	Coverage from facility reports divided by survey for the most recent comparable year
12	External comparison: institutional deliveries	Coverage from facility reports divided by survey for the most recent comparable year

The GAVI Data Quality Self-assessment (DQS)

The GAVI data quality self-assessment (DQS) tool is designed to complement the external Data Quality Audit (DQA) described below. The DQS consists of a flexible toolbox, designed for staff at the national, provincial or district levels to evaluate different aspects of the immunisation monitoring system at district and health unit level to determine the *accuracy* of reported numbers of immunisations and the *quality* of the immunisation monitoring system (WHO 2005). The DQS aims to diagnose problems and provide orientation to improve district monitoring and use of data for action. Two Excel workbooks are available for different components of the toolbox.

The assessment includes a review of data accuracy at different levels and a self-designed questionnaire reviewing monitoring quality issues (e.g. availability of vaccination cards, use of tally sheets, directly observed recording and reporting practices). These are then analysed, strengths and weaknesses identified, conclusions reached and practical recommendations made. These recommendations aim to improve the use of *accurate, timely and complete* data for action at all levels.

Implementation is usually through a national participatory workshop involving key people from the national and district levels. This workshop is immediately followed by an assessment in a number of districts and health units that provides a self-diagnosis of the monitoring system in the country.

Independent assessment approaches

The World Bank Statistical Capacity Indicator

As noted earlier, initial attempts to develop indicators for assessing the performance of statistical systems ran into the challenge of balancing objective and subjective measures of performance. Since 2004, the World Bank has been compiling an annual composite statistical capacity indicator that brings together a manageable set of objectively verifiable indicators. The “statistical capacity score” is intended to provide an overview of the statistical capacity of each developing country, while also enabling comparisons to be drawn across countries and over time. The score is made up of three aspects:

Statistical methodology measures the capacity to meet internationally recommended standards, methods and data reporting practices in economic and social statistics. Benchmarks include the use of a recent base year for estimating a national accounts base year, the use of the latest Balance of Payments manual issued by the IMF, recent reporting of external debt data, subscription to IMF’s Special Data Dissemination Standard, and recent reporting of school enrolment data reporting to UNESCO.

Source data assesses the ability to collect relevant data at recommended intervals, such as the periodicity of censuses and surveys. The benchmarks used are the periodicity of population and agricultural censuses, the periodicity of poverty and health related surveys, and the completeness of vital registration system coverage.

Periodicity and timeliness reviews the capacity for making data available and accessible to users. The periodicity of key socioeconomic indicators is assessed by examining the contents of international databases. Indicators used include income, poverty, child and maternal health, HIV/AIDS, primary completion, gender equality, access to water and GDP growth.

The scores are put together from publicly available information for most countries and calculated through a desk review by external technical experts. A score for each aspect is derived, and an overall score is calculated by combining the scores for the three aspects, giving equal weight to each. The score is scaled to provide a value between 0 and 100; a score of 100 indicates that the country meets all the benchmarks in all three aspects of statistical capacity. The World Bank uses the score to analyse differences and changes in statistical capacity resulting from its STATCAP lending program to support more efficient and effective statistical systems in developing countries.

Table 3 shows the aggregate scores of the Statistical Capacity Indicator for 111 middle and low-income International Bank for Reconstruction and Development / International Development Association (IDA) countries with a population of a million or more. The table also presents a breakdown of the indicator for IDA (mostly low income) countries in Sub-Saharan Africa and other regions. On average, the scores increased for all the aspects over this period, which demonstrates that countries generally made progress in the way statistics are collected, compiled, disseminated and reported to international agencies. For instance, significantly more

countries now use an updated base year for national accounts and report enrolment data to UNESCO than in 1999. Health survey periodicity has also improved considerably, with almost double the number of countries conducting a health-related survey at least

Analysis of the individual country scores indicates that 31 out of the 111 countries assessed achieved substantial increases in their scores (by 20% or more) between 1999 and 2009 (Detmer 2003). Of these 31 countries, about a third are from Europe and Central Asia, with

Table 3 – World Bank Statistical Capacity Indicator (scale 0–100)

	All countries		<i>of which:</i> IDA Sub-Saharan Africa		<i>of which:</i> IDA Non-Sub-Saharan Africa	
	1999	2009	1999	2009	1999	2009
Overall	52	65	47	53	48	68
Methodology	45	56	35	37	40	58
Source Data	53	63	46	47	50	67
Periodicity	59	77	61	76	54	78

Source: World Bank n.d.

every three years (or three or more surveys in a 10-year period). Indeed, data periodicity is the area in which country scores increased most over the last 10 years.

It should be noted that many international agencies estimate data that are missing from countries, so the use of these data for assessing periodicity imposes limitations on the analysis. The World Bank justifies this decision on the grounds that the alternative—assessing data availability at national level—would be time consuming and costly; however, this does introduce a significant positive bias into the overall score, especially for sub-Saharan Africa. For example, between 1999 and 2009, the overall score for countries in Sub-Saharan Africa improved by almost 13%. However, the improvement in “methodology” was only 6% and in “source data” 2% compared with 25% in “periodicity and timeliness”. While the latter may well reflect increasing availability of national datasets, it also includes the estimates generated by international agencies using statistical models to fill gaps in countries with no information. The situation appears to be better balanced in other countries where the improvements over the period are much more significant across all three aspects (between 35% and 45%).

eight countries from the region being among the top 10 countries with the highest score increases. There are 19 countries whose scores declined compared with 10 years ago, of which 13 are from Sub-Saharan Africa. Most of these declines are minor, but for three countries they exceed 10%.

The statistical capacity indicator is useful for providing snapshot pictures of country statistical capacity. Because it uses available metadata, it is consistent over time and across countries, and there is no data-reporting burden on countries. However, it is important to understand that this limits the choice of components of the indicator, and that there can be occasional large year-to-year fluctuations in measured statistical capacity, for example, when specific surveys are conducted.

To address some of the limitations, the World Bank is working to improve its database of information relating to measuring and monitoring country statistical capacity. The improved system, called the “Bulletin Board on Statistical Capacity”, includes options for countries to provide regular updates to the data, either through correspondence or directly online (World Bank n.d.).

It is anticipated that regular input from countries will improve the collection and dissemination of key information about statistical capacity that is currently missing from the database, such as financial, human and material resources. It may also help to align the information with other data quality and statistical capacity frameworks, such as the IMF DQAF, the PARIS21 SCBI, and the African Statistical Development Index of the African Centre for Statistics.

The WHO country health information systems report

The WHO report on the state of country health information systems offers an overview of the health information situation for low and lower-middle-income countries as a group (WHO 2011b). The report is loosely based on the HMN Framework and examines the prerequisites, processes and products of the HIS, including the policies, indicators, data sources, financial and human resources, health system functioning, disease-specific information practices, and products of the HIS. WHO use of this tool has been limited to a global perspective; although it is feasible, no attempt has been made to systematically assess each component on a country-by-country basis. Countries query if the purpose of assessing the HIS is to supply information for a global report or to establish country needs for data to inform health performance and planning reviews. An additional weakness is that the report does not systematically define measurable indicators for each component, instead using a more descriptive approach. Only for the component of data sources has an attempt been made to define standardised indicators; the report focuses on eight indicators, each of which can be monitored by reference to published materials or country HIS and statistical web pages. However, the indicators refer mainly to data availability and timeliness, with only two indicators addressing completeness. The indicators cover:

- availability of a 2009 health statistics report on the web
- availability of an annual health statistics report between 2006 and 2009 on the web
- completeness (coverage) of death registration in the civil registration system
- completeness (coverage) of birth registration in the civil registration system

- availability of national and sub-national population projections on the web
- availability of at least one national health account between 2006 and 2010
- availability of population household surveys between 2006 and 2010 (minimum one, or more than one)
- availability of a national census during the 2010 census round.

Figure 8 shows the results of the 2011 country health information systems report in relation to data sources in 40 low income countries. In principle, these indicators could be reported individually for each country, but the information has not been made public by the WHO.

The WHO report offers a valuable overview of the state of HIS in developing countries, but its usefulness as a monitoring tool is limited due to the absence of individual country scores and the restricted number and scope of objectively verifiable indicators covering HIS performance across multiple dimensions. There are also some weaknesses in the definitions of the indicators, which in many cases are insufficiently precise for monitoring purposes.

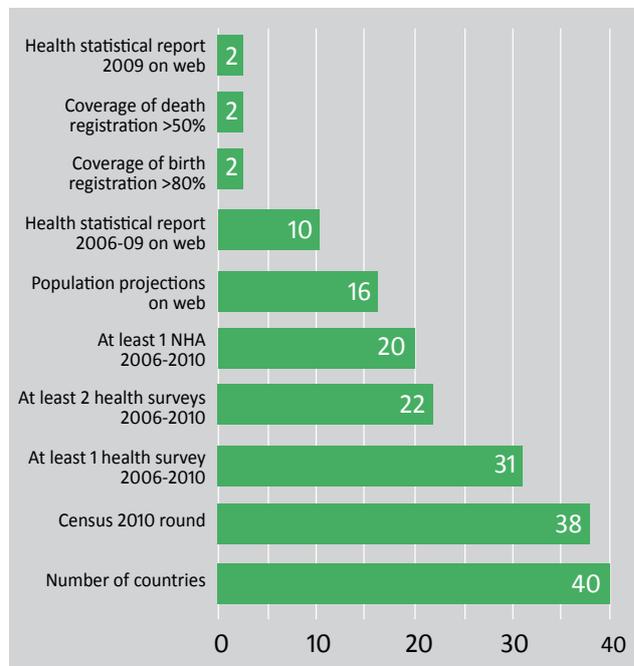


Figure 8 – State of country health information systems in 40 low income countries, selected indicators, 2010

Source: WHO 2011b, p. x

HIS performance index

The WHO has outlined a HIS performance index (HISPIX), a summary measure based on standardised indicators for assessing data quality and the overall performance of the HIS. The score is calculated from public domain information using standard indicators to enhance objectivity and comparability over time and across countries. For the majority of the indicators, a simple binary scoring system (yes/no) is used without weighting. For the few indicators that are measured in terms of percentages, the score is calculated as described in Table 4. The advantage of this approach is that it permits countries and development partners to identify key areas for improvement as part of a HIS-strengthening plan. However, several of the indicators are imprecisely defined, and for others the benchmarks are set quite low so that a country could appear to score relatively well despite having a basically weak HIS. The approach focuses on data availability and timeliness rather than on other aspects of quality, such as completeness or accuracy. For example, indicators refer to the availability of data on child and maternal mortality but say nothing about the quality of those data or the use of appropriate data sources and data collection methods.

The crucial difference between the HISPIX approach and the HMN self-assessment is that the former can be generated on the basis of information largely available in the public domain. Information on data sources and data availability can be compiled from WHO databases and those of other international agencies. Information on inputs and resources is available from country health statistics reports and from the self-assessments conducted through HMN. For countries that have not conducted such assessments, it may be necessary to gather the information working through WHO and other agency country offices and through direct contacts with country health information units and statistics offices. The relative ease of data collection implies that the HISPIX could be applied at intervals in order to gauge HIS performance trends over time. However, the HISPIX has too many indicators for regular application. The complete list has never been applied in countries and remains a theoretical construct only, but a number of the indicators are included in the country HIS report (see previous section).

