WORKING PAPER

Barriers to Use of Health Data in Low- and Middle-Income Countries

A Review of the Literature

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CONTENTS

ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
DDU	data demand and use
DHP	district health profile
DQA	data quality assessment
DQR	data quality review
GIS	geographic information system
HIS	health information system(s)
HIV	human immunodeficiency virus
HMIS	health management information system
ICT	information and communications technology
INASP	International Network for the Availability of Scientific Publications
M&E	monitoring and evaluation
MOH	Ministry of Health
PEPFAR	President's Emergency Plan for AIDS Relief
PMTCT	prevention of mother-to-child transmission
PRISM	Performance of Routine Information System Management
USAID	U.S. Agency for International Development

INTRODUCTION

Health information is one of the essential functions of a strong health system. Global commitments to improving health systems and outcomes have led to improved monitoring and evaluation (M&E) and health management information systems (HMIS). HMIS produce data about health service provision and population health status to be used for decision making and program planning at all levels of the health system. Quality and timely data from a health information system should be used to guide decision making across all the other health system functions (service delivery, health workforce, access to essential medicines, financing, leadership, and governance) (AbouZahr & Boerma, 2005). These decision-making processes include priority setting, annual health planning and budgeting, health resource allocation and utilization, and introducing and improving service delivery and policymaking to promote greater utilization of health services and improve health outcomes. Data-informed decision making contributes to a culture of transparency and accountability, as available information is used to ensure that resources such as workforce, finances, and commodities are being used effectively and appropriately.

Despite improvements in technological solutions facilitating the collection of data and improving data analytics and visualization, actual use of data remains limited in many settings, especially at lower levels such as the district or community (Sacks, et al., 2015; Wickremasinghe, Hashmi, Schellenberg, & Avan, 2016). Data-informed decision making entails that potential courses of action are given full and unbiased consideration and the option most likely to be successful is chosen, based on a full assessment of relevant, available data that meet quality criteria. However, decision making is complex and influenced by several factors such that data are not always the basis for decisions (Pappaioanou, et al., 2003; Walshe & Rundall, 2001; Wilkins, Nsubuga, Mendlein, Mercer, & Pappaioanou, 2008). There are multiple facilitators that strongly influence the ability of individuals and organizations to use data effectively, as well as barriers that prevent this from happening. Despite the global recognition for the need to strengthen data-informed decision making, little is known on how to best accomplish this goal. We conducted a literature review to examine the barriers to data use and have highlighted interventions that sought to overcome those barriers.

METHODS

This review focused on the following key questions:

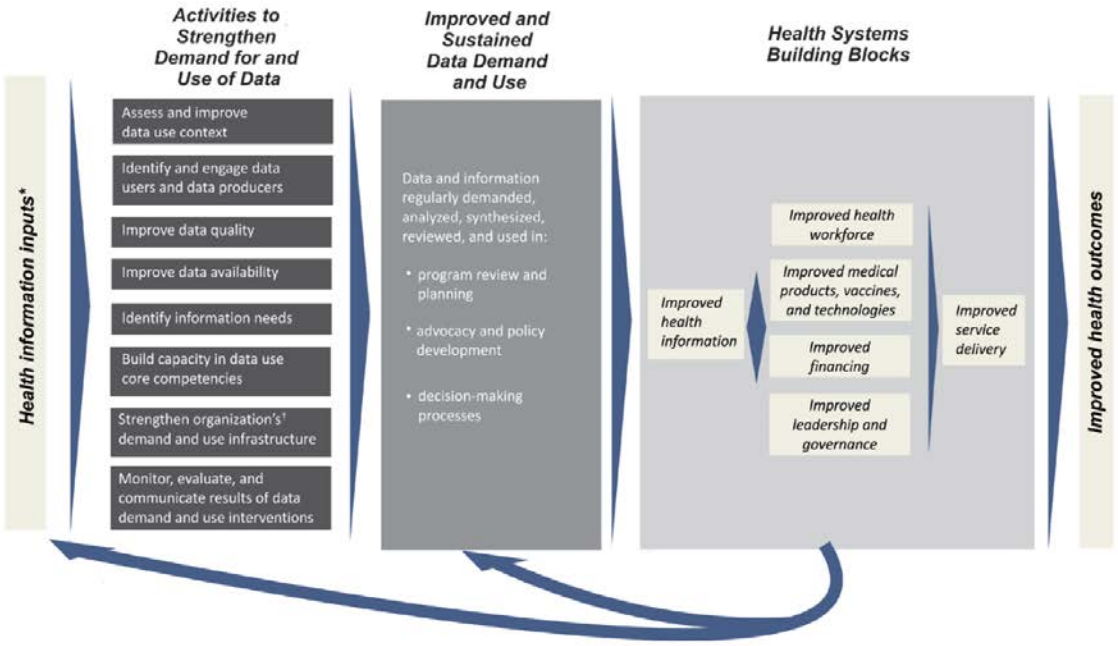
1) What are the barriers to the use of routine health information data in decision making in low- and middle-income countries?
2) What types of interventions have been implemented to address these barriers?

PubMed was used to search the scientific, peer-reviewed literature using the following key words related to health data and information: “data use,” “data utilization,” “data informed,” “evidence-informed,” “data driven,” “decision-maker,” “decision making," "priority setting," "resource allocation," "program planning," "quality improvement," "performance improvement," and "management and planning." In addition, websites for MEASURE Evaluation, PATH, JSI, FHI360, Cooper/Smith, Bill and Melinda Gates Foundation, USAID, Evidence-Based Policy in Development Network (EBPDN), International Network for the Availability of Scientific Publications (INASP), and Overseas Development Institute, along with the DataUseNet listserv, were searched for grey literature.

Articles were categorized according to either barriers to data-informed decision making, or interventions that improved data use. Classification of articles on the barriers to data use was based on the Performance of Routine Information System Management (PRISM) framework, which describes technical, organizational, and behavioural factors as key determinants in the processes, outputs, and outcomes of health information systems (Aqil, Lippeveld, & Hozumi, 2009). Behavioural determinants are the knowledge, skills, attitudes, values, and motivation of the people who collect and use data. Technical determinants are the data collection processes, systems, forms, and methods. Organizational determinants are the information culture, structure, resources, roles, and responsibilities of the health system. Classification of articles describing interventions to improve data use was based on MEASURE

Evaluation's data use conceptual framework for improving data use in decision making, which was developed to build on the PRISM framework (Nutley & Reynolds, 2013). This data demand and use (DDU) framework's associated logic model lists specific intervention areas that most directly affect the demand for and use of data (see Figure 1). Selected interventions were then further classified according to the categories of barriers identified.

Figure 1. Conceptual framework for the use of health data in decision making



* Defined as processes by Health Metrics Network.

† The data demand and use approach broadly defines an organization as a division of the ministry of health at the national, state, or district-levels; a specific program within the ministry; or nongovernmental organization or program.

RESULTS

We identified nine overarching categories of barriers to data demand and use. In each section, the barrier and its implication for data-informed decision making is described, followed by a text box highlighting interventions that address that specific barrier. After each barrier is described, examples of interventions addressing the barriers are provided.

A. Insufficient Skills in Data Use Core Competencies

Core competencies in data analysis, interpretation, synthesis, presentation, and the development of data-informed recommendations at all levels of a health system are essential for improving the demand and use of data (Amaro, et al., 2005; Nutley & Reynolds, 2013). These skills are often deprioritized compared to capacity building initiatives that focus more on data management, verification, and validation, resulting in a lack of technical capacities and skills in data use core competencies amongst the workforce.

Data producers—i.e., the individuals responsible for generating and managing data (data managers, data clerks, M&E professionals, front-line health workers, etc.)—require the skills to access, analyse, interpret, and summarize data into clear messages for decision-makers in comprehensible formats. Depending on the role that the data producer fills in the data collection and use process, they may also need specific skills in information and communications technology (ICT) and use of HMIS, data analytic tools and techniques (e.g., GIS), and data communication and advocacy (Harrison & Nutley, 2010). In general, there are limited personnel with data analysis and presentation skills, especially at lower levels of health systems where front-line health workers have responsibilities for both data-related tasks and service delivery. For data producers, these competencies should be included in standard monitoring and evaluation (M&E) trainings, but often these programs are one-off, short-term programs with limited follow up. Thus, these skills are not fully developed resulting in a lack of confidence to apply data use skills in regular work settings (Baldwin, Abeykoon, Orton, & Stout, 2016; Homer, Bhatia, Stout, & Baldwin, 2016). M&E and research capacity building programs also tend to place a greater focus on developing systems to collect and manage data, with little or no pedagogic emphasis on using those data in decision making.

