Strengthening Health Information Systems in Low- and Middle-Income Countries

A Model to Frame What We Know and What We Need to Learn

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ABBREVIATIONS

CBP   community-based organization

CHW   community health worker

EMR   electronic medical record

EPI   epidemiology

FP   family planning

HIS   health information system(s)

HR   human resources

ICD   International Classification of Diseases

MCH   maternal and child health

MDG   Millennium Development Goal

NGO   nongovernmental organization

PBF   performance-based financing

RHIS   routine health information system(s)

SDG   Sustainable Development Goal

TAG   technical advisory group

TB   tuberculosis

USAID   United States Agency for International Development

WHO   World Health Organization

1.0. INTRODUCTION

Health information is one of six core functions of the health system (United States Agency for International Development [USAID], 2015). Health information, generated by health information systems (HIS), supports data-informed decision making at each level of a health system. An HIS encompasses all health data sources required by a country to plan and implement its national health strategy. Examples of these data sources are electronic health records for patient care, health facility data, surveillance data, census data, population surveys, vital event records, human resource records, financial data, infrastructure data, and logistics and supply data. Health information can inform the planning and targeting of national and subnational health programs to support the achievement of health equity and universal health coverage. In addition, HIS supports a country's ability to report on progress in meeting the ambitious goals of global initiatives: the Sustainable Development Goals, an AIDS-free generation, ending preventable child and maternal deaths, and the elimination of malaria.

HIS strengthening is the implementation of one or more interventions targeting one or more components of the HIS to improve the quality and use of data for decision making at all of the health system's levels. HIS strengthening consists of a range of technical, behavioral, and organizational interventions. The output of a strengthened HIS is the improved availability of high-quality data that are used on a continuous basis for decision making at all levels of the health system.

MEASURE Evaluation has developed a model for strengthening HIS in low- and middle-income countries. The HIS strengthening model (HISSM) is a starting point for framing what we know now and the opportunities we have to learn more about strengthening the HIS. Using the Health Metrics Network (HMN) Framework as a foundation (HMN, 2008), we worked with experts around the globe to develop a model to address four key objectives:

1. Promote HIS as an essential function of a health system
2. Define HIS strengthening
3. Measure HIS performance
4. Monitor and evaluate HIS interventions

The HISSM is intended for use by HIS managers, MEASURE Evaluation staff, and other project staff implementing HIS interventions. (Box 1 offers some examples of how the model has been used to date.) The model also supports country-specific and global stakeholders as they assess, plan, design, implement, and monitor and evaluate their HIS interventions. This model will expand and evolve as our working context changes, and as we learn and understand new developments and approaches in strengthening HIS. The dynamic nature of HIS strengthening demands that we regularly review and update the model through the feedback of experts and practitioners. Feedback on the HIS strengthening model will be gathered on an ongoing basis through targeted solicitation and ad hoc contributions and shared through the MEASURE Evaluation HIS strengthening resource center: https://www.measureevaluation.org/his-strengthening-resource-center.

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Box 1. Examples of how the HISSM has been used to date

- **Mapping of MEASURE Evaluation HIS interventions in 11 countries with high investments in their HIS:** Using the HISSM, a team mapped all of the HIS interventions since the beginning of MEASURE Evaluation Phase IV in these 11 countries, creating summary documents. This led to an analysis of the most requested and funded intervention (support to develop and pilot an HIS data source). These two resources provide information on HIS strengthening needs and investments in low- and middle-income countries and presents the findings in a way that allows us to understand the areas of the system being addressed (https://www.measureevaluation.org/his-strengthening-resource-center/his-interventions/his-interventions-by-country).

- **Used to train public health and informatics professionals.** The HISSM provides a common language for teaching public health and informatics students and professionals. For example, it was used by a lecturer in Indonesia to teach about HIS strengthening (https://www.youtube.com/watch?v=wCV5FUi8yro).

- **Used to frame additional MEASURE Evaluation tools and resources** to define and provide learning and understanding in the areas of data use, measuring HIS performance in Kenya, HIS assessment tools, and the HIS indicator registry

- **Used to map the contributions of health informatics interventions** to the strengthening of HIS (https://www.measureevaluation.org/our-work/health-informatics/health-informatics-supports-health-system-strengthening)

- **Used to show how electronic health record interventions fit in the larger HIS.** The HISSM is a framework for understanding how different parts of the system interact and highlights the importance of positioning an electronic health record intervention in the larger health system so that all areas of investment can be understood (https://www.measureevaluation.org/resources/publications/tr-18-285).

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Within this document, in addition to describing the HIS strengthening model, we describe the HIS strengthening process and discuss the HIS as a function that supports the entire health system. We also discuss the importance of the human element in HIS strengthening and the selection of interventions to strengthen HIS, based on appropriate assessment methods, HIS sustainability, and describe the need to measure HIS performance and monitor and evaluate specific HIS interventions.

2.0. HIS AS ONE PART OF THE HEALTH SYSTEM

Strengthening HIS is important, but before we discuss how this is accomplished, we must clearly understand what makes up an HIS and how it relates to the health system as a whole. An HIS is part of the larger health system and meets that system's information needs. The health system itself is part of the larger country context and political system. We bring this up because, often, we focus so closely on HIS that we forget that an HIS is only a tool of the larger health system, which in turn is operating in an even larger system. The reality is that the decisions to invest in the health system come from outside of the health system itself and we have to consider who all the audiences are for the information generated from the HIS. This means that both the decisions to invest in health systems and the demand for information from the HIS come from public and private stakeholders across sectors and at the subnational, national, and global levels.

Health information is one of the six core functions of a health system, along with service delivery; human resources for health; medical products, vaccines, and technologies; financing; and leadership and governance (USAID, 2015). The figure below shows these six functions and how they work together to achieve key health system strengthening outcomes. The impact of these outcomes will be sustained improvements in health and health system performance.

Figure 1. USAID's vision of the core functions of health system strengthening
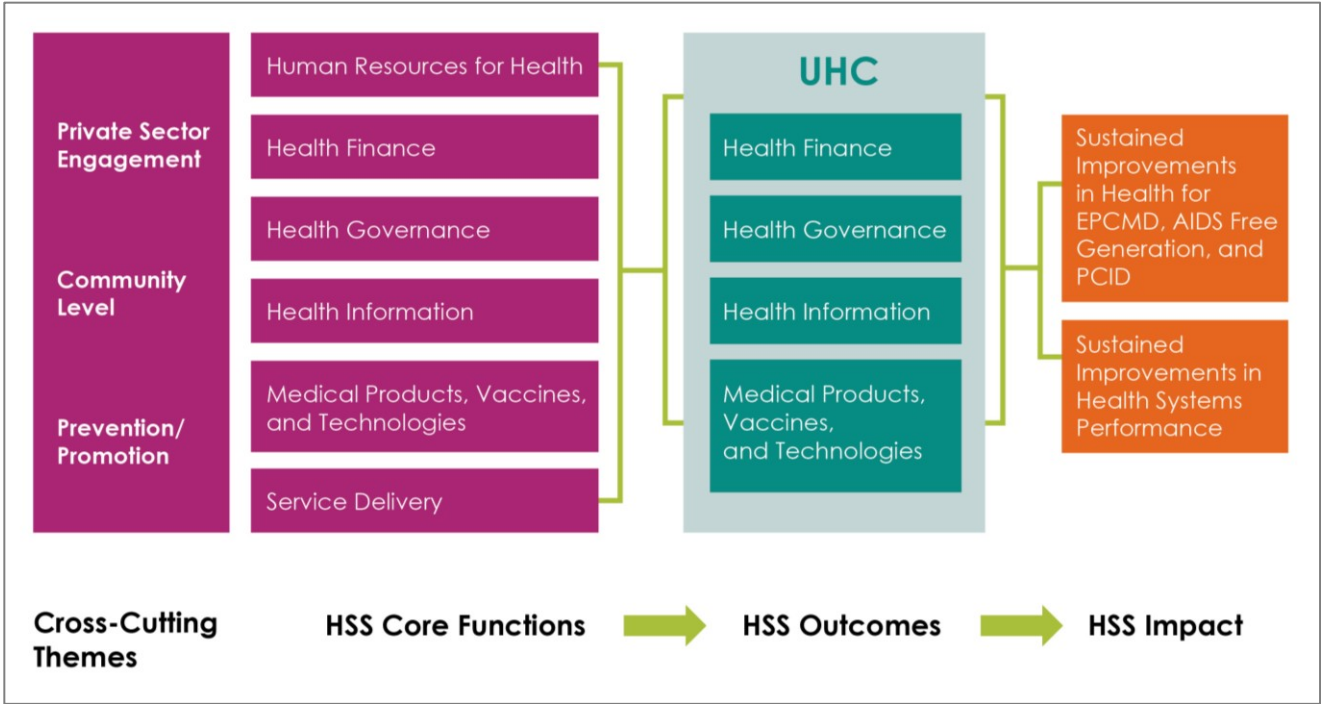
The World Health Organization (WHO) states that health systems do not consist of their components alone; "multiple relationships and interactions" convert the individual components into a system (WHO, 2009). This means we need to take a systems-thinking approach when working to improve specific components of a system, such as the HIS. The premise of WHO's *Systems Thinking for Health Systems Strengthening* is that we must first understand a health system before we can strengthen any part of it, and that many interventions don't succeed because of failure to account for a system's unpredictable behavior. Understanding a system involves assessing how its components affect

the specific intervention we intend to implement and the consequences of these interactions on the system's other core functions. Thus, to improve an HIS, we must understand how each core function of the health system affects the HIS and how the HIS (a strong, average, or weak system) affects other core functions of the health system. The HIS is not separate from the larger health system and by itself will not lead to an improved health system or improved health. Instead, the HIS is a core function that helps to strengthen the overall health system and that the health system's weaknesses can hinder.

For example, data from the HIS may help district health managers identify an area with an outbreak of measles, but without vaccines or health workers to administer them, the outbreak will not be contained. Contextual factors beyond managers' control also affect the health system and the HIS; we discuss some of these in the next section.

The Performance of Routine Information System Management (PRISM) framework also helps us to link the HISSM to the larger health system (Figure 2; Aqil, Lippeveld, & Hozumi 2009). The framework was developed specifically for routine health information systems (RHIS), but it can also be applied to the larger HIS.

Figure 2. PRISM framework
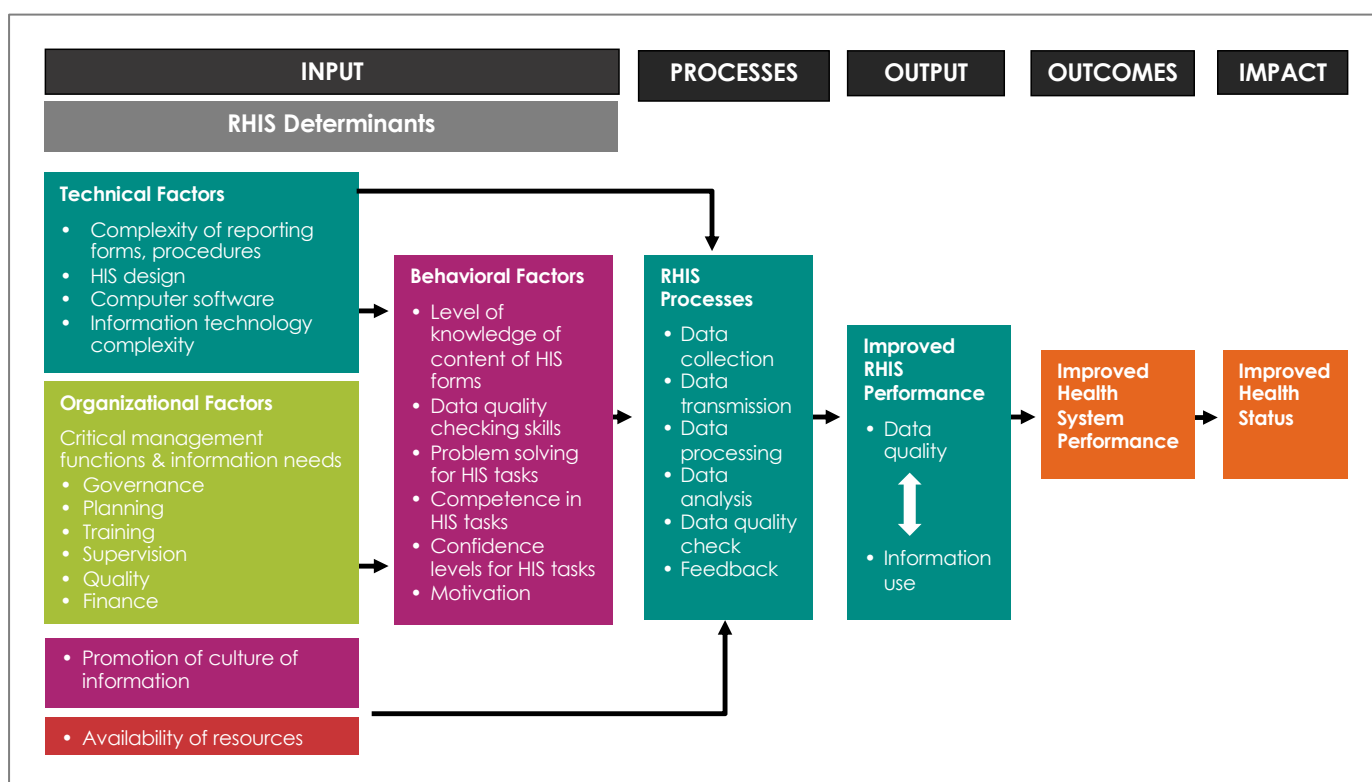
Source: MEASURE Evaluation (2017). Chapel Hill, NC: Carolina Population Center, University of North Carolina

PRISM places HIS strengthening efforts in the context of the familiar logic of monitoring and evaluation (M&E), where the output of HIS strengthening efforts is an improved HIS and the outcome is improved health system performance. The ultimate impact of these efforts is the improved health status of the population. The PRISM framework also describes three separate factors that are part of the inputs: technical, behavioral, and organizational. This framework demonstrates how these factors influence the processes and outputs. It is necessary to assess these

inputs in order to prioritize what interventions to employ to strengthen HIS. We use these categories in a later section to describe the types of HIS interventions available.