Table 4 WHO HIS performance index: summary of core indicators and data collection methods

	Indicator	Definition	Data collection method
1	Country has a 10-year costed survey plan that covers all priority health topics and takes into account other relevant data sources	Survey plan comprises modular contents with periodicity for specific indicators calibrated to achieve maximum sensitivity and efficiency. It includes data collection about health-related behaviours and bioclinical measurements.	Country reports
2	Two or more data points available for child mortality in the past 5 years*		Country reports, DHS, MICS
3	Two or more population-based data points for maternal mortality in the last 10 years*		Country reports, DHS, MICS
4	Two or more data points for coverage of key health interventions in the last 5 years	Comprising coverage of key maternal and child health care interventions, risk behaviours, care seeking	Country reports, DHS, MICS
5	One or more data points on smoking and adult nutritional status in the last 5 years	Nutritional status clinically measured	Country reports, DHS, MICS
6	Percentage of births registered	<i>Numerator:</i> Number of births registered, as reported by civil or sample registration systems, hospitals and community-based reporting systems <i>Denominator:</i> Total births for the same time period and geographic region. Where information on total births is not available because of incomplete civil registration, total births can be estimated by extrapolating from the census or on the basis of information about natality rates derived from population surveys.	Civil registration or sample registration systems <50% score 0 50–89% score 1 ≥90% score 2
7	Percentage of deaths registered	<i>Numerator:</i> Number of deaths registered as reported by civil or sample registration systems, hospitals and community-based reporting systems <i>Denominator:</i> Total deaths for the same time period and region. Where information on total deaths is not available because of incomplete civil registration, total deaths can be estimated by extrapolating from the census or on the basis of information about mortality rates derived from population surveys.	Civil registration or sample registration systems <50% score 0 50–89% score 1 ≥90% score 2
8	ICD-10 used in district hospitals and causes of death reported to national level	<i>Numerator:</i> Number of district hospitals using ICD-10 to certify cause of death <i>Denominator:</i> Total district hospitals	Routine HMIS reports <50% score 0 50–89% score 1 ≥90% score 2

9	Census completed within past 10 years		Bureau of the census, national statistics office and ministry of health
10	Population projections for districts and smaller administrative areas available in print and electronically, well documented		
11	Number of institutional deliveries available, by district, and published within 12 months of preceding year	Includes deliveries in public, private and NGO facilities	Country HMIS reports
12	HIV prevalence for relevant surveillance populations published within 12 months of preceding year		National AIDS Committee reports
13	Country website for health statistics with latest report and data available to the general public		Country HIS reports
14	Reporting of notifiable diseases makes use of modern communication technology, and reporting of statistics from district to national levels is web-based		Country HMIS reports
15	Percentage of districts that submit timely, complete, accurate reports to national level	<i>Numerator:</i> Number of health districts with timely and complete reporting of key data series <i>Denominator:</i> Total districts Countries should define core data series that should be reported by all facilities and reported to districts and compare reports against this list.	An accurate listing of public and private service delivery points should be available in all countries. (see #19)
16	Data quality assessments carried out and published within last 3 years	Assessment should cover all routine administrative data sources (e.g. civil registration, facility reports)	Country HMIS reports
17	International Health Regulations (IHR) implemented according to international standards	Compliant with IHR monitoring and evaluation framework	Country health sector reports
18	At least one national health account completed in last 5 years		NHA report
19	National database with public and private sector health facilities, and geocoding, available and updated within last 3 years	Database should separately distinguish public, private and non-profit facilities; should also include key infrastructure, human resources, medicines, equipment and supplies, and service availability	Health facility assessments (see also #21)
20	National database with health workers by district and main cadres updated within last 2 years	Database comprises data from multiple sources, including census, labour force surveys, professional registers, training institutions, facility assessments	National health sector review

21	Annual data on availability of tracer medicines and commodities in public and private health facilities	Aligned to national essential medicines list	Essential medicines reviews; health facility assessments
22	There is a designated and functioning institutional mechanism charged with analysis of health statistics, synthesis of data from different sources and validation of data from population and facility sources	Ideally, the body should be quasi-autonomous or independent and should adhere to the Fundamental Principles of Official Statistics	National health sector reports
23	There is a national set of indicators with targets and annual reporting to inform annual health sector reviews and other planning cycles	Indicators cover key issues, including health determinants, health system inputs, processes and outputs, use of health care services, mortality, morbidity, health system responsiveness, etc.	National health sector reports
24	There is a national microdata archive for health surveys and censuses that is operational		
25	Survey data are used to assess and adjust routine reports from health facilities on vaccinations with the results published within 12 months of the preceding year	Validation by an independent reviewer would be needed to ascertain the extent of analysis and validation	Information available from health statistics reports
26	A burden of disease study has been conducted within the last 5 years by national stakeholders		
27	A study of health systems performance has been carried out within the last 5 years by national stakeholders		
28	There is national commitment to transparency in data dissemination and acknowledgement of uncertainty	Published health data include metadata descriptors, margins of uncertainty, methodologies	Review of annual health statistics report
29	The official annual health statistics report has been published within 12 months of the preceding (calendar or fiscal) year		Review of annual health statistics report

* Indicators 2 and 3 only relevant to countries with incomplete civil registration systems (<90% coverage of births and deaths)

The GAVI Alliance Data Quality Audit

The GAVI Alliance has developed a Data Quality Audit tool designed to be implemented at random by external consultants who independently verify the levels of basic immunisation coverage achieved in countries receiving GAVI funds (GAVI Alliance n.d.). The DQA reviews both the number of children reported to have received a DTP3 injection and the accuracy of a country's reporting methods. The audits are intended to ensure that GAVI's future performance-based funding is correctly calculated, while also guarding against corruption. Moreover, the DQA encourages countries to focus on their monitoring and reporting systems (WHO 2003).

The goal of the DQA is to make sure that management of immunisation services and the allocation of GAVI funding for immunisation services are based on sound and accurate data. The specific objectives of the DQA are to:

- assess the quality, accuracy, timeliness and completeness of administrative immunisation reporting systems
- audit the reported DTP3 vaccinations given to children under one year of age (DTP3<1) in a specific calendar year and then estimate the national verification factor (VF, recounted/reported vaccinations) for use in the allocation of Vaccine Fund shares.

These objectives are achieved by examining data and the information system in operation at all administrative levels, from collection of data at the point of vaccination to the periodic compilation of data at national level, and by providing practical feedback to managers on how to improve the quality of their administrative immunisation reporting system. Not all data can be checked during the DQA, and therefore samples of the health infrastructure will be chosen for audit and review. The quantitative results of the DQA are presented in tables and charts using an Excel workbook. For each of the three administration levels (national, district and health unit), there are four sections in the summary page that can easily be printed:

- *Performance indicators:* Performance indicators include the DTP drop-out rate (i.e. difference between DTP1 and DTP3 immunisations), DTP vaccine wastage, and the DTP3<1 coverage rate
- *Report availability:* Presents the proportion of reports that can be retrieved (availability is an indication of reporting completeness) at national and district level

- *Quality of the system index (QI):* The quality of the system index is based on a series of questions regarding the practices of recording, reporting and storing the data; monitoring and evaluation; denominator issues; and system design. The QI is presented in a "radar graph" based on average values of each component by normalising the values of each index to a scale from 0 to 5.
- *Accuracy estimate of the DTP3<1 data:* The accuracy chart compares the reported DTP3<1 values (and recounted values at the health unit level) with the source of the data. The DQA *verification factor* for DTP3<1 is a statistical estimate provided with a confidence interval. The factor is the ratio of recounted DTP3<1/reported DTP3<1. As an audit tool, the DQA is not meant to provide a statistically valid estimate of the total number of DTP3<1 doses given in a country (coverage). This is because there is no attempt to improve completeness by estimating the doses not reported. At the same time, reported doses that cannot be verified are treated as not given.

In addition to these indicators, auditors check and discuss a number of additional indicators referred to as the *core indicator set*. The auditors keep a logbook containing all the descriptive information obtained during the DQA, for example, the dates of interviews, people interviewed, and answers to the series of questions for the QI along with relevant explanations. The logbook also contains documentation of all data collected and the information source of all data used for the audit. It is anticipated that during the DQA, both the health workers and the auditors will discover issues and problems, which are then discussed to identify solutions and provide immediate practical feedback.

Mixed objective and subjective assessment methods

The HMN Progress Tracking Tool

The HMN Progress Tracking Tool (PTT) was developed in light of perceived limitations of the original HMN Assessment tool in terms of complexity, objectivity, comparability over time and across countries, and suitability for monitoring progress. Development partners and donors were asking for a simple tracking tool, based on a few tracer indicators, to allow for cross-country

comparability and to solicit continuing donor funding. This would enable countries to define baselines and targets for a few HIS indicators, such as coverage of existing data systems, and to assess and monitor HIS status and progress when implementing HIS development plans. An important attribute of a new tool, from the perspective of donors especially, was that it should enable an objective assessment and provide HIS performance metrics that are comparable over time and between countries. Satisfying these demands presents some challenges. Of the six HMN framework components of health information systems, two lend themselves more readily to objective measurement than the others, namely *data sources* and *information products*. However, measurement of these components alone will not generate diagnostic information on the process weaknesses in the HIS.

In the process of development, the PTT evolved into two separate but linked instruments: a Global Tracking Tool (GTT), to satisfy global tracking needs and fill the current gaps in the information area; and a country support methodology (CSM), to help countries address HIS issues. The GTT consists of 22 tracer indicators spread across the six HIS components of the HMN Framework. The tool is available in an Excel file that has summary information and raw data for each of the 22 indicators: metadata, baseline and, where possible, data from subsequent years. It also includes graphics that update automatically. The baseline element draws largely on the completed HMN self-assessment tools but also on other organisations' publicly available tools and adds element for tracking performance over time, shown for each indicator. The CSM is intended to help countries define indicators to measure and track progress in strengthening country HIS. It builds on the HMN Assessment tool by creating a baseline upon which countries can establish targets, measure gaps, design interventions and evaluate progress against the targets.

In practice, neither the GTT nor the CSM have been rigorously applied or evaluated using country data. Despite the aim of generating objective and comparable data on HIS performance, the GTT relies on the results of the HMN self-assessments for all but four of its 22 indicators. Given that no countries have undertaken two separate HMN assessments, monitoring progress on the remaining 18 indicators relies on "country validation" and "Delphi" techniques, which are not standardised and therefore subject to the same criticisms as the original HMN Assessment tool.

The Pacific HIS assessment tool

The demise of HMN has not totally halted the search for better methods of assessing country HIS. In the Pacific, WHO Western Pacific Region, in collaboration with the Pacific Health Information Network (PHIN), have put into practice some of the approaches for monitoring HIS performance initially pioneered by HMN and WHO. The indicators have been distilled down to 15 to keep the burden of data collection low (Table 5). The emphasis is on measuring to monitor progress, not to manage the HIS, which is driven by the priorities around availability and use of reliable health information for evidence-based decision-making. The PHIN, a Pacific network of country health information system experts, has acted as an informal peer-review group as well as being a good vehicle for capturing inputs from time to time to inform national HIS status and functionality improvements. Although this is essentially a self-assessment approach, the use of objectively verifiable indicators and the informal peer-review mechanisms provided by the PHIN distinguish this approach from the HMN self-assessment tool.

Table 5 – The Pacific health information system assessment indicators

1	Governance	There is a representative, multi-sectoral and functioning national committee in charge of HIS coordination
2	Policy	The country has up-to-date legislation and policy frameworks for health information
3	Planning	HIS assessment is complete and a costed HIS strategic plan is complete, used and integrated with health sector strategies/plans
4	Financial resources	At least one National Health Accounts completed in last 5 years
5	Human resources	National database with health workers by district and main cadres updated within last 2 years
6	HIS workforce	HIS workforce job descriptions and training plan exist and staff have individual professional development plans and receive training
7	Indicators	There is a clear and explicit official strategy for measuring each of the health-related MDG indicators relevant to the country
8	Births/Deaths	Percentage of births and deaths registered in the civil registration system
9	Cause of death	ICD-10 used in district and central hospitals and causes of death reported to national level
10	Health surveys	A health survey has been conducted in the past 5 years
11	Health facility reporting	Percentage of health facilities submitting weekly or monthly surveillance reports on time to the district level
12	Integration	The HIS unit at national level is running an integrated “data warehouse” containing data from all data sources.
13	Completeness and quality	A mechanism is in place to verify completeness and consistency of data from district to national-level facilities
14	Dissemination	Year last annual summary of health service statistics was published with statistics disaggregated by major administrative region
15	Use	Senior managers and policymakers demand complete, timely, accurate, relevant and validated HIS information

USAID Health Information System Indicators

USAID has developed a “how to” manual on the assessment of health systems to help guide policymakers and program planners in strengthening health systems to address key disease priorities, including HIV/AIDS (INDEPTH 2002). The Health Systems Assessment Approach (HSAA) has been used in 25 countries across Asia, Africa, Latin America and the Caribbean (USAID 2012).

The tool consists of assessment modules on each of the health system’s building blocks, including the HIS. Each technical chapter is divided into topical areas,

topical area, along with suggestions of data sources and stakeholders to interview. Indicator tables are organised by topical area and include detailed description of each indicator, as well as key issues and questions related to that indicator.

A particular strength of the HSAA is that it consists of assessment tools for each of the health system’s building blocks and shows how the information block draws from and supports each of the other building blocks (Figure 9).