Furthermore, capacity building initiatives in M&E rarely target data users, and curricula may not include data use competencies specific to this group. Data users (i.e., those that use data in program improvement and development) require skills to analyse, critically review, and interpret analyses, and translate information into programs, plans, and policies (Harrison & Nutley, 2010; Homer & Abdel-Fattah, 2014; Qazi & Ali, 2011; Uneke, et al., 2017). Moreover, decision-makers also require training to develop skills in identifying information needs and data use opportunities, as well as leadership and advocacy skills to secure funding and buy-in to push forward data-informed recommendations into action.

Poor training in technical competences and support systems to produce reliable information also impacts the quality of data as described in Section B, as staff feel overburdened and unable to fulfil their data-related tasks (Akhlaq, McKinstry, Muhammad, & Sheikh, 2016; Ikmari, Adewuyi, & Akinlo, 2007). High attrition rates amongst technical professionals, due to low salaries and motivation, exacerbates the capacity gap in contexts without continual training and mentorship in data use core competencies. Strategies to improve capacity in core data use competencies can be found in Box 1.

Box 1. Interventions to build capacity in data use core competencies

We found several examples of interventions that involved a capacity building element. Capacity building is commonly one aspect of integrated data use interventions, taking the form of workshops, trainings , and on-the-job coaching and mentoring on data use, analysis, interpretation. One of the first examples of data use capacity building occurred from 1991–1996, with the CDC/USAID Data for Decision-Making (DDM) Project which aimed to build the capacity of decision-makers to identify information needs, interpret data, and use data in decision making. It also built the capacity of technical advisors to produce quality data and focused on strengthening countries' health information systems. This strategy led to improved evidence-based public health policies in Bolivia, Cameroon, Mexico, and the Philippines (MEASURE Evaluation; Pappaioanou, et al., 2003).

The International Network for the Availability of Scientific Publications (INASP) has conducted capacity building trainings for different audiences in several countries. In **Sudan**, INASP, through the VakaYiko Consortium, conducted a capacity building workshop on gender mainstreaming for policymakers within the Ministry of Labour and the Ministry of Education. The purpose of this workshop was to enable policymakers to identify, analyze, and use data and research in decision making. The workshop addressed the topics of evidence-informed policymaking, research strategy, assessing evidence research, and gender analysis to inform policymaking. After the four-day workshop, INASP held a one-day conference where policymakers, researchers, journalists, and members of civil society were invited to discuss the role of evidence in policymaking. Participants rated the training favorably, though follow-up must be done to understand the success and impact on data use (Ali & Osman, 2016). In **Nigeria**, INASP organized a capacity building workshop for local government staff in urban areas to build capacity to understand and use evidence for more consistent and cost-effective public services. This training was implemented by the Improving Information Literacy for Urban Service Planning and Delivery Project (INFO-LIT), which took a participatory approach towards planning the workshop and developing the curriculum. The training focused on field data collection, data analysis, and decision making. The training used local data, such as census and service use data to improve participants' information literacy. Ninety-five percent of participants trained said that they believed the training had increased their capacity to conduct their jobs (INASP, 2016). In **Ethiopia** between 2015 and 2016, Jimma University organized a training for the Federal Ministry of Health (FMOH) on using evidence for policymaking combined with a six-month mentorship program and a community of practice for participants to share knowledge. The training focused on addressing three identified barriers to data use: 1) institutional culture; 2) staff capacity; and 3) evidence availability. The follow-up mentorship and community of practice programs allowed participants to continue to learn and build their capacity after the workshop and share knowledge and information with one another. INASP found that participants' knowledge of data-informed decision making increased by 20% through capacity building efforts (Jones, Champalle, Chesterman, Cramer, & Crane, 2017; Sudhakar & Woldie, 2016).

Finally, the Overseas Development Institute (ODI), through its Research and Policy in Development (RAPID) program, has conducted capacity building to improve research uptake since 2002. RAPID has conducted multiple capacity building workshops throughout Africa, Asia, and Latin America to improve research use in policymaking. RAPID's capacity building focuses on both individual and institutional learning and includes topics such as producing and using research; communicating with different audiences; networking and building communities; and monitoring, evaluation, and learning. They focus on eight core themes: 1) policy entrepreneurship; 2) research communications; 3) knowledge management and learning; 4) outcome mapping; 5) RAPID outcome mapping approach (ROMA); 6) M&E; 7) network development and facilitation; and 8) organizational and project management. They promote capacity building in a variety of ways, including the production of toolkits, conducting workshops, mentorship, and communities of practice. Overall, they found that workshops are their most successful and appealing offerings; however, they should be accompanied by exercises and support materials that can result in longer term engagement. Overall, through an analysis of ODI's work in capacity building for the past ten plus years, they have found that "effective capacity development for better research update is best achieved through real-time application of theoretical concepts, the setting of clear objectives and approaches, a range of multi-layered interventions, and the clarification of relationships between 'collaborators'" (Mendizabal, Datta, & Young, 2011).

MEASURE Evaluation has developed a suite of capacity building resources focusing specifically on data use core competencies, including trainings on data demand concepts and data analysis and interpretation, as well as tools to identify and engage stakeholders, identify information needs, and link questions of interest and data to action (MEASURE Evaluation). These trainings have been conducted in multiple locations, for example, in Ethiopia, Nigeria, and Lesotho.

B. Poor Data Quality

Data of poor quality—that is, data that are not sufficiently timely, credible, accurate and complete—cannot effectively be used to track program performance, and thus negatively impacts strategic planning and decision making. (Andermann, Pang, Newton, Davis, & Panisset, 2016; Harrison & Nutley, 2010). Inadequate data quality limits the confidence and value that decision-makers place on data, impacting future demand for data in decision-making processes (Ikmari, et al., 2007). Data quality can be compromised due to excessive data collection processes at local service delivery levels, often due to complex reporting procedures (e.g., multiple reporting forms), lack of standardized and harmonized systems for data collection, limited technology, and the lack of infrastructure and computers, and connectivity issues necessitating manual data collection on paper forms (Harrison & Nutley, 2010; Homer, et al., 2016). If the information needs of stakeholders are not identified and prioritized, health workers can spend a significant proportion of their time collecting large amounts of data that are rarely analysed and used, especially at the point of collection as they lack relevance to decision making (Odhiambo-Otieno, 2005). As described in Section A, limited skills in data management and validation and limited visibility on the value of data contribute to weak incentives for front line health workers to improve the quality of data for its use (Akhlaq, et al., 2016; Custer & Sethi, 2017). A case study from Sri Lanka noted that importance was not placed on collecting and analysing data that measures program outputs and outcomes (Baldwin, et al., 2016). Without access to data that are relevant to their needs, there is little motivation to ensure the quality of data that is collected. The literature also cited several examples where data are deliberately manipulated due to perverse incentives, for example falsely increasing target populations to get more funds or commodities, or falsifying performance data to meet targets tied to performance incentives (Custer & Sethi, 201; Qazi & Ali, 2011).

Although improvements in information systems have facilitated improvements in data collection and management, these benefits are not always realized at lower levels where staff are overburdened with high workloads and may not have adequate time for data-related tasks. For example, in Tanzania a new health management information system (District Health Information Software [DHIS 2]) was introduced at the district level, though paper-based reporting remained at the facility level due to limited access. Data management at the facility level is often rushed when reporting deadlines approach, resulting in data backlogs and limiting the amount of time available to spend on data compilation, facility-level analysis and use (Bhatia, Stout, Baldwin, & Homer, 2016). Strategies to improve data quality can be found in Box 2.

