K4D | Knowledge, evidence and learning for development

Designing and Implementing Health Management Information Systems

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Question

1) *What are the lessons learned from what has and hasn't worked in designing and implementing Health Management Information Systems (HMISs) in other countries?*

• *Consider the barriers/obstacles and enablers for designing and implementing a successful HMIS*

• *Consider the approaches/strategies that have worked in ensuring better donor co-ordination in demands for data*

• *Consider how data are aggregated from local areas up to the national level, who is responsible for compiling, and points where discrepancies occur in the process.*

2) *What is the global evidence on strategies/approaches that have worked in influencing key stakeholders in country governments (relevant Ministries, agencies, departments, etc.) to address the barriers/obstacles in designing and implementing successful HMIS?*

Contents

1. Executive summary

Various 'lessons learned' from what has and has not worked in designing and implementing country Health Management Information Systems (HMISs) have been found in different countries. Reasons for success vary according to the country they are based in, and are due to a number of factors.

HMISs are often also called Routine Health Information Systems (RHISs) or HISs, and relevant data using any of these terms is included in this rapid review. However, studies evaluating development of HISs in developing countries are limited. Specialists were consulted about key sources of information for this rapid review. These experts confirmed that most HMIS evidence is from single-country experiences, as well as the scarcity of comparative studies.

More literature was available for the implementation stage approaches, than at the design stage – especially for barriers. Most of the available data are based on pilot projects or cross-sectional studies (Seitio-Kgokgwe et al., 2015). Research on technologies in health management in developing countries has been on single technologies. Only Chikumba (2017) focussed on multiple technologies (such as District Health Information Software [DHIS2] and reports) used at different levels, and how they support each other to enhance health information management.

The evidence and commentaries on evidence included in this review did not discuss gender or disability as a focus.

Global evidence, taken from cross-country systematic analysis and individual country experiences, suggests that setting up a new HIS alone does not guarantee its success. Key findings are displayed below:

- An integrated HIS requires a long-term, high-level focus on good HMIS governance, capacity building for data management and information use, and strong commitment to change by leadership across stakeholder groups (Heywood and Booth, 2015:56).
- In the design stage, a mission statement which names primary stakeholders, and articulates how the organisation provides value to stakeholders, is essential (Heywood and Boone, 2015).
- Key enablers include:
    - Financial and motivational support: no matter how good the design, the HMIS will not be effective unless there is internal commitment of leadership (Chaulagai et al., 2005; Le Pape et al., 2017).
    - Proper implementation and maintenance (Kpobi et al., 2018): lack of 'ownership' of the HMIS implementing principles was found in Ethiopia (MEASURE Evaluation, 2014), while Health manager 'ownership' was a success factor for the Pakistan HMIS (Qazi and Ali, 2009).
    - Information and computer technology (ICT) can strengthen HMIS implementation: this has been also observed in some studies in LMICs, including Ghana (Kpobi et al., 2018), India (Krishnan et al., 2010), and Nigeria (Asangansi, 2012). Rwanda's web-based system (R-HMIS) has become a trailblazer in training health personnel since its inception in 2012. However, in Morocco, few IT employees are knowledgeable of health care processes (Le Pape et al., 2017).

- o Key barriers include:
    - o An unclear information framework (Kpobi et al., 2018). This may have more of an impact on low- and middle-income countries (LMICs), leading to errors in population health management and clinical care (Kumar et al., 2017).
    - o Organisational factors: These constitute the main barriers in the implementation process, and include ineffective reporting, as well as lack of staff training and management issues (Lorenzi and Riley, 2000; Qazi and Ali, 2009: Le Pape et al., 2017). Lack, or misuse, of resources is also an issue (Qazi and Ali, 2009; Nyamtema, 2010; Anwari et al., 2015; Akhlaq, 2016; Kpobi et al., 2018). Lack of attention to issues of organisational structure was a major pitfall in HMIS development in Botswana (Seitio-Kgokgwe et al. 2015).
    - o Implementing electronic health record systems can be an expensive process in high-income settings. In low-income settings, such as Kenya, open source software may offer some respite from the high costs of software licensing (Muinga et al., 2018).
    - o Hierarchical organisational structures hindered decision making in Morocco, particularly with senior officials (Le Pape et al., 2017). However, despite challenges, multi-stakeholder committees in the provinces and districts of Afghanistan proved to be an invaluable entry-point to the governance of the provincial and district health systems (Anwari et al., 2015).
    - o Community workers or staff with poor language skills: These can hinder the data aggregation process. Discrepancies occur in the collection and data entry processes (Qazi and Ali, 2009). This affects the decision making stage- which can also be affected by lack of funds (Anwari et al., 2015).
    - o The main obstacles to data quality and data use include conceptual technical, organisational/ political, behavioural, economic, legal, ethical, and capacity building barriers (Kumar et al., 2017).
    - o Staff, such as health managers, can be overburdened by requirements to produce multiple reports demanded by vertical programmes, besides the national HMIS (Qazi and Ali, 2009). Therefore, closer co-ordination among various information systems should be encouraged (Chaulagai et al., 2005; Qazi and Ali, 2009; Asangansi, 2012; MEASURE Evaluation, 2014).

Effective approaches to donor co-ordination in demands for data:
- o Effective strategies to influence donor involvement include all-phase involvement from design to implementation, improving governance, investment in improved data sources, and more collaborations (WHO, World Bank Group & USAID, 2015).
- o Developing a system based on the 'three-ones' strategy (one database, one monitoring system, one leadership) can harmonise the efforts of donors in support of developing countries (WHO, World Bank Group, & USAID, 2015).

Data aggregation, responsibilities and discrepancies:

- o Ministry of Health (MoH), Ministry of Public Health (MoPH), and Federal Ministry of Health (FMoH) are the main ministries responsible for compiling health data for LMICs.

- There is a hierarchy of indicators, which are used differently at every level of the system – *international; national; state/province; district; sub-district/community, and patient level-*as, depending on management functions (Heywood and Boone, 2015).
- In Ethiopia, HMIS focal persons are delegated to undertake HMIS tasks on top of their regular duties and responsibilities. Hence, because of workload, data recording may not be done with necessary care (MEASURE Evaluation, 2014:2).
- Standard operating procedures (SOPs) for data management at health centres and district hospital levels can help improve data quality, along with a routine data quality audit (DQA) system, as found for example in Rwanda.
- At the provincial and district level, health co-ordination committees are given responsibility for monitoring and oversight of health service delivery. However, in Afghanistan, the decision-making processes were not adequately open and transparent, and these committees were not equipped with adequate skills, authority or resources to carry out their mandated governance functions (Anwari et al., 2015).

2. Barriers and enablers for designing and implementing an HMIS

The World Health Organisation (WHO) defines a well-functioning Health Management Information System (HMIS) as one that "ensures the production, analysis, dissemination, and use of reliable and timely information on health determinants, health system performance, and health status (WHO, 2007). A national HMIS refers to a comprehensive set of integrated software solutions for data collection, compilation, analysis, synthesis, and communication across health facilities and organisations. This is to generate relevant, accurate data for decision making, and improve public health outcomes (Lippeveld et al., 2000; Le Pape et al., 2017:57).
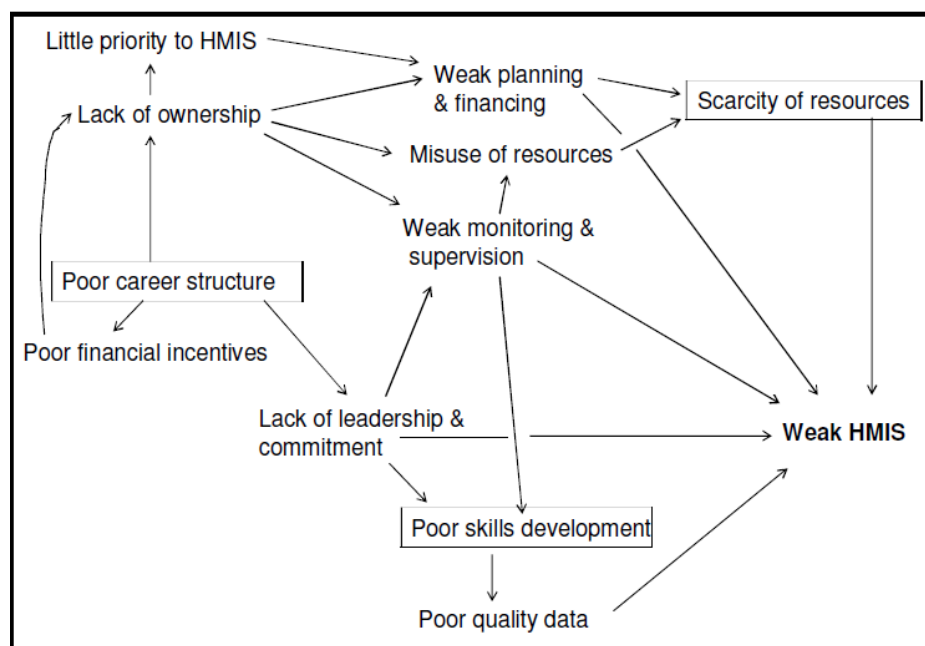
HMISs are often also called Routine Health Information Systems (RHISs) or HISs. Mental Health Information Systems (MHISs) are a sub-system of HMISs. However, studies evaluating development of HISs in developing countries are limited. Most of the available data on design and/or implementation are based on pilot projects or cross-sectional studies (Seitio-Kgokgwe et al., 2015).