The objective of the HIS assessment is to provide a better understanding of a country’s capacity to “integrate data collection, processing, reporting, and use of the

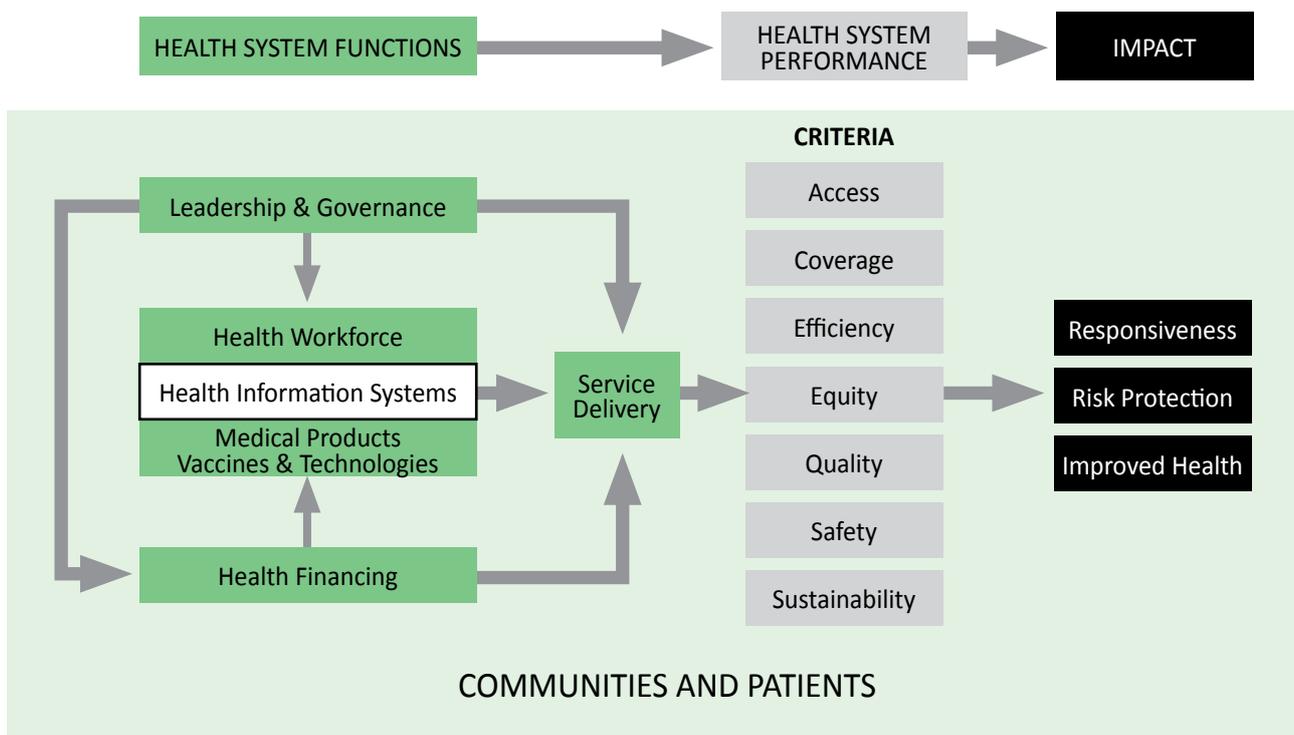


Figure 9 – Impact of building block interactions

and indicators are defined based on readily available, internationally comparable data. This provides quick background information for the chapter. In addition to the set of indicators provided, quantitative and qualitative indicators are suggested within each topical area. This information is collected through country-level document review and stakeholder interviews. Subsections within each chapter provide an overview by

information necessary for improving health service effectiveness and efficiency through better management at all levels of health services” (Lippeveld et al. 2000). This definition should be broadly interpreted to include the government-supported public health system as well as data from the country’s private and not-for-profit health care providers. HIS performance should be measured by the quality and comprehensiveness (e.g. all

actors delivering health services and products) of data produced and by evidence that all health system stakeholders regularly use the data to improve the performance of the entire health system—public and private alike.

The HIS section of the manual is subdivided into five topical areas:

- definition of the HIS and its key components; this section draws to a great extent on the HMN Framework
- guidelines on preparing the HIS profile of a country
- topical areas that the HIS assessment should be structured around and detailed descriptions of the indicators to assess the performance of the HIS
- suggestions on how the assessment results can be developed into possible solutions to address HIS-related issues
- a checklist of topics that the team leader or other writers can use to make sure they have included all recommended content in the chapter.

The key topical areas around which the HIS assessment is structured are:

- HIS inputs: more particularly, the human, financial and technical resources available
- HIS processes: how indicators are selected, what the data sources are for those indicators, and how the data are managed and analysed
- HIS outputs: including the quality of the information products, and the dissemination and use of information.

Some of the indicators proposed for assessing HIS performance are similar to those in the HMN Assessment tool, but in general the HSAA indicators are more clearly defined and there are fewer of them, which is an important advantage. The methodology is designed to be applied by USAID staff but includes strong stakeholder involvement from health information staff in countries. Special efforts are made to integrate inputs from private health care systems. The methodology for the assessment combines a desk-based review of documents with stakeholder interviews to identify strengths and weaknesses in the technical area and relate them to health system performance. The stakeholder interviews complement the desk-based assessment, provide information on the health system performance indicators that cannot be obtained from document review, and explore possible recommendations.

The output of this assessment should be:

- an assessment report summarising key findings for each health system function, highlighting important strengths, critical cross-cutting health system weaknesses that limit performance, and recommendations for priority health systems strengthening interventions
- a stakeholder workshop for validating findings, identifying priorities and formulating recommendations.

The manual stresses the importance of involving a wide range of health system stakeholders—government, non-government and civil society groups, research and academia, and the private sector—throughout all phases of the HSA. The results should form the basis for a work plan for health systems strengthening.

The Global Fund/MEASURE Evaluation Data Quality Assessment tools

The Global Fund, MEASURE Evaluation and other partners have developed a data quality assessment approach that builds on the external audit approach developed for the GAVI Alliance but also incorporates a self-assessment component. Two versions of the DQA Tool have been developed:

- The Data Quality Audit (DQA) Tool provides guidelines to be used by an external audit team to assess a program or project's ability to report quality data
- The Routine Data Quality Assessment (RDQA) Tool is a simplified version of the DQA for auditing, and allows programs and projects themselves to assess the quality of their data and strengthen their data management and reporting systems (GFATM, Office of the Global AIDS Coordinator, PEPFAR, USAID, WHO, UNAIDS & MEASURE Evaluation 2008).

The purpose of the DQA is to evaluate data quality for performance-based funding. It consists of an external assessment using the GAVI DQA methodology for evaluating the accuracy of coverage data and the accuracy of national-level reporting. It has two components: one assessing reporting systems and the other verifying data through facility visits (facilities selected through randomised cluster sampling).

The DQA focuses on data quality at facility level because of the heavy dependence on these data for monitoring interventions to address HIV, tuberculosis and malaria.

The RDQA is designed for self-assessment by programs and to provide the foundations for programming development and/or adjustments. It also helps programs and projects prepare for an external audit using the DQA tool. The distinctions between the two tools are shown in Box 2 below.

The two tools share a similar conceptual framework, illustrated in Figure 10. The underlying hypothesis is that the quality of reported data is dependent on the

underlying data management and reporting systems; stronger systems should produce better quality data. In other words, for good quality data to be produced by and flow through a data management system, key functional components need to be in place at all levels of the system: the points of service delivery, the intermediate level(s) where the data are aggregated (e.g. districts, regions) and the monitoring and evaluation unit at the highest level to which data are reported. The DQA and RDQA tools are therefore designed to (1) verify the quality of the data; (2) assess the system that produces that data; and (3) develop action plans to improve both.

Box 2 Distinctions between DQA and RDQA tools

Distinctions between DQA and RDQA	
DQA	RDQA
Assessment by funding agency	Self-assessment by programs
Standard approach to implementation	Flexible use by programs for monitoring and supervision or to prepare for an external audit
Conducted by external audit team	Programs make and implement own action plans
Limited input into recommendations by programs	

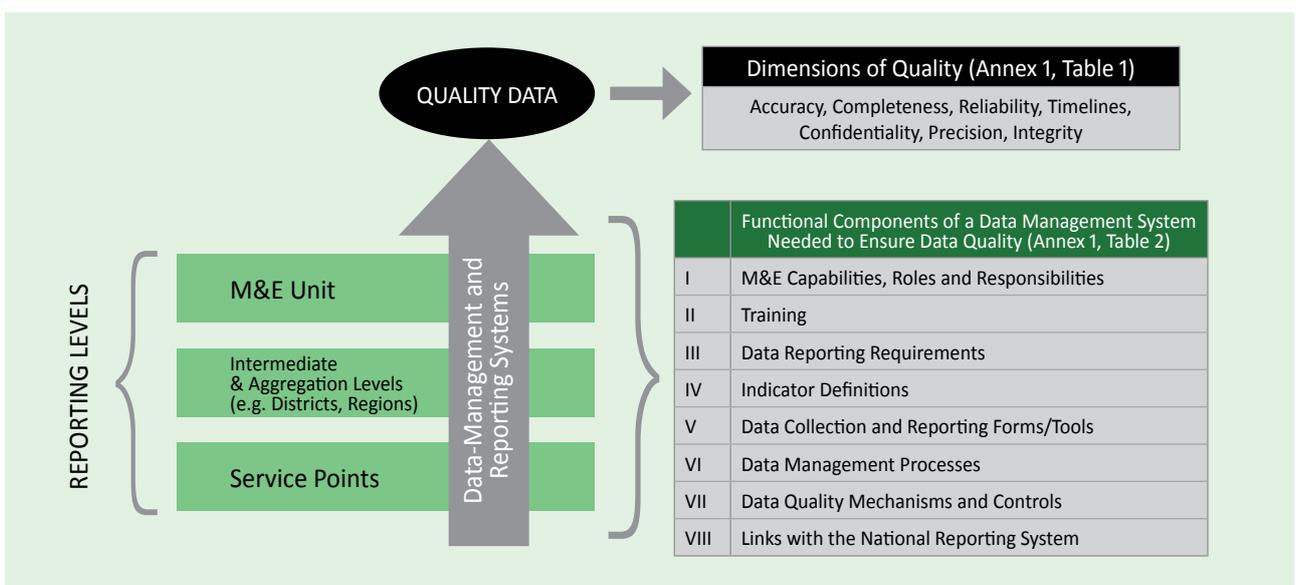


Figure 10 – Conceptual framework for the RDQA: data management and reporting systems, functional areas and data quality

Source: GFATM, Office of the Global AIDS Coordinator, PEPFAR, USAID, WHO, UNAIDS & MEASURE Evaluation 2008, p. 2

The objectives of the DQA/RDQA tools are to:

- *verify* the quality of reported data for key indicators at selected sites and the ability of data management systems to collect, manage and report quality data
- *implement* corrective measures with action plans for strengthening the data management and reporting system and improving data quality
- *monitor* capacity improvements and performance of the data management and reporting system to produce quality data.

The RDQA has been designed to be flexible and easy to use by programs and projects themselves. It comes in a Microsoft Excel spreadsheet that includes 10 sub-components, or sheets. The tool can serve multiple purposes:

- routine data quality checks as part of ongoing supervision
- initial and follow-up assessments of data management and reporting systems, to measure performance improvement over time
- strengthening staff capacity in data management and reporting
- preparation for a formal data quality audit
- external assessment by partners and other stakeholders.

Typically, the implementation of the RDQA can be conducted in six steps:

- determine purpose of the RDQA
- select levels and sites to be included
- identify indicators, data sources and reporting period
- conduct site visits
- review outputs and findings.

The RDQA methodology is in two parts: data verification and systems assessment. The data verification component enables a quantitative comparison of recounted to reported data and a review of the timeliness, completeness and availability of reports. The purpose of this component is to assess the extent to which service delivery and intermediate aggregation sites are collecting and reporting data accurately, completely and on time, and whether the data agree with reported results from other data sources. The methods used include documentation review at service delivery level, recounting reported results and cross-checking of reported results against other sources of comparable data.

The systems assessment component of the RDQA Tool is designed to elicit qualitative assessments of the relative strengths and weaknesses of functional areas of a data management and reporting system. The purpose of assessing the system is to identify potential threats to data quality posed by the design and implementation of the system. The seven functional areas are:

- monitoring and evaluation capabilities, roles and responsibilities
- training
- indicator definitions
- data reporting requirements
- data collection and reporting forms and tools
- data management processes and data quality controls
- links with national reporting systems.

The RDQA generates three major outputs. The first is a series of dashboards that are directly generated from the Excel spreadsheets. They present graphics of summary statistics for each site or level of the reporting system and a “global” dashboard that aggregates the results from all levels and sites included in the assessment (Figure 11).