Box 2. Interventions to improve data quality

Several strategies exist for improving the quality of data. Many data quality assessment tools exist to understand the strengths and weaknesses in data quality systems and processes for routine health information, including the data quality review (DQR) and the routine data quality assessment (RDQA) (Chen, Hailey, Wang, & Yu, 2014). We found several examples of ways in which organizations have improved data quality. In KwaZulu Natal, South Africa, a data improvement intervention was implemented in antenatal clinics and delivery wards to improve the quality of prevention of mother-to-child transmission (PMTCT) data routinely recorded in the DHIS 2. This intervention involved training on data collection emphasizing the importance of public health information, feedback for health information personnel and program managers, monthly reviews of routine data carried out by PMTCT improvement task teams, and data audits at individual facilities, and resulted in increases in data completeness (from 26% to 64%) and data accuracy (from 37% to 65%) (Mphatswe, et al., 2012). Regular data quality audits (Bosch-Capblanch, Ronveaux, Doyle, Remedios, & Bchir, 2009) and data review meetings (Shimp, et al., 2017) have been found to improve the quality and accuracy of routine immunization program data.

As part of the African Health Initiative Population Health Implementation and Training (PHIT) partnership programs in Mozambique, Rwanda, and Zambia, data quality interventions were embedded within comprehensive health system strengthening approaches. In Mozambique, annual data quality audits were conducted assessing the availability, consistency, accuracy, and validity of HIS data, with summary analyses shared with district officials. Health facilities were publicly ranked based on data quality, and those with poor data quality outcomes received additional supportive supervision and capacity building in data quality. Data quality outcomes (measured as concordance) improved significantly in the two years after implementation, before plateauing as intervention activities continued (Wagenaar, et al., 2015). In Rwanda, quarterly DQAs were conducted comparing facility reports to HMIS data, along with community level lot quality assurance sampling to assess the quality of community-based health information. Data quality is also included in mentoring to enhance supervision in health centers' (MESH) quality improvement efforts. In Zambia, a data quality audit system was introduced for the community health information system, and there was continuous on-site mentoring of MOH staff to ensure completeness and accuracy of data entry. Data quality activities that both assesses and improves data quality (e.g., linking data quality assessments with mentorship and supportive supervision) were identified as core intervention components. Other important components of data quality interventions identified included the routine review of HMIS data quality (including cross-check across facilities), clarification of stakeholder roles and responsibilities in this process, feedback loops between collection, management, and policy, and engagement of managers across facility, district, and provincial levels (Gimbel, et al., 2017).

C. Inadequate Availability of Data

Access to Relevant Information (Content)

Previous assessments of constraints to data use found that an overall lack of access to data to support decisions is a key barrier to use. Government officials are not always aware of existing data or how data might be useful for decision making (Homer, et al., 2016). It can be time-consuming and complicated to gather relevant data, especially if a central repository with information on all available data does not exist (Ikmari, et al., 2007). Data may be fragmented across ministry and agency silos, and a lack of data standards for reporting and interoperability between data systems can limit the ability to synthesize information across multiple data sources to fully understand programmatic issues (Akhlaq, et al., 2016). Parallel information systems, often satisfying different donor requirement, can result in duplication of efforts and conflicts in available information without a means of validating findings (Ikmari, et al., 2007; Qazi & Ali, 2011).

The lack of access to data that are most relevant for decision-makers is a major barrier to its use. Data that are available are not always aligned to the needs of decision-makers or have restrictions for access. Decision-makers may not have access to all relevant data sources for making program management decisions, including information linked to other health system functions (e.g., financial management, commodities and logistics, and human resources). Moreover, full raw data sets are often difficult to access, thus limiting the ability to support trends, output and outcome analyses, and to compare disaggregated data across key populations and reporting units or identify and further investigate site-specific issues. This can make it challenging to benchmark performance and design appropriate interventions for populations in need (Avan, Berhanu, Umar, Wickremasinghe, & Schellenberg, 2016; Bhatia, et al., 2016; Graham, et al., 2006; Harrison & Nutley, 2010; Homer, et al., 2016; Jenkins, Robbins, et al., 2005; La Vincente, et al., 2013). For example, although the introduction of DHIS 2 has streamlined data sharing in Tanzania, district officials are unable to see data disaggregated to district levels and benchmark their own performance (Bhatia, Stout, Baldwin, & Homer, 2016). The unavailability of data that are most influential for decision making is a major barrier to its demand.

Data Synthesis and Communication Channels

The way that information is synthesized, packaged, and communicated to decision-makers impacts its availability and thus its use in decision making (La Vincente, et al., 2013; Malawi Ministry of Health, 2016; Naude, et al., 2015). Excessive levels of detail and inappropriate presentation formats can constrain the ability to understand the data and apply them to decision making. For example, data can be presented in formats that aren't synthesized to convey a message (tabular formats, non-machine readable, hardcopy reports, or in formats that don't provide context for the data being presented (e.g., performance graphs that don't include the desired target). Poor synthesis and packaging of data limit a data user's ability to understand the message behind the data. The perceived relevance of data is a key determinant of whether stakeholders are likely to use information. A study on the use of governance data found that data was deemed irrelevant to decision-makers if they did not highlight important insights or provided a concrete set of recommendations (Masaki, Sethi, & Custer, 2016).

There can be a mismatch between the technical level of the information disseminated and the ability of stakeholders who are the target audience for this information. An overload of data disseminated to decision-makers can be overwhelming and frustrating for those trying to use data to answer their programmatic questions. For example, Amaro, et al., describes stakeholder forums where decision-makers were unable to conceptually process excessively detailed data presentations, thus impairing the group's ability to interpret and discuss data (Amaro, et al., 2005). There is often a failure to present data in user-friendly, comprehensible, and accessible formats, as well as difficulties in translating information into practical and actionable guidance (Andermann, et al., 2016; Harrison & Nutley, 2010; Jones, et al., 2017; Lavis, Posada, Haines, & Osei, 2004; Oliver, Innvar, Lorenc, Woodman, & Thomas, 2014). The lack of information segmentation for different audiences may also impede data use, as managers at different levels require different types of information and levels of aggregation for various types of decisions. Decision-makers at a systems level often prefer less detail, whereas those at the district or health facility level prefer disaggregated data to compare their district performance against others (Sauerborn, 2000). Similarly, in Timor-Leste, for example, senior leaders preferred polished analytic products summarizing top-line indicators and take-away messages, whereas mid-level managers preferred more detailed information or wanted access to raw data to perform their own analysis (Custer & Sethi, 2017).

Box 3. Interventions to improve data synthesis, communication, and access

There are many example of electronic health information systems and medical records that have increased access to health information and expanded the use of these data. For example, an evaluation of a national electronic logistics management system in Tanzania indicated implementation of the system increased data accessibility, timeliness, appropriateness for decision making needs, and transparency and improved supply chain outcomes such as stockout rates and stockout duration, indicating that implementation of the tool supported better supply chain management and monitoring practices (Mwencha, et al., 2017). The implementation of software platforms such as DHIS 2 can also facilitate the accessibility of health data across many sources, as well as the easy generation of tables, graphs, charts, and information products that facilitate data use. Introduction of DHIS 2 has been shown to improve data quality and reporting, though analysis, interpretation, and use of data can remain a challenge (Garrib, et al., 2008).

Tools that help decision-makers to better analyze, visualize, and interpret their data can improve data availability, data quality, and ultimately data use. In 2016, MEASURE Evaluation assisted the Guinea Ministry of Health to expand the use of DHIS 2 for more than data reporting and data management, promoting the use of routine health data for health service management across the health system. Through technical working group discussions and workshops, MEASURE Evaluation was able to bring together a diverse group of government programs—the Office of Strategy and Development which managed the HMIS, Reproductive Health, Malaria, Tuberculosis, and the Expanded Program for Immunizations—to work together to select key monitoring indicators and standardize their presentation for a quarterly regional feedback bulletin. This collaboration led to an improved understanding, clarification, and harmonization of program indicators for the HMIS. The quarterly bulletins were considered an introduction to the HMIS to manage services, and regional managers were encouraged to access other data on DHIS 2 to better understand their performance. Indicators were analysed using the DHIS 2 data visualizer and national level program representatives provided narrative analysis and recommended actions to reach objectives in the National Health Development Plan (PNDS) 2015–2024. Each bulletin included a story highlighting the achievements of other health teams in using data on DHIS 2 to improve their performance. Regional managers also received nationally-validated data review guidelines with their bulletins that outlined the process for regular meetings to: (1) identify and prioritize program issues; (2) link questions to relevant data sources; (3) perform analyses; (4) communicate and interpret results; (5) develop data-informed action plans; and (6) monitor actions to improve performance.