Barriers for design and implementation

Organisational and cultural factors can be barriers to both HMIS design and implementation. Organisational factors can include lack of a clear vision of change; ineffective reporting structure, rapid staff turnover; low staff competency; lack of full support from higher management; confusion on roles and responsibilities; inadequate resources; failure to benchmark existing practices, and inability to measure success (Le Pape et al., 2017:62). Cultural problems include hostile cultures within the information systems organisation. Adapting experience gained abroad to local culture norms is therefore a key proposition (Le Pape et al., 2017).

Figure 1 shows the organisational concerns due to poor design and implementation of HMISs in the context of decentralisation, i.e. the transfer of authority from central to local government (Qazi and Ali, 2009:12).

Figure 1. Organisational concerns about HMIS

Source: Qazi and Ali, 2009:12.

Several other factors can act as barriers to design and implementation of HMISs. Lorenzi and Riley (2000) suggested that information system failures occur for various reasons, including lack of psychological ownership; communication problems; under-estimation of complexity (e.g. missed deadlines, cost overruns, and lost credibility); failure to define and maintain success criteria; technological factors (e.g. system too technology oriented); and training factors (e.g. inadequate or poor-quality training, poor timing of training, i.e. too early or too late). Evidence from country cases were available for the majority of these reasons, and are included below.

Barriers for design

The adverse impact of HIS design barriers on data integrity and health system performance may be greater in low- and middle income- countries (LMICs) than elsewhere, leading to errors in population health management and clinical care (Kumar et al., 2017:e7).

The main barrier for the design of effective HMISs is an unclear information framework at the initial design stage. A clear information framework should make the system easy to access and use by the relevant stakeholders. In Ghana, while a new MHIS had obvious benefits, its usefulness was compromised by the lack of identifying and incorporating relevant indicators and categories of data to be collected (Kpobi et al., 2018).

Barriers for implementation

Lack of psychological ownership

"Ownership of the programme" is an umbrella term that encompasses many issues. It relates to making financial arrangements for the HMIS, establishing the system through appropriate strategic and operational planning (including, for example, designing and disseminating job

descriptions of personnel at every level), and bringing about well-planned changes when required (Qazi and Ali, 2009:14).

- **Ethiopia**: When programme specific parallel reports were being demanded from health facilities, this was seen as a problem of ownership in implementing the principles set for HMIS at all levels (MEASURE Evaluation, 2014:21).
- **Pakistan**: Research suggests that due to the strong political will and feeling of ownership among health managers, the Pakistan HMIS has been sustained long after the end of major funding from USAID. This is unlike other donor-funded projects, which typically collapse after funding is withdrawn (Qazi and Ali, 2009:11).

Communication problems

At the data collection and aggregation stages, language and data entry skills are important. Data collected through the system should be reported in a manner which is meaningful and accessible to potential or actual users, otherwise it defeats the purpose of facilitating equity and improved healthcare (Kpobi et al., 2018).

- **Global**: There is a lack of reporting on key morbidity indicators: population-based cancer registries, and integrated disease surveillances are weak or non-existent in most countries (Alwan et al., 2016:842; Uzochukwu, 2018 in prep.).
- **Pakistan**: In many instances, data entry in the HMIS reporting forms is entrusted to auxiliary health workers, who have little knowledge of English (Qazi and Ali, 2009:12).

Failure to define and maintain success criteria

Stakeholder expectations of progress achievement should be considered when setting targets (Heywood and Boone, 2015:78).

- **Ethiopia**: There is no specific supervisory checklist for HMIS tasks, particularly for checking data quality and use of information (MEASURE Evaluation, 2014:24).
- **Ghana**: Although information that is generated from MHIS is useful for the healthcare staff as well as patients, service users and policymakers, research has shown that staff perceive the MHIS as a further layer of bureaucracy within the healthcare hierarchy of the hospital (Kpobi et al., 2018). This may explain the apparent lack of interest in the optimal use of the MHIS by some of the participants in a focus group discussion (Kpobi et al., 2018) – if it is simply extra work for which they did not receive feedback, then it is not surprising that they were not keen on exploring how to make the system function well for them.

Organisational factors

<u>Lack of resources</u>

One of the foremost problems in the implementation of information systems in LMICs is inadequate resources,

- **Afghanistan**: Some actions selected by Provincial Public Health Co-ordination Committees (PPHCCs) and District Health Co-ordination Committees (DHCCs)[1] needed extra budget to help at the decision making phase - which the Ministry of Health (MoH) could not provide because of resource constraints. District Health Offices and DHCCs were less well established compared to the Provincial Public Health Directorates and PPHCCs as the ministry did not have adequate resources to equip them well (Anwari et al., 2015).
- **Ghana**: In developing the MHIS at the Accra Psychiatric Hospital in 2010, new hardware and software were made available for the MHIS data entry unit. However, as approximately 100 records generated each day required entry onto the database, these few computers proved to be inadequate to support the hospital's needs (Kpobi et al., 2018).
- **Pakistan**: Lack of financial resources affected training and travelling allowances available for health staff; as well as computer repairs, internet and software purchases (Qazi and Ali, 2009:11).

Lack of staff support/ supervision

- **Botswana**: Longitudinal analysis revealed that lack of central co-ordination, weak leadership, weak policy and regulatory frameworks, and inadequate resources limited development of the national HIS (Seitio-Kgokgwe et al., 2015). Lack of attention to issues of organisational structure was a major pitfall.
- **Ghana**: Data from an evaluation 4 years after a compete reform suggest that optimal use of the current MHIS faced significant implementation challenges in a number of areas. Central challenges include increased staff workload, poor staff involvement and training, and absence of logistic support to keep the system running (Kpobi et al., 2018).
- **Tanzania**: Gaps in the HMIS are linked to lack of training, inactive supervision, staff workload pressure, and the lengthy and laborious nature of the system (Nyamtema, 2010). Nowadays, specific forms are assigned only to health facilities with special equipment and skilled personnel who can deal with this data (Mahundi et al., 2018:7-8).

Underestimation of complexity

Systematic review analysis has concluded that human dynamics and financial constraints are the key challenges to district-level decision making in LMICs (Wickremasinghe et al., 2016) including Pakistan (Kumar et al., 2017:e5).

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[1] The DHCC is chaired by the District Public Health Officer and its members include a district governor's representative, private health sector representative, religious leader from the district, director of the district hospital, an implementing NGO representative, head of the district education department, and head of the district council which is an informal assembly of elders in the district. Decision making in DHCC is similar to that of PPHCC i.e. decisions are generally taken by consensus, and if it fails, by a majority vote. The PPHCCs, DHCCs, and community and facility health *shuras* are performing a governing role. PPHCC and DHCC governance has the potential to make a difference in the care delivered during patient visits at the health facilities (Anwari et al., 2015).

- **Pakistan**: Delays in publishing reports due to outdated methods used for saving and sending data (floppy disks) was found in Pakistan (Qazi and Ali, 2009:12).