Global Dashboard

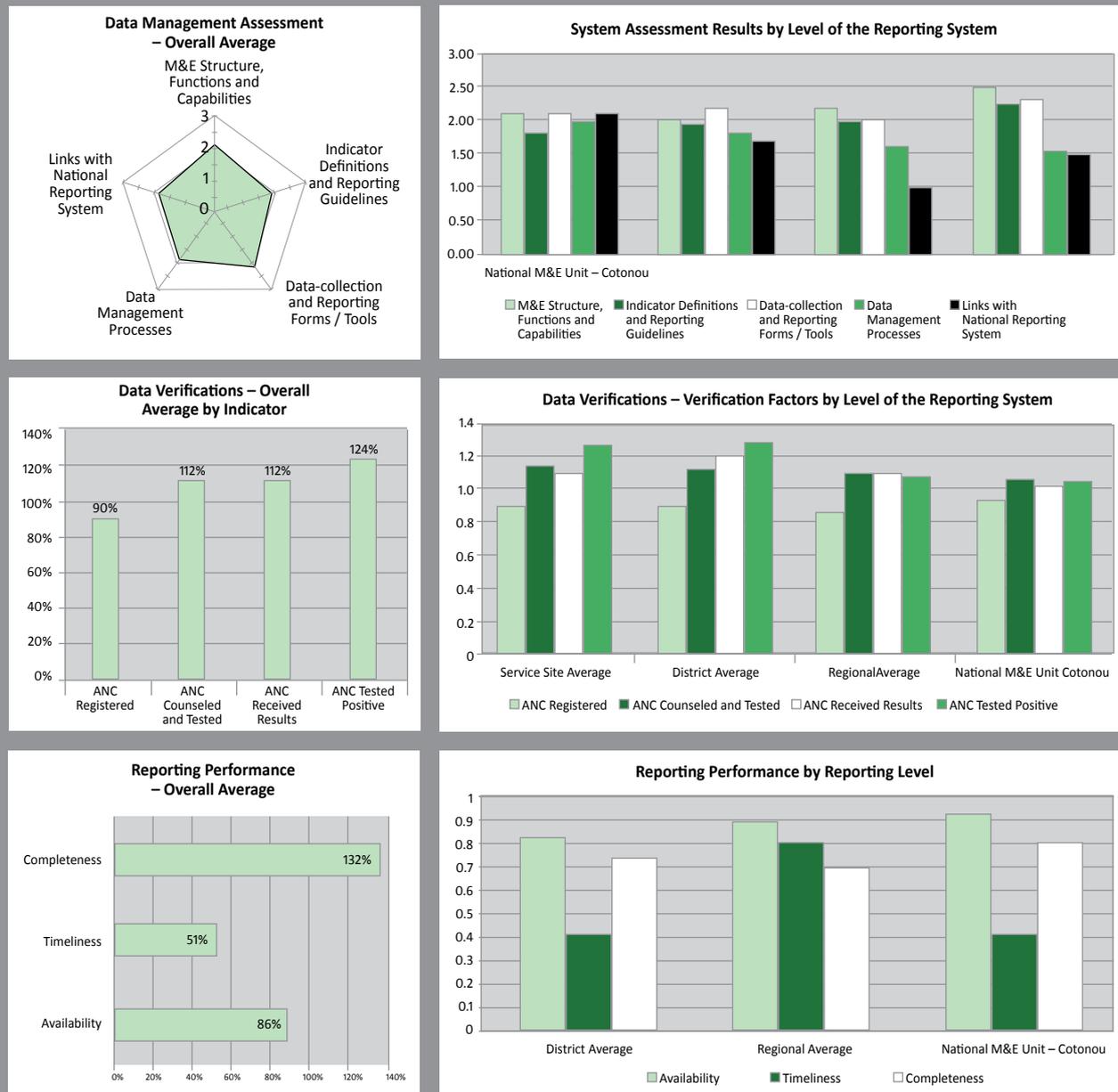


Figure 11 – Global dashboard of RDQA outputs

Secondly, the RDQA Tool makes recommendations to service delivery sites and intermediate aggregation level sites included in the assessment, organised according to a standard template. The third output is an action plan for improving data quality, which describes the identified strengthening measures, the staff responsible, the timeline for completion, resources required and follow-up.

What can we conclude from this review?

This review has demonstrated the wide variety of tools that are available to assess the functioning of statistical and/or health information systems. Although no formal comparative evaluation has ever been conducted, some conclusions emerge that will inform Part III of this working paper.

Most assessment tools are too long and complex to permit their regular use in countries. As a general rule, the shorter and simpler the tool, the more likely it is to be used continually by countries themselves as opposed to by external partners.

Keeping a tool to a manageable size generally implies focusing on only some aspects of the HIS. In health, this tends to imply a focus on disease-specific assessment of the HIS, but there is some evidence that broader approaches can also be kept within manageable proportions.

Assessment approaches performed as desk reviews by external partners may gain objectivity at the expense of country ownership and buy-in.

Tools that require multi-sectoral stakeholder involvement for their application are generally more suited to developing a sound understanding of the way the HIS works and fostering relationships across programs and departments than at objectively evaluating the outputs of the HIS.

Tools that combine a degree of stakeholder involvement with some objectively verifiable indicators appear to offer the best compromise between ownership and independence of an assessment.

The most important aspect of the HIS that needs to be evaluated is its ability to generate the data needed to monitor health system performance and inform planning, in other words, the HIS products. It is this aspect that most concerns country decision-makers. However, there is a case to be made for assessing HIS input and processes, especially when the reasons for the poor performance of the HIS need to be elucidated.

Finally, very little effort has been directed to building the institutional and individual capacities in countries that would enable them to conduct reliable assessment of their HIS (and by extension of their health system performance) that are trusted and accepted by external partners.

We take up these points in Part III of this working paper.

PART III: Criteria, metrics and methods for assessing information system performance

In Part I of this paper, we examined the systemic aspects of a health information system—the institutional context, capacities and culture—that need to be in place alongside the technical components. In Part II, we looked at experiences in assessing HIS performance, which showed its complexity and the need to work across disease entities and sectors using multiple and diverse information sources. The challenge now is to distil this knowledge into intelligible and meaningful indicators that enable monitoring of HIS performance. At the outset, we described the goal of the HIS in terms of its ability to generate high quality data and in terms of the extent to which these data are used for decision-making. These two key elements—data quality and data use—are the most important indicators of the extent to which the HIS is delivering on its core performance objectives. In addition, process indicators on the inputs and outputs of the HIS are needed for diagnosing where weaknesses lie and for monitoring activities and efficiency.

Lessons learnt from different assessment approaches

Assessment tools vary in scope and methods. Some relate to the statistical or health information system as a whole; others are confined to specific diseases such as HIV/AIDS. Some are intended to be conducted through a self-assessment by multiple stakeholders, while others are undertaken by independent, external agents. Several of the disease-specific assessment tools are driven by the need for monitoring and evaluation and results-based financing. Some confine themselves to assessing outputs, that is, the quality of statistics in terms of accuracy and reliability. Others pay greater attention to the underlying prerequisites and processes of a statistical system as well as its outputs.

This review shows that while the various approaches are important tools in the data quality assessment toolbox, they have some limitations. In practice, they may not improve the quality of data, especially in the short term, for a number of reasons:

- They require additional data collection, which requires planning, labour and resources and is likely to affect the timely collection and processing of information that measure the quality of data. This is despite the requirement that all health personnel—from the lowest level of health service provider to

bureaucrats in the national health ministry—ensure that quality data are produced.

- Once information on the quality of data, the reporting systems and the organisational determinants has been ascertained, systemic problems need to be corrected. Some problems are easily rectified, but correction of other problems requires a lot of time and attention.
- Because the information from the different assessments is often sample-based—particularly when assessing facility data—the size and representativeness of the sample will dictate the level to which inferences can be made about data quality. If the sample is inadequate, inferences about data quality can only be made with respect to the facilities in the sample.
- Some of these assessments focus on only one disease-specific program, even though the challenges are usually cross-cutting and systemic.
- There are trade-offs between self-assessment approaches, which generate widespread consensus and buy-in, and independent, external assessments, which are generally more objective but may lack country ownership.

A new approach for assessing health information system performance

Guiding principles

To address these limitations, we have formulated some guiding principles for assessing health information system performance. These include the need for tools and methods that:

- are country-focused and supportive of country needs for evidence-based and reliable information system planning
- take a systems-building approach that fosters capacity development, both institutional and individual
- provide a unifying framework for the multiple disease-specific monitoring and evaluation strategies
- are simple to administer and can be used for both baseline assessment and for subsequent monitoring
- generate results that are objectively verifiable
- offer the basis for both country and global monitoring of HIS and health system performance.

Methodological approach

One of the major lessons learnt from the HMN Assessment tool is the importance of clearly defining the assessment questions, the rationale for asking them, and who will act on the responses. This is particularly important when it comes to assessing the quality of the HIS products because of the risks of conflict of interest when programs are responsible for assessing the quality of their own data.

In this regard, it can be helpful to draw a distinction between evaluative information and diagnostic information. Evaluative information seeks an answer to the question, “Is the HIS delivering the information required of it?” Diagnostic information is designed to answer the question, “What are the reasons for the (inadequate) performance of HIS?” The former has to focus on the products of the HIS, namely, the availability and quality of key information items and their use for health-related decision-making. The latter should delve into the structure, organisation, processes and resources (human, infrastructural and financial) of the HIS to identify the areas that need strengthening to improve HIS performance.

While these aspects are clearly related, it is important to distinguish between them because assessing them will require different approaches. One of the problems with the HMN Assessment tool was that it tried to address both components using the same tool and methodological approach. This resulted in an instrument that worked quite well for bringing stakeholders together but did not generate objectively verifiable data on HIS performance and trends over time and was too cumbersome to be used as a monitoring device. To avoid repeating this error, we clearly differentiate these two aspects of an assessment strategy and propose that indicators of HIS performance be separated into the following two groups:

7. *Indicators of HIS products and impact*, comprising the availability and quality of statistical outputs and the dissemination and use of information. The focus is on the degree to which the HIS is meeting its goal of generating reliable and high quality data that are used for decision-making. These indicators should be objectively verifiable and assessed by independent experts using standard criteria so that progress can be monitored over time.
8. *Indicators of HIS inputs and processes*, comprising the resources available to the HIS; the processes of selecting indicators; and methods for data collection, compilation, management and analysis. The approach for locating and diagnosing weaknesses in the HIS system will be context-specific and influenced by stakeholder perceptions and circumstances. The main purpose is to generate information needed to develop improvement strategies, so this assessment should be conducted by the people most intimately involved in generating this information and using it for program delivery.

When used in a systematic way, these complementary assessment instruments will help build confidence in the quality of available health information to inform health decision-making, identify critical data weaknesses that need to be addressed, provide guidance on HIS planning and resource mobilisation, and enable evaluation of the results of HIS investments.

Review of health information system products and impact

Indicators of data availability and quality

Indicators of data availability and quality should cover the core national dataset comprising both indicators of health status and coverage of health care. Note that predicted data values, developed using statistical modelling methods (as is often done for health status indicators in low income countries), should not be considered in the quality review, which is focused on empirical data generated from country sources such as administrative systems, health facility reports, household surveys or the census. Similarly, while using statistical methods to impute values for data gaps can be justified by the need to produce an estimated value for advocacy purposes, this can introduce serious bias that an imputation strategy cannot correct. Because imputation fills gaps in data completeness, timeliness, and periodicity, using such values to assess data quality would defeat the purpose. Evaluation of data quality should, therefore, focus only on empirically measured country data.

A limited set of indicators should be identified for the evaluation, covering all domains, including determinants and risk factors such as socio-economic factors and individual behaviours, inputs such as human resources, outputs such as service availability, outcomes such as coverage of care, and impact such as health status. In many countries, the national minimum dataset would be the logical starting point to identify the indicators to be evaluated. Typical indicators could cover water and sanitation, tobacco use, obesity prevalence, diabetes prevalence, coverage of measles immunisation, percentage of births in health care facilities, contraceptive prevalence, HIV prevalence in pregnant women, stunting in children under five years old, mortality in children under five, maternal mortality ratios, and mortality due to non-communicable diseases and injuries. A more detailed list of potential indicators is provided in Figure 12. Note that this list does not include indicators on the determinants of health.

It is not feasible to conduct a detailed evaluation of data quality across all these indicators simultaneously and regularly. Instead, the assessment should focus on key indicators selected for their importance to country planning and programming. Indicators may be chosen to reflect diseases and conditions that contribute significantly to the burden of disease and high priority disease-focused and system-wide interventions such as effective coverage or Universal Health Coverage (UHC). To avoid overburdening the assessment process, the number of indicators may be limited in a given assessment period, depending on the country epidemiological situation and intervention priorities. Quality assessment of other indicators can be conducted on a rolling basis so that all important indicators are assessed over a period of time.

Objectively verifiable criteria for determining the quality of the selected indicators should include, as a minimum, the following:

- completeness of the indicator in relation to the population of interest
- representativeness of the indicator in relation to the whole population and relevant sub-populations
- accuracy of the indicator in terms of indicator values being close to the (unknown) true values, as expressed by confidence intervals or other measures of uncertainty
- coherence of the indicator in terms of use of standard statistical definitions and methods with any variations in methodology made clear
- timeliness of the indicator with minimum delays between data collection and dissemination
- optimal periodicity of the indicator for monitoring purposes and to meet policymakers' needs for up-to-date information
- disaggregation of the indicator possible by sex, age, socio-economic status and major geographical or administrative region
- accessibility of the indicator in terms of ability to locate and access data and metadata in multiple dissemination formats.