In Kenya, a decision support tool called the District Health Profile (DHP) was developed to enable district-level decision-makers to better review, monitor, and use their data to make decisions. An automated system was created that integrated health program data from multiple sources and compiled it into an automated, easy to use format, allowing decision-makers to analyze data faster. Decision-makers also stated that the DHP allowed them to target and plan programs better through the increased availability of data and the visual nature of the data, as well as the easy to use nature of the system. Ultimately, the DHP increased data-informed decision making through improved data analytics and availability (Nutley, et al., 2014). Maps can also be an excellent data visualization tool that enable data to be used in decision making. In Rwanda, Partners in Health (PIH) implemented a low-cost, community-based GIS intervention to identify gaps in emergency obstetric care using routinely collected maternal and child health data at the health center and facility levels in the country. PIH recruited a college graduate specializing in GIS to build the capacity of health district staff to analyze, interpret, and use geographic data. Additionally, the team recruited someone to collect and map data on several maternal health indicators, which were linked to geographic data on patient residences. These maps enabled local decision-makers to visualize the location of where women lived in conjunction with which women were getting C-sections and determine where there were gaps in unmet need for C-sections in the area. As a result of these maps, decision-makers advocated to add another ambulance in a more remote area, which could allow more women to have access to emergency C-sections. While it is widely known that GIS can be a helpful tool in decision making, this intervention shows the potential of implementing such an activity in a low-resource setting and the improvement it can have on both data use and health outcomes (Sudhof, et al., 2013). In Liberia, an Excel-based dashboard was used to present timely data on nutrition and child health monitoring to track quarterly program performance. Dashboards are a way to display information in a comprehensive and accessible manner and can allow program managers to quickly assess program achievements and identify important programmatic information for decision making. Displaying information visually can also promote the interaction, review, and discussion of program results (Guyon, Bock, Buback, & Knittel, 2016).

To inform decision making, data must also be available at the time they are needed. Data are more likely to inform decisions when they are readily available at specific windows of opportunity for policy and planning actions (e.g., work planning and budgeting cycles). However, the cycle of data aggregation, synthesis, analysis, and communication is often prolonged such that information products are disseminated infrequently and based on outdated data. Data are often not analysed and disseminated in a timely manner to contribute to decision making processes (Andermann, et al., 2016; Sauerborn, 2000; Shaxson, et al., 2016; Wickremasinghe, et al., 2016). For example, many countries produce an annual health report each year, based on outdated data with untimely dissemination such that information cannot inform local management decisions (Odhiambo-Otieno, 2005).

D. System Design

Substantial investments have been made toward improving both paper-based and digital health information systems to produce high quality and available data for decision making. However, a recent literature review found that the lack of systems design thinking in HIS design and development, especially in terms of complexity and usability, can impede data quality and use. For example, an assessment of surveillance systems in five countries found that the primary factors limiting decision-makers' access to data were related to the design of the health surveillance system, including overly complex systems with an unclear flow of reports, too many reporting forms, lack of flexible systems that could adapt to reflect the changing needs of decision-makers, and limited applicability due to lack of local ownership, participatory design, and mechanisms for dissemination and review (Wilkins, et al., 2008). For digital systems, usability constraints, such as information technology user interfaces that complicate data entry processes, excessive mouse clicks to navigate the system and retrieve information, and the lack of built-in data analysis tools, can create workflow barriers and impede their use for decision making (Akhlaq, et al., 2016; Kumar, Gotz, Nutley, & Smith, 2017). For example, a pilot assessment of DHIS in Tanzania found low usability of the software due to an inability to accommodate data from specific health programs and a mismatch between online data entry forms and their respective paper-based counterparts (Lungo, 2008).

Box 4. Interventions addressing the design of health information systems

There has been increased attention to and proliferation of electronic health information systems in resource-limited settings. The Principles of Digital Development are a set of best practices for digital development practitioners which were established to ensure the usability, relevance, and sustainability of new digital tools, such as management information systems. The first principle is to 'design with the user', that is, partnering with users to iteratively design systems to ensure that the digital tool is rooted in an understanding of the users' characteristics, needs, skill level, and challenges. Another core tenet is to "understand the existing ecosystem," to better understand the cultural and socioeconomic context in which users work to ensure feasibility and uptake of the digital system. We found examples in the literature of how these principles have been applied to the design and development of information systems. For example, in Kenya, a tablet-based digital health tool to record patient data and assist health workers with clinical decision support tasks underwent usability and feasibility testing prior to roll-out (Vedanthan, et al., 2015). This included "think aloud" exercises where a health worker talked about what they were seeing, thinking, doing, and feeling as they used the system; "mock patient encounter" exercises, and focus group discussions to understand user perspectives on efficiency and satisfaction; how the tool interacted with a health worker's environment and workflow; learnability; and errors associated with the system. Identified issues were then incorporated into an updated version of the tool, including fixes to user interface issues, the removal of extraneous steps from processes, and standardizing response options across questions. In Nigeria, design thinking methodology was used to analyse the experiences of field workers during the Ebola epidemic to develop a surveillance and outbreak response management system. During design workshops, different user types (or personas) and their role, system expectations, interaction with other users, and information needs were identified to inform the design of the surveillance system. The user interfaces in the system were then designed to fulfill all the data collection and information needs of those personas, enabling usability and relevance of the surveillance system (Fahnrich, et al., 2015). Other design activities, including "card sorting" to explore how users cognitively prioritize elements and organize data into groups, have also been used to inform the design of interfaces and information systems (Saleem, et al., 2007).

Demand for data from information systems is also limited when systems are not aligned with the needs of its users (Hotchkiss, Eisele, Djibuti, Silvestre, & Rukhadze, 2006; Li, Makulec, & Nutley, 2017). Designing responsive information systems requires system designers to know what information is useful and necessary for decisions—this is often a difficult task if managers are not familiar with the available information, indicators, and monitoring requirements (Cibulskis & Hiawalyer, 2002; Odhiambo-Otieno, 2005). Information systems are often built for upward reporting, and are often too rigid to respond to adaptations needed for local planning and decision making (Ikmari, et al., 2007; Mubyazi, Kamugisha, Mushi, & Blas, 2004; Odhiambo-Otieno, 2005).

E. Relationships between Actors Who Produce and Use Data

A major barrier to data use is the limited interaction and subsequent disconnect between actors who produce data and those who use data to make decisions, throughout the stages of data collection, synthesis, analysis, interpretation, and use. A lack of mutual respect and mistrust in the skills and competencies of those producing data often exacerbates perceptions of data quality issues and prevents decision-makers from demanding and acting on data (Jones, et al., 2017; Naude, et al., 2015). Moreover, in small health facilities or community programs, front-line health workers (such as nurses and community-based health workers) fill the dual role of data producer and data user yet don’t fully recognize that they are responsible for both roles. With hierarchical reporting structures, staff at lower levels often see themselves only as data producers and are unaware of their potential duties in analysing and interpreting data (Homer & Abdel-Fattah, 2014; Ikmari, et al., 2007). Missed opportunities for data use may be due to limited knowledge of existing data sources or their responsibility to use them, the types of information available, analytic tools or techniques that could facilitate effective program decisions, and how data may be useful in their work (Harrison & Nutley, 2010; Kim, Sarker, & Vyas, 2016). This absence of data create conditions in which personal biases, informal networks, and inappropriate shortcuts are relied on for information, adversely affecting the quality of decision making (Custer & Sethi, 201; Jenkins, Averbach, et al., 2005).

Furthermore, data producers are often far removed from those making decisions and make assumptions about perceived information needs and incentives for acting on data, resulting in data generated without local relevance or practical utility (Custer & Sethi, 201; Jenkins, Averbach, et al., 2005; Uneke, et al., 2017). Data producers are often unaware of policy- and decision-making cycles, strategic priorities and information needs and timelines, and thus may not plan for the requisite time needed for the generation, synthesis, analysis, and presentation of data. This is due to poor mutual communication about decision-making priorities, the types of information likely to be needed by each stakeholder, those decisions the information is likely to inform, and how data should be sourced, analysed, interpreted, and disseminated to meet decision-maker needs (Oliver, et al., 2014; Shaxson, et al., 2016). Related to the data availability barriers mentioned earlier, understanding the technical ability of decision-makers is crucial to ensure that information is packaged in understandable and digestible formats and disseminated at appropriate times (Malawi Ministry of Health, 2016). Without formal approaches to encourage ongoing engagement and collaboration between data producers and users (e.g., mechanisms to request data, guidelines and processes for decision making, data use plans to communicate priority information needs, and communication plans to disseminate information), the data demand and use cycle breaks down.