The health system is complex and has many sublevels, each with different information needs. Here are some examples of the types of health system levels and a type of information needed at that level:

- Patient/client level (information to provide care to the client)
- Community level (information on community health services provided)
- Facility level (information on monthly use of commodities)
- District level (information to allocate staff)
- Provincial/regional level (information to assess service coverage)
- National level (monitor progress towards national health targets)
- The international or global level (reporting on sustainable development goals)

See the appendix for a complete, annotated list of HIS data use and needs by each sublevel and subsystem.

The purpose of describing the levels and sublevels of the health system is to make clear how complex and dynamic the health system is and to help us understand these levels to better assess and implement appropriate intervention for HIS strengthening. These understandings will help us be more precise when describing the HIS. Each HIS is unique, because it is dependent on the country context. No two countries will be in exactly the same stage of development; describing any given country's HIS in detail will help us understand and learn across contexts.

3.0 HIS STRENGTHENING MODEL

This section describes the HISSM in more detail. We already discussed how an HIS is part of the larger health system, but this model focuses on HIS as a system in itself. Improved HIS performance, measured by data quality and data use, are outputs of a larger, interrelated system that the HISSM depicts. This model should help us identify areas that we need to address first when we set out to improve an HIS. The model can also serve as a common point of departure to organize and map assessment results, strengths and weaknesses; prioritize areas for intervention; and track country experiences.

Figure 3. Health information system strengthening model

Source: MEASURE Evaluation. 2017. Chapel Hill, NC: MEASURE Evaluation, Carolina Population Center, University of North Carolina.
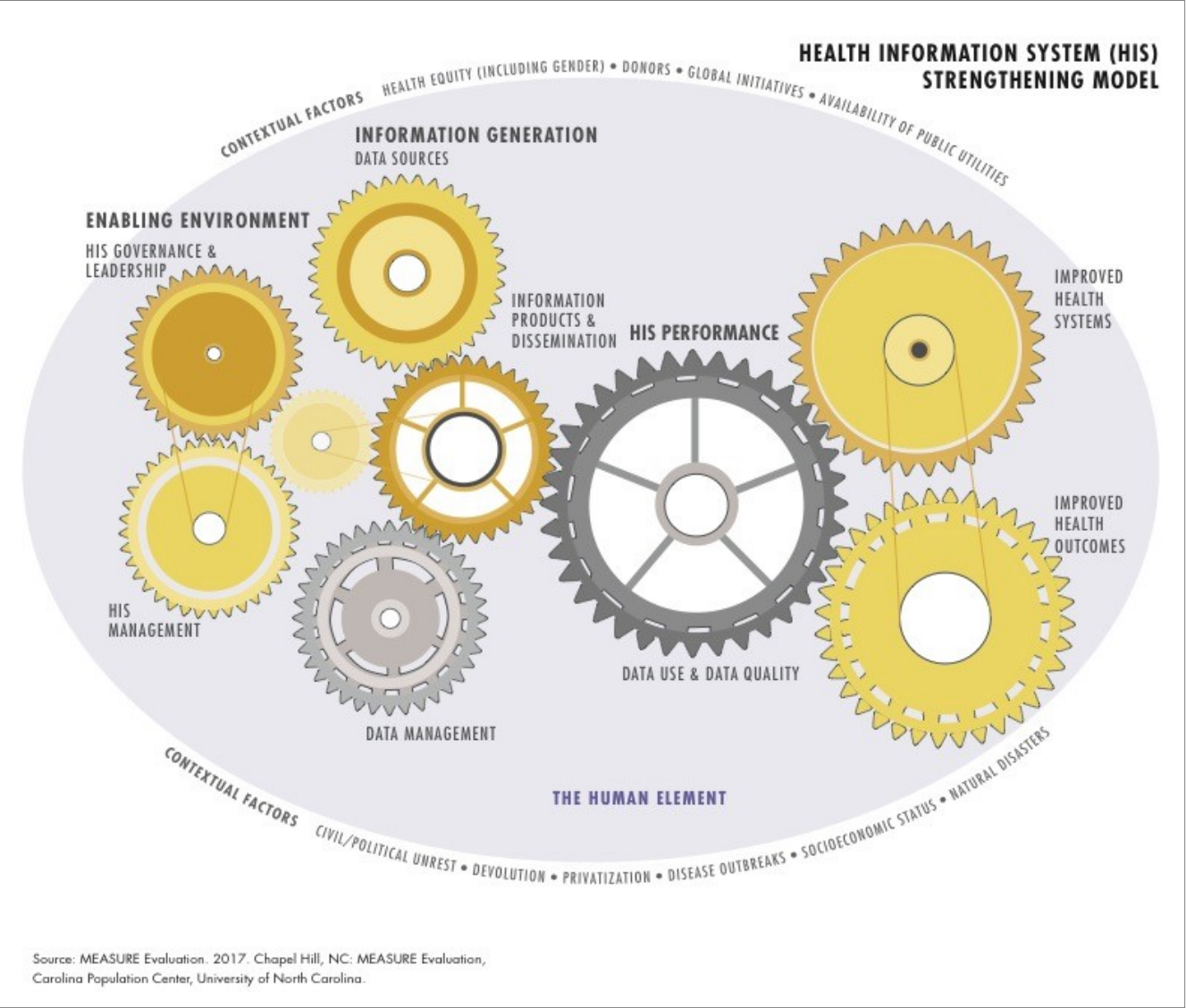
For the purposes of this model, we have drawn components from the HMN framework and elaborated key aspects of them (HMN, 2008). To help us describe the model, we will introduce the following terms used as an organizational framework for the HISSM. The model consists of four areas; Table 1 offers descriptions of three of them. The first

area (which is not in the table) is the human element: this refers to all of the people who interact with the HIS and drive its development, maintenance, and improvement. The remaining three areas are the enabling environment (the foundation for planning, implementing, and maintaining the HIS); information generation (the collection, analysis, and dissemination of health information); and HIS performance (measurement of HIS performance). In addition, the HISSM visually represents the relationship between strengthening the HIS and improved health outcomes and services, as a reminder of the importance of the HIS in meeting the needs of the health sector. We have also depicted contextual factors that can influence the HIS positively or negatively.

Human element. In the HISSM, the human element serves as a backdrop for the gears to show that it is the foundation for HIS strengthening. In fact, it is a necessary element of successful HIS strengthening efforts. The human element may include individuals who engage with the HIS as part of the HIS workforce, a data user, or a health system beneficiary. An individual may interact with the HIS through more than one role. For those in the HIS workforce, strengthening efforts involve the effective management of the workforce and the capacity of HIS staff to develop, plan, implement, use, and strengthen the HIS. For data users, strengthening efforts address capacity building and system and product design. The system must meet the user's information needs and abilities to use information. A system beneficiary is directly affected by the use of data in health decision making. For health system beneficiaries, strengthening efforts involve including and considering the perspectives, needs, and experience of individuals.

Enabling environment. The second area in the model is the enabling environment, which has two domains: HIS governance and leadership and HIS management. Governance and leadership in health systems involves "ensuring strategic policy frameworks exist and are combined with effective oversight, coalition building, regulation, attention to system-design and accountability" (WHO, 2007: vi). HIS governance and leadership consists of the following:

- Legislation that outlines specific activities under HIS (maintaining data privacy, security, and confidentiality; establishing national statistics offices; and conducting civil registration)

- Partnerships and coalition building to leverage resources

- Governance structures across and beyond the health sector

- Policies and standards (i.e., national health plans, health-sector M&E plans, health indicators to track and collect data to meet various information needs, HIS policy and strategy, and digital health strategies, and knowledge management and information use strategies)

- HIS costed plan

- The presence of HIS champions (individuals at various levels who promote the development of HIS as well as the use of data)

- Information communication technologies for health and infrastructure

HIS management covers such activities as planning and organizing HIS activities, human resources for HIS, financial management for HIS, training and continuous education, information management, and infrastructure development. This depiction of the enabling environment isn't exhaustive, but we feel it covers the most important elements necessary to improve HIS. The enabling environment also includes other domains that are outside of the HIS, including policies and the legal framework for health in general.

Information generation. The third area of the HISSM encompasses the entire process of collecting, cleaning, processing, managing, and analyzing health and health-related data from a variety of sources, as well as the creation and distribution of health information products. Here, we find data sources, data management, and information products and dissemination. Many types of data sources exist to meet information needs at each level of the health system. This model considers three categories of data sources:

1. Institution-based data sources, which include individual records, service records, human resources information, logistics management information systems, and health facility census and surveys

2. Population-based surveys and the civil registration and vital statistics system

3. Mixed-data sources, such as the public health surveillance information system and national health accounts

Data management underlies or supports the availability of data sources and the functioning of data subsystems, and it leads to the development and dissemination of information products. Many types of information products (e.g., facility service reports and national annual health statistics reports) are available for a variety of users and purposes, and can be disseminated narrowly or widely, depending on the product, by such means as distribution at meetings, e-mail, and websites. HIS and M&E units or specific disease programs could develop these information products.

HIS performance. The main purpose of HIS is to produce high-quality information to meet health sector decision-making needs at all levels. Therefore, the HISSM defines HIS performance using the dimensions of data quality and the use of data in four different ways. We discuss this in Section 6.

Box 2. Health equity and HIS

Health inequalities are observed by gender, socioeconomic class, race/ethnicity, and geographic area. Inequalities persist if we don't pay specific attention to them, so if we want health equity, we must measure health inequalities by developing and using an HIS to track them. To do this, HIS data must be collected, analyzed, and used to examine inequity. These data can be collected through such HIS sources as a census, vital registration, household surveys, and facility-based data. For gender specifically, nonroutine data are more often collected by sex. It is important for routine health information systems to integrate gender through sex-disaggregation and gender-sensitive indicators (indicators that directly measure aspects of gender, and that try to more thoroughly examine how gender relations affect health and development outcomes), because this will allow continuous monitoring and timely course corrections. In addition to enabling data collection and analysis structures to include stratification by sex or other gender-sensitive indicators, it is equally important to build a culture of equity-oriented decision making in HIS, through capacity building and awareness raising (Nolen, Braveman, Dachs, Delgado, Gakidou. et al., 2005).

Contextual factors. Donor priorities, privatization of health services, epidemics such as Ebola, and natural disasters are good examples of the contextual factors that the model incorporates. Such factors influence an HIS as a whole and can have positive or negative effects on it, depending on the global and country-specific context. Another important contextual factor is the value a country places on health equity (the absence of health differences between

more and less socially disadvantaged groups; see Box 1). Other contextual factors are corruption and competing priorities (Thomas, 2016).