Lack of perceived technological need

Effective information systems support is increasingly being seen as integral to high-quality health care delivery through improved information availability, relevance, and accuracy, as well as through improved efficiency of clinical and administrative processes (Le Pape et al., 2017:57). Less reported though has been the logic of network-centric organisation where network technologies, such as web and mobile-based HMIS, disrupt existing power structures because they allow more communication (Asangansi, 2012).

Designing or adapting technologies to the limited infrastructures of LMICs are needed to circumvent the lack of certain resources. If they are not simple enough to use, they may not compensate for the shortage of skilled workforce (WHO, 2010:34).

- **India**: Research from a district level assessment reported that data quality issues were compounded by information work flow barriers and unfriendly software features that adversely affected data flow and required institutional capacity building in addition to individual trainings (Mishra et al., 2012; Kumar et al., 2017:e5).
- **Morocco**: Health IT in Morocco is in its infancy; primary care is not computerised and, out of the 140+ hospitals of the country, only nine are implementing some kind of hospital information system (Le Pape et al., 2017:63). Therefore, few IT employees are knowledgeable of health care processes.

Enablers for design

Organisational collaboration

The *Guidelines for Data Management Standards in Routine Health Information Systems* recommends a stepwise approach, i.e. "plan for a collaborative process with participation from a wide range of stakeholders at all levels" (Heywood and Boone, 2015:67). Country case studies provide evidence of this successful practice:

- **Malawi**: The country began strengthening its HMIS with an analysis of the strengths and weaknesses of existing information systems, sharing findings with all stakeholders. All were agreed on the need for reformation of various, vertical programme-specific information systems into a comprehensive, integrated, decentralised and action-oriented simple system. As a first step towards conceptualisation and design of the system, a minimum set of indicators was identified, and a strategy was formulated for establishing a system in the country. The design focused only on the use of information in planning, management and the improvement of quality and coverage of services (Chaulagai et al., 2005). *Lessons learned*: A mid-term review of the achievements of the health information system judged it to be one of the best in Africa. For the first time in Malawi, the health sector has information by facility by month.
- **Morocco**: The HMIS scale-up in Morocco is to take place over an 11-year span. *Lessons learned*: From the clinical perspective, the system is designed as a patient-centric electronic health record – an approach designed to break data silos and to facilitate the integration of all patient data (Le Pape et al., 2017:63). To better serve underserved

communities in rural and remote areas, clinical stations preloaded with the patient population's clinical records were suggested, and designed to be used either synchronously or asynchronously with the capability to upload data to synchronise servers' databases. Fingerprints were also proposed as a means to identify individuals, such as nomads or migrants, who may not have personal health cards or any other means of identification. The budget projected for implementation was designed to support capacity-building efforts, because simply rolling out software components is unlikely to ensure users' uptake.

- **Pakistan**: An initial needs assessment of existing health information systems by the MoH in 1991-92 helped with management of resources and ownership (Qazi and Ali, 2009). *Lessons learned*: Based on the MoH's recommendations, the reporting systems were transformed into a comprehensive National HMIS through a consultative process that continued through 1993 (Qazi and Ali, 2009:10-11).

- **Tanzania**: Local variations within health care provision units can be taken into consideration of the design of health care data collection processes and tools (Mahundi et al., 2018:2). This is so that the HMIS truly supports the workflow in the complex environment of health care delivery. *Lessons learned*: Information systems are often not designed to systematically accommodate variability from the beginning of the design stages. Variations are often addressed on an 'ad hoc' basis following challenges brought by rigidity in some standards and, eventually, the line between standards and variability becomes unclear. Mahundi et al. (2018) recommend, in situations where there are many variations, to put standards into clusters that addresses the characteristic differences within the organisation.

Institutionalisation of work ethics

One way of addressing work ethics is to adopt a code of ethics, and introduce it to staff and managers.

- **Pakistan**: The institutionalisation of work ethics starts right from the top-level managers at the highest levels of power and decision (Qazi and Ali, 2009:14).

Improved Information and Communication Technology (ICT)

ICT plays various roles in strengthening HMIS.

- **Ghana**: A new computerised system was found to ease record keeping workload (Kpobi et al., 2018).
- **India**: Computerisation has enabled implementation of a good system in health care (Krishnan et al., 2010).
- **Nigeria**: Introduction of new technologies such as mobile technology has strengthened HMIS (Asangansi, 2012).

Staff training

LMICs have long since needed a standardised and basic training package to meet the challenge of strengthening their RHISs at all levels. Leaders in the field of RHIS[2] developed a Curriculum on Basic Concepts and Practice in Routine Health Information Systems, which is available online.[3] Its purpose is to enhance participants' capacity to conceptualise, design, develop, govern, and manage an RHIS – and use the information the system generates to improve public health practice and service delivery.

- **Botswana**: Training of health information professionals in local institutions strengthened the human resource capacity of the national HIS (Seitio-Kgokgwe et al., 2015).
- **Pakistan**: A good HIS requires investment in staff who need to be properly trained in how to collect, process and analyse the data (Qazi and Ali, 2009:14). Organisation, including defining new roles of staff and healthcare professionals, as well as career structures for managing HMIS, has been suggested as facilitating health information management and sharing (Qazi and Ali, 2009; Kumar et al., 2012; Akhlaq et al., 2016).
- Rwanda: Recognised as a trailblazer, the country's official web-based Health Information System (R-HMIS) has been operational countrywide since February 2012, and collects data from over 700 public health facilities. *Lessons learned*: It took just two years for Rwanda's highly dedicated teams to roll out District Health Information Software 2 (DHIS2) across Rwanda. Intensive training in web-based technology took place very early on in the process for health personnel to empower local teams with the expertise necessary to control their country's health data.

Enablers for implementation

Two common success factors are so basic that they can be considered axiomatic: innovative leadership and collaboration with health workers (Uzochukwu, 2018 in prep.):

1. *Leadership, motivation and regular feedback*

At the national level, implementation requires, at a minimum, committed leadership and governance (Chaulagai et al., 2005). Innovative leadership includes; vision and decision making; appointment of an authorised health system integrator; addressing tangible and practical needs; establishing an organisational process for implementation and monitoring achievement of objectives; and clear commitment and involvement of leadership throughout the process (Alwan et al., 2016:847; Uzochukwu, 2018 in prep.). Only by long-term, high-level focus on good HIS

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[2] Including the USAID-funded MEASURE Evaluation project; WHO; the Free University of Brussels/European Agency for Development and Health (AEDES); the University of Oslo, Norway; the National Institute of Public Health (INSP) in Mexico; the University of Queensland, Australia; and the Public Health Foundation of India (PHFI).

[3] Silva, A. (2017). Filling the training gaps in routine health information systems. 23 February 2017. Experts include - the USAID-funded MEASURE Evaluation project; WHO; the Free University of Brussels/European Agency for Development and Health (AEDES); the University of Oslo, Norway; the National Institute of Public Health (INSP) in Mexico; the University of Queensland, Australia; and the Public Health Foundation of India (PHFI). https://www.rhinonet.org/filling-the-training-gaps-in-routine-health-information-systems/

governance, capacity building for data management and information use, and strong commitment to change by leadership across stakeholder groups, can an integrated HIS be achieved (Heywood and Booth, 2015:56).

- **Afghanistan**: Great strides in reconstruction of its health system that was decimated by protracted periods of conflict have been made. Leadership and management of its health system have improved, with the support of its development partners, and a robust HMIS is in place (Anwari et al., 2015).

- **Morocco**: Strong political will within MoH leadership was needed to reconcile individual and institutional priorities, as well as predominance of long-terms objectives over short-term objectives (Le Pape et al., 2017:62).

- **Pakistan**: Leadership can motivate and encourage staff by identifying mistakes during supportive supervision, and recognising hard work through financial incentives or letters of appreciation for good work. Frequent inter-departmental meetings, which can help to highlight their problems and settle such questions as training requirements, assignment of material, and definition of areas of activity. Similarly, regular feedback from centre to peripheral levels is thought to build confidence among staff that their work is being observed and valued by senior management (Qazi and Ali, 2009:13).

- **Uganda**: Government's political will is reflected in its commitment, funding, and effort to engage experts and collaborate actively with local and foreign institutions, especially those institutions that are experienced in the development and implementation of relevant technologies (Umezuruike et al., 2017).