Box 5. Interventions to improve engagement between data users and producers

We identified several examples of interventions that increase the engagement between data users and data producers. MEASURE Evaluation supported the MHSP in Cote d’Ivoire to strengthen their health information system (named the Systeme d’Information de Gestion, or SIG). To ensure that data users and data producers were involved in HIS strengthening efforts, a national HMIS working group was formed with membership consisting of government M&E and program staff along with partner organizations. The working group shared information, harmonized and validated national data collection forms, coordinated HMIS activities, and exchanged best practices in M&E and data use (Nutley, Gnassou, Traore, Bosso, & Mullen, 2014).

Meetings that regularly convene data users and producers to critically review the performance of key indicators, discuss program progress, and identify programmatic issues and implications for program improvement can also improve the engagement between these two groups. In Zanzibar, quarterly data use workshops were introduced by the HMIS unit (i.e., data producers) with the active engagement of data users themselves in presenting their district's routine data. This is followed by a systematic peer review in which these presentations are discussed and critiqued, encouraging self-assessment, identifying common issues, and promoting local involvement. These workshops have served as a way to provide direct feedback to HMIS planners to revise indicators and data sets—for example, the simplification of forms due to the realization that it was unnecessary to disaggregate data by certain elements. Involving data users in these workshops also built their capacity in using the HMIS and data analysis tools to link raw data and indicators to local plans and targets, thus increasing their appreciation of the value of improved data quality (Braa, Heywood, & Sahay, 2012). Similarly, the objectives of the PEPFAR/CDC supported data use workshops (described in Box 1) were designed to include both strategic information and HIV program staff so that these groups could work together to answer specific, relevant questions about their programs. This type of workshop proved valuable for program staff to either learn to analyse data using new tools or help them learn to communicate to SI staff the types of program questions and analyses they would like to use data to answer (Courtenay-Quirk, Spindler, Leidich, & Bachanas, 2016). In Lesotho, Pact held in-depth and participatory data review meetings to improve interactions between data users and data producers. During these meetings, a core team of M&E and program staff were assigned to analyse monthly data and identify trends. Time was also allocated for data interpretation related to program performance and improvement, which relied heavily on the active participation of program staff and engendered their participation in the M&E process. In these meetings, discussions about the causes of problems identified generated additional programmatic questions from end users, thus sparking demand for additional data (MEASURE Evaluation, 2014b)

There are also interventions from the evidence-informed policymaking space that have been shown to increase engagement between researchers and policymakers. Knowledge translation (KT) interventions aim to build trust and dialogue among researchers, policymakers, and other users by strengthen their engagement and coordination to improve evidence-informed policymaking. For example, in Malawi, a knowledge translation platform was formed in partnership between Dignitas International and the Malawi Ministry of Health to improve the use of research evidence in the country's national health policy. As a part of this platform, two communities of practice were formed, bringing together researchers, policymakers, and implementers and enabling them to discuss the best approaches on how to gather and synthesize research to produce briefs for policymakers. These evidence briefs were then reviewed during structured deliberative dialogues, where policymakers, researchers, policy implementers, and civil society members discussed the magnitude of the issue (i.e., hypertension in HIV-infected individuals), factors underlying the issue, policy options, and implementation considerations. An outcome of these dialogues was harmonization of indicators across organizations piloting policy options, ensuring that generated research would be usable for future policymaking. These dialogues between researchers and policymakers improved relationships and communication, contributing to an enabling environment for evidence-based policymaking in Malawi (Berman, et al., 2015). A similar intervention was conducted in Cabo Verde, Chad, and Mali, where researchers and policymakers were brought together for policy dialogues where stakeholders discussed areas of common interest, considered different options for decisions, and decided on actions to take for the outcomes to be implemented (Dovlo, Nabyonga-Orem, Estrelli, & Mwisongo, 2016). This process creates buy-in and commitment to the policy outcomes and strengthens the transparency and inclusiveness of decision-making processes. In Burkina Faso, a *knowledge broker* approach was used to create connections between data users and producers to encourage information exchange. The knowledge broker is an individual tasked with responsibilities in information management (e.g., developing research strategies, constructing database to facilitate access to information, drafting knowledge synthesis and policy briefs), liaising between knowledge producers and users (e.g., disseminating messages to users at the community level through mass meetings, participation in partner meetings, etc.), and accompaniment of users through deliberative workshops and the development of action plans to change practices.

F. Institutional Factors Influencing Data Use

Decision-Making Autonomy and Authority Structures

Decision making involves multiple actors with competing priorities, biases, and values. Power differentials due to positional authority (across levels of government, sectors or departments) can influence the role of information in decision-making processes and agenda setting (Barasa, Cleary, English, & Molyneux, 2016). Hierarchical reporting structures may be more likely to prioritize reporting and compliance over analysis and innovation using data. Highly bureaucratic organization with rigid rules, structures, and processes can make it difficult to coordinate across cadres and between levels to review data, as well as limit the time and ability to access, share, analyse, and interpret information (Jones, et al., 2017; Kawonga, Blaauw, & Fonn, 2016; Oliver, et al., 2014).

The lack of clarity about relationships between national and subnational levels related to local planning, policymaking and target setting can limit demand and use of data at local levels. For example, Kawonga, et al., found that in South Africa, planning, supervision, and monitoring of HIV services lied within the remit of district managers, however a centralized health system structure and rules-based management style undermined the ability for district managers to lead decisions. While devolved decision making can promote demand for data at the district level for local planning and decision making, health programme officers often ignore local data on past performance, local disease burden, and population characteristics and instead set targets and make decisions based on political priorities, both local and national (Baldwin, et al., 2016; Murthy, 1998).

Decision-making autonomy often lies beyond the authority of the health sector, limiting the influencing capacity of decision-makers to act upon data-informed recommendations. In Kenya, county governance structures determine the extent to which data-informed recommendations are acted upon. While country health sector strategic plans, which outline the strategic objectives, activities, targets, resource requirements and financing requirements, may be evidence informed, other authorities responsible for upstream budgeting in the county-wide, cross-sector integrated development plan have final decision-making power over activities and budgets in the plan.

Weak accountability relationships and non-transparent policy processes can contribute to the limited use of data in decision making. Information is often not the main driver of policy and program decisions, and data can be overlooked in favour of political jockeying, organizational imperatives, personal interests, political pressure, and competing agendas (Barasa, et al., 2016; Ikmari, et al., 2007; Qazi, Ali, & Kuroiwa, 2008; Wickremasinghe, et al., 2016; Custer & Sethi, 201). Often information has no direct bearing on budgets, as only a fraction of budget allocations are released, often with delays (Homer & Abdel-Fattah, 2014). This disincentivizes the use of data in local budgeting processes. Disempowerment and lack of control in decision making can discourage future demand for data, especially if there is no tangible impact from previous efforts to advocate for data-informed recommendations.