Table 1. Area, subareas, and elements of the HISSM

Area	Subareas	Examples
Enabling environment	HIS governance and leadership	Private partnerships; partnerships across and within government agencies; international partnerships and coalitions; community coalitions; a health sector plan; a health sector M&E plan, including the identification of information needs and indicators; HIS policy and strategy; ehealth policy and digital health standards including privacy and security; various information and communication technology standards; technical working groups and coordinating bodies; data stewardship; and HIS champions at the national, regional, and facility levels
	HIS management	Financial resources management; infrastructure development and maintenance; supply and maintenance; in-service and continuous education; human resources training development, training at higher levels of the health system, and incentives; standard operating procedures and guidance; information and communication technology; roads; vehicles
Information generation	Data sources	Population-, institution-, and resource-based data systems. Population: census, population surveys, facility surveys, and civil registration and vital events. Institution: patient records. Human resource: infrastructure including technology, human resources, and pharmaceutical and laboratory supplies and logistics
	Data management	Standard operating procedures for specific data sources, guidance for data managers, data quality-assurance practices, development and production of data collection tools, supportive supervision procedures, data quality assessments, training at lower levels routine data quality assessments, data analysis protocols, and data ethics procedures.
	Information products and dissemination	Routine reports, bulletins, data briefs, stakeholder dissemination meetings, and feedback mechanisms (dashboards and scorecards); nonroutine reports; websites and social media; and other publications
HIS performance	Data quality	An area of HIS performance measured by the quality of the data collected to support the HIS
	Data use	An area of HIS performance measured by the use of HIS data to generate health indicators, statistics, trends, and coverage, and for data-informed decision making based on the health sector's decision making needs

Box 3. Indicators and Information Needs in the HISSM

A strong HIS will meet a health sector's decision making needs. Thus, a prerequisite of designing an HIS is to determine what information you need to know. This informs the selection of indicators, and knowing your indicators informs what data need to be collected. In some contexts, the type and number of health indicators collected throughout the country vary tremendously. One intervention is to establish a standard set of indicators with common definitions that can be used across the country based on national needs. But in order to do this, we must first ask, is there a national health strategy that outlines the health priorities and goals for the next five years? Is there an M&E and review system in place for the national health strategic plan that comprises all major disease programs and health systems? Usually, having a well-defined set of indicators is the first step in measuring results, but indicators are just one part of the larger health information system. We need to ask: How will the indicators be collected? Which indicators should be sex-disaggregated? Does the current system have the ability to collect high-quality indicators? Guidelines and standards to define indicators and to manage the collection, aggregation, and analysis of the data must exist to accompany a list of indicators. Human resources and capacity are other important components of the system. Without these, the indicators can't be collected. Processes must be in place to train and manage staff, such as doing regular data-quality checks and providing feedback to the data collectors. National indicators require periodic review to ensure they continue to meet data needs and expectations of quality. It is also possible for indicators to change at the global level, which would affect how indicators are collected nationally. The HIS needs to be flexible enough to incorporate these changes as they happen.

Each of these areas builds upon the others to create strong HIS, which the model reflects as leading to improved health systems and improved health outcomes. Not everything listed in Table 1 would need strengthening. Priorities will depend on the country context, where some of the subareas will need greater attention in order to strengthen the HIS. A strengthened health system will lead to improved health outcomes over time, and it is possible that these improvements will occur simultaneously. This is why the model presents them at the same level. These two components are included in the HISSM to remind the user of a strong health information system's purpose. Box 3 presents one example of how the various areas and subareas described work together.

4.0. THE HUMAN ELEMENT IN HIS STRENGTHENING

The human element in HIS strengthening is separate in the HISSM for the following reasons:

- People, including those who use health services, interact with the HIS in various ways.

- The human element is integral in every area of the model.

- Many interventions in HIS strengthening focus on helping people perform better.

- The DOING in HIS strengthening rests on people (the HIS does not perform; the people who interact with it do).

- Behavior change is difficult. It takes time and money, and we tend to focus on the system itself and not on changing the behavior of the humans who interact with the system.

The success of HIS interventions involves having the right number of well-trained, well-supervised, fairly remunerated, and motivated workers. All of the advancements in technology and in research that points to the most promising technological solutions and the highest level of commitment by policymakers will not be enough to strengthen HIS if the human side is not addressed. We must also address the burden that HIS strengthening can put on health workers, particularly in settings where there are no dedicated staff to focus only on HIS. Most of the time, routine data collection is performed by a health worker who is also supposed to be providing high-quality care to patients. Given the investments in HIS, it is possible for a single health worker to have seen various interventions come and go; this can affect their personal motivation to learn and implement a new HIS intervention. Therefore, this area focuses not only on workforce development and capacity but also on the behavior of staff who are implementing HIS reforms.

Human Resources and Capacity for HIS

Other core functions such as finances and leadership and governance are important in HIS strengthening, but human resources has overarching importance, because the success of any HIS strengthening efforts will depend on the people who work in HIS. Donor-funded activities will come and go. The long-term success of the initiatives donors fund will depend on the institutionalization of these interventions within the larger system by the country nationals tasked with improving HIS. Furthermore, strengthening an HIS will only be sustainable if there is a clear plan for engaging the entire health sector to supporting that effort. Each person in the health sector has a role in promoting the strengthening and ensuring the sustainability of the HIS.

This plan for the development and maintenance of the human resources for HIS must be part of the enabling environment, along with the development of policies and standards under governance. It is essential for roles and responsibilities to be clearly defined, for human resources to be available in adequate numbers and with the needed mix of skills (e.g., M&E, information technology (IT) support, and communications), and for pre-service and in-service training programs to be aligned with country HIS needs.[1] The human element is not limited to the health

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[1] MEASURE Evaluation has developed a curriculum for RHIS—https://www.measureevaluation.org/our-work/routine-health-information-systems/rhis-curriculum—that addresses the following core competencies: data analysis, presentation, interpretation, and communication and reporting; data use, demand, and generation; data management; design, improvement, and implementation; RHIS assessment and monitoring; RHIS management; use of information and communication technology (ICT); and HIS governance.

workforce and does not refer only to HR management. HR development and production are key domains that HIS resource management does not necessarily cover.

HIS success depends on having a wide and varied workforce; human capacity for HIS is broader than it seems. We can use the HISSM to identify specific capacity needs across the different areas of the model (Table 2).

Table 2. Examples of skills needed in different areas of the HISSM

Enabling Environment		Information Generation		
Governance & leadership	Management	Data sources	Information products and dissemination	Data management
Skills in developing training curricula, policies, and guidelines; leadership skills	HIS management skills	Interviewing skills for household surveys, data collection tool development skills, software development skills, IT support skills	Skills in data visualization, report writing, and graphic design	Data entry, cleaning, and analysis skills

In the enabling environment, we need people with skills to develop and update policies, standard operating procedures, guides, and legislation for HIS. We need people with leadership skills to form and sustain partnerships and leverage resources for HIS. We need people with management skills to oversee the implementation of HIS strategies. Under information generation, staff need to be capable to collect data for a population-based survey or census, to collect routine health data, and to collect data for civil registration and vital events. All of these data sources have their own specific requirements and skills. What methods are used to collect this data? Are electronic systems developed and deployed in these efforts? If so, we will also need staff who are able to develop and update data collection mechanisms as well as provide IT maintenance and support for equipment, networks, and servers. Staff also need skills to present information to different audiences using the most appropriate methods as well as to advocate action or change. We also need staff who are trained to process, manage, and analyze all of these data sources, and who can examine differences between populations and subgroups such as gender, key populations, or other vulnerable groups. We also need people who can train and supervise others as well as project and estimate what their HIS human resources needs will be in the future, so that the work will be sustainable.

Capacity building's foundation is a good general education. Pre-service and in-service training, continuing education, and supervisory visits are important ways to transfer knowledge and skills for HIS improvement. Pre-service education will most likely require the involvement of the federal department of education that sets curricula for training institutions. This highlights how an HIS needs to work across sectors in order to succeed. Capacity building can be done for existing occupational categories, such as health workers, M&E or HMIS officers, and community workers. However, one of the possible results of strategic planning for HIS is the creation of new occupational categories to meet emerging HIS needs: for example, the creation of health information technicians in Ethiopia to focus on data entry and management and IT support for health facilities and offices.

Human Behavior and HIS Strengthening

The behavior and performance of HIS staff are critical to HIS success; this area needs study so we can fully understand it. One researcher has called the human behavior component the "third dimension of health system strengthening" and proposes turning to what we have learned from the health behavior-change literature for guidance (Nutley, 2016). People interested in improving the performance of clinical duties and in improving performance of health workers in general are also paying attention to this topic. These discussions offer a starting point for thinking about specific HIS tasks. For example, IntraHealth provides a framework for health worker performance that includes both organizational and individual factors (Murphy & Sebikali, 2014). Organizational factors are organizational systems to support performance, incentives, tools and physical environment. Individual factors are knowledge, skills, and individual attributes. Table 3 presents these in detail.

Table 3. Determinants of health worker performance

Factor	Question	Examples
Organizational	Do the organizational systems support the desired performance?	• Effective leadership • Clear job expectations and authority • Standards and procedures • Supportive supervision system • Clear and accessible communication and information channels
Incentives	Do employees and teams have a reason to perform as they are asked to perform?	• Constructive performance feedback • Fair compensation and rewards systems • Recognition for good performance; consequence for poor performance • Professional development and career opportunities
Tools and physical environment	Do employees and teams have the necessary tools and physical resources they need to do their jobs?	• Equipment and supplies • Physical work environment • Protocols and job aids • IT and communication systems
Knowledge and skills	Do employees and teams know how to do their jobs?	• Basic education for literacy and math • Technical skills • Problem-solving, critical-thinking, teamwork, and leadership skills • Relevant work experience
Individual and unit attributes	Do personal attributes of individuals and their work units affect their ability to work together and perform their jobs?	• Internal motivation • Gender, ethnic, and class identities • Emotional, intellectual, and physical, creative abilities • Previous life and work experience
External environment	Do factors in the external environment impede or support the ability of the organization and employees to perform and achieve their goals?	• National policies, regulations, standards, and scope of work • Social norms • Socioeconomic conditions; education levels • Political changes in government

The framework presented in Table 3 encapsulates all of the possible determinants of health worker performance. Determinants that are specific to the individual (knowledge and skills, individual attributes) are important but not enough to ensure workers do their jobs well. For example, nurses in a health center need job descriptions that cover both their clinical and HIS duties. They need to receive constructive feedback on the quality of their HIS work, have access to HIS guidelines at the workplace for reference, have the technical training for HIS (both indicator definitions and any IT skills needed), and possess individual attributes that allow them to take pride in their work.

The framework shows that behavior change in health service and HIS staff can be achieved only if we work within the entire health system and across the core functions of health system strengthening. For example, the information core function can only address components such as having appropriate tools to perform your job. The information core function is partially responsible for HIS-specific training. However, training of health workers is also addressed by the human resources core function and in the education sector outside of the health system. Salaries and incentives have to come from the financing and the leadership and governance core functions. To yield successful outcomes, these efforts must be coordinated across the core functions of health system strengthening.

It is necessary to assess and monitor the capacity of health workers to ensure that they have all the skills needed and receive constructive feedback on their performance. However, assessing individual capacity is a sensitive endeavor. The PRISM Series,[2] for example, includes measures of self-reported confidence and ability and skills assessments where workers are asked to perform tasks such as graphing and interpreting data. PRISM assessment findings in Mali and Côte d'Ivoire in 2018 (Barry, 2018) reported participant reluctance and sometimes avoidance in completing the assessment. This raises the question of how to assess workplace skills and performance in a nonthreatening way, so that we can address the need to support workers with the training and resources they need to perform their job optimally. We need to be careful to present these assessments as nonthreatening and explain that the assessments are tools to help workers do their job better.

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[2] https://www.measureevaluation.org/resources/tools/health-information-systems/prism

5.0. STRENGTHENING THE HIS PROCESS

This section focuses on key principles in strengthening an HIS through interventions. The strengthening of an HIS is accomplished through the assessment, identification, planning, implementation, and monitoring and evaluation of interventions based on the current state of the HIS and the context in which the system was developed. Many HIS are developed piecemeal and only respond to specific demands, particularly for specific diseases (for example, HIV or maternal health), without always addressing how the selected interventions affect the greater HIS or how weaknesses and gaps in the HIS will undermine the effectiveness of inputs or require redundant work-arounds. These fragmented HIS lead to such problems as duplication in the collection of data for key indicators, failure to use health data at the local level, and multiple independent data systems (WHO, 2014; Boerma & Stansfield, 2007). Interventions must be selected thoughtfully, to make sure the most appropriate ones are implemented at the right time.