2. Donor support and collaboration

HMISs need funding. This can be external, and sometimes from international donors as was the case of Japanese funding for the Tanzania HMIS strengthening initiative (Mahundi et al., 2018:5). Making and implementing the decision to invest in HMIS is essential, even if there is a lack of sufficient empirical and quantitative evidence regarding return on investment (Alwan et al., 2016:847; Uzochukwu, 2018 in prep.).

- **Kenya**: Apart from the MoH-operated GHRIS[4], health systems are 'open source' and 'externally funded' (Kihuba et al., 2016). There has been top management support to overcome structural challenges (such as departmental silos and non-standardised data formats) at the time of implementation by training of users, simplifying the software design, procurement of ICT equipment, appointment of district champions, and piloting. During the implementation of the Integrated Financial Management Information System (IFMIS),[5] actions to support implementation fell under two categories:
  - '*ICT to support*' – aimed at providing the infrastructure and support required for a fully functional financial management system.

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[4] Government Regulatory Human Resources Information System.

[5] IFMIS is from the national treasury and contains data about revenue, tender prices, and expenditures IFMIS is regularly audited and believed to demonstrate high data validity. Government of Kenya (2014). Integrated Financial Management Information System. http://www.ifmis.go.ke/

o '*Communicate to change*' – aimed at supporting change management, capacity enhancement, information generation and dissemination, education, and effective communication among stakeholders.

3. Stakeholder co-ordination in demands for data: effective approaches/ strategies

Key stakeholders in HMIS include civil society, donors, non-government organisations (NGOs), patient groups, health insurance groups, the private sector, and all concerned MoH departments (Le Pape et al., 2017:64). They can also be consumers, or those who require health information to inform decision making (Heywood and Boone, 2015:72).

These stakeholders can address barriers to HMIS design and implementation. Nine effective approaches are:

1. *Identifying governance (design phase)*

A mission statement is an effective approach, as it names primary stakeholders, and articulates how the organisation provides value to stakeholders (Heywood and Boone, 2015:73).

- **Afghanistan**: In implementing their governance development action plans, three PPHCCs and eleven DHCCs worked to improve engagement with the public and communities, and to become more transparent, accountable, and responsive (Anwari et al., 2015).
- **Morocco**: An action plan (including the implementation strategy and an assessment of needed human and financial resources) was designed to produce quick returns (e.g. on hardware investment). The architecture design leverages principles of systems integration and inter-operability, so the HMIS may exchange data with the private health care sector and other organisations (Le Pape et al., 2017:60).

2. *All-phase involvement*

The '*Guidelines for Data Management Standards in Routine Health Information Systems*' – developed by HIS experts with support from USAID through its project MEASURE – state that "comprehensive stakeholder involvement from all actors in the system, including the community the health system serves" is necessary (Heywood and Boone, 2015:53).

- **Morocco**: Involving all stakeholders, particularly health care professionals, in all phases of the implementation of large and complex HMIS from inception to full rollout, was a key success factor (Le Pape et al., 2017:64).

3. *Improving governance through co-ordination*

HMIS strengthening requires an enabling environment and robust collaboration between health and other sectors, including ICT, across public and private spheres. A multi-sectoral co-ordination mechanism should co-ordinate and oversee activities and investments for HMIS and eHealth. This can help build national institutional and human capacities through peer-to-peer

networking and knowledge exchange (WHO, World Bank Group, & USAID, 2015:9; Uzochukwu, 2018 in prep.).

- **Afghanistan**: The MoPH faced significant challenges, such as lack of staff and capacity to support monitoring of the governance intervention. It also didn't have much experience in improving its own governance. Despite these challenges, the leadership and involvement of the Ministry in the intervention mattered. The provincial and district health governance leaders were inspired to improve their governance because the ministry leaders were interested in a pilot intervention (Anwari et al., 2015).

  Lessons learned: Members from 3 PPHCCs and 11 DHCCs reported that steps were taken to recruit more women to community health nursing educator posts; suggestion and complaint boxes were placed outside health posts and the community complaints were discussed during regular meetings; attendance of members at the meetings improved; civil society groups, community leaders and representatives from other sectoral departments were invited to the committee meetings; community concerns were discussed as a standing agenda item during committee meetings; and vaccination rejection in some villages was addressed by negotiating with elders and through community mobilisation efforts (Anwari et al., 2015).

4. Investments in data sources and capacities

These investments will strengthen governance of HMIS by national authorities, eHealth architecture, and data standards – allowing inter-operability and improving health information workforce skills and capacities for using health statistics and data (WHO, World Bank Group, & USAID, 2015:8; Uzochukwu, 2018 in prep.).

Information and communication technology (ICT) innovation can help improve the availability, completeness, timeliness, quality, and use of data for decision-making in health. Minimizing the burden of data collection, analysis and reporting through eHealth strategies can improve health service delivery and management as well as facilitate the generation of accurate and timely data. Data should be secure and shared more freely, allowing rigorous comparison, and learning and building of the evidence base for scaling up interventions (WHO, World Bank Group, & USAID, 2015:9; Uzochukwu, 2018 in prep.).

Development partners and national institutions should align their investments (WHO, World Bank Group, & USAID, 2015:14; Uzochukwu, 2018 in prep.). Data, monitoring and accountability should be integrated into the 'three-ones': one plan, one budget, and one monitoring and evaluation [M&E] framework[6].

5. Co-ordination during implementation

Stakeholders must co-ordinate and work together to ensure that national HMIS implementation meet tangible and measurable goals of electronic health (eHealth): access, equity, efficacy, and quality (Le Pape et al., 2017:65).

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[6] "Three Ones" principles were first identified through a preparatory process at global and country levels, initiated by UNAIDS in co-operation with the World Bank and the Global Fund to Fight AIDS, TB and Malaria. Built on lessons learned from over two decades, it will help improve the ability of donors and developing countries to work more effectively together, on a country by country basis. http://www.who.int/3by5/newsitem9/en/

- **Pakistan**: Research has shown a lack of inter-departmental and intra-departmental co-ordination in terms of information sharing (Qazi and Ali, 2009:12). At the federal level, the perception is that HMIS is purely a provincial issue, while at the district level the managers are indifferent because the feedback to district level is either absent or delayed, so the information cannot be used effectively for health planning. Health managers also mentioned that they were overburdened by requirements to produce multiple reports demanded by vertical programmes, besides the national HMIS (Qazi and Ali, 2009:12).
- **Sub-Saharan Africa**: Co-ordination between stakeholders in the design phase, as well as supervision and facilitation in the implementation cycle, has been highlighted for overcoming implementation challenges in both Ghana and South Africa (Ahuja et al., 2018:45).

6. Process re-engineering

Another recommendation is to promote the use of scalable, affordable, open access software systems and work with collaborations to develop and use common health information architecture, standards, guides, tools and solutions (WHO, World Bank Group, & USAID, 2015:9; Uzochukwu, 2018 in prep.).

- **Ethiopia**: In 2006, the Federal Ministry of Health (FMoH) embarked on a major reform of the HMIS and monitoring and evaluation (M&E) system based on the principles of Business Process Re-engineering (BPR). Lessons learned: Design of the reformed HMIS (r-HMIS) included a clear policy, strategy, and guidelines for improved HMIS performance in the country and use of data for decision making at all levels of the health system (John Snow, Inc., n/d).
- **Morocco**: To keep momentum going among key stakeholders such as MoH leadership, providers, patients, and payers, incorporating process re-engineering of workflows into overall HMIS reform design was found to be critical. This is because stakeholders are all too often resistant to change and simply wish for the automation of familiar workflows, which inevitably leads to the automation of poorly designed processes (Le Pape et al., 2017:64).

7. Using data to improve policy and service delivery

With a focus on equity, disaggregated data and access to need-based, good quality services, health information should be used by and provided to decision-makers at all levels for improving health policy, system and services (WHO, World Bank Group, & USAID, 2015:9; Uzochukwu, 2018 in prep.).

- **India**: Barriers to data sharing include gaps in the public sector's data collection systems, data utilisation and communication; and private providers' fears of disclosure and perceptions of the level of work involved (Gautham et al., 2016). *Lessons learned:* The private sector's willingness to share public health data can be harnessed by the public sector through increased communication, trust and relationship building, and establishing a sustainable system for data collection and synthesis (Gautham et al., 2016).