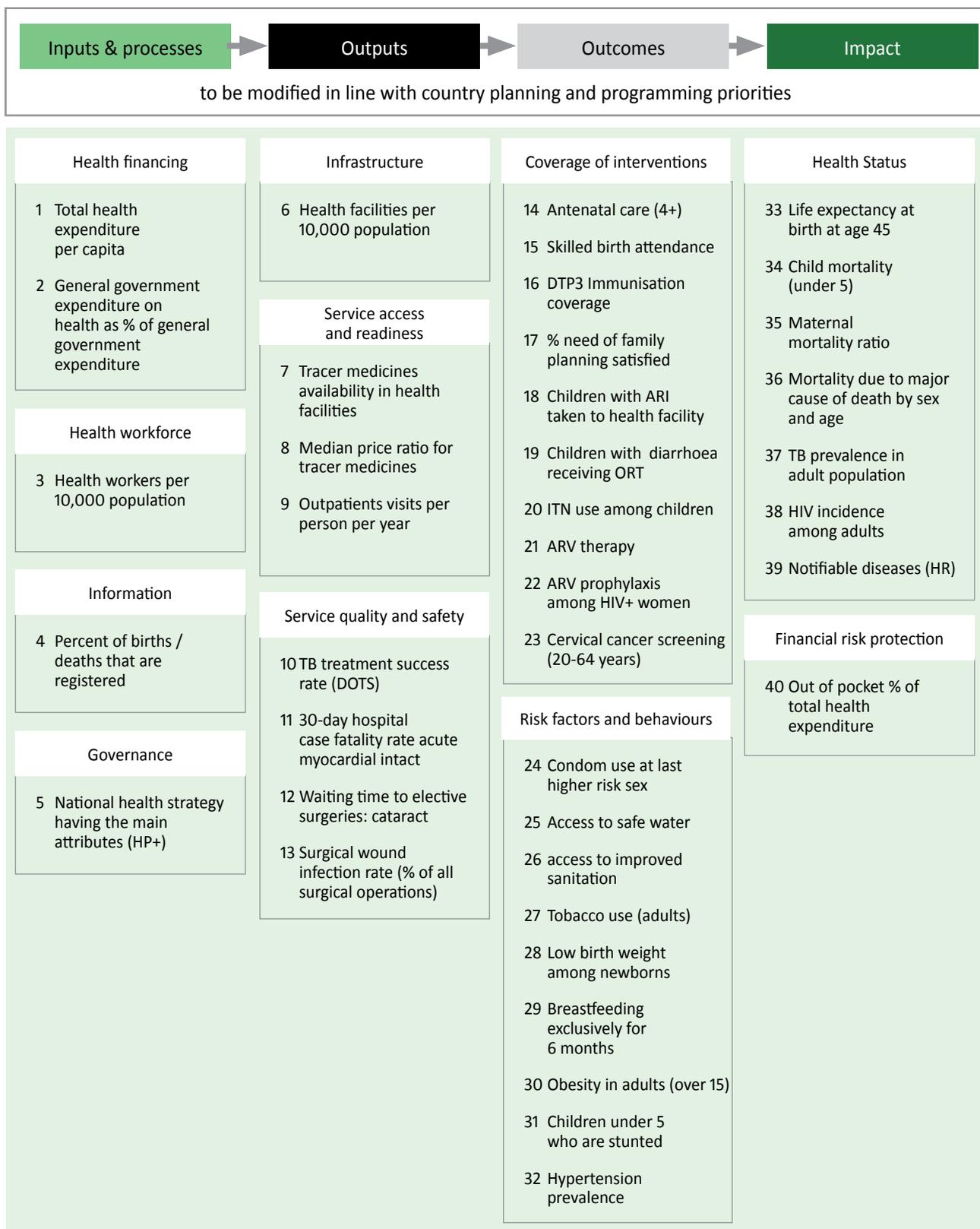


Figure 12 – Potential tracer indicators for assessing health information systems

Source: adapted from WHO & IHP 2011b

Depending on the indicator selected, the evaluation criteria may need to be modified. For example, periodicity requirements will be higher for indicators that can change rapidly from one year to the next, such as use of health care services, but may be less stringent for slow-to-change indicators such as cause-specific adult mortality. On the other hand, timeliness and accessibility requirements are similar across all indicators and should be considered as part of the quality framework.

Indicators of data use

Indicators may measure how HIS data are used, for example, to guide changes in budget levels or funding allocation. These indicators also measure the extent of feedback from data users to data producers. In principle, HIS data should be used to inform decision-making in areas such as human and financial resource allocation, disease alert and response, health promotion, disease prevention and management, and the issuing of health insurance cards.

Criteria for assessing the use of data include the following (USAID 2012):

- Planning is indicator-driven, for short-term (one year) and medium-term (three to five years) planning.
- Organisational routines hold health planners and managers accountable for performance through the use of results-based indicators at all levels of the health system.
- Behavioural constraints to data use are addressed through incentives such as rewards for most complete and timely data reporting by facilities and health districts.
- There is a supportive organisational environment for packaging and communicating information products to target key audiences and data users in a variety of formats.

The evaluation criteria and summary indicator definitions for data availability, quality and use are shown in Table 6. The precise wording of the evaluation criteria would have to be modified for different indicators. For example, quality assessment of indicators of health care utilisation would not include items 2 and 3.

Table 6 Criteria and indicators for assessing the outputs of the health information system

Quality criteria		Definition	Unit
Completeness	1	Estimated completeness of statistics reported from public and private health care facilities (for each relevant indicator)	%
	2	Completeness of civil registration of births (for fertility indicators)	%
	3	Completeness of civil registration of deaths (for mortality indicators)	%
Representativeness	4	The indicator is based on a total count or on a representative sample of the population	Yes/no
Accuracy	5	Confidence intervals of indicator values derived from sample surveys (benchmark below +/- 10%)	%
	6	Proportion of medically certified causes of death assigned to ill-defined causes (for mortality indicators) (benchmark <5%)	%
Coherence	7	Data collection for the indicator is based on standard international definitions of numerator and denominator	Yes/no
Timeliness	8	Indicator is published within two years of data collection	Yes/no
Periodicity	9	Indicator is collected at appropriate intervals	Yes/no
Disaggregation	10	Indicator is disaggregated by:	
		Sex	Yes/no
		Age (neonatal, infant)	Yes/no
		Socio-economic status	Yes/no
		Province	Yes/no
		Lowest administrative level	Yes/no
Accessibility	11	Indicator values and metadata (including data source and data collection method) readily accessible in the public domain	Yes/no
Data use	12	Under-five mortality rates used in short- and medium-term health sector plans for both national and sub-national budgets and resource allocation	Yes/no
	13	At sub-national/district level, local managers use data on under-five mortality for local level planning and health system management	Yes/no
	14	Key indicators are made available to a variety of users in different formats	Yes/no
	15	Targets are monitored using empirically generated country data	

Review of HIS inputs and processes

Having conducted an assessment of HIS outputs and detected limitations in the availability, quality and use of HIS statistical outputs, it is important to undertake a more in-depth investigation of the underlying causes. In contrast with assessing statistical outputs and data use, assessing HIS inputs and processes should be carried out by teams representing all stakeholders involved in different aspects of data production and at all levels of the HIS.

Health information systems have developed over time within national health, statistical and administrative systems. They evolve in a non-linear way, in response to different pressures: administrative, economic, legal or donor. This can result in multiple, fragmented and overburdened HIS. Parallel sub-systems frequently arise from a lack of coordination among local stakeholders and donor-driven vertical systems. The inputs and processes of the HIS comprise the resources and activities needed for the HIS to overcome such problems and function effectively. These include:

- *Coordination and leadership:* Mechanisms are needed to effectively lead and coordinate the HIS and use the system's data. A HIS coordination committee should be responsible for developing a national HIS strategy that outlines goals for streamlining and improving existing reporting mechanisms, roles and responsibilities of all stakeholders (public and

private); funding for HIS-strengthening, including maintenance of the current HIS system; and improving integration of data at national and sub-national levels. Private sector stakeholders should be members of the coordination committee, actively involved in creating the national HIS strategy.

- *Information policies:* Legislative and regulatory frameworks should be in place covering public and private providers, use of standards, and guidelines for data collection, transmission, management and storage.
- *Financial resources:* Government investments in the production of health information—data collection, collation, analysis, dissemination and use—must be sufficient and sustained.
- *Human resources:* Adequately trained personnel with the skills and expertise to compile and analyse health-related information should be present at all levels of the national administration system.
- *HIS infrastructure:* There should be sufficient and adequately distributed infrastructure for HIS comprising both paper-based systems as well as information and communication technology (hardware and software) for electronic systems.

Proposed summary indicators of HIS inputs are described in Table 7 below.

Table 7 HIS input indicators and definitions

	Indicator	Definition and interpretation
1	Availability of financial and physical resources to support HIS	<p>This indicator is assessed by determining the extent of government funding for the key items listed below. The indicator should be assessed separately for the central and local levels.</p> <p>data processing and reporting equipment and software (e.g. computers, printers, telephones)</p> <p>meetings of interagency committees</p> <p>record books, forms, stationery, instruments for data collection, storage and reporting</p> <p>maintenance of a functioning communications infrastructure</p> <p>HIS-related training</p> <p>operational costs related to data collection/transmission (e.g. fuel, per diem, phone bills)</p> <p>population-based surveys (e.g. health surveys, census)</p> <p>facility-based records</p> <p>administrative records</p>
2	Evidence of ongoing training activities related to HIS data collection and analysis	<p>Training is essential to maintain analytical skills of personnel. This indicator covers the presence of training curricula, their content, frequency and duration and the extent to which private health care providers are trained in HIS data collection and analysis.</p>
3	The national HIS strategic plan is developed in broad consultation with key stakeholders, and widely accepted	<p>The national strategic plan provides direction and coherence to HIS-strengthening efforts. The HIS strategic plan should be developed in close collaboration with key stakeholders, including the national statistical system, and should comprise:</p> <p>overall HIS vision</p> <p>description of current and planned HIS-strengthening efforts</p> <p>HIS objectives and interventions</p> <p>timeframes for phasing in the interventions</p> <p>plans for activity implementation</p> <p>costing of the strategy</p> <p>a system/plan for monitoring and evaluation of the strategy and the overall performance of the HIS.</p>

4	<p>Presence of a functioning interagency body with the mandate and capacity to guide the implementation of the national HIS strategy</p>	<p>Because of the interagency nature of HIS, an interagency body should be formed to oversee the implementation of the national HIS strategy. This body should include representatives from the ministry of health, national statistics office, academia, telecommunications, local government and the private health care sector. The interagency committee should have the official mandate to function effectively in a wide range of areas, including:</p> <ul style="list-style-type: none"> strategic leadership to align partners and their activities with the strategy coordination of stakeholders, including establishing mechanisms for coordination and regular communication project management that includes planning, monitoring and holding people accountable for results gaining commitment and support from decision-makers creating demand for health information.
5	<p>Existence of policies, laws and regulations mandating public and private health facilities/providers to report indicators determined by the national HIS</p>	<p>A regulatory framework for the generation and use of health information enables the mechanisms to ensure data availability of public and private providers. If a general law is not available, decrees that are pertinent to individual subsectors should be reviewed. For example, assess whether or not the legal framework is consistent with the United Nations' Fundamental Principles of Official Statistics. Key criteria include:</p> <ul style="list-style-type: none"> designation of a person or office responsible for regulating interactions with the private sector existence of specific requirements in terms of periodicity and timeliness of reports existence of a minimum set of core health indicators that both public and private health care providers should report.
6	<p>Presence of mechanisms to review the utility of HIS indicators for planning, management and evaluation, and processes by which to modify the indicators accordingly</p>	<p>The HIS must provide relevant and important information to stakeholders. HIS design should provide for a dynamic process subject to periodic review and adaptation to the changing health environment in the country. Mechanisms include the existence of an active national HIS steering committee, a national HIS policy and periodic HIS review meetings.</p>

Source: adapted from USAID 2012

Key processes for the HIS relate to those involved in selecting key indicators: data collection, processing and storage; data compilation and integration; data analysis and reconciliation from multiple sources; and data presentation, dissemination and sharing.

The process of identifying a national minimum indicator set should be through a consensus-building process involving both users and producers of health statistics, including stakeholders in sectors other than health who rely on data to help them plan the delivery of their health services and products.

Obtaining the data required for evidence-based decision-making requires using different data collection methods, querying different data sources, matching data items or indicators with the most cost-effective tool for generating them, and reconciling data derived from different sources. Understanding the strengths and limitations of

each data source and knowing the purposes of data contribute to making the right choice of data source.

The processes of data compilation, analysis and dissemination frequently involve a mixture of paper-based manual processes and computer-based electronic processes. In evaluating data management, it is important to observe the way that these processes interact and whether high quality information is produced as a result. At some point in the development of a national HIS, an electronic repository would be created to bring together the multiple data sources across a given country, be they paper-based or electronic. Proposed indicators for assessing HIS processes are provided in Table 8.