HIS Strengthening as a Process

The HMN framework described a three-phase HIS improvement plan with the following phases:

- Phase 1: leadership, coordination, and assessment

- Phase 2: priority setting and planning

- Phase 3: implementation of health information strengthening activities

The HISSM builds on this and can help guide the process of strengthening the HIS, which is most successful with the ongoing engagement of local stakeholders, or preferably, if it is led by the local stakeholders. For example, a country may use the HISSM to guide the description of the state of its HIS and to document the areas of the model being strengthened and those that need attention. The following sections highlight key points in HIS assessment and considerations in implementing HIS interventions.

Assessment

An HIS assessment is a systematic review of a single component or multiple components of the HIS to substantiate existing HIS functionality. If such an assessment has not been conducted in the past 10 years, conducting one should be the first step, because doing so will identify weaknesses, establish a baseline to measure strengthening efforts, and guide decisions about which interventions and strategies should be employed. If an assessment has been conducted and a strategic plan was developed, the first step could be to review the main actions identified and evaluate progress in implementing these strategies. Local stakeholders should be engaged in the HIS assessment and the development of strategic plans based on the assessment.

Mixed methods are often used to do an HIS assessment. Quantitative data collection is important to establish baseline values for indicators that can be monitored over time to measure change in the system's performance. Qualitative methods help us understand how and why some subsystems are or are not working.

A mixed-methods HIS assessment may also include assessing determinants specific to the performance of the HIS. Examples of HIS assessment tools are the PRISM Series, the RHIS Rapid Assessment Tool (https://www.measureevaluation.org/resources/tools/rhis-rat/routine-health-information-system-rapid-assessment-tool), the Integrated Disease Surveillance and Response Tool, and tools to support the collection of data for civil registration and vital statistics. HIS assessments require a great deal of resources, time, and participation by stakeholders; it is important to monitor follow-through with decisions informed by the assessment findings. Users should be aware of the strengths and weaknesses of HIS assessment tools and know when to use each tool. MEASURE Evaluation built an annotated catalog of HIS tools which is available here: https://www.measureevaluation.org/his-strengthening-resource-center/his-assessment-tools.

Assessing and selecting the best interventions for HIS strengthening in a particular country are labor- and time-intensive and thus are undertaken infrequently, but the process is valuable, because it yields a road map for the work ahead. Assessment approaches are part of the HISSM's enabling environment. The HIS as a whole has to be flexible and resilient to change when new and immediate needs arise, such as an emergent disease that must be added to a surveillance system. It must also address crosscutting issues, such as gender and other health-equity concerns. Contextual factors, which are part of the HISSM, must also be considered, because they often play a big role in HIS assessment and decision-making processes. Examples are the historical role of donors influencing HIS strategic planning and priorities; turnover and unavailability of stakeholders, which can dilute local support for HIS strengthening; and political or health events that may change a country's priorities and ability to sustain strengthening of the HIS.

Considerations in HIS Planning and Implementation

Ideally, interventions are designed and a plan for implementation is determined once the assessment has been conducted and gaps and priority areas are identified. An HIS strategic and implementation plan needs to be harmonized with the national health plan and M&E plan, as explained in a guide to the M&E and review of national health strategies, developed by WHO and the International Health Partnership (WHO & International Health Partnership, 2011).Harmonization entails several considerations.

First, the implementation approach depends on the overall country context. We can't assume that an intervention that has been effective in one country will work as well in other countries. HIS interventions, as any other public health interventions, need to be created for the local context. Specific contextual factors that affect the HIS are literacy, access to electricity and the Internet, and national health priorities. National health priorities are also an extremely important contextual factor influencing the data elements required for collection, the architecture of the system, organizational support and roles and responsibilities of the system, and the overall culture of data use.

Second, the state of the HIS may affect the success of interventions to strengthen the system. For example, if the intervention is to train health records officers in data analytics, the details of this approach must be informed by whether or not these people have been trained in the past, the style of training most effective in this country's context, and other standard considerations for determining the most appropriate way to deliver

the training (e.g., through a workshop, mentoring, or on the job). The intervention has to be tailored to the maturity of the HIS, which can be determined if the HIS has been properly assessed.

Third, even an intervention that targets a specific element of HIS is part of a larger system. This means that the effect of the intervention can be realized across the system, but it also means that the intervention can be limited if other parts of the HIS are weak. Mapping interventions to the HISSM can be helpful for understanding where the interventions fall in relationship to the expected performance of the HIS.

Fourth, intervention activities, regardless of which aspect of the HISSM they are targeting, should focus on one or more of the key determinants of HIS performance. To do this, we can draw from the PRISM framework again, which identifies three types of determinants that influence HIS performance: organizational, technical, and behavioral. These three types of determinants can categorize intervention activities, based on how those activities are expected to strengthen the HIS. Intervention activities are not mutually exclusive and often address one or more determinants as well as one or more components of the HISSM.

The determinants defined in PRISM are as follows:

- **Behavioral.** People involved in the health system require confidence, motivation, and competence to contribute to a high-performing HIS. Interventions addressing this determinant tend to focus on improving an individual's ability to execute tasks in support of the HIS; examples are establishing pre-service training in RHIS, developing HIS curricula, and creating supportive supervision structures to provide feedback and support on HIS tasks.

- **Organizational.** HIS are designed, implemented, and sustained within a health service system. Examples of organizational factors are inadequacies and poor support for management, supervision, and leadership. Organizational determinants influence the HIS, by affecting the system's performance through organizational structure, resources, procedures, support services, culture, and—directly or indirectly—behavioral factors. Interventions addressing this determinant tend to focus on improving an organization's ability to execute tasks in support of the HIS. Some examples are creating legal and regulatory HIS guidelines, developing a framework for the health information enterprise architecture, developing job descriptions, and holding performance review meetings.

- **Technical.** This determinant encompasses developing indicators, designing data collection forms, preparing manuals, using IT, design and developing software. Interventions addressing this determinant tend to focus on strengthening a specific person's technical skills and the infrastructure to support the system.

The following table maps examples of interventions addressing these three determinants as PRISM defines them to the main areas of the HISSM.

Table 4. Mapping interventions to the HISSM

Enabling Environment		Information Generation		
Governance & leadership	Management	Data sources	Information products and dissemination	Data management
Development of policies and guidelines (organizational) Coordination of national indicator review (technical) Training in data use for decision making (behavioral)	Establishment of HIS coordinating body (organizational) Data warehouse development (technical) Developing data use framework (organizational)	Designing electronic system for RHIS (technical) Revision and redesign of specified data source systems	Training for staff in data visualization, report writing, and communications (behavioral) Data analysis, triangulation, and compilation tools and skills (technical)	Creating interoperability among data sources (technical) Developing a job aid to assist in data entry (behavioral) Creating data collection forms for civil registration and vital statistics (technical) Developing tools for data quality assessment (DQA) (technical) Establishing a schedule and budget for DQAs (organizational)

Most of the organizational and technical interventions are part of the enabling environment, even though they directly affect the area of information generation. Behavioral interventions can occur across all of the areas of the HISSM; the two examples in the table relate to "information products and dissemination" and "data management." This table is not exhaustive. It illustrates some examples of how the various interventions map to the HISSM.

Strengthening Health Information Systems in Low- and Middle-Income Countries

6.0. SUSTAINABILITY OF HIS

"Sustainability" is a local system's ability to produce the desired outcomes over time (USAID, 2014). The concept embodies the processes undertaken to ensure an HIS is stronger, more resilient, and able to perform to a high standard of reliability, and eventually operated and maintained without external support. The approach and outputs of sustainability are not linear but are complex, therefore requiring purposeful planning and clearly identified inputs.

Key sustainability principles supporting HIS strengthening are the following (MEASURE Evaluation, 2014; Draft):

1. **National leadership with broad stakeholder engagement**. The country government is the architect of the health sector response and design of its HIS. Working toward a sustainable HIS involves inclusive partnerships that engage a wide range of stakeholders—for example, donors, regional actors, communities, nongovernmental organizations, civil society, faith-based organizations, and industry leaders.

2. **Institutionalization and routinization.** Country systems are vehicles for health service delivery. Technical assistance should be demand-driven and embedded in complex national systems through routine and regular processes, with clearly defined roles and responsibilities and management by national actors. The institutionalized and routinized processes, however, adapt to cope with emerging challenges and opportunities.

3. **Process and direction.** Local stakeholders are engaged proactively and regularly in a process to ensure the maintenance and improvement of the HIS. Although the process route is not linear, the goal is defined. The process is inclusive, in that the voices and concerns of industry leaders and civil society are properly accommodated.

4. **Resource mobilization and management.** Country sustainability ultimately depends on the assurance of a country's commitment to finance its own systems, with diminishing donor financing and support of system operations, maintenance, and development.

Chapter 201 of USAID's Automated Directives System (ADS) states the main concepts required to support the long-term success and sustainability efforts that can be applied to strengthening the HIS. These include local ownership and capacity building at all levels of the HIS to produce the HIS outcomes of interest. In addition, donors, organizations, and projects providing technical assistance for strengthening HIS must respond to the priorities and perspectives of local stakeholders, including the partner country government, beneficiaries, civil society, the private sector, and academia (USAID, 2016).

7.0. M&E OF HIS PERFORMANCE STRENGTHENING EFFORTS

This section focuses on monitoring the performance of the HIS and M&E of specific HIS interventions. Just as we develop monitoring systems for health-service delivery programs, we need a system for countries to monitor the progress and performance of their HIS. This is important, because in order to know if the HIS is meeting the information demands of the health sector, we must be aware of how the HIS system itself is performing. An HIS is strengthened when there has been a positive change in the performance of the HIS, as characterized by improved data quality and the use of those data to generate health-sector indicators and inform data-informed decision making. To maximize strengthening, we need to monitor the system's performance (using both direct and proxy measures) and evaluate whether the interventions selected are having the intended effects.

Monitoring HIS Performance

The true performance of the HIS depends on the performance of the people who interact, develop, maintain and use the system. Ideally, a country will have an HIS strategy or policy that outlines its plan to strengthen its HIS. This strategy should include an HIS M&E framework or plan that outlines how the health ministry will accomplish the following tasks:

- Measure HIS performance inclusive of all data sources through the identification of HIS indicators.
- Assess baseline values for selected indicators.
- Routinely monitor important HIS indicators.
- Evaluate high-priority (highly resourced) HIS interventions.
- Share progress and solicit feedback in HIS strengthening and performance.

AbouZahr (2013) describes a conceptual scheme and timeframe for HIS assessment and monitoring activities (Figure 4). This lays out a five-year plan that begins with a formative review of HIS inputs and processes and the development of an HIS strengthening plan, plus the continuous review of HIS products and selected indicators to monitor progress. (We discussed assessments in Section 5 of this narrative.)