Organizational Structures and Processes for Data Use

Organizational structures can play a role in constraining or facilitating a culture of data-informed decision making. For data use to become a regular and sustained activity, effective organizational supports are needed to promote the skills, processes, and relationships necessary to use information, as well as to outline the coordination and management practices needed to ensure sharing and information exchange

Box 6. Interventions addressing decision-making and authority structures

Several tools can be implemented to help understand an organization's decision-making and authority structures. These include MEASURE Evaluation's Stakeholder Engagement Tool, which outlines a process for identifying stakeholders involved in data improvement initiatives, defining their roles and resources, identifying dynamics amongst stakeholders, and creating an engagement plan (MEASURE Evaluation, 2011b). A political economy analysis can be used to describe the rules that govern decision-making processes and the incentives to use data in decision making. These can include structural factors, institutional factors (including formal regulations and processes and informal social norms and practices), and stakeholders. This approach has been utilized to understand the factors determining the use of knowledge in policymaking processes in Indonesia (Datta, et al., 2011). Lastly, Shaxson, et al., describes a framework for understanding the organizational context for evidence-informed decision making for government departments. There are three elements to this framework. First, internal factors such as the structures, functions, and relationships between people and teams influence how people and their teams work. Next, external factors, including policy environments, sector politics, and pressures to use data, influence the use of evidence. Lastly, internal systems and processes (such as budgeting, planning, and resource allocation) also impact the production and use of evidence (Shaxson, Datta, Tshangela, & Matomela, 2016).

across teams (Akhlaq, et al., 2016; Ikmari, et al., 2007). However, many authors have noted that the legal support and existence of guidelines that mandate staff to use evidence in decision making are rare in lower resource settings (Oliver, et al., 2014; Uneke, et al., 2017). The lack of systems and processes to support M&E and data use activities, such as data quality assurance protocols, supportive supervision, allocation of sufficient time for M&E activities, and regular feedback mechanisms, can negatively impact the perceived importance and value of data (Harrison & Nutley, 2010). A lack of formal or informal structures in place related to the discussion, review, and interpretation of data hinders communication and limits interaction between M&E units and policy and planning teams (Shaxson, et al., 2016). Inadequate standardized processes, clear standard operating procedures, and guidelines that support data use activities are major barriers to use and can contribute to a perceived lack of importance for data use amongst management (Malawi Ministry of Health, 2016; Qazi & Ali, 2011; Shaxson, et al., 2016).

There is often fragmentation between health facility and public health officers, M&E professionals, and decision-makers across levels, with a lack of clarity on roles and responsibilities for key data functions. Staff at lower levels often see themselves as data collectors and aggregators, and believe that data analysis and interpretation responsibilities fall to others (Abajebel, Jira, & Beyene, 2011; Homer & Abdel-Fattah, 2014). At the same time, evidence shows that some mid- and senior-level staff do not feel it is their duty to analyse data (Baldwin, et al., 2016). One study from South Africa noted that separate guidelines specified conflicting data collation tasks for program and district managers, and that neither of these guidelines specified the role that managers should play in the use of data (Kawonga, et al., 2016). The lack of clarity about roles and responsibilities for functions related to using data impedes its use.

There are rarely explicit requirements that decision-makers use evidence to make their decisions, and data analysis and interpretation are not explicitly recognized or rewarded (Development Gateway, 2016). Organizations often lack a strategic approach outlining the institutional connections between data and budgeting, planning, and resource allocation processes. While these processes should regularly incorporate data about progress to date to inform what would be needed to achieve an organization's mission and future goals, in reality, data are often not tied to resource allocation and budgeting processes (Shaxson, et al., 2016). This can make it difficult to advocate for adequate budget allocations needed for the generation, management, and use of data to inform future program and planning decisions. An example from Sri Lanka noted that a lack of coordination and weak feedback loops between the planning unit and other departments meant that results data were not reported to the finance commission in charge of budgeting. Furthermore, there was limited monitoring of programs after the release of funds such that information was not used to inform the allocation of provincial budgets to well-performing programs (Baldwin, et al., 2016). Organizations that practice "management by crisis" and focus on ad-hoc, short-term solutions may also be less likely to value timely information as opposed to organizations committed to long-term strategic planning (Ikmari, et al., 2007; Qazi & Ali, 2011).

Clearly established procedures to incorporate data in planning and budgeting processes can promote the use of information. For example, in Cameroon, provincial budget plans were accepted by the Ministry of Health only if they incorporated data on past performance (Sauerborn, 2000). In Tanzania, each district is responsible for developing an annual comprehensive council health plan with well-defined targets. Performance against these targets are regularly monitored to secure budget from a basket fund. Linking performance with finances encourages the use of information to set realistic goals and targets in strategic planning, as well as use of information for regular program monitoring and adaptive learning (Bhatia, et al., 2016).

In general, there are inadequate organizational incentives for the analysis and use of data and few penalties for not doing so (Harrison & Nutley, 2010; Ikmari, et al., 2007; Moreland, Misra, Agrawal, Gupta, & Harrison, 2010; Qazi, et al., 2008). Where incentives related to data exist, they tend to be focused on data collation, data quality, or reporting in order to demonstrate compliance rather than using data for shaping plans and programs (Homer & Abdel-Fattah, 2014). Countries have shown some successes in incorporating data quality in departmental performance metrics to promote improved outcomes, however, rarely is data use included (Bhatia, et al., 2016).

Box 7. Interventions to strengthen organizational supports for data demand and use

Pact Lesotho was interested in improving data demand and use in their global programs by institutionalizing data demand concepts, approaches, and tools in their organization. Pact developed a data use policy providing country-level guidance for implementing activities and strategies to improve the use of data in decision making. This policy included specific roles and responsibilities for data use tasks, a schedule for data review meetings, guidance on how and when to use DDU tools (such as the Framework for Linking Data with Action), and data quality assurance processes (MEASURE Evaluation, 2014b).

Insufficient M&E staff to lead, implement, and engage with others poses challenges for HIS strengthening and data use in decision making. Organizational restructuring can be a way to improve data use for decision making, particularly as motivation for the use of data often comes from an organizational commitment to ensure that adequate human resources are dedicated to M&E and data use. In Botswana, one of the main impediments to a functioning health information system was the lack of trained and qualified personnel, partially due to a lack of HIS and M&E training within tertiary institutions. To address this gap, Botswana used task shifting to create a new cadre of staff within the health system: district M&E officers. Botswana recruited and trained recent university graduates to "assume most data-related activities previously conducted by a range of health workers" (Ledikwe, et al., 2013). They provided on-the-job training and mentoring in HIS and M&E, with the goal of "strengthening health data collection, ensuring regular and timely reporting and feedback, promoting a culture of data utilization and evidence-based planning, and building capacity within the health system." They were also responsible for district-level reporting, which was used to inform national level decision making. Ledikwe, et al., found that this approach of organizational restructuring and capacity building has led to health information system improvements in Botswana, including improved data management, data quality, data reporting, and data use for evidence-based planning. The authors state that "in a context where a pool of trained health informatics personnel is not available, university graduates can be recruited to participate in intensive on-the-job training and mentoring programs, a successful approach to strengthening health information systems." Three years after this intervention in Botswana, Mpofu, et al., assessed the performance of the newly created district M&E officer cadre (Mpofu, et al., 2014). They found that the development of this cadre had contributed to an improvement in Botswana's HIS, including improved capacity in program M&E, improved data quality, management, and reporting; and improved data use for decision making and planning. According to the assessment, "health program monitoring and evaluation data has been used to guide the planning process and determine priorities" at the district level. Additionally, the introduction of this new cadre allowed clinical staff to focus on their core service delivery duties, since they were no longer required to do data management on top of their normal workloads. The assessment found that if such an intervention is country-led and conducted collaboratively with stakeholders, it can be both successful and sustainable.

Organizations can also support staff by providing clear processes and systems to facilitate data use tasks. In Nigeria, MEASURE Evaluation provided AIDSRelief with a data demand and use supportive supervision checklist to support evidence-based decision making at the facility level. During these visits, each facility's monthly performance is reviewed and hand-on coaching and support is provided in data compilation, analysis, and interpretation (MEASURE Evaluation, 2011a). In Cote d'Ivoire, a set of national supervision guidelines, a Data Management Procedures Manual, and a National DQA Protocol were developed to provide guidance to those undertaking DDU activities (Nutley, et al., 2014).

External Donors and Organizations

The wider external context in a country, region, or organization can shape how data are used for decision making. Global and donor pressure for evidence-informed policy and program decisions can facilitate better data use. For example, a political economy analysis on the use of evidence in policymaking in Indonesia found that while formal bureaucratic rules can promote the demand and use of data, the extent to which organizational procedures are followed also depends on incentives driven by informal rules and practices. In this case, the need to maintain favour among international donors to secure donor investments acts as a motivator for data use (Datta, et al., 2011).

However, donor support for data initiatives inevitably influences which data are collected, the methods used to capture information, and analyses and outputs. These may not align with the priorities and information needs of local stakeholders, and can exacerbate data quality issues due to parallel reporting systems and the burden of collecting less relevant data (Custer & Sethi, 201; Homer & Abdel-Fattah, 2014).

Box 8. Interventions addressing external donors and organizations

In 2016, MEASURE Evaluation was tasked with addressing gaps identified in previous HMIS assessments in Guinea. In order to address these issues, it was necessary to organize the many stakeholders around a common strategic vision for HMIS strengthening. The work resulted in a strategic plan to strengthen the HMIS from 2016 to 2020. The plan provided a reference framework to prioritize and share activities among partners through annual operational plans and to monitor progress during regular HMIS technical working group meetings.