Table 8 HIS process indicators and definitions

	Indicator	Definition
1	Availability of minimum core indicators at national and sub-national levels	Qualitative description of available data and how it links to the overall HIS system. Availability of indicators and information on definitions, data sources and data collection methods are indicative of the HIS performance and organisation. Data should be comprehensive and cover all categories of health indicators: determinants, inputs, outputs, outcomes and health status.
2	Availability and accessibility of data sources	Yes or no, with qualitative description of data sources used. Population and institutional data sources should include the census; civil registration; population surveys; individual, facility and administrative records; and surveillance. Data sources should be accessible to the public.
3	Timeliness of updates to the national health information database	Review of the regularity and recency of updating the national database of health facilities and assessment of completeness of the data in the database. The review should also cover the existence and updating of a national database of facilities with geo-coordinates.
4	Percentage of districts represented in HMIS information	Number of districts in HIS reports divided by the total number of districts. The absence of this indicator reveals a weakness in the HIS and absence of quality control mechanisms to review and improve data and report quality.
5	Percentage of private health care facility data included in HMIS data	Ministries of health reports should indicate whether private facilities or services are included.
6	Availability of standards and guidelines for data collection, reporting and analysis	Clear instructions and guidelines contribute to increased data quality. In many instances, staff will indicate that procedures, standards and guidelines exist but will be unable to produce copies or evidence of them. There should also be guidelines on basic data analyses that are carried out at local levels.
7	Presence of procedures to verify the quality of reported data (accuracy, completeness, timeliness)	Many HIS assign the task of monitoring the quality of data to the supervisory level but often such supervision is not carried out in practice. Although most systems have general checklists, these may not include steps to improve the quality of data or reports. Data entry staff, or those who aggregate the data reporting forms, often make corrections and carry out data quality functions.
8	Availability of a national summary report (for example, annual health statistics report) that contains information, analysis and interpretation	Information availability is a key to its widespread use. Such reports offer an opportunity to bring together results of different HIS sub-systems and integrate their analysis and interpretation.
9	Compilation and reconciliation of data from different sub-systems of the HIS	Data derived from different health programs and sub-sectors are grouped together for reporting purposes or integrated in a single document and documents are widely available. Too many parallel sub-systems are indicative of a fragmented HIS that cannot provide the type of analysis necessary for good planning, management or evaluation of health policies or programs.
10	Availability of appropriate and accurate denominators for calculating rates and ratios	These should cover population by age group, facility catchment area, sex and number of pregnant women. Denominators for the district level and above are based on census data with assumptions about population growth. At lower levels, denominators and effective catchment area populations may be difficult to calculate.

Source: adapted from USAID 2012

Institutional arrangements for conducting the review

As noted earlier, our methodological approach distinguishes between evaluative information and diagnostic information. The former focuses on the availability and quality of key information items and their use for health-related decision-making. The latter addresses the structure, organisation, processes and resources (human, infrastructural, and financial) of the HIS to identify areas in need of improvement. Our assessment methodology therefore differs for conducting the review of HIS products compared with the review of HIS inputs and processes. For the assessment of HIS products, credibility depends on the perception of objectivity and independent verification. We therefore propose that the assessment of availability and quality of data be carried out by an independent review group composed of multi-sectoral technical experts in each country. We do not recommend that the review be conducted by external technical partners, as this would detract from country leadership and ownership of the process. However, external technical advisers may be asked to participate in circumstances where country capacity is considered insufficient.

An independent institution with defined responsibilities for coordination and quality assurance is important to ensure that the data quality assessment is relevant to country priorities and adapted to the technical requirements of each indicator. The technical review group should comprise not only those working to produce health statistics—in the health and statistical sectors and in disease-focused programs—but also users of data at sub-national, national and international levels. Users include country policymakers, researchers and academics, as well as development partner representatives. It is important that the review group be country-led, although development partners may contribute as requested. However, country ownership of the assessment process is of paramount importance and will help ensure follow-up action in cases where indicators do not meet minimum data quality standards.

By contrast, the review of HIS inputs and processes should be conducted by the people most involved in data collection, compilation and use at all levels of the HIS, as they are best placed to identify structural weaknesses in the HIS and ways of overcoming them.

Sources of information for the HIS performance assessment

There are many sources to help the evaluation teams assess and analyse the performance of the HIS. These can be organised into three categories:

9. *Standard indicators*: Data are drawn mainly from existing and publicly available databases such as:
 - data on information products in publicly available databases at the country level
 - databases maintained by global and regional institutions, including WHO (2013a), the World Bank (2013) and the United Nations Statistics Division (UNdata 2013). When using such international databases it is important to be aware that several of the indicator values may be derived from statistical models rather than empirically generated data. When assessing country HIS performance, modelled data estimates should be used only as a consistency check against country-reported values
 - databases that compile indicators from internationally supported household survey programs include:
 - USAID-supported Demographic and Health Surveys (DHS)
 - UNICEF-supported Multiple Indicator Cluster Surveys (MICS)
 - AIDS Indicator Surveys
 - Household health expenditure surveys
 - National health accounts (NHA)
 - Living Standards Measurement Surveys (LSMS)
10. *Secondary sources*: Information on HIS performance can be gathered through desk review of reports, forms and other documents. These may include:
 - reports of HIS functioning by development partners and donors
 - ministry of health budgets, regional and district budgets
 - national HIS strategic plans and operational plans/ budgets (if available)
 - human resources information systems
 - logistics and procurement systems
 - vital events records (as available), longitudinal health and demographic surveillance sites (HDSS), or Sample Vital Registration with Verbal Autopsy (SAVVY)

-

- national data management software platforms
- donor reporting guidelines and/or monitoring and evaluation plans
- supervision checklists; ministry of health district-level procedures and directives
- reports, graphs or maps that display the information provided through the HIS.

11. *Stakeholder interviews:* The indicator data collected from primary and secondary sources should be supplemented with additional information obtained in the stakeholder interview process. Stakeholders consulted for and involved in the HIS assessment should include:

- ministry of health planning unit, health information unit
- key private sector health care providers: private physicians and/or medical groups, laboratories, pharmacies, hospitals and home care providers
- central-level ministry of health budget authorities
- central-level program managers (especially the head of the planning or health statistics unit); regional and district program managers
- HMIS director or director of eHealth (as appropriate)
- other agencies involved in HIS strengthening, such as the ministries of telecommunication and local government
- national statistics offices
- public health program officers such as the head of the malaria or HIV/AIDS programs
- staff working in the statistical department of the ministry of health and particularly staff who analyse the data
- international advisers and monitoring and evaluation staff of development partners.

Periodicity of HIS performance assessment

We have proposed a total of 31 indicators to be included in the assessment of overall HIS performance, of which 15 relate to HIS outputs (data quality and use), 6 to HIS inputs and a further 10 to HIS processes. While this represents a significant abbreviation of the HMN assessment tool, conducting the assessment across the many indicator domains that a HIS is responsible for would be demanding and resource-intensive. As we have seen from the review of data quality assessment approaches provided in Part II, the more complex the assessment and the more stakeholders that need to be involved, the less likely the assessment is to be repeated regularly and institutionalised. We therefore propose that a comprehensive review of HIS products, inputs and processes be limited to baseline assessment and evaluation after a significant period of time, say five to seven years. For monitoring progress, we propose that assessment of HIS products (data quality and use) should be conducted on a rolling basis and confined to a subset of indicators selected on the basis of importance and periodicity requirements. Periodicity would vary according to type of indicator. For example, because mortality changes relatively slowly over time, assessment of mortality indicators would take place every three to five years. By contrast, assessments of coverage indicators, which are more responsive to program inputs and environmental changes, would take place more frequently depending on the topic.

An initial comprehensive baseline assessment of HIS inputs, processes and products should serve as the starting point for the development of a national HIS improvement plan. For monitoring progress on the implementation of the plan we propose a summary version of the assessment tool comprising a subset of eight indicators (Table 9). The purpose of this abbreviated list is to enable tracking of HIS performance over time and to guide a team with severe time constraints to focus on the most important activities of the HIS. Depending on needs, scope, time and resources available, the summary table can be modified to customise the list of key indicators. Figure 1 provides a visualisation of the proposed conceptual scheme for HIS monitoring and evaluation.

Table 9 Summary metrics for HIS monitoring (summary indicators extracted from Tables 6, 7 and 8)

Indicators of HIS inputs	1	Availability at each level of a sufficient number of qualified personnel and infrastructure to operate, compile and analyse health statistics	Locally defined
	2	Availability of the national HIS strategic plan consistent with resources available and developed in broad consultation with key stakeholders	Plan available
	3	Existence of policies, laws and regulations mandating public and private health facilities/providers to report indicators as determined by the national HIS	Policies/laws/regulations available
	4	Presence of an independent, national coordination body mandated to ensure coordination across stakeholders involved in data production, analysis and use and tasked with reviewing the utility and quality of HIS indicators for planning, management and evaluation.	Coordination body formed
Indicators of HIS processes and outputs	5	Percentage of private sector health facility data included in reported data	%
	6	Annual availability of a national summary statistical report that contains HIS information, analysis and interpretation	Annual statistical report available
	7	Examples of data use for planning, budgeting and resource mobilisation	Examples can be accessed
	8	Examples of feedback of data analyses and results to data producers	Examples can be accessed

Capacity building for assessment and monitoring

Performing an assessment of a country's health information system makes multiple demands on available skills and capacities, especially with regard to the analysis of data quality and reliability. In this paper, we maintain that addressing capacity gaps by providing external technical assistance is an expensive, unsustainable and not necessarily high quality solution. It does not foster country ownership and cannot replace the need for sustained domestic capacity for data analysis and quality assurance. Instead, we make the case for building institutional mechanisms that can maximise the use of available in-country expertise and gradually build up the needed analytical skills. Such institutional mechanisms should maintain independence from program implementation so as to maximise objectivity and minimise risks associated with vested interests.

The current situation in many countries is that HMIS units within ministries of health are under-resourced and lacking in capacity. There are few formal links with national statistics offices or with academic or public health institutions. In some countries, for example Uganda and Ghana, there have been recent efforts to upgrade institutional capacities through the establishment of "resource centres" or "health information centres". This is a step in the right direction, but such centres are rarely sufficiently well resourced

or independent enough to be effective and often confine their data quality assurance activities to internal validation/verification and only to data generated from health care facilities.

National statistics offices that have aligned their activities with the Fundamental Principles of Official Statistics (UN 1994) have the needed analytical skills and can assure objectivity and transparency. However, in many settings, statistics offices do not get heavily involved in health and social statistics, which are considered the responsibility of line ministries.

Academic, research and public health institutes may be well placed to support capacity-building efforts. Many countries have relatively strong research institutions and also maintain one or more demographic surveillance sites where there is considerable epidemiological and statistical capacity. Their staff often have the skills needed for data quality assessment and enhancement but are rarely linked to routine, ongoing administrative data collection and analysis. As a general rule, the body responsible for data quality assurance and validation should have a degree of independence from programs. However, data quality improvement is best achieved through close connections with programs and their delivery mechanisms and hence the trade-off between independence and embeddedness needs to be carefully managed.

Conclusions

Demand for reliable and accurate health-related information and data will continue to grow, fuelled by emerging epidemiological trends, growing concerns about inequalities in health status and access to care, and increasing needs for efficiency and effectiveness in the delivery of health interventions. In most low- and lower-middle- income countries and many middle-income countries the capacity of HIS to respond to this demand is limited. As a result, the supply of health information has been largely determined by the availability of funding to monitor and evaluate disease-specific or population-focused programs. The resulting information silos foster overlap, duplication and inefficiencies. Moreover, they do little to build in country skills and capacities for data collection, compilation, analysis, dissemination and use.

Several recent initiatives have taken a more systems-wide approach to strengthening country HIS and statistical systems. Building on these experiences and lessons learnt, we propose a comprehensive strategy and methods for assessing and monitoring HIS performance. We define a parsimonious set of indicators for assessment of HIS products—the availability, quality and use of data for decision-making—and for monitoring the inputs and processes that characterise well-performing health information systems. The indicators proposed have been tested in different initiatives, but this is the first time they have been brought together in an integrated framework, with principles for implementation designed to build country capacities first and foremost. This comprehensive framework requires strong institutional mechanisms for implementation. An important next step would be to evaluate these indicators in countries.

No matter how sophisticated the assessment tool and how intensive the effort put into evaluating HIS performance, many of the factors that affect it cannot be put into a simple spreadsheet. The ability of the HIS to produce data for health system performance assessment and planning depends on a series of technical determinants, such as data architecture and HIS resources, and on organisational and environmental determinants relating to the information culture within the country context, the structure of the HIS, and the roles and responsibilities of the different actors. In turn, these are underpinned by behavioural determinants such as the knowledge and skills, attitudes, values and motivation of those involved in producing, collecting, collating, analysing and disseminating information. In this working paper we argue strongly for increased attention to building institutional and individual capacities in these areas.

We also make the case for the establishment in countries of an independent body, at “arm’s length” from government programs and ministries, mandated to provide technical appraisal of the availability, quality and use of the key products of a health information system. Such an independent body could be comprised of academic institutions, public health institutes, technical subject-matter experts and decision-makers who use health data in policy and practice.

A prerequisite for success is government commitment, at the highest levels, to improve the functioning of the health information systems and provide critical review and analysis of available information.

Annex I: The HMN Framework revisited

Goal, functions and scope of the health information system

The goal of a HIS is to produce relevant and quality information that stakeholders use to make transparent and evidence-based decisions for health. The performance of the HIS is measured on the quantity and quality of data produced and on evidence that the data are used to improve health system performance, to

respond to emergent threats and to enhance public health.