Figure 4. Conceptual scheme for monitoring HIS performance
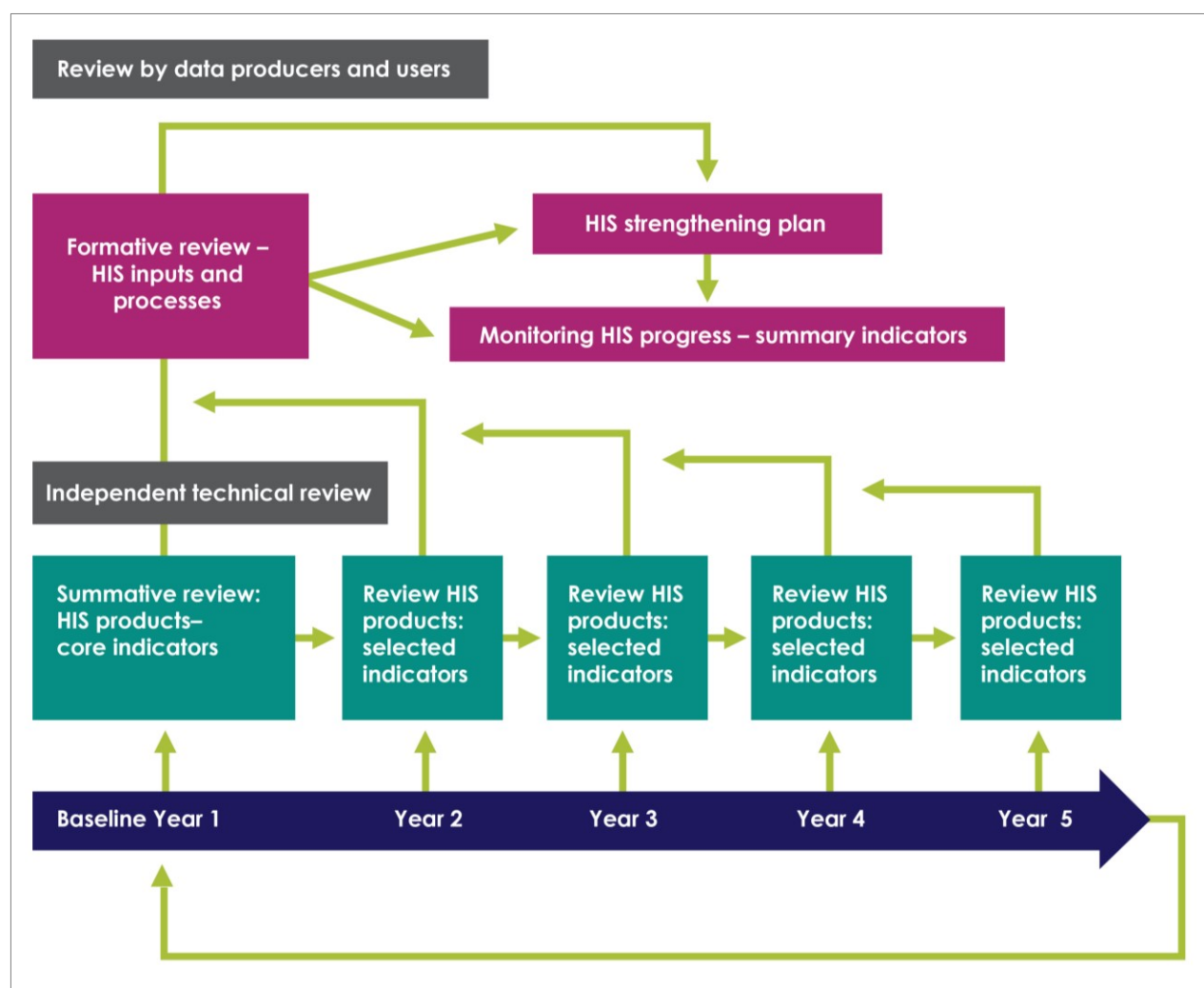
Monitoring of HIS performance is defined as the institutionalized routine monitoring of the performance of the HIS, which consists of monitoring the outputs "data quality" and "data use." This involves identifying HIS indicators to be monitored across the HISSM and within each of the data subsystems.[3] The HIS includes all data sources, so how performance is measured will vary by the type of data source.[4] The methods used to measure data quality for routine health data will not be the same as those used to assess the quality of data obtained from civil registration and household surveys. HIS managers should actively monitor, document, and use these data to pinpoint issues in data quality and identify opportunities to improve data quality and use. There are many possible HIS performance indicators, and another MEASURE Evaluation activity is to identify HIS performance indicators, characterize and prioritize those indicators, and understand the data

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[3] MEASURE Evaluation has compiled a list of HIS indicators that countries can use to measure performance, available here: https://www.measureevaluation.org/his-strengthening-resource-center.

[4] Guidance on HIS data source standards are available on the MEASURE Evaluation website: https://www.measureevaluation.org/resources/publications/tr-17-225

sources and methods needed to populate them and interpret their results. This will help us to understand better when and how to use HIS performance indicators.

Data Quality

Data quality can be measured through completeness, timeliness, and accuracy. This section focuses on routine data. However, each nonroutine data source will have its own mechanisms to ensure data quality, and many of these principles apply. For example, the Demographic and Health Surveys program provides detailed information on how data quality is monitored throughout the data collection, processing, and analysis phases of the household and facility surveys conducted worldwide (see http://dhsprogram.com/data/Data-Processing.cfm).

The feasibility of routine monitoring depends upon availability of data. In the case of data sources that are collected routinely, some HIS data quality indicators will be easier to collect, report, and use in countries that have electronic systems. This is most clearly the case with indicators specific to health-sector data quality, where electronic systems should be able to report timeliness and completeness of data.[5] This is still possible in paper-based systems, but there may be some delay in getting this information. Another important factor in the completeness dimension of data quality is the proportion of private service providers in the health sector and their level of participation in reporting to the national system. This will vary by country, and a picture of what is happening in the health sector will not be complete without full private-sector participation. Interventions under way worldwide specifically address engaging the private sector. Doing so can begin with passing legislation that mandates reporting and enforcement and engagement strategies.

Several strategies exist for improving the quality of routine data. One strategy is to conduct data checks and reviews within the facility and at higher levels where data are collected. For example, data collected at service points can be aggregated and sent for review at the district and regional level. Feedback can then be provided to lower-level units to improve the quality of the data, with job aids developed to help staff review data systematically. Another such strategy is to implement data quality assessment by routinely administering tools such as those for data quality assessment (DQA) and routine data quality assessment (RDQA) (MEASURE Evaluation, 2016).[6] The latest guidance for assessing data quality can be found in the Data Quality Review, developed through MEASURE Evaluation in 2016, to be available publicly in 2017. This a labor- and resource-intensive activity, so it is done only every few years and only on selected indicators. Although global and country-adapted tools for data quality assessment exist, most focus on routine data collected at facilities. Often the data quality activities are applied to inconsistent samples, preventing the construction of a longitudinal trend for data quality. Other data sources in an HIS, such as household surveys and the census, have protocols to assure data quality: careful training of data collectors, formatting data entry to reduce errors, supervisory checks, returning to selected households, and data entry checks.

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[5] Guidance on data quality reviews using electronic systems will be available from MEASURE Evaluation later in 2017. Please check our website for details.

Data Use

Data use "…is the analysis, synthesis, interpretation, and review of data as part of decision-making processes, regardless of the source of data" (Nutley & Reynolds, 2013). Data use—a key output of the HISSM—relies on the use of data from multiple HIS data sources. It occurs at every level of the health system: formally and informally, and planned and ad hoc. For example, data are used regularly at service points for client management by clinicians and this can be monitored using such technology as electronic health records. Data are also used on a regular basis for health facility management, such as using information to avoid medication stockouts or to improve health facility efficiency.

Data are used to improve health system functions; data use has two main objectives in the context of the HISSM, which are important in identifying ways to measure it. The first objective is the use of data to improve the HIS by improving data quality. The second objective is the use of data to drive informed decision making. The second objective of data use is more challenging to measure, because actual use of data (decision making and action for health program improvement) falls within the other health system functions (e.g., governance). Moreover, often data do not inform decision making, owing to factors outside of the health sector that inhibit data use, such as political ideology and priorities, culture, and other competing priorities.

To address the complexities of measuring data use, we present a continuum that takes into account the two objectives of data use (for information system improvement and for health program improvement). The continuum meets information needs within and outside of the HIS and captures the two objectives of data use, regardless of the health program, data source, frequency of collection, or level within the health system where the data are used. Category 1 addresses the first objective: strengthening the HIS. Categories 2–4 address the second objective: improved health programs. The first categories in the continuum are precursors of the ultimate goal of data-informed decision making.

Each of the points along the continuum requires different or specific considerations when identifying measurement indicators and each is influenced by different HIS strengthening interventions. The continuum of data use is relevant at each level of the health system: client; community; facility; a subnational level, such as a district or province; national; and global. Figure 5 shows the flow of the continuum from improved data quality, to the generation of health statistics, to the development of information products, with the use of data for informed decision making being the action in closest proximity to improved health services and outcomes. This assumes that health systems and outcomes will improve when data are used to manage clients and facilities; to inform resource allocation, targeting, or planning at national and subnational levels; or to inform policy. Each level of this data-use continuum pertains to all types of data sources (population- and nonpopulation-based), although the timing of these events will differ. For example, some routine data are collected quarterly, whereas a household survey occurs every four to five years.

Figure 5. Continuum of data use
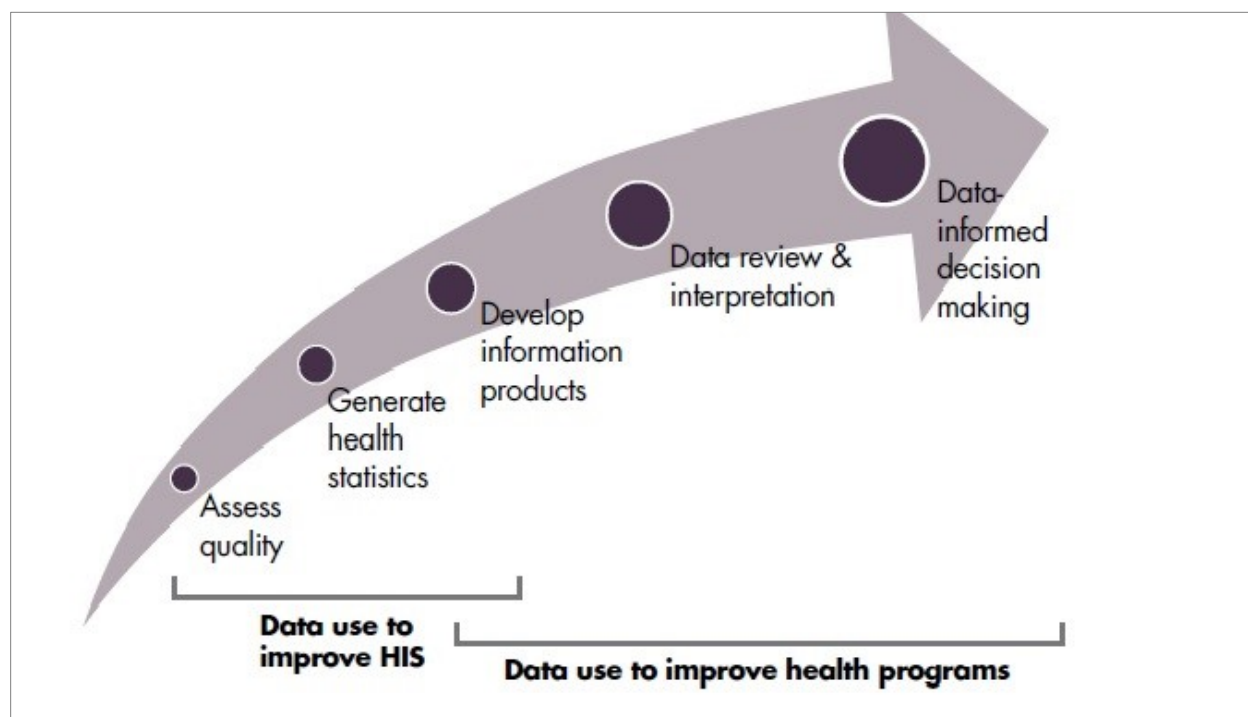
The continuum has the following five components, which can contribute to improving the HIS itself as well as to the improvement of health programs:

Assessing data quality. As previously discussed, in order to strengthen an HIS, we need data on how it is performing. The ongoing identification and targeting of HIS strengthening interventions for all data sources and at each level of the health system can be informed through the use of HIS assessment data (as discussed in Section 5) and routine reports on the quality of data. Organizations managing the HIS are responsible for using these data to strengthen the HIS. At each level of the health system, an opportunity exists for routinely collected health data to be shared with health providers and managers collecting this information. In practice, this involves the review of data quality reports by HIS and health managers to understand gaps, inconsistencies, and inaccuracies in reporting. Corrective actions can be identified and implemented so that future reporting is complete, consistent, and accurate, thus strengthening the HIS. Data quality review is not a one-time event. Often, after data quality reviews have been conducted and staff are ready to analyze the data to understand their programs, they discover that data quality issues remain, compromising the validity of the analysis. Staff discover that data are missing, or staff mistrust what they see, and in response, they decide to conduct more data quality exercises.

Calculating health and management statistics. Data are needed to calculate health statistics. These statistics can include facility-level indicators needed for facility management; they can also include the calculation of health indicators required by donors and or the country's ministry of health (outlined in a national health strategy and health sector or health program-specific M&E plan). The reality is that even in countries where the HMIS program is strong, the national indicators collected are not sufficient for the day-

to-day management of facilities. For example, the national indicator may ask for the number of new and current family planning acceptors, but for facility management, you may also want to know what type of family planning method these acceptors are using. If an HIS performs well, HIS staff should have the tools and knowledge to review and analyze data so that they can calculate statistics for all providers of services within the health system. Such analysis encompasses calculating coverage and trends for specified health indicators. Staff then express these health statistics in a table, chart, or chalkboard format that can be quickly read, reviewed, and reported at all levels of the health system and to global entities requesting these data. These types of statistics can be generated on a schedule or upon request. Ideally, private sector data should be incorporated at this stage to complete the picture of health and management statistics in a given geographic area. Capacity for this work varies greatly from country to country.