At the end of 2017, the same partners, in collaboration with the regional and district data users, conducted a review of the strategic plan and reported on solutions, interventions, and recommendations for the 2018 annual operational plan. Among these recommendations were activities that required external support from partners. MEASURE Evaluation then provided advocacy training to these same partners to help them create advocacy objectives; map potential partners by level of influence and support; develop strategies and activities to move partners towards action; develop a detailed plan to reach their advocacy objectives; and create advocacy messages. Participants were given opportunities to deliver their advocacy messages to their target audiences at national data review meetings.

This experience provided government staff with the opportunity to engage with potential partners outside of their routine working environment. Advocacy themes ranged from extending access to DHIS 2 to health centers, to more resources for leadership and management trainings and data review meetings. Participants were challenged to articulate and communicate their needs to an external audience, one unfamiliar with the importance of a robust and useful HMIS that was essential to providing health services to the population.

G. Leadership for Data Use

Research across Africa and Asia has shown that lack of data use is tied to weak leadership for evidence-informed decision making. Top level decision-makers assign low priority to data due to the perception that the quality of data are poor (Akhlaq, et al., 2016; Garrib, et al., 2008; Mate, Bennett, Mphatswe, Barker, & Rollins, 2009). Low confidence in the quality of data creates a negative cycle that impacts future demand for data and leadership support for systems that collect quality data. Of note is that leadership support has been cited as the most important driver for the use of information. This type of support is necessary to ensure not only functioning data collection systems but also that the analyses, exchange, and interpretation of information for decision making is valued, adequately budgeted, operationalized, and sustained within an organization (Ikmari, et al., 2007; Uneke, et al., 2017). The lack of authority to imposture penalties, as well as limited expectations for analysis and use of data from leaders can also lower the perceived value of data for decision making (Akhlaq, et al., 2016; Hotchkiss, et al., 2006).

Senior decision-makers and political leaders can bring about change in organizational norms by verbally and financially supporting data use, and setting an example in demanding health information, using information to formulate policies and plans, and openly disseminating data (Baldwin, et al., 2016; Cibulskis & Hiawalyer, 2002; Homer & Abdel-Fattah, 2014). These actions can motivate their teams to seek, use, and share data. This is especially true for senior managers, who can drive change by communicating data use mandates and priorities, and create spaces for the teams to innovate for data use (Shaxson, et al., 2016). Strong leaders can also promote open environments of neutrality, transparency, ability to dissent, and participation, which enables the role of evidence in decisions (Amaro, et al., 2005).

Box 9. Interventions addressing leadership in data use

In Cote d'Ivoire, multiple ministries were responsible for the collection, dissemination, and use of HIV/AIDS data. Leadership was identified as a challenge impeding the coordination and collaboration of ministries to establish, harmonize, and validate a set of HIV indicators. With MEASURE Evaluation support, the M&E team from four ministries (Ministry of Health, Ministry of HIV/AIDS, Ministry of Women, Family and Social Affairs, and Ministry of Education) participated in a Leadership Development Program (LDP). The Leadership Development Program strengthens the capacity of teams to meet health challenges by developing action plans addressing organizational or programmatic challenges. Modules focus on requiring teams to identify their mission and vision, assess their current situation relative to their vision, articulate a desired result, and understand barriers to achieving this result. Workshops focused on developing leadership practices such as aligning, mobilizing, and inspiring; management skills such as giving feedback and managing change; and developing and implementing action plans. The four ministries developed a shared vision and agreed on desired result "to revise and validate all the national M&E tools for collection of HIV/AIDS data." At the end of the program, a final compendium of harmonized and validated indicators was developed, helping to clarify information needs and streamlining data collection processes. These leaders contributed to building a culture of data use by advocating for high-quality and timely national HIV data (MEASURE Evaluation, 2010).

In Ethiopia, in 2011, The U.S. Centers for Disease Control and Prevention (CDC), in partnership with two local organizations, developed a year-long course in leadership in strategic information for surveillance officers, laboratory technicians and HIV project managers. Participants in the training held leadership positions (e.g., department heads, team lead). The purpose of this course was to build capacity in data analysis, surveillance, and M&E to improve data use. Trainees formed small groups and also completed an applied learning project using skills they learned from training modules. Trainees learned data skills in descriptive and analytic epidemiology, M&E, and surveillance, and reported that they were effectively able to collect, analyse, and interpret data and use the findings. One limitation noted with this training was a high attrition rate, potentially due in part to a shortage of public health professionals and balancing with regular work duties (Rolle, et al., 2011).

MEASURE Evaluation developed a six-month "Building Leadership for Data Demand and Use" program that brought together health teams of data users and producers to: (1) build skills in leadership and management practices; (2) identify and overcome barriers to data use; and (3) achieve measurable results in applying DDU skills to make data-informed decisions. MEASURE Evaluation has implemented this program at a national level with the Rwanda School of Public Health and Biomedical Center, and at regional/district levels within five regions of Guinea. The program provides an opportunity for health teams to apply skills to "real life" challenges by: (1) the development of action plans informed by analyses and interpretations of available data; (2) coaching visits to reinforce skills, provide access to outside expertise to refine intervention strategies, monitor, and visualize performance indicators, and document team efforts; and (3) the reporting of team successes and challenges with recommendations for continued work and engagement with health information systems. Teams that have been able to make significant achievements within existing resources are selected as DDU champions and their stories are shared in Ministry of Health publications as an example to others of how to engage with available data to improve health service performance (MEASURE Evaluation, 2013).

H. Data Use Culture

Closely linked to leadership is the culture of an organization. Culture comprises the norms and values that are promoted and practiced by leadership and other employees in an organization. This includes the attitudes and beliefs of employees, the extent to which employees are committed to the organization's collective objectives, how they are rewarded and organized, and the value placed on various organizational functions (Kawonga, et al., 2016). A data use culture should support the generation of quality information and promote participation and inclusiveness between stakeholders in the processes of data analysis, review, interpretation, and use. For example, performance management frameworks at individual and team levels should reflect an organization's commitment to organizational priorities and ensure accountability amongst staff responsible for strengthening those priorities. If strengthening data-informed decision making is not an identified priority, staff will not feel motivated or supported by supervisors to improve their data use behaviours

Moreover, regular systemic feedback from supervisors, especially related to performance trends, progress meeting targets, success stories, or comparative results, serves as a motivating factor for health workers. When this doesn't exist, it contributes to the devaluing of data use at all levels (Harrison & Nutley, 2010). Data collectors at lower levels desire feedback but there is generally only a one-way flow of information such that they rarely know how data will be used or why it is collected (Li, et al., 2017; Qazi & Ali, 2011). One anecdote from Ghana illustrated how benchmarking, comparison, and competition between facilities and community health workers' zones were not regularly done, but had great potential to identify performance issues, advocate for changes, and compel decision-makers to take action (Homer, et al., 2016).

Demand for data outside of an organization also helps to promote a data use culture. There has been increased attention placed on the role of accountability, especially at local levels, where wider audiences such as community members or civil society organizations demand access to data to hold public servants and politicians accountable for health policies and programs. The value that others place on data can encourage an organization to transparently share and communicate data—for example, by summarizing and distributing health statistics to wide audiences (Cibulskis & Hiawalyer, 2002). Building a data-driven culture requires a multifaceted approach involving stakeholders across different levels of the health system. Box 10 describes a comprehensive, integrated approach to address multiple barriers to data use and foster a data use culture.