In pursuance of this goal, the HIS must determine what information needs to be collected and tracked, establish mechanisms for collecting the information, build and sustain an ongoing process of adding value to the data collected, ensure that the data are understood and used, and substantiate the need for data collection so that funding is maintained (Figure 13).

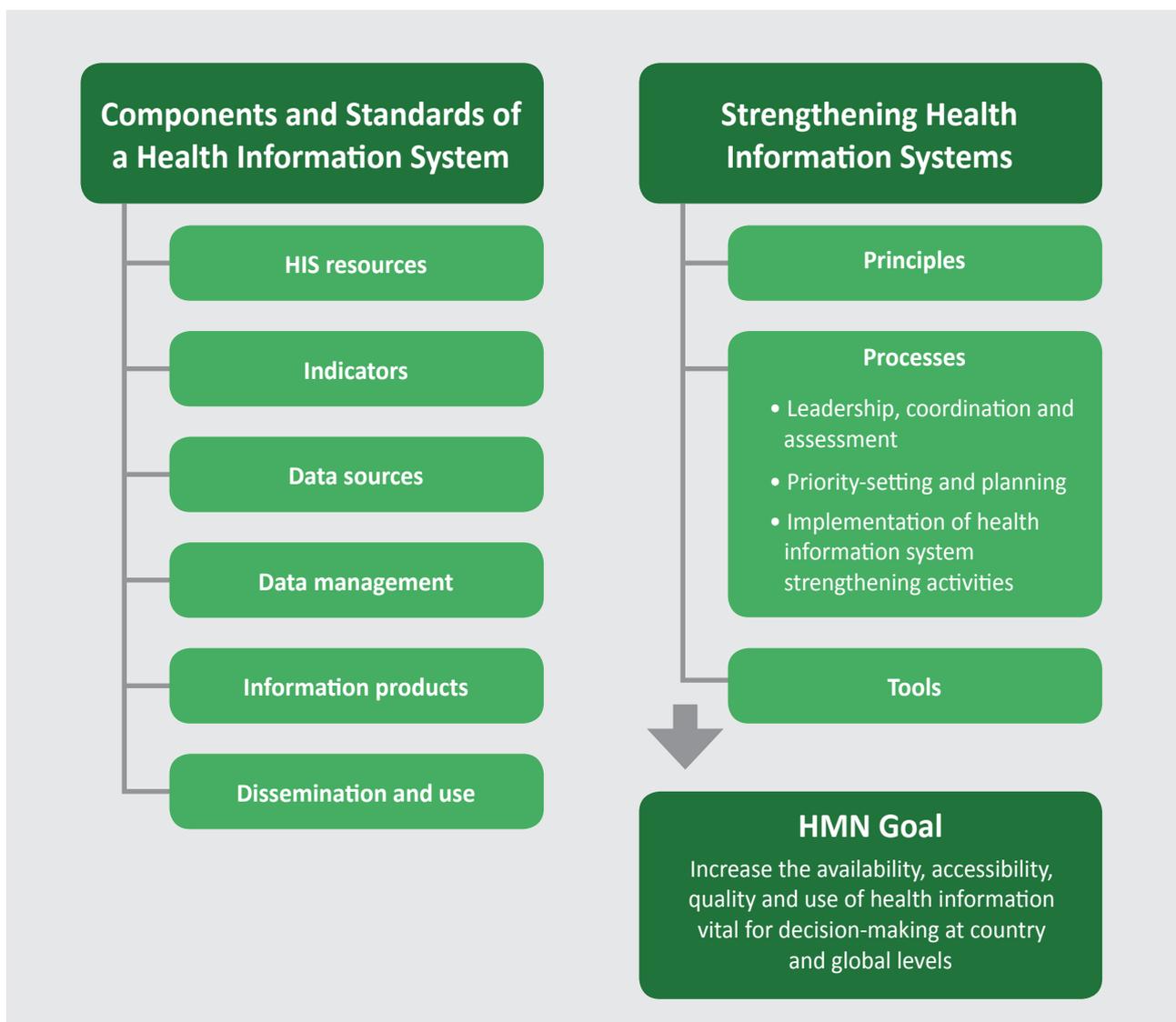


Figure 13 – The HMN Framework

Source: HMN 2008a

In tandem with the HMN Framework, HMN developed an assessment tool designed to enable countries to understand how their systems function (HISHub n.d). This suggests a sequence of steps for conducting the assessment, including:

- establish a coordination and steering committee under high-level leadership
- identify stakeholders across health programs, statistics, academic institutions, development partners, academia and other interested parties
- conduct the assessment itself in multi-stakeholder workshops
- share the findings, identify priority activities and develop an action plan to strengthen the HIS.

A planning guide was also developed to support this last phase. The underlying philosophy is that the mere process of conducting the assessment engages all stakeholders in the system, facilitating a shared vision of a more coherent, integrated, efficient and useful HIS, to which a national HIS-strengthening plan can aspire. Some of the major lessons learnt from the implementation of the HMN assessment tool in countries are described later in this guide.

The HIS has four key functions: data collection; data compilation; data analysis and synthesis; and information dissemination, communication and use. The HIS collects data from the health sector and other relevant sectors; analyses the data and ensures their overall quality, relevance and timeliness; and converts data into information for health-related decision-making. Data collection is only a first step towards attaining the goal and must be accompanied by data quality assurance, analysis and interpretation. Data quality has been defined as “the degree to which data items are accurate, complete, relevant, timely, sufficiently detailed, appropriately represented (e.g. consistently coded using a clinical coding system) and retain sufficient contextual information to support decision making” (Wyatt & Liu 2002). The HIS can contribute to evidence-based decision-making only to the extent that the data it generates are subject to in-depth quality assessment along with a clear and transparent process of appraisal and interpretation (Rychetnik et al. 2004).

The HIS is often equated with monitoring and evaluation, but this perspective is too reductionist. In addition to being essential for monitoring and evaluation, the HIS also serves broader ends, providing an alert and early-warning capability of emerging health threats, supporting patient care, underpinning health system management, enabling planning, supporting and stimulating research, permitting health situation and trends analysis, enabling global reporting, and underpinning communication of health challenges to diverse users such as policymakers, planners, managers, health care providers, communities and individuals. Therefore, dissemination and communication are essential functions of the health information system.

Although there are differing opinions in the literature about the scope of health information systems, there is general agreement that they are complex, dynamic, context-based and of great social importance (Lenz et al. 2002; Detmer 2003). Their scope is, therefore, very wide. The HIS must bring together different kinds of information, including from public, private, non-government and faith-based organisations as well as from non-health sectors. Data needs comprise (Figure 14):

- health determinants (socio-economic, environmental, behavioural, genetic factors) and the policy, legal, institutional, and socio-economic contextual environments within which the health system operates
- inputs to the health system and related processes, including policy and organisation, health infrastructure, facilities and equipment, budgets, finances and costs, human and technical resources, health information systems
- the performance or outputs of the health system, such as availability, accessibility, quality and use of promotive, preventive, curative and rehabilitative services; responsiveness of the system to user needs; and financial risk protection
- health outcomes (mortality, morbidity, disease outbreaks, health status, disability, wellbeing)
- health inequities in terms of determinants, coverage and use of services; and health outcomes by key stratifiers, such as sex, socio-economic status, ethnic group and geographic location.

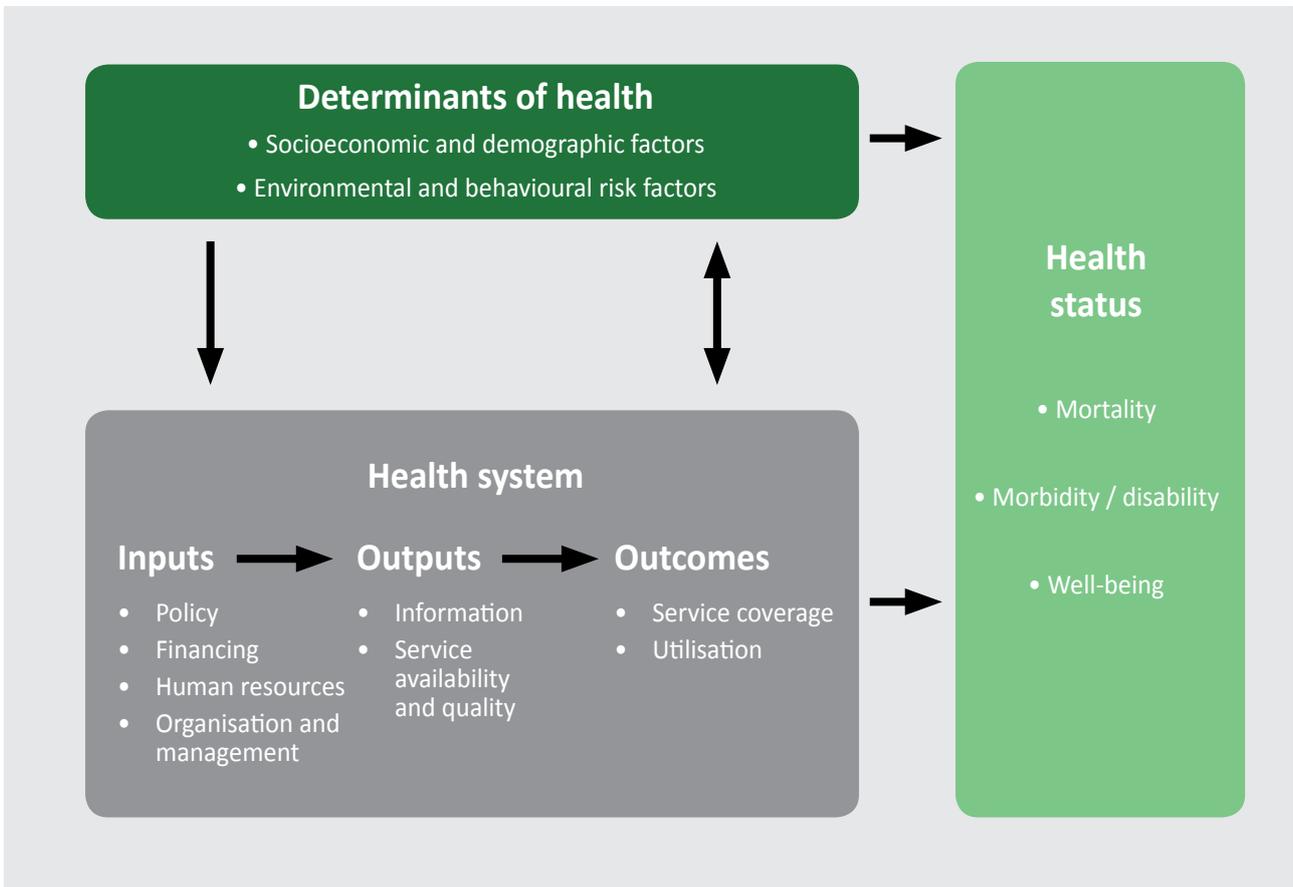


Figure 14 – Domains of indicators for health information systems

Source: HMN 2008a

Given the scope of information needs, it follows that to produce empirical, primary microdata, the HIS must draw upon many diverse sources of information. Although data requirements are potentially infinite, in practice there is only a limited set of data sources, which are summarised in the following section.

Multiple sources of health-related data

The HIS draws on multiple sources of health-related data. In the HMN framework, health data sources are broadly differentiated into those that collect data as a by-product of the activities of the health care system and those that collect data from defined populations. Within the latter, a further differentiation can be made between total population counts, such as registers of vital events and the census, and counts that relate to a subset of the population, usually a random sample, for example household or school-based surveys.

Routine registration of vital events

Civil registration systems collect birth and death information in a highly standardised manner, accurately and continuously recording all births and deaths in the population and including cause-of-death certification and coding according to the WHO *International Statistical Classification of Diseases and Related Health Conditions* (ICD-10) (WHO 2010a). These data are particularly valuable if each record is associated with a national unique identifier (ID), which allows matching to other data collected in the census or household surveys, for example on socio-economic status.

In practice, few low-income and lower-middle-income countries have routine registration systems of sufficient completeness and quality to be usable for health-related decision-making, although improvements are underway in several countries. Some countries—such as China, India and, more recently, Tanzania—have introduced systems that register vital events in a random sample of localities that are intended to be representative of the entire country. Many more countries have longitudinal HDSS in which vital events occurring in specified locations are routinely recorded through active surveillance. In most cases, these sites were initially set up for the purpose of research and have been used for large-scale clinical trials. However, several are now long established and have diversified and extended the

range of information collected. Because they are not designed to be nationally representative, HDSS are not appropriate for monitoring national population and health trends, but they can provide valuable insights into population dynamics and emerging health challenges. Many HDSS are part of the International Network for the Demographic Evaluation of Populations and Their Health in Developing Countries (INDEPTH) which helps ensure quality standards across sites (INDEPTH 2002).