Developing and disseminating information products. Health statistics can be disseminated to stakeholders in such formats as reports, dashboards, PowerPoint presentations, articles, special interest papers, policy briefs, and speeches. This requires HIS and health managers to employ tools and knowledge that go beyond what is required to calculate health statistics. The use of analyzed data, requires that the HIS and health managers responsible for developing and disseminating health information products synthesize indicators and data into information that describes the findings and may also recommend action. Managers need to understand the purpose, objectives, and audience for the product. In addition, this work often takes place with support from communication specialists, who focus on ensuring that the product meets the information needs of the stakeholders and addresses a clear issue. These products need to be tailored to different audiences to be effective. These activities are usually taken up both by HIS staff and individual program staff working across one or multiple health system functions (i.e., human resources) or specific health program areas (i.e., malaria).

Data review and interpretation. Once the information products are prepared and disseminated, the products are then reviewed and interpreted for program performance in a proactive and interactive process that brings together the people who produce the data and those who use the data. This is a critical step in the continuum, because it is not enough to produce information; a critical review of what is being produced is needed, too. The health statistics and information products are reviewed during program monitoring, planning, and improvement; advocacy; and policy development and review. This review process helps to identify priority problems, craft solutions to address them, and advocate decisions that will ultimately improve health programs, systems, and outcomes.

Data-informed decision making: Data-informed decision making refers to the proactive and interactive processes that consider data during program monitoring, review, planning, and improvement; advocacy; and policy development and review (Foreit, Moreland, & LaFond, 2006). This last point in the continuum is substantially different from the previous three, where the focus on data use has been on strengthening the information system by ensuring confidence in the quality of the data being used, that the data are analyzed to answer key health questions, and that the analyses and findings are synthesized and disseminated through tailored information products. In addition, data-informed decision making focuses on improving health systems, programs, and health outcomes. The three previous phases in the continuum are functions led by organizations managing the HIS. But the responsibility to use health statistics and information products to inform decision making is beyond the authority and control of the organization responsible for the HIS and,

in some cases, the health sector itself. The actual use of data for making decisions is a health and multisector-wide function influenced by governance structures, human capacity, and commitment to use health data to make informed decisions. It occurs at all levels of the health system and within each of the six health-system building blocks. Regardless of the quality of health data, this type of decision making is directly influenced by factors that have nothing to do with data, such as the availability of funds to implement a data-informed decision, the political will to advocate a decision, and the general complexity of decision-making processes and structure. This makes measuring data-informed decision making with an HIS lens difficult. That said, monitoring of inputs in HIS performance can help us understand if the HIS has been designed in the best way possible to support data-informed decision making. In addition, when we monitor identified decisions, measurement is possible through follow-up on a specific, anticipated health or health-system outcome at the client, community, subnational, or national level. As we continue to learn more about the strengthening of HIS, we will continue to learn and improve upon the guidance and standards available for the routine monitoring of data-informed decision making.

This data use continuum was applied in the Democratic Republic of the Congo to map MEASURE Evaluation's activities to improve the use of data from DHIS 2 to the components of the continuum (https://www.measureevaluation.org/resources/publications/fs-19-344). In addition, MEASURE Evaluation expanded on the discussion of data use in a separate document, where there is a description of activity areas to strengthen the demand for and use of data for decision making, a summary of indicators to measure the process and outputs of data use, and a review of tools to measure the dimension of data use (https://www.measureevaluation.org/resources/publications/wp-18-214).

Building the Evidence Base for HIS Interventions

As previously mentioned, many evidence gaps exist, interfering with our ability to understand how HIS are strengthened and which interventions are the most effective (Shuvo, Islam, Hossain, Evans, Khatun, et al., 2015). To improve HIS performance, measured by data use and data quality, a more robust evidence base for HIS strengthening interventions will help planners identify promising interventions to meet their needs.

 In general, global demand exists to build evidence on the effects of all health system interventions on health systems strengthening and health outcomes (Naimoli & Saxena, 2016). Unfortunately, evidence on how HIS interventions strengthen health systems and contribute to health improvements is scarce and not well known. At a time when we are investing a lot of effort in implementation, M&E of these interventions is needed.

At minimum, HIS interventions should have an M&E plan with a clear theory of change guiding the selection of inputs and activities, which in turn informs what indicators are needed to track performance of the intervention, implementation context, and systems-wide effects. This should be a requirement that is agreed upon by those funding and implementing the strengthening initiatives (i.e., governments, donors, and beneficiaries). Evaluations require additional funding and planning, and it is not feasible to evaluate every single intervention, but all interventions can be monitored for performance and to see if the product has been rolled out as planned. Country governments and donors should evaluate novel or innovative approaches and give other potentially effective interventions priority for evaluation, based on available resources. Among these interventions may be ones that have been shown to be effective in other countries and HIS interventions where considerable resources are being spent (which will vary from country to country). We are

not just talking about impact evaluations but also other types of evaluations, such as process and performance evaluations, any of which contribute to the evidence base for HIS strengthening. Evaluating HIS interventions is challenged by an intervention's complexity, the length of time it takes to see improvements in health system performance, difficulties in linking HIS strengthening to improved health outcomes, and a lack of comparison groups. This means we need to think beyond the classic evaluation methods. For example, randomization is nearly impossible to do, because interventions are implemented in a world where many decisions are beyond the control of the evaluators. Even in highly controlled studies, we may still fail to answer questions about whether certain HIS interventions can be adopted, scaled up, and maintained outside the environments in which they were originally studied. Strict adherence to only one method limits the understanding of what worked, what didn't work, and why it did or did not work. We need to emphasize both qualitative and quantitative methods, community-based participatory research, and organizational theory and other methods such as developmental evaluation; multiple case studies; most significant change and outcome mapping; and collaborative outcomes reporting.

8.0. CONCLUSIONS AND NEXT STEPS

This narrative describes an HIS strengthening model that can be used to guide HIS planning, development, and monitoring. We developed the HISSM according to the following key principles:

- An HIS serves the health system and does not function in a vacuum.

- An HIS has to work with the other core health-system functions in order for health system strengthening to occur. The HIS is only as strong and useful as the system it is supporting.

- Country context will influence an HIS.

- The human element is often overlooked in favor of technological fixes, even though the success of any HIS intervention depends on the people interacting with that system.

- HIS activities and interventions need to be selected carefully, considering a country's longer-term needs as opposed to prioritizing short-term solutions that may not be appropriate or sustainable.

- Monitoring HIS performance is critical to ensure it is performing as intended. This can be done by measuring data quality and data use.

- HIS interventions should have M&E components to measure their effectiveness and to build the evidence for what works.

The HISSM consists of four areas: the human element, the enabling environment, information generation, and HIS performance. Contextual factors are also important and need to be considered, even if they can't be addressed by the HIS or health system alone. For example, IT infrastructure and IT personnel in a country influence HIS design, deployment, and maintenance but are not managed by the health system. Evidence shows that information system performance (different from HIS performance, described in this document) affects data quality and use at all the levels. Within each of these areas, we have highlighted knowledge gaps in HIS strengthening that need exploration. To do this, first we need to apply this model to a group of diverse countries to see how it aligns with reality and to identify mechanisms for HIS improvement. As part of this process, we should be able to identify and document the countries' contextual factors that influence HIS strengthening. Existing HIS interventions and gaps in HIS strengthening can also be identified and documented using the HISSM. Together, these two steps, if undertaken for multiple countries, can provide us with information to illuminate the dynamic nature of HIS strengthening. We need to have a better understanding of how all of the core health-system functions work together to improve health system performance and health outcomes. Moreover, many questions remain about which specific HIS interventions, if any, are the big-impact interventions that move HIS strengthening forward. This type of information can be obtained through additional resourcing and technical emphasis on evaluations of HIS interventions that include health system and health outcome measures. This task may be challenging, but some outcomes measures, such as improved service coverage, exist through which, with the right design, it may be possible to show an effect. The study of HIS strengthening will have to rely on building theory and emphasizing

plausible evaluation methods to make the case for the positive effect of investments on health systems and health outcomes. Such research will be helpful to countries, where budgets for HIS improvement are limited, when they are prioritizing interventions to select. We also need to understand how to improve the behavior and performance of the health providers and managers who support and use the HIS. We still need to understand how to establish and nurture an information culture in countries so that information is valued and used at various levels of the health system. As mentioned, researchers are drawing from the health behavior-change literature to try to understand how best to improve health-provider performance. Finally, we need to identify and test measures of data use as part of HIS performance monitoring. We identified ways in which data are used, but research is needed to develop accurate metrics to track, understand, and improve these processes.

MEASURE Evaluation aims to answer these questions through the following mechanisms:

1. The HIS strengthening resource center and learning agenda, to share MEASURE Evaluation's work and findings related to HIS strengthening: literature, tools, and HIS indicators

2. Creating HIS country profiles

3. Working with countries on specific HIS intervention research

4. Researching and working with experts to develop HIS performance measures

5. Identifying additional opportunities and resources to synthesize HIS strengthening lessons learned and best practices, undertake targeted research, and develop guidance for the M&E of HIS interventions

6. Working on data use and HIS governance activities

REFERENCES

AbouZahr, C. (2013).Assessing and monitoring the performance of health information systems: Metrics and models. Working Paper Series, Number 29, School of Population, University of Queensland. Brisbane, Australia: University of Queensland.

Aqil, A., Lippeveld, T., & Hozumi, D. (2009). PRISM framework: A paradigm shift for designing, strengthening and evaluating routine health information systems. *Health Policy and Planning*, 24(3):217–228. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2670976/.

Barry, A. (February 26, 2019). PRISM implementation and challenges of the use of the newly revised PRISM tools in Mali and Cote d'Ivoire. [Unpublished presentation]. Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina.

Boerma, J. T., & Stansfield, S.K. (2007). Health statistics now: Are we making the right investments? *The Lancet*, 369(9563):779–786. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/17336655.

Foreit, K., Moreland, S., & LaFond, A. (2013). Data demand and information use in the health sector: A conceptual framework. Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina. Retrieved from https://www.measureevaluation.org/resources/publications/ms-06-16a.

Health Metrics Network. (2008). Framework and standards for country health information systems, 2nd edition. Geneva, Switzerland: Health Metrics Network, World Health Organization. Retrieved from https://www.measureevaluation.org/his-strengthening-resource-center/resources/hmn-framework-and-standards-for-country-health-information-systems

MEASURE Evaluation. (2016). Data quality assurance tools. Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina. Retrieved from http://www.cpc.unc.edu/measure/resources/tools/monitoring-evaluation-systems/data-quality-assurance-tools

MEASURE Evaluation. (2008). Data quality audit tool. Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina. Retrieved from http://www.cpc.unc.edu/measure/resources/tools/monitoring-evaluation-systems/data-quality-assurance-tools/dqa-auditing-tool-implentation-guidelines.pdf

MEASURE Evaluation. (n.d.) Performance of routine information system management (PRISM). Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina. Retrieved from https://www.measureevaluation.org/our-work/routine-health-information-systems/performance-of-routine-information-system-management-prism?searchterm=prism

MEASURE Evaluation. (2014; Draft). Phase IV. Description of country-led partnership and sustainability of health information systems. Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina.

MEASURE Evaluation. (2017). Routine health information systems: A curriculum on basic concepts and practice. Syllabus. Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina. Retrieved from https://www.measureevaluation.org/our-work/routine-health-information-systems/rhis-curriculum.

Murphy, C. & Sebikali, B. (2014). Guide to optimizing performance and quality: Stages, steps, and tools. Chapel Hill, NC, USA: IntraHealth International. Retrieved from https://www.intrahealth.org/opq/wp-content/.../OPQ_Guide_Final_June-2014.pdf.

Naimoli, J., & Saxena, S. (2016). Impact of health system strengthening on health systems performance and outcomes. Marshalling the evidence: A status report. Washington, DC, USA: United States Agency for International Development /Bureau of Global Health and Health System Strengthening. Retrieved from https://www.hfgproject.org/impact-hss-health-systems-performance-outcomes-marshalling-evidence-status-report/.

Nolen, L. B., Braveman, P., Dachs, J. N. W., Delgado, I., Gakidou, E., Moser, K., . . . Zarowsky, C. (2005). Strengthening health information systems to address health equity challenges. *Bulletin of the World Health Organization*, 83(8): 579–603. Retrieved from http://www.who.int/bulletin/volumes/83/8/597.pdf.

Nutley, T. (2016). Behavior: The 3rd dimension of health system strengthening. Presentation given at MEASURE Evaluation Partners Meeting, February 9, 2016.