8. Strengthen accountability and reporting of results

There should be national oversight mechanisms for key indicators of national health targets and goals (including all three aspects of universal health coverage (UHC): population coverage, service coverage and financial protection), and mechanisms of regular reviews and analyses to assess progress and performance against national health sector related priorities. These reviews should be transparent with mechanisms to share the analysis, discuss the implications, and identify remedial actions (WHO, World Bank Group, & USAID, 2015:12; Uzochukwu, 2018 in prep.).

WHO recommends that data quality assessments (DQAs) be carried out regularly to assess HMIS performance. WHO is currently working on guidance on analysis and use of Health Facility Data that could be linked in the DHIS2 (a health data management platform widely used in routine HMIS). However, it is still work in progress and therefore not an official publication. Overall health facility density data should include facilities of all managing authorities (public, private for profit, private not-for-profit, military, etc.) (WHO, 2018:52).

Indicators and data collection systems should be standardised across all HIS data sources (Heywood and Boone, 2015:60). However, this is not always the case as HMIS employs a mix of paper-based and technology-based practices.

Data collection mechanisms used by HMISs in LMICs may be of varying quality due to human error, measurement error, or missing values (O'Hagan et al., 2017). In several countries, for example, a large volume of routinely collected HMIS data eventually reaches the national level without being cross-checked, analysed or utilised (Upadhaya et al., 2016).

- **Nigeria**: Community-based HMIS data collection is often either poor, or non-existent, in low resource settings. Efforts at establishing community-based HMIS in the past have often failed, or at best, become dysfunctional, beset by challenges with supporting infrastructure such as erratic power supply, poor road transportation and poor telecommunication. However, the advent of mobile technology with its increasing penetration into the rural areas has permitted a re-envisioning and redesign of HMIS data collection (Asangansi et al., 2013:76).
- **Pakistan**: HMIS data are not reliable, many of the districts do not report on HMIS, and those who report usually submit incomplete data (Haq et al., 2017).
- **Sub-Saharan Africa**: Studies have shown variability in data quality from national HMISs in which threatens utility of these data as a tool to improve health systems (Nisingozwe et al., 2014).

9. Collaboration: Government and health agencies

Partnership and collaboration with health workers and other stakeholders have also been demonstrated to be a critical factor in the successful implementation of HMIS. This includes: (Uzochukwu, 2018 in prep.)

- Establishing a multi-disciplinary working group consisting of health managers, development partners, health workers and IT people at the outset to create a joint vision of the HMIS upon which the decision to enter the process is based.
- Financial incentives for health workers.

- Establishing an ongoing collaborative process, making sure that benefits for health workers are clear and visible.
- Providing training and ongoing support to health workers.

- **South Sudan**: The design of the routine HMIS tools was followed by their pre-test in Jonglei and Upper Nile States. In these two states, the combination of appropriate tools, training and support resulted in health facilities, counties and states officers able to provide consistent and quality routine reports. While this happened in the two states, at central level tools were refined and explained to MoH programmes staff and partners staff; consensus was built on the need for collecting only the relevant data for action and the database for the South Sudan information system was developed in the DHIS. This joint approach provided the needed impulse for the health agencies to adhere to the MoH system. *Lessons learned:* The implementing of a routine HMIS from scratch is challenging but possible. In this is a joint effort between stakeholders, negotiation and pragmatism are key concepts (Laku et al., 2012). The joint approach between stakeholders has started to pay off, and the routine information system is progressing. The system requires tools and procedures but also an enthusiastic, motivated and proficient team who understands the value of data for planners and managers. South Sudan has professionals in the public health care system who are working to make the routine HMIS a reality and to implement the mandate of the government of a system based on evidence. While there are still challenges ahead there is also measurable progress.
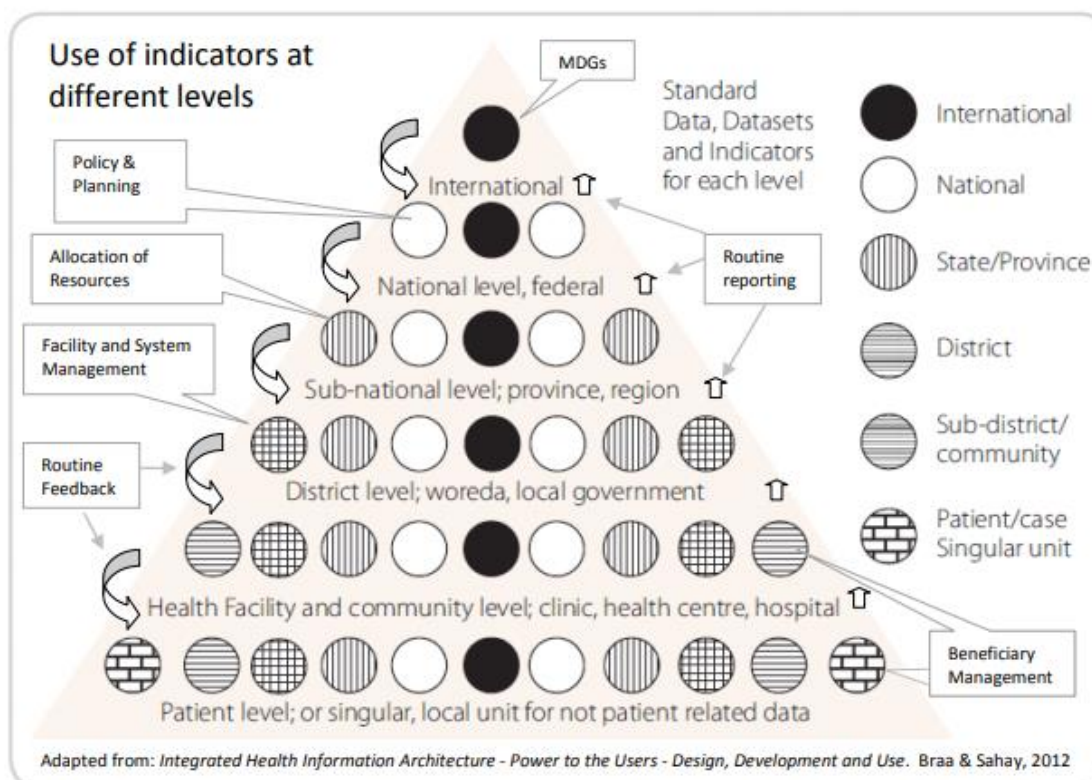
4. Data aggregation, responsibilities, and discrepancies

Data aggregation

HMISs produce large amounts of data about health service provision and population health, and provide opportunities for data-based decision-making in decentralised health systems (Wickremasinghe et al., 2016). Data aggregation is any process in which information is gathered and expressed in a summary form, for purposes such as statistical analysis. A common aggregation purpose is to get more information about particular groups based on specific variables such as age, profession, or income.

Defining HIS users' data and support needs is the starting point for RHIS design and management (Heywood and Boone, 2015:5). Data needs are different at different levels, and it is important to note that, although not all data should be reported upwards, lower levels need to collect and report all data necessary for higher levels (Heywood and Boone, 2015:13). There is a hierarchy of indicators, which are used differently at every level of the system, depending on management functions (Figure 2). RHIS information should also be shared with, or *fed back to,* data producers at all levels, of the health system (Heywood and Boone, 2015:76) – especially the lower levels.

Figure 2. Use of indicators at different levels

Source: Heywood and Boone, 2015:13

- **Northern Nigeria**: Data flow was designed to be hierarchical, and in a command-and-control structure that reached from health facilities to districts, to state, and then to the federal level (Asangansi, 2012).

- **Nigeria**: Health data are generated from government institutions at the federal, state and local government agency level, using harmonised data tools. Hence, HMIS draws upon multiple data sources, such as civil registration and vital statistics systems, census, population-based surveys, routinely generated data from health facilities and administrative information systems (Uzochukwu, 2018 in prep.).