Censuses

The census is potentially a valuable source of demographic and health-related information, including population size and geographical distribution; patterns of fertility; and social, demographic and economic characteristics. International standards for population and housing censuses have been developed by the Statistics Division of the United Nations Department of Economic and Statistical Affairs (UNDESA 2010).

From a health perspective, information on population size and distribution by age, sex and other characteristics is essential for national and local planning, estimating target population sizes and trends, and evaluating rates of service coverage and future needs. The census can also provide useful information on the availability and distribution of health care professionals. The census has been used to estimate levels and trends in child mortality, using both direct estimation (asking respondents about deaths in the household in a specified time period) and indirect methods (through questions about children ever born and children still alive) (UN 1983). These methods work well for estimating mortality in children under five years of age but have proven more difficult for estimating adult mortality and cause-specific mortality, such as maternal mortality. The information on factors such as poverty, housing conditions, water and sanitation that are collected in a census are invaluable for understanding the socio-economic determinants of health. The nature of the census also allows for small-area estimation.

Household surveys

Internationally supported household surveys on health started in the 1970s with the USAID-supported World Fertility Surveys, which were later extended in scope and became the DHS. During the 1990s, UNICEF established the Multiple Indicator Cluster Surveys (MICS), which

focused specifically on generating data to monitor the goals and targets of the 1990 World Summit for Children. Other internationally supported survey programs are the Pan Arab Project for Family Health (PAPFAM), the Pan Arab Project for Child Development (PAPCHILD) and the United States Centers for Disease Control and Prevention Reproductive Health Surveys. These surveys provide valuable information across and within countries because they are implemented in a standard way in all countries and over time. They are particularly useful because they generate a vast amount of detailed information on fertility and health, including individual behaviours. Other standardised multi-country surveys have a primary purpose of generating socio-economic data but also may also include health modules. Examples include the World Bank supported Living Standards Measurement Surveys (LSMS) and the United Nations Household Surveys. The LSMS includes detailed health questions that are helpful in measuring the utilisation of health care and health care expenditures.

Several countries implement national household health interview surveys that are tailored to a country's health profile and information needs. In the United States, the National Health Interview Survey has been conducted for over 30 years, and the Behavioural Risk Factor Surveillance System is a state-based system designed to collect standardised data on health risk behaviours, clinical preventive health practices and health care access. Data are collected from a representative sample in each state and the sampling is designed to provide national estimates when data from all states are combined (Mokdad et al. 2003).

Many health surveys focus on disease-specific or condition-specific data collection, often sponsored by WHO programs or UNAIDS. These surveys cover conditions such as malnutrition, adolescent risk factors, oral health, HIV-related knowledge and practices and health conditions associated with ageing. The WHO Global Database on Child Growth and Malnutrition brings together information collected from population-based national and sub-national surveys that follow a standard procedure to obtain comparable results from about 155 countries. Household surveys are also used to collect information on mental health and wellbeing and on self-reported disability (Altman 2001). Some of these surveys take clinical measurements—for example, height and weight—in addition to interviewing respondents (WHO 2013b). These health examination surveys may also collect blood samples, administer audiometry or

optometry tests, conduct radiological examinations or administer performance tests for basic functional health status (for example, motor capabilities) (CDC n.d).

Health facility records

Health care facilities generate statistical information as a by-product of the activities of health facilities and patient–provider interactions, such as interventions offered, quality of care, treatments administered and patient outcomes. The data are used for a wide range of purposes, including epidemiological surveillance, monitoring of intervention-specific programs, audits and adverse events enquiries, and assessments of patient safety and quality of care. Point-of-service data collection is not highly standardised, with the exception of data collected on high profile interventions such as immunisations, directly observed treatment short course for tuberculosis, or antiretroviral drugs for HIV infection.

The major strength of health service statistics is their local use for facility management. Where appropriate, such service statistics may be used to develop population-based estimates of, for example, immunisation coverage and maternal care. Such estimates provide a regular source of information that can be validated periodically with statistics from occasional household surveys. However, the estimates can be imprecise due to the need to calculate denominators and the possibility of either undercounting or double counting.

Hospital discharge data are a specific type of health service registry data. They are widely available and very useful for monitoring the quality of health services because they capture different dimensions of the interactions between the health service and the individual. The data include patient attributes (age and sex), treatments and interventions, cause of admission and cause of discharge (often using the ICD). When a patient dies in hospital and is assigned an ICD-based cause of death, this information is reasonably comparable across populations, though obviously dependent upon the quality of medical certification by the certifying physician. In settings where population-level cause-of-death data are not available due to the weakness of civil registration and vital statistics systems, information on hospital deaths are a potentially useful alternative. Because hospital deaths are not representative of all deaths in the population, statistical methods have been developed to estimate population

cause-specific mortality fractions using in-hospital death records (Murray et al. 2007). However, there is no evidence of the widespread use of such methods in diverse country settings.

Administrative data, budgets and expenditures

Administrative sources provide data on budgets and expenditures, usually at the summary level. Such data are often provided by financial management information systems, which are sometimes maintained for the government as a whole, rather than just for the health system. There is less information collected on individual expenditures on health care, but these data can be generated through household surveys. For policy development and strategic planning, financial data are often compiled using the methodology for national health accounts (NHA) (OECD 2011; Poullier et al. 2003; World Bank, WHO & USAID 2003). The NHA system provides information on the financial resources available for health and their flows across the health system. The data are sufficiently detailed to permit breakdown into private and public sector categories and disaggregation of financial information by major disease or health programs. At sub-national levels, budgetary information linked to health system functions and, in particular, health interventions is a minimum requirement for performance budgeting.

Health facility assessments

Health facility assessments are intended to capture the availability of human and infrastructure resources and of essential medicines, equipment and supplies in health centres and hospitals. **The USAID-supported Service Provision Assessment** is a health facility assessment that provides a comprehensive overview of a country's health service delivery, including both availability of services and assessment of quality of care (MEASURE DHS n.d.). Modules include facility infrastructure, health centre budget reviews, pharmaceutical inventories, secondary output review, and services for specific conditions such as tuberculosis treatment. The WHO Service Availability and Readiness survey is designed to generate information on the distribution of health care facilities, skilled health workers and resources for prevention, diagnosis and treatment (O'Neill et al. in press). Depending on circumstances and available resources, the facility survey can be applied either to a

nationally representative random sample of facilities or to all facilities within a random sample of districts.

Health and disease surveillance

Surveillance is frequently used to refer to systems for detecting, reporting and responding to specific notifiable conditions, usually epidemic-prone communicable diseases. For such disease events that need to trigger urgent public health action and for other health conditions to which special resources are dedicated, special separate surveillance systems or monitoring and evaluation strategies exist. These include targeted surveillance systems, cancer registries, specialised clinical care systems for diseases of special significance (such as tuberculosis) and often elaborate and distinct ("vertical") monitoring and evaluation strategies for diseases of great global interest (such as HIV/AIDS or vaccine-preventable diseases). However, surveillance is not only about tracking epidemics but is also relevant for monitoring public health trends or epidemiological "situational awareness and monitoring". In this context, surveillance draws on many data sources, both population-based (such as mortality surveillance in sentinel populations) and institution-based (such as disease surveillance in sentinel health facilities). Thus, rather than being linked to one data source, surveillance now includes specialised approaches to monitor vital events, frequent and increasing use of survey methods (for example, HIV/AIDS surveillance in antenatal care surveys) and analysis of health service records. Surveillance also now includes measuring risk behaviours (for example, tobacco use or unsafe sex) and risk factors (such as high blood pressure) through household surveys, monitoring administrative systems (such as surges in the purchasing of particular pharmaceuticals) and monitoring rumours or lay reports of unusual illness patterns reported in the media or unusual query activity on the Internet.

Research and epidemiological observational studies

Epidemiological observation studies follow a cohort of individuals over a number of years and are useful for providing information about disease progression and other key factors for disease and survival. They are generally completely researcher driven but can be useful for assessing population health.

Linking data needs and data sources

In an ideal world, it would be possible to map each data item to a particular data source. In practice, things are more complex. While there may be one gold-standard data source for a given indicator, this source may not be available or functional in a given setting. For example, it is acknowledged that the most efficient source of data on maternal mortality is a system in which all births and deaths are counted and all deaths accurately medically certified, in other words, a well-functioning civil registration and vital statistics system. However, few developing countries have such systems in place and must therefore rely on other sources such as household surveys or health facility reports.

Many indicators can be derived from several sources. Thus, data on child mortality can be generated from the census and from household surveys. Data on immunisation coverage can be generated through household surveys and facility reporting. Even within a single data source, different ways of collecting the information may be used. For example, the census can be used as the source of child mortality data using both direct and indirect estimation methods. The problem is that different sources and different ways of collecting the information inevitably produce different values for the indicators, and this can lead to difficulties in interpretation.

Each data source has its strengths and limitations. Health service records are continuously available, which is an advantage, but they are subject to bias because they cover only the populations using health facilities. Population surveys are considered to be more representative, but they are time-consuming and expensive and conducted only occasionally (every five years or so). Thus the results generally span several years rather than the immediate past. They also produce indicator values that have margins of uncertainty (confidence intervals) because they are based on sampling. Population surveys generally do not generate annual data or provide information for small geographical areas. Health facility data can provide frequent data on small populations if special investments are made to ascertain data quality and completeness.

When indicator values are obtained using more than one source, reconciliation of the resulting different statistical values is necessary. Population survey results can be used to adjust the rates and trends seen in health facilities.

A good example is the measurement of HIV prevalence among adults in countries with generalised epidemics. Antenatal clinic-based surveillance systems provide annual data on HIV prevalence trends among pregnant women, but this is a biased sample. Through nationally representative household surveys that include HIV testing, unbiased estimates can be generated that cover all regions in a country and include non-pregnant women and men. However, cost considerations preclude annual population-based surveys of HIV prevalence. Antenatal surveillance results are used to monitor progress, and occasional household survey results provide data to calibrate and adjust surveillance findings.

This example illustrates that data reconciliation is not always a simple matter, generally requiring high levels of statistical and analytical skills. The precise combination of different data sources depends on the indicator in question and the methodologies available to generate the data. In response, analytical tools have been developed to help in decision-making. One such tool is the Estimates and Projections Package tool developed to monitor trends in HIV prevalence (UNAIDS 2013).

If no suitable data sources exist for some indicators, a proxy may be needed. For example, routine statistics on the administration of the third (final) dose of the diphtheria, tetanus and pertussis (whooping cough) vaccine (DTP3) are used as a proxy for assessing full immunisation coverage when household survey measurements cannot be used. Another example is the use of measles immunisation as a proxy for child mortality in the MDG framework. There is a role for such proxy indicators in health monitoring if they are closely correlated to health outcome, but it is overly simplistic to limit proxies to a single indicator—immunisation against measles is only one component of the reduction of child mortality. Similar considerations apply to the use of an indicator on births attended by skilled health personnel as a proxy for maternal mortality. Moreover, proxy measures tend to gradually evolve into the main indicator of interest, distracting attention from the original objective of a policy or program.

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The Knowledge Hubs for Health Initiative

The Health Information Systems Knowledge Hub is one of four hubs established by AusAID in 2008 as part of the Australian Government's commitment to meeting the Millennium Development Goals and improving health in the Asia and Pacific regions. All four hubs share the common goal of expanding the expertise and knowledge base to help inform and guide health policy.

The Knowledge Hubs are funded by AusAID's Strategic Partnership for Health Initiative.

Health Information Systems Knowledge Hub

The University of Queensland

Aims to facilitate the development and integration of health information systems into the broader health system strengthening agenda, and increase local capacity to ensure that cost-effective, timely, reliable and relevant information is available. The Health Information Systems Knowledge Hub also aims to better inform health information systems policies across Asia and the Pacific.
www.uq.edu.au/hishub

Human Resources for Health Knowledge Hub

The University of New South Wales

Aims to contribute to the quality and effectiveness of Australia's engagement in the health sector in the Asia–Pacific region by developing innovative policy options for strengthening human resources for health systems. The hub supports regional, national and international partners to develop effective evidence-informed national policy-making in the field of human resources for health.
www.hrhub.unsw.edu.au

Health Policy and Health Finance Knowledge Hub

*The Nossal Institute for Global Health
(University of Melbourne)*

Aims to support regional, national and international partners to develop effective evidence-informed national policy-making, particularly in the field of health finance and health systems. Key thematic areas for this hub include comparative analysis of health finance interventions and health system outcomes; the role of non-state providers of health care; and health policy development in the Pacific.
www.ni.unimelb.edu.au

Compass: Women's and Children's Health Knowledge Hub

Compass is a partnership between the Centre for International Child Health, The University of Melbourne, Menzies School of Health Research and Burnet Institute's Centre for International Health.

Aims to enhance the quality and effectiveness of women's and children's health interventions and focuses on supporting the Millennium Development Goals 4 and 5—improved maternal and child health, and universal access to reproductive health. Key thematic areas for this hub include regional strategies for child survival; strengthening health systems for maternal and newborn health; adolescent reproductive health; and nutrition.
www.wchknowledgehub.com.au



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