Nutley, T., & Reynolds, H. W. (2013). Improving the use of health data for health system strengthening. *Global Health Action*, *6*, 10.3402/gha.v6i0.20001. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3573178/.

Shuvo, T. A., Islam, R., Hossain, S., Evans, J. L., Khatun, F., Ahmed, T., Gazi, R., & Adams, A. M. (2015). eHealth innovations in LMICs of Africa and Asia: A literature review exploring factors affecting implementation, scale-up, and sustainability. *Innovation and Entrepreneurship in Health* 2:95–106. Retrieved from https://www.dovepress.com/ehealth-innovations-in-lmics-of-africa-and-asia-a-literature-review-ex-peer-reviewed-article-IEH.

Thomas, J.C. (2016): Contextual factors affecting health information system strengthening. *Global Public Health*. Retrieved from http://www.tandfonline.com/doi/full/10.1080/17441692.2016.1256419.

United States Agency for International Development. (2016). ADS chapter 201, program cycle operational policy, Office of Policy, Planning, and Learning. Partial Update October 12, 2016. Retrieved from https://www.usaid.gov/sites/default/files/documents/1870/201.pdf.

United States Agency for International Development (USAID). (2014). Local systems: A framework for supporting sustained development. Washington, DC, USA: USAID. Retrieved from https://www.usaid.gov/sites/default/files/documents/1870/LocalSystemsFramework.pdf.

United States Agency for International Development (USAID). (2015). USAID's vision for health system strengthening, 2015–2019. Washington, DC, USA: USAID. Retrieved from https://www.usaid.gov/global-health/health-systems-innovation/health-systems/usaids-vision-health-systems-strengthening.

World Health Organization (WHO). (2014). A rapid assessment of the burden of indicators and reporting requirements for health monitoring. Geneva, Switzerland: WHO. Retrieved from http://www.internationalhealthpartnership.net/fileadmin/uploads/ihp/Documents/Tools/M_E_Framework/Rapid_Assessment_Indicators_Reporting_report_for_WG_revised_03Mar14.pdf.

World Health Organization. (2007). Everybody's business: Strengthening health systems to improve health outcomes; framework for action. Geneva, Switzerland: World Health Organization. Retrieved from http://www.who.int/healthsystems/strategy/everybodys_business.pdf.

World Health Organization (WHO). (2009). Systems thinking for health systems strengthening. Geneva, Switzerland: WHO. Retrieved from http://www.who.int/alliance-hpsr/resources/9789241563895/en/.

World Health Organization (WHO) and International Health Partnership. (2011). Monitoring, evaluation and review of national health strategies + related initiatives: A country-led platform for information and accountability. Geneva, Switzerland: WHO. Retrieved from https://www.internationalhealthpartnership.net/fileadmin/uploads/ihp/Documents/Tools/M_E_Framework/M%26E.framework.2011.pdf.

APPENDIX

A Matrix of Health Service and Support Subsystems and Related Functions of a Health Information System

The following matrix supports the health information systems (HIS) framework of the Health Metrics Network.[7] It also supports an HIS strengthening model developed by the Learning Agenda Technical Advisory Group (TAG) of the USAID-funded MEASURE Evaluation project.

This matrix describes the service and support subsystems common in the national health systems of low- and middle- income countries. It lists the data that each level of a health system requires and collects, along with data and information functions. Its main purpose is to link the data and information that HIS receive and generate to the health service or support system that the data support.

Underpinning the matrix is the idea that clearly defined government responsibilities for promoting and protecting the health of the population inform the design of national health systems. These responsibilities vary somewhat from country to country, so the matrix covers the functions performed by health systems in most countries. We have drawn from common experience to identify the data requirements and products of each subsystem at each level of the health system.

This matrix supports the MEASURE Evaluation Learning Agenda. It aims to contribute to the HIS strengthening model; the creation of a national HIS country profile; and a process for assessing the status of national HIS development in selected countries. It also outlines the results of strengthening efforts and provides links to a reference collection of articles and documents related to HIS frameworks and strengthening. As we continue to learn about the strengthening of HIS and as HIS continue to evolve, technical consultations will be needed to revise this document.

Components of the Matrix

The second column in this matrix contains service, support, and enabling functions that commonly appear as components of the overall national health system in all countries. For each subsystem, we indicate the appropriate health system building block of the World Health Organization in parentheses.[8]

The third column defines the types and sources of data that predominantly support or are generated by the functions in each subsystem across all levels of the health system.

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[7] Health Metrics Network. (2008). Framework and standards of health information systems, 2nd edition. Geneva, Switzerland: World Health Organization. Retrieved from http:/www.healthmetricsnetwork.org

[8] World Health Organization. 2007. Everybody's business: strengthening health systems to improve health outcomes; framework for action. Geneva, Switzerland: World Health Organization. Retrieved from http://www.who.int/healthsystems/strategy/en/

The fourth column denotes the levels of the health system at which the subsystem or support system is felt to be most present and essential, functionally.

The common functions of each subsystem at each level are titled and described in the fifth column to characterize the use made of the data captured, generated, or received at each level in support of the given service or support system. These data management functions and uses are generic and illustrative in nature and may not appear in all countries at the levels shown. They are provided as examples of the service or support functions that require or generate data for each of the service and support subsystems shown.

This version of the matrix has been piloted with project staff and aligned with the HIS strengthening model. The matrix and its contents will need continual review and improvement in order to become more broadly understandable and acceptable. The value of health data and information systems is their use in supporting the proper delivery of health services and the fulfillment of national public health responsibilities.

Matrix of Common Health Service Subsystems and Related HIS Functions

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
1	**Basic health services** (health service delivery)	Individual patient/client data from patient records, summary tabulations, and reports derived from original service records; summary data appearing in the RHIS and higher-level summaries; census, civil registration, and survey data at various levels for planning and monitoring purposes.	Patient/client	**Maintenance of patient registers and records within service sites:** Use of clinical protocols and data management procedures that guide the management of outpatient and inpatient cases. A principal source for assessing quality of care and quality of data. Family and child registers of growth and vaccination.
			Community	**Community registers:** Pregnancy and antenatal care, vaccination coverage, infectious disease treatment observation, water and sanitation development and maintenance, vector control activities, drug coop operations.
			Facility	**Maintenance of a facility's client register:** Used as a measure of client/service load and as input to periodic facility reports; basis for monitoring coverage of the responsibility area, detection of service gaps, and ability to initiate interventions to improve the performance of services. Patient registers are a principal source for assessing quality of care and quality of data.
			District	**Review and summary of facility service reports:** Facility reports received monthly and quarterly are used to monitor trends in categories of preventive and case-management services, and are the basis of monitoring district services output, coverage, and community access, along with identification of service gaps; basis for maintaining performance-based financing (PBF) data capture and management; basis for summary reports to higher levels, often submitted through online connections and websites.
			Provincial/ Regional	**Review and summary of district service reports:** Enables monitoring of the performance of provincial services, summaries of coverage of essential services, and trends in cases by cause; is one basis for annual planning and budgeting
			Central	**Review of provincial/regional service performance levels and trends:** Receive and maintain reports and selected indicator values

No	Service and Support Subsystem	Data Types and Sources	Level	Common Functions Supported by the Management and Use of the HIS by Level of the Service System
				within central registries and data warehouses; summarize levels and trends of core indicators for dissemination through website and publications; analyze trends in service performance across regions and districts to detect areas requiring increased funding, infrastructure, staff, training, and supervision; use summaries during policy, strategy, and program formulation.
			International	**Global and regional indicator summaries:** Receive periodic data and indicator reports from member states; summarize and share indicator levels and trends with partnerships, international organizations, and donors for consolidation in global data sets (Global Fund, Millennium Development Goals, World Bank, WHO, United Nations Statistical Office)
2	**Specialized health programs (TB, HIV, malaria, EPI, MCH, FP, and nutrition)** (health service delivery)	Detailed case-specific data, family registers, home-based records and service summaries from the community, basic and special program service outlets, and campaign activities. Some special program data may be integrated within and obtainable from the integrated, comprehensive routine health information system (RHIS). Surveys, censuses, and civil registration are also used for planning and monitoring.	Patient/client	**Maintenance of patient registers and service records:** Receipt of health worker and community support for recording (including home-based records) and follow-up of prevention and treatment services.
			Community	**Case identification and monitoring:** Support of education, preventive, and treatment services; suspected case notification; case outcome (treatment completion, referral ,and death) notification
			Facility	**Case registration and service record maintenance:** Monitoring of case-finding activity and results; submission of periodic reports on total and new cases, treatment continuation and outcomes, complications and drug resistance; preparation and submission of required program-specific reports including basic indicator data to the routine health service reporting system.
			District/ province/ region	**Receipt, use, and management of facility reports:** Monitoring of case-finding and treatment activities and outcomes; maintenance of laboratory records and results of analysis; identification of areas with low coverage and high incidence.

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
			Central and program management	**Maintenance and use of program service data by central program offices:** Registries and databases of reports received from the districts and tabular and geographic displays of incidence and prevalence, high-risk populations, and areas experiencing drug resistance are maintained. Gaps in service coverage and quality are detected and action taken, including supervision, support, and in-service training. Periodic program performance reports are prepared for the health ministry and donors. Results of performance monitoring are fed into annual plans, budgets, and requests for donor support.
			International organizations and donors	**Receipt, maintenance, and use of national program indicator data:** Receive and integrate reports of selected core indicators (i.e., Millennium Development Goals and global program and disease trends [WHO, USAID]); use of national and regional trends to review and revise global and regional strategies and recommended protocols.
3	**Hospital services** (health service delivery)	Data on outpatient and inpatient caseloads, patient diagnostic group, ICD-coding, length of stay, staffing data (including vacant positions), drug and equipment availability and needs, fees and other payments, cash flow and management, patient referral records, transportation and communications availability and use, results of quality of care assessments. Survey, civil registration, and census data used for hospital	Private and NGO hospitals	Maintain patient information summaries and reports as required by the hospital management, the government, and the funders. Maintain electronic medical records (EMRs). Submit notifications of suspected and confirmed infectious diseases to the national surveillance system.
			District	Monitor and oversee the submission and content of reports prepared by government and private hospitals within the district; develop and maintain EMRs; track inpatient and outpatient admission and discharge by cause over time, along with areas of the district least well covered with hospital services. Monitor the types and quantity of laboratory analysis and existing or potential participation in disease surveillance and diagnostic support. Monitor the performance and gaps of the case referral system and procedures, from lower-level facilities, practitioners, and agencies (social and law enforcement), as well as to higher-level medical care services. Support referral-system improvement. Participate in quality assessments of services and data systems and support improvement of their performance.

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
		planning and performance monitoring.	Province/ region	Similar to those described for the district level, with special attention to hospitals managed at the provincial and regional levels and the flow of patients from level to level.
			Central and referral hospitals	Maintenance of all required patient records and summary reports: inpatient, outpatient, referral, and laboratory. Contribution to the national disease surveillance and reporting system. Monitoring and management of the case referral system through review of referral communications and records; identification of referral gaps and failures and leading efforts to strengthen referral procedures, practices, and training. Monitoring and managing referral of complicated cases to medical institutions outside of the country (both government-funded and privately funded).
			Health ministry medical care program	Monitors and oversees the performance and development of the national medical care program and services; leads the analysis, diagnosis, and idea generation necessary to formulate new policies, systems, and plans for development of medical facilities and institutions for inclusion in the national and health development strategies and plans. Monitors care standards and practices and the continual updating of appropriateness and quality of care in pursuit of international standards, and in the context of the healthcare financing of the country. Formulates and monitors the policy and practice of referring complicated cases to institutions outside of the country.
4	**National disease/health surveillance and case and outbreak response system** (health service delivery)	Principal data are case and outbreak notifications filed by government service points and private practitioners. In addition, there are the results of outbreak investigations and lab diagnostics. Geographic information on population dispersion and location of cases is monitored closely.	Community	**Community support to disease surveillance:** Community-based organizations and community health workers (CHWs) contribute to disease notification and participate in outbreak control efforts. Private clinical practitioners and clinical NGOs contribute to disease notification.
			Facility	**Health facility participation in disease surveillance:** Submit notifications of suspected and confirmed cases as prescribed by the system procedures, case definitions, formats, and time requirements. Manage the collection and transfer of specimens or patients for laboratory diagnosis. Submit monthly summaries of cases and outbreaks through the service reporting system.