- **Rwanda**: Prior to 2008, the HMIS existed almost entirely in paper form. Rwanda began using an electronic HMIS in 2008 to capture facility healthcare data. However, HMIS data quality in Rwanda has been improving over time, according to a recent five year-period of analysis (Nisingizwe et al., 2014). Indicators collected include service uptake data for key programmes (e.g. immunisation, family planning, and antenatal care) and general health systems data (e.g. drug availability and financial information). Data are aggregated at the facility-level and monthly reports are submitted to the district team. Prior to 2012, reports were then forwarded to the central MoH office and imported into an electronic system. Since 2012, MoH introduced a web-based system (DHIS2) allowing data entry to be done at the facility. This system allows data to be stored centrally, and the facility to maintain and view their data from a local database.

Stakeholders should be engaged in defining information needs and the format for data presentation. For example, it might be simple and concise for politicians or the general public, but more detailed and more technical for RHIS managers (Heywood and Boone, 2015:52). The following section describes responsibilities further:

Data responsibilities and discrepancies

The designation of an active integrating organisation responsible for developing and managing the system is a key success factor (Uzochukwu, 2018 in prep.). At the country level, new methods to track performance at various levels of the health system (such as at primary, secondary and tertiary care level) can and should be explored (Ahuja et al., 2018:45).

The following country case studies provide evidence for who is responsible for compiling HMIS data, and highlights where discrepancies occur in the process:

- **Afghanistan:** At the central level, the Ministry of Public Health (MoPH) contracts NGOs to provide services through health posts and health facilities. At the provincial and district level, health co-ordination committees are given responsibility for monitoring and oversight of health service delivery (Anwari et al., 2015).

  Lessons learned: Many governance challenges remain in the central ministry of public health and its offices in the provinces and districts, and hospitals and health facilities. While multi-stakeholder committees have been established in the provinces and districts,[7] and consultative committees at health facility and village levels,[8] they do not interact sufficiently with each other and for that matter, with the health facilities and communities. There is a lack of concerted action. Decision-making processes are not adequately open and transparent, and these committees are not equipped with adequate skills, authority or resources to carry out their mandated governance functions. Inter-sectoral collaboration is scarce at all levels. Despite the challenges, these multi-stakeholder committees in the provinces and districts are an invaluable entry-point to the governance of the provincial and district health systems (Anwari et al., 2015).

- **Botswana:** Health services are delivered through the public and private health sectors. The public health sector is organised into different levels based on the complexity of

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[7] Provincial Public Health Co-ordination Committees (PPHCCs) provide a formal forum for co-ordination and information sharing among various stakeholders in the provincial health system. They discuss community health concerns, and co-ordinate and participate in all stages of the emergency response. They also monitor and supervise health posts and health facilities. They are expected to meet on a monthly basis and co-ordinate delivery of the basic package of health services, and the essential package of hospital services (Anwari et al., 2015).

[8] The MoPH has also formally established consultative community health shuras and health facility shuras at health post, health facility, and district hospital levels. Hospital community boards were established at the provincial hospital level. In the last 4 to 5 years, the MoPH has been establishing District Health Co-ordination Committee (DHCCs) in the districts to perform a role similar to that of the PPHCCs in the provinces. *Shuras*, or informal consultative assemblies of elders, have a long and well-established tradition of resolving disputes and solving contentious issues in communities in Afghanistan (Anwari et al., 2015).

services provided.[9] Before April 2010, the MoH was responsible for all public hospitals, while the Ministry of Local Government was responsible for clinics, health posts and mobile stops. Since then all services were consolidated under the MoH. The private health sector in Botswana is poorly understood and undocumented. Generally, it comprises not-for-profit and for-profit hospitals, clinics, pharmacies, laboratories and Medical Aid Schemes (Seitio-Kgokgwe et al. 2015).

Three types of electronic health systems are used to collect health data: the Integrated Patient Management System (IPMS), used in hospitals only to collect patient diagnostic information; the Patient Management System, used in clinics with a maternity sector; and the DHIS2, used for aggregating health data from all facilities within the country.[10] Recent figures from MEASURE Evaluation (2016-2018) show that 100% of public health facilities report through DHIS2. All hospitals are on centralised IPMS. Other public facilities use a stand-alone system.

Lessons learned: According to the MEASURE Evaluation, data is mostly used at district and national level for planning.

- **Ethiopia**: Since 2009 USAID/MEASURE Evaluation has been scaling-up the national HMIS in Southern Nations, Nationalities and People's Region (SNNPR) of Ethiopia. By July 2011, 7 zones and 2 special woredas out of 15 zones and 7 special woredas in SNNPR were implementing the reformed HMIS (MEASURE Evaluation, 2014:1).

For a uniform implementation of HMIS, pre-requisites were set by the FMoH to scaling-up HMIS in any region; the Regional Bureau of Health (RHB) were made responsible to renovate Medical Card Unit (MRU), provide Master Patient Index (MPI) boxes, shelves for filing Individual folders at MRUs, recruit full-time salaried HMIS focal persons, hire and train Health Information Technicians (HIT) and put appropriate number of staff in the MRU (card room). The FMoH took the responsibility to print and provide HMIS instruments, and to provide funds for training health staff in the health facilities (MEASURE Evaluation, 2014:2).

Lessons learned: In most of the health facilities, HMIS focal persons are delegated to undertake HMIS tasks on top of their regular duties and responsibilities. Hence, because of workload, data recording may not be done with necessary care. However, throughout the country, the pace of training of health staff and scaling-up of the reformed HMIS was not encouraging (MEASURE Evaluation, 2014:2).

A focus group discussion highlighted reasons for the gap between staff confidence and HMIS task competencies: knowledge of checking data quality methods ranged between 58%-70% at health facilities. Problem-solving skills were also low. This indicates that more importance is placed on how to collect data rather than analyse and use them for local decisions. This approach is restrictive when data collectors are the facility

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[9] At the lowest level are 810 mobile health stops, 340 health posts and 243 clinics. There are 16 Primary Hospitals and seven District Hospitals, while three National Referral Hospitals represent the highest level of the system.

[10] https://www.measureevaluation.org/his-strengthening-resource-center/country-profiles/botswana

managers, responsible for the health of the catchment area population, and information is needed and useful to fulfil that responsibility (MEASURE Evaluation, 2014:24).

- **Ghana**: The new HIS is partially electronic, with patient information being collected first on paper through forms which are filled out by nurses and doctors, and later being entered into an electronic by clerks (Kpobi et al., 2018).

  Lessons learned: Increased staff workload occurs due to the cumbersome nature of the form. This resulted in more mistakes and less accurate data being entered into the system. Incomplete data also led to data having to be re-entered for subsequent patient contacts, further burdening the staff (Kpobi et al., 2018).

- **Kenya**: The Kenyan government, working with international partners and local organisations, has developed an eHealth strategy, specified standards, and guidelines for electronic health record adoption in public hospitals and implemented two major health information technology projects: DHIS2, for collating national health care indicators and a rollout of the KenyaEMR (a customised version of OpenMRS – Open Medical Records System) and International Quality Care Health Management Information Systems, for managing 600 HIV clinics across the country (Muinga et al., 2018). Staff include clinical officers, nursing officers, health records and information officer (HRIO), and data clerks at the HIV clinic. Consultants based in Kenya, working with developers in India and project stakeholders, implemented the new EMR system into several public hospitals in a county in rural Kenya (Muinga et al., 2018).

User documentation is needed by electric medical record (EMR) end users and should be written in simple, user-friendly language. User documentation includes user reference guides and training manuals. The '*Standards and Guidelines for Electronic Medical Record Systems in Kenya*' document (2010) provides a step-by-step guide on EMR system functionalities, and instructions on how to use the system for healthcare professionals. It should cover how to run the system, how to enter data, how to modify data and how to save and print reports. It should also include a list of on-screen error messages and advice on what to do if something goes wrong.

Lessons learned: Three categories of staff have been identified for successful implementation and operation of EMR systems:

- Facility based users who are responsible for collecting, entering, and reporting health data using the EMR system.
- Higher level managers who use information collected and stored in the EMR system for service delivery and resource management decisions.
- IT system developers and administrators who develop and maintain hardware and EMR software as well as provide general user support.

High level managers who are familiar with how data is collected, entered, and managed within the EMR and HIS system are in a stronger position to identify the source of poor data and to take the appropriate action to remedy the situation that resulted in poor data being made available (Ministry of Public Health and Sanitation and the Ministry of Medical Services, 2010:61).