Strengthening Health Information Systems in Low- and Middle-Income Countries

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
				Participate in further case detection and outbreak control activities. Mapping of case and outbreak locations for geographic analysis and follow-up.
			District	**Participation by the district health office in disease surveillance:** Receive and transmit notifications of suspected and confirmed cases; manage the transfer of specimens and patients for lab confirmation of cases; participate in and help manage outbreak investigation and control activity; carry out monitoring and supervision of surveillance system functioning, including problem solving and in-service training.
			Province/ region	**Participation by the provincial or regional health office in disease surveillance:** Monitor district and laboratory performance; oversee outbreak investigation and control activities.
			Central	**Central-level management and oversight of national disease surveillance:** Receive outbreak notifications and monitor/manage the response to emerging cases and outbreaks; develop and maintain system procedures and guidance; update case definitions according to improving diagnostic capability at various system levels; issue epidemiological bulletins; maintain and analyze disease trend data and detect high-risk areas; coordinate corrective and preventive activities with disease control programs; prepare and submit proposals for system strengthening and resource expansion; plan and oversee communications improvements. Submit required reports according to the International Health Regulations to WHO.
			International organizations and collaborators (WHO, U.S. Centers for Disease Control and Prevention)	**International disease and outbreak monitoring and response:** Monitor trends in new case incidence, prevalence, and health outcomes of reportable infectious diseases; produce international disease and epidemiological newsletters and alerts; support outbreak assessments; mobilize international development planning and funding of national surveillance systems; designate and maintain International Centers of Excellence in infectious disease diagnosis and management; contribute to, manage, and coordinate international response to cross-border outbreaks and

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
				regional epidemics; continually review and update infectious disease detection and control strategies and procedures.
5	**Human resource management** (health workforce) (partially managed outside the health sector)	Human resource (HR) management systems in the health sector produce and maintain a wide array of data on the size and characteristics of the health professional and nonprofessional workforce. The data are generated from all HR administrative procedures and occasional HR surveys, as well as from training institutions.	Community	Cooperate with the selection and involvement of CHWs, and the training of traditional practitioners and midwives; support their registration to the national health system.
			Facility	Maintain staff records, including training; submit routine reports of staffing complement and vacant positions; confirm staff appointments, placement, absences, and departures to higher levels; administer and transmit performance appraisals as required; support recruitment and training of CHWs and volunteers; monitor and report private-sector health providers within responsibility area.
			District	Monitor facility and community staffing reports and situation; identify vacancies and communicate priority recruitment and placement requirements; plan and report on in-service training for all community, facility, and district staff; monitor, register, and report private-sector health providers.
			Provincial/ regional	Monitor district and facility staffing situation; receive and process requests for staff placement and reassignment.
			Central	Develop and maintain standard classification of public-health staff categories and levels, including the government civil service's post classification system; develop and update facility-specific staffing norms; receive reports and maintain staff inventories by district and type of facility; monitor staff turnover; develop and pursue HR development plans; coordinate with basic and in-service training institutions the numbers and qualifications of health staff production and skills/capacity development and maintenance. Report public and private HR levels and trends as requested to international agencies.
			International	Monitor national, regional, and global HR levels, trends, and capacity for HR development. Coordinate HR standards for quantity and quality of staff required for essential public and

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
				curative health services. Mobilize financial and technical support for countries in greatest need of HR development.
6	**Health supply and logistics management** (availability of essential medicine)	Health supply and logistics management requires extensive data generation and maintenance on all aspects of drug and equipment procurement, storage, distribution, use, loss and misappropriation, stockouts, expiry, drug reactions, and resistance. In addition, sample testing and certification both of locally produced and imported drugs and supplies generate important data for managing the system.	Facility	Maintain records, inventories, and rates of use of basic medicines, vaccines, and supplies, and expiry experience, stockouts, and report as required. Maintain and adjust as necessary procurement and distribution requirements and submit as necessary. Monitor medicine and supply consumption rates in relation to consultation and care trends by cause in order to detect misappropriation. Monitor the availability of essential medicines in private-sector services and pharmacies. Report resistance and adverse drug reactions. Manage transaction data.
			District	Receive reports from facilities and monitor rates of use in comparison with reported client services; supervise and investigate apparent supply management problems and stockouts. Receive, review, and communicate medicine and supplies replenishment. Maintain and manage stocks of emergency medicines and supplies.
			Province/ region	Receive reports from facilities and districts and monitor rates of use in comparison with reported client services; supervise, investigate, and respond to apparent supply management problems and stockouts. Receive, review, and implement replenishment of medicine and other supplies. Maintain and manage stocks of emergency medicines and supplies; maintain medicine and supply procurement, storage, and distribution for supported services.
			Central	Monitor medicine and supply requirements and usage rates; manage procurement of supplies requiring national-level bulk purchasing and importation; create, maintain, and update essential drug lists and standards; oversee national regulations on drug procurement and sales, within public services and through the private sector. Monitor domestic drug production and international importation including donations of medicines and supplies. Prepare estimates of future drug requirements, budgets, and resource surpluses and shortfalls. Monitor adverse drug reactions and resistance.

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
			International	Monitor national reports of drug resistance and adverse reactions; coordinate with donors the requirements for supporting national drug shortfalls and emerging needs. Maintain international recommendations of essential drug lists in response to changing epidemiological situations in countries and regions. Monitor the national and international production and sales of essential drugs and adherence to international quality and standards.
7	**Health infrastructure management (facilities, equipment, transport)** (health service delivery)	This service-support system requires and generates data on current and planned health facilities: their state of functionality, equipage, and available utilities. The data are generated through health-infrastructure development plans, routine service reports, inspection, and surveys. Census and population estimates are required for monitoring facility coverage.	Facility	Maintain records of facility maintenance and repair, including costs incurred; maintain and submit facility, equipment, and transport inventory, including current condition and needs for repair or replacement; arrange local maintenance.
			District	Receive, review, and respond to facility infrastructure reports; monitor and maintain records of facility operational status; take action to address facility, equipment, and transport maintenance needs. Budget and implement routine and ad hoc repairs across health facilities in the district; conduct routine visits for inspection of facilities, equipment and transport and the monitoring of new construction and repairs.
			Province/ region	Plan, budget, and oversee public health-sector facility construction and maintenance, equipment procurement and maintenance, and transportation procurement, distribution, and maintenance; formulate annual operating budgets for facilities, equipment, and transport; operate and maintain repair facilities, and designate approved sources of repair.
			Central	Formulate, implement, and oversee health-facility expansion plans and budgets that address national health-system development strategy; oversee the specification of health-facility design and construction standards; provide specifications for required equipment and vehicles. Negotiate and oversee donor support for infrastructure development and expansion.
8		Budget and expenditure data are primarily	Community	Create and manage community health funds for use by families and for emergency response; may also manage a community drug

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
	Health financial management (health system financing)	generated at the central level through the submission of all units and programs to which resources are allocated and which are required to submit expenditure reports. The sources of funding—such as central ministry of finance; provincial, district, and municipalities offices; donor organizations; and charitable agencies—often maintain their own financial records. Performance-based payment schemes generate the facility- and district-specific basis for payment, as do community insurance schemes. Per capita and geographic expenditures require census data.		outlet and fund; community-based health insurance, its monitoring and member and records management and reporting.
			Facility	Maintain financial records related to fee administration, bank account management, local expenditure management and receipt control, and performance-based funds for service operations. Monitor and report expenditure trends to service budget control offices and provide justified recommendations for budget adjustment.
			District	Support the preparation of annual or biannual facility and health office budgets; monitor within-district expenditure; prepare reports on expenditure levels and trends across the district. Monitor salary disposition and confirm distribution and receipt. Maintain funds for use in emergencies and communicate requirements for replenishment. Monitor use of donor financial support including staff emoluments. Oversee PBF and the data required for the management of PBF.
			Province/ region	Monitor area-wide expenditure reports and analyze trends by district, season and year. Oversee annual and medium-term planning and budgeting with attention to facility and staffing trends and norms. Monitor the allocation and use of program and donor-specific funding and expenditure.
			Central	Develop and maintain overall organization and program budgeting, PBF systems, and financial management systems and procedures, including the entry and flow of budget and expenditure data and reporting. Adhere to finance ministry regulations and procedures for administering, accounting for, and reporting on government and donor financial resources received. Establish and maintain audit procedures for each level of the system. Oversee and coordinate the receipt, allocation, and use of external donor funding.
9	**ICT management**	Inventories of hardware and software throughout the health service system; data	Community	Participate in the creation, maintenance, and use of mHealth, landline, and radio communications for defined purposes according to established procedures for requirements such as

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
	(health information system)	on technical and managerial staff, their expertise, training and responsibilities; database locations, content, and functional descriptions; plans and budgets for system development, expansion, and maintenance.		disease and outbreak notification, obtaining care, referral and transport of emergency cases, responding to emergency plans, and mobilizing and participating in community health actions such as immunization days and payments to CHWs.
			Facility	Establish and maintain communications with communities and CHWs as described above. Maintain access to the Internet and to health ministry websites and email as possible with computers provided by the health ministry or donors. Establish and maintain data entry and database management as possible with available computers and data transmission and entry procedures. Design and maintain EMR systems, usually in hospitals.
			District	Populate required databases and reporting according to established procedures and available equipment and Internet/web communications. Maintain and use mHealth, landline, and radio communications as possible and for which procedures are specified. Monitor which communities and facilities are reachable through these means of communication. Prepare required electronic reports and transfer as required via available means. Monitor availability and functionality of community and facility communications and eHealth data management.
			Province/ region	Same as described for districts plus overall area monitoring and management of mHealth and eHealth systems and procedures; provision and maintenance of equipment, software, and training to expand communications and processing.
			Central	Develop and pursue planned e/mHealth systems development, standards, procedures, training, and maintenance. Seek and coordinate donor support for nationally designed systems development, including software development and maintenance, while assuring national management and sustainability. Cooperate with donor-provided data and monitoring systems while pursuing their integration with the national HIS.
10		Documents and data from designated sources for	District	Maintain district health data assembled for reports; produce required quarterly and annual summaries.

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1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
	Knowledge management and dissemination (health information system)	inclusion in the health ministry archives; data and results from selected surveys and research efforts for national and international publications; data from routine databases for analysis, periodic publications, and website presentations.	Province	Maintain provincial health data as assembled from routine reports; produce quarterly and annual summaries of district reports as required.
			Central	Maintain data warehouses, platforms, and means of dissemination to the public and for program management; analyze, compile, and issue compendiums of health and service data with attention to core health indicators through formats such as epidemiological newsletters, annual health statistics, annual health situation reports, and website health situation summaries; prepare and submit required reports to international agencies and partnerships such as the MDG authority. Maintain data repositories resulting from routine reporting, surveys, surveillance, and research studies for access and use by national and international institutions and researchers.
11	**Management, leadership, and governance of the health sector** (leadership and governance)	All core health service and resource indicators; data on health and disease levels and trends; resource and budget levels and trends, existing and draft legislation, regulations, policy, strategy, and program documentation; international health policy, strategy, and regulations.	Community	Participate in health facility, district, provincial, and central health committees and advisory councils to provide citizen feedback on healthcare satisfaction and needs; support community health committees and councils to implement and manage new strategies and services at the community level; select CHWs.
			Facility	Create and maintain facility management committees; maintain a staff quality and performance monitoring team; staff a rewards and discipline committee; prepare operational plans and budgets.
			District	Monitor service performance, identify gaps, and prepare annual plans and budgets with development and performance improvement components; create and maintain a district health management team and committee; send delegates to provincial and central health governing councils and development planning groups; reward high-performing facilities with recognition, funding, and professional training and advancement; mobilize private-sector and community-based organization (CBO) involvement in health initiatives and campaigns.
			Province/ region	Similar to the district level across all its districts. Mobilize private sector and CBO involvement in health initiatives and campaigns; monitor adherence to national health legislation, public health

1 No	2 Service and Support Subsystem	3 Data Types and Sources	4 Level	5 Common Functions Supported by the Management and Use of the HIS by Level of the Service System
				regulations, and service and reporting standards; identify noncompliance and issue sanctions and penalties as necessary. Create and maintain a provincial health management and information committee.
			Central	Create and maintain a national HIS coordinating committee. Create and continue health professional associations; create national health council with cross-sectoral, political, and citizen participation; create and maintain national health committees and technical working groups to analyze the health situation and needs, and formulate new health legislation, regulations, policy, strategy, and development programs and projects; monitor adherence to national health legislation, public health regulations, and health policy and standards; operate recognition and discipline procedures; designate national delegates to international organizations such as the such as the World Health Assembly, WHO's executive board, and the governing councils of the United Nations Development Program, the United Nations Population Fund, and the United Nations Children's Fund.

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