However, with regard to implementation experiences of EMRs, there is a concern that the level of support may be insufficient in relation to actual needs at the health facility level.

Duties are uncertain: for example it is unclear if data-entry clerks enter clinical data following the patient visit, or whether clinicians do this during or following the visit – both approaches (retrospective data entry and point of care, respectively) will have different HR requirements in terms of numbers of staff and their skill levels (Ministry of Public Health and Sanitation and the Ministry of Medical Services, 2010:57,58).

Printing electronic data from one system and re-entering it into another system manually is commonplace. Manual data entry by staff is labour intensive and prone to transcription errors. It increases the time from when the indicator data are generated in the EMR to its availability in the aggregate data system, and increases the workload for health workers responsible for reporting (Kariuki et al., 2016). Implementing eHealth/EMR systems is a challenging process in high-income settings. In low-income settings such as Kenya, open source software may offer some respite from the high costs of software licensing, but the familiar challenges of clinical and administration buy-in, the need to adequately train users, and the need for the provision of ongoing technical support are common across the North-South divide (Muinga et al., 2018).

Furthermore, a report evaluating EMR implementation experience in 25 hospitals in Nairobi shows that these were faced by a number of challenges, partly because there was 'lack of consensus between senior managers and user departments' and 'poor planning' (Franklin, 2011; Kihuba et al., 2016).
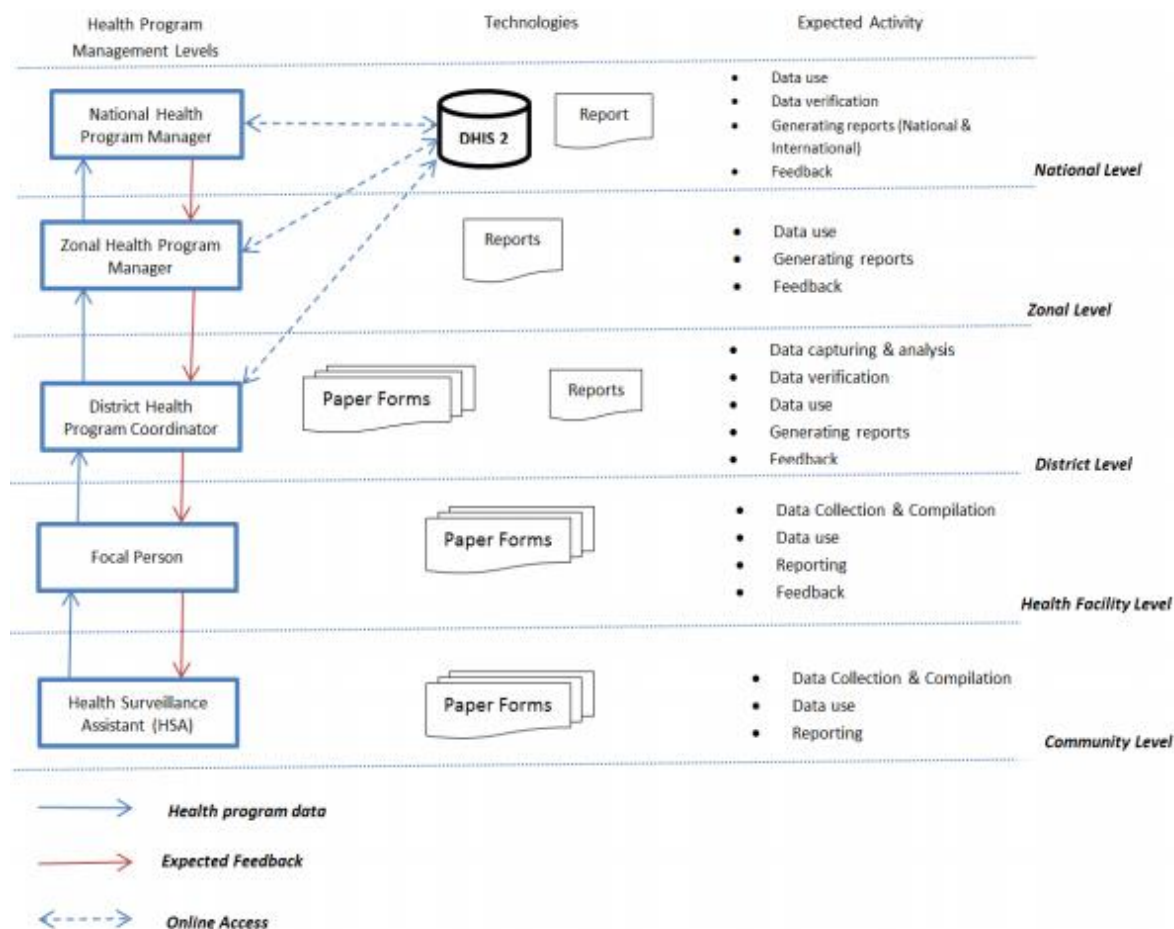
- **Malawi**: Malawi has adopted a system use practice that builds on a number of data managers (e.g. HMIS officers and DHIS2[11] team) who are key personnel in health information management practices. Although health programme co-ordinators and Central Monitoring and Evaluation Division[12] officials, for example, have access to DHIS2, they usually depend on HMIS officers and DHIS2 teams, respectively, to extract data from, and even enter data into, DHIS2. This can be due to lack of time, lack of access and even lack of skills (Bertulis, 2008). It has been noted that HMIS officers and DHIS2 team have received more training, although less attention have been given to health managers and co-ordinators who are actual information users (Chikumba, 2017:163). Figure 3 shows the expected data flow at different levels.

  Lessons learned: Technology plays a role in strengthening HMIS in Malawi, as Figure 3 shows. However, this should be supported by enhancing a culture of information management. It has been noted that DHIS2 is the main information system but it requires the enhancement through inclusions of other technologies. The DHIS2 alone cannot do everything (Chikumba, 2017).

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[11] District Health Information System 2.0 (DHIS2, www.dhis2.org) is a tool for collection, validation, analysis, and presentation of aggregate and patient-based statistical data, tailored (but not limited) to integrated health information management activities.

[12] CMED is only the division within MoH which is responsible for managing data, implementing systems and providing technical support at all levels.

Figure 3. Expected data flow in Malawi HMIS and position of DHIS2

Source: Chikumba, 2017: 161.

- **Morocco**: Morocco is moving toward UHC with the ambition to cover the majority of its population (Le Pape et al., 2017:57). However, the organisation and delivery of health care is fragmented, and faces severe resource constraints.

  Lessons learned: Hierarchical structures can hinder decision making, particularly when senior officials must be implicated. Members of key committees did not feel entitled to list, let alone prioritise, objectives and relegated the responsibility of doing so to the expert team. Such issues can compromise HMIS ownership (Le Pape et al., 2017:64).

- **Nigeria**: Because data collection and storage using mobile solutions involves longitudinal individual data, community workers, using mobile devices, can seamlessly retrieve historical data for individuals on follow-up visits. Such seamless retrieval would have otherwise been impossible, or at best difficult, in the paper based system as it would have required checking through piles and shelves of paper for even the simplest data point (Asangansi et al., 2013:83-84).

- **Pakistan**: As well as the English language skills of auxiliary workers mentioned earlier, at higher levels many doctors do not write down the age of their patients or the diagnosis, casting doubt on the accuracy of the data (Qazi and Ali, 2009:12).

- **Rwanda**: Patient-level data are recorded in paper-based registers by care providers (Nisingizwe et al., 2014). With the arrival of R-HMIS, web reports from every health facility in the country can be made available in a few clicks.[13]

  Lessons learned: Data validation rules are keeping the data clean and of near to perfect quality. DHIS2 experts went to great lengths to meet as many requirements as possible. For example, they revised data collection tools, including patient forms and registers, and health facility reporting tools. Standard operating procedures (SOPs) for data management at health centres and district hospital levels were introduced along with a routine data quality audit (DQA) system. Finally, referral hospitals, private dispensaries and clinics were integrated. Data quality assessments show excellent results. Data completeness is approximately 98% today, according to DHIS2.org figures. People at all levels within the health sector use the collected data; at district and at central level.

- **South Sudan**: Two health system assessments conducted in 2007 and 2009 highlighted the absence of a working routine HMIS (Laku et al., 2012). An M&E Scoping Mission conducted in March 2010 noted the lack of tools and procedures for data collection, the inconsistent data flow, and the limited capacity for analysis and use of data for action at all levels of the system. The design of the routine HMIS tools was followed by their pre-test in Jonglei and Upper Nile States. While this happened in the two states, at central level tools were refined and explained to MoH programmes staff and partners staff; consensus was built on the need for collecting only the relevant data for action and the database for the South Sudan information system was developed in the DHIS.

  Lessons learned: This joint approach provided the needed impulse for the health agencies to adhere to the MoH system. From February 2011, a number of activities supported M&E in states and counties, including provision of equipment, printing and distribution of registers and manuals and training in HMIS and DHIS of MoH officers, partners and programmes staff.

- **Tanzania**: HIS review initiatives resulted in a semi-computerised HIMS in 1993 (Smith et al., 2008; Mahundi et al., 2018:1; Nyamtema, 2010), under Danish International Development Agency support. In 1998 it was translated from English to Kiswahili. The translation named the HMIS as "*Mfumo wa Taarifa za Uendeshaji Huduma zaAfya* (MTUHA)" (Mahundi et al., 2018:4).

  Lessons learned: Research has revealed a state of poor health data collection, lack of informed decision-making at the facility level, and the factors for change in the country's HMIS (Nyamtema, 2010). Software systems, human resources, procedures, and data collection tools have since been subjected to standardisation (Mahundi et al., 2018:2). The level of education contributes a lot in understanding the different data content to be collected and exchanged, especially with regards to the details. As a data collection form with the requirements for detailed data will likely be filled in correctly by those staff with higher level of professional education than those without, the dispensary is expected to have at least a clinical officer as the highest education level in the facility while the health centre is expected to have at least one medical officer (graduate) with a few clinical

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[13] Rwanda HMIS powered by DHIS2 (2016): https://docs.dhis2.org/master/en/user-stories/html/user_story_rwandaHMIS.html

officers. This number increases as one goes high up in the health facility levels (Mahundi et al., 2018:5-6).

Barriers and data process discrepancies: global evidence

The van Panhuis et al., (2014) systematic review identified 20 potential barriers to sharing routinely collected public health data across country borders (Kumar et al., 2017:e5). These barriers are divided into 6 categories:

1. *ICT and parallel reporting*

Technical barriers such as restrictive data formats, lack of metadata and standards, and absence of technical solutions (e.g., interoperability) hamper data sharing and use (van Panhuis et al., 2014:3). These technical challenges are compounded by a lack of incentives for using data in decision making (Kumar et al., 2017:e5).

- **Ethiopia**: *Lessons learned*: The technical aspects of HMISs, such as integration of data collection tools, availability and accessibility of user friendly database, and availability of data collection and definition procedure manual, are not well-established in the three zones/special woreda (MEASURE Evaluation, 2014:24-25). Health facilities are still submitting parallel reports due to demands from programmes and donors. This parallel reporting creates a huge work burden and compromises data quality and the motivation and commitment of the staff towards the new system. Moreover, though the new eHMIS intends to reduce data entry and processing burden of Woreda Health Offices (WoHOs) and Zonal Health Departments, the database is not accessible on timely basis to inform plans and decisions. As a result, woredas and zones are still entering and aggregating data for local consumption, and have to report to their respective administrative council. Improving report timeliness, speeding the data entry and processing at regional level and expanding access to the database to woreda health office level are crucial to enhance data quality and use of information for evidence based decision at all levels.

- **Uganda**: *Lessons learned*: Although Uganda has shown success in the use of HMIS in the areas of disease surveillance reporting and monitoring, various challenges have hindered the full implementation of HMIS in Uganda. These include: complex health system structure, inadequate funding, inadequate ICT, facilities, training, knowledge gap, incompatibility and inter-operability problems, and user engagement problems (Umezuruike et al., 2017).

2. *Motivational barriers*

These include barriers based on personal or institutional motivations and beliefs that limit data sharing. They include lack of incentives, credit for work, possible criticism, and disagreement on data use. Solutions for this group of barriers lie in building trust or developing transparent legal agreements (van Panhuis et al., 2014:4-5). Data collection, storage, analysis, and sharing require investment in people, infrastructure, and organisational processes. These economic factors can act as barriers to data sharing and use (Kumar et al., 2017:e5).

- **Ghana**: None of the staff questioned was aware that the new HMIS could have benefits for clinical work such as fewer prescription errors, increased adherence to treatment

guidelines and improved clinician communication, as other literature has reported (Kpobi et al., 2018).

3. Economic barriers

These barriers concern the potential and real cost of data sharing. Solutions depend on the recognition of data value and on sustainable financing mechanisms:

Data sharing in public health is challenged by the economic damage that this may cause to data providers. Public sharing of disease outbreak data, for example, can result in economic damage due to reduced tourism and trade. The global SARS outbreak led to estimated economic losses of USD 50 billion between 1998 and 2004 and Foot & Mouth Disease in the UK resulted in losses of USD 30 billion between 1998 and 2003. The possibility of such significant economic implications due to (over) reactive market forces could cause great reluctance among health agencies to rapidly release disease data (van Panhuis et al., 2014:5).

The process of data sharing requires human and technical resources for data preparation, annotation, communication with recipients, computer equipment, internet connectivity, etc. These resources are frequently lacking in public sector agencies under economic pressure or in low income settings (van Panhuis et al., 2014:5).

4. Political, legal and ethical barriers

Political barriers to data sharing include lack of trust, lack of guidelines, and restrictive policies (van Panhuis et al., 2014:5; Kumar et al., 2017:e5).

Legal factors such as ownership, copyright, and data privacy affect how data is shared and used. The purpose of data use and its impact on data producers influences how the data is shared and used (van Panhuis et al., 2014:5; Kumar et al., 2017:e5).

Ethical barriers are normative barriers involving conflicts between moral principles and values. Solutions for these barriers will involve a global dialogue among all stakeholders on the ethical principles that should govern data sharing.

HMIS implementation has become a major challenge for researchers and practitioners because of the significant proportion of failure of implementation efforts. Researchers have attributed this significant failure, in part, to the complexity of meeting with and satisfying multiple (poorly understood) logics[14] in the implementation process (Asangansi, 2012), including behavioral issues and misuse of resources for 'quick wins':

- **Nigeria**: Corruption and unpredictable change in policies and regulations are important barriers. Political commitment and priority given to HMIS constitute major barriers. This is because they are grossly inadequate due to fragmentation of existing systems coupled

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[14] For example: a project's short-term 'quick win' focus and a long-term infrastructure-building perspective; similar to the issue between a non-government organisation (NGO)'s initial 'quick win' focus and the state's long-range focus. The conflict between focusing small-scale and going large-scale is crystallised in the struggle between running pilot projects that then struggle to scale in line with the goals for universal coverage; focusing on small/vertical scope (one disease) or focusing broadly on the larger primary health system (broad horizontal scope); balancing decentralisation-centralisation, and hierarchical vs. network-centric logics (Asangansi, 2012).

with low capacity to collect, verify and disseminate data and information (Alwan et al., 2016:841; Uzochukwu, 2018 in prep.).

- **Pakistan**: A questionnaire study revealed that some employees failed to comply with HMIS reporting, as they knew that no action could be taken against them due to their corrupt association with politicians (Kumar et al., 2012; Akhlaq, 2016). The misuse of resources is also an important barrier. In a qualitative study which interviewed 30 health managers, concerns about the corruption of HMIS staff and management cited the misuse of HMIS office resources. This included typing of unofficial letters, the appropriation of computers by senior management, and data manipulation to hide the causes of epidemic diseases (Qazi and Ali, 2009:12; Akhlaq, 2016).

Political, legal, and ethical barriers are less tangible and transparent compared to technical barriers, and will need to be clearly outlined and presented for a dialogue across sectors with international agencies such as the World Intellectual Property Organisation (WIPO), WHO, the World Trade Organisation (WTO), countries, development and funding agencies, and experts in ethics and law (van Panhuis et al., 2014:6).

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Key websites

- World Health Organisation (WHO) Health statistics and information systems: http://www.who.int/healthinfo/country_monitoring_evaluation/documentation/en/
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