Box 10. MEASURE Evaluation's comprehensive data use intervention

The USAID-funded MEASURE Evaluation project has developed a comprehensive approach to improving data-informed decision making, which involves eight intervention areas. These intervention areas are: 1) assess and improve the data-use context; 2) engage data users and data producers; 3) improve data quality; 4) improve data availability; 5) identify information needs; 6) build capacity in data use core competencies; 7) strengthen the organization's data use infrastructure; and 8) monitor and evaluate data use interventions. When implemented together, these eight activities provide a comprehensive data use intervention that links data to decision-making processes and ultimately strengthens the capacity of an organization to sustainably use data over time. MEASURE Evaluation implemented this comprehensive approach in Cote d'Ivoire in an effort to improve the Ministry of Health and Public Hygiene (MSHP)'s use of data from its national routine health information system (Nutley, et al., 2014). This intervention involved many activities, including conducting a PRISM assessment to understand why the health information system was not being used in the country, as well as conducting quarterly data review meetings that brought data users and data producers together, a data use workshop to build capacity of key stakeholders, and data quality audits and routine data quality assessments at the national and regional levels. After this four-year intervention, the authors found that data use increased from 40% to 70% at the district level, while data use did not improve at the facility level. The Cote d'Ivoire intervention serves as an example of the potential success of a large-scale data user intervention that can improve data-informed decision making. This approach has also been successfully applied to strengthen data-informed family planning programs in Ethiopia and OVC programs in Lesotho (MEASURE Evaluation, 2014a, 2014b, 2017).

I. Low Individual Commitment and Motivation

Individual attitudes, motivations, and values also impact the use of data (Jenkins & Carey, 2005). Low commitment to work and morale amongst health workers can compound low motivations for using data among staff. Poor motivation among staff can be due to low salaries, late wages, poor working conditions, lack of feedback on performance, and an overburdening of work responsibilities. Reports at lower levels of the health system show that health personnel often do not have time for data-related tasks due to competing demands, and consider data-related tasks to be thankless and of a low priority (Ikmari, et al., 2007; Malawi Ministry of Health, 2016). Individual factors, such as unfamiliarity of technology and resistance to innovation and new work processes (particularly if associated with additional work burden or a lack of perceived usefulness), have also been recognized as barriers to the use of health information (Akhlaq, et al., 2016).

It is important to recognize that individual behaviours also shaped organizational factors such as leadership, policies, and systems, and organizational incentives and pressures. Individuals can be motivated by different goals to succeed in their work, such as the accumulation of power, prestige, and income; pride in one's performance; and a desire to serve the public good (Shaxson, et al., 2016). People may be unmotivated to use data if it does not help them achieve their professional goals and priorities, or if it is not aligned with the mission and value of their organization. A lack of understanding about the importance of data and their intrinsic value in one's own work and performance means that individuals often give lower priority to data tasks, resulting in data that are not analysed or used (Akhlaq, et al., 2016).

Box 11. Interventions to improve commitment and motivation

The MEASURE Evaluation approach to enhancing individual commitment and motivation is an underlying aspect of all DDU interventions. It begins with equipping people with the knowledge and skills of DDU core competencies. These skills are further enhanced with coaching teams of health professionals, both data users and data producers, to further develop these skills to use data to understand and to overcome their challenges to health service delivery. Teams that demonstrate significant progress are identified and publicly highlighted as change agents who demonstrate a cultural shift in an organization. Data use initiatives spearheaded by identified data use champions included the creation of an information governance committee in Tanzania to regularly review and correct data errors before they were entered into DHIS 2, and the development of a data reporting and visualization template to facilitate the review and interpretation of data during performance review meetings in South Africa. The DDU champions, representing local health teams, are then used to persuasively communicate the value of data to improve performance and how to do it. The aim is to recognize and reward data-informed decision making to incentivize others in the health system.

DISCUSSION

As this review demonstrates, there are multiple factors that inhibit the use of routine health data in decision making for programs, policy, and advocacy. The barriers we identified all fell within the PRISM framework describing technical, organizational, and behavioural determinants for routine health information system performance. For each barrier, we found that there was often an intersection of technical, organizational, and individual factors that affected its impact on data use for decision making. For example, low data quality can be attributed to a variety of root causes and is exacerbated when health workers are unmotivated to collect accurate data. Data quality practices can also be dependent on leaders that value and incentivize quality data for decision making; organizational supports that outline roles, responsibilities, or procedures for data quality improvement activities; and the design of health information systems that facilitate easy collection and reporting of data. Due to this complexity, it is difficult to understand the relative individual importance that each barrier has on the outcome of data use. Applying a comprehensive, integrated approach that simultaneously addresses the multiple factors that limit the use of data is necessary to sustainably achieve lasting results to improve data use. Multifaceted interventions may have a multiplicative effect on sustained data use as opposed to single interventions focused on one specific barrier. MEASURE Evaluation's comprehensive data use intervention (described in Box 10) is one example of an approach that has been found to be successful in addressing the multiple domains that affect data use.

To date, there has been more attention in the health information system literature focused on the technical barriers to data use. There have been more interventions focused on building capacity in data use core competencies or improving the availability and quality of data, often by incorporating new technological solutions focused on streamlining data processes and facilitating the generation of data reports and visualizations. These activities are often not linked with capacity building and organizational strengthening interventions, particularly at the health worker level, thus resulting in limited data use (Hazel, et al., 2017). For example, a mobile health tool was introduced in Guinea to collect and analyze Ebola contact tracing data for decision making (Sacks, et al., 2015). While the tool was found to improve data access and quality, actual use of data from this innovation was limited due to the competing interests and responsibilities of the intended users. This further supports the need to apply behavioural and organizational interventions simultaneously to support technical interventions.

Moreover, we found limited examples of literature on organizational and behavioural barriers from the health information systems space. For organizational barriers, we instead relied on articles focusing primarily on political economy and evidence-informed research to policy both in health and other sectors (e.g., climate and energy, agriculture, etc.), particularly in relation to understanding the sociopolitical structures, actors, and incentives impacting data use in decision-making processes. Understanding decision-making authority and the space available to make decisions, especially at community, facility, district, and provincial levels, can help further elucidate information needs and the skills needed to advocate for decisions at specific opportune moments. There is also a paucity of literature on individual commitment and motivation of health workers, particularly related to health information and data-related tasks. Behavior change is often not a primary consideration when designing information systems, processes, and interventions. It can be challenging to identify appropriate interventions to affect behavior change. We did not find any interventions specifically focusing on improving health worker motivation for data-related tasks. Existing frameworks focusing on health worker performance in general exist but do not focus primarily on health information systems (Franco, Bennett, & Kanfer, 2002; Rowe, de Savigny, Lanata, & Victora, 2005). In general, we found few examples of interventions focused on addressing the organizational and behavioural determinants to data use, especially those not related to activities supported by MEASURE Evaluation. These areas have been underemphasized in the health information systems area, and more evidence is needed that rigorously evaluates how interventions targeting organizational and behavioural barriers can impact sustainable data use for decision making.

Many published works described efforts to improve the use of data in decision making. However, it was difficult to compare the outcomes of interventions that addressed these barriers to data use. Few articles explicitly included a definition of data use, and there was limited evidence evaluating the effects of data use interventions. While many articles indirectly measured data use qualitatively through key informant interviews, we found only one example measuring quantifiable changes in data use post-intervention using a baseline and endline assessment (Nutley, et al., 2014). Data use is particularly difficult to measure, especially since decision making is a multisectoral function influenced by governance structures, commitment to use data for decision making, political will to advocate for decisions, and availability of funds. It is difficult to gather evidence to retrospectively assess whether recommendations, decisions, and actions were data informed and led to improvements in health system functioning and health outcomes. Nevertheless, better measures of the use of data in decision making are needed. It is important to understand the outcomes of data use interventions using novel and innovative approaches to understand best practices and replicate successes.

It is important to note that many barriers to data use, particularly organizational and behavioral barriers, cut across the overall performance of a health system. For example, motivation and retention of health workers is an issue that impacts multiple functions of a health system, including service delivery, commodities, and health information. This supports the need for integrated systems-wide interventions linking data use interventions within broader efforts to strengthen health systems to provide a cohesive way to address barriers. For example, the African Health Initiative's health system strengthening projects in Mozambique, Rwanda, and Zambia embedded interventions to increase data-driven decision making to drive improvements in health system performance. These projects focused on building a quality improvement culture where health workers were focused on the collective improvement of service delivery using repeated visualizations and presentation of quality data, and collaborative performance reviews and stakeholder feedback, amongst other interventions (Wagenaar, et al., 2017). Similarly, Chee, et al., advocates for health system strengthening interventions that comprehensively address performance drivers, such as organizational structures and behaviours across the health system, to strengthen relationships between the health system building blocks (Chee, Pielemeier, Lion, & Connor, 2013). Addressing various technical areas can potentially increase multiplier effects and reinforce the value of data for decision making across the health system building blocks. Strengthening the use of data for decision making is essential for decision-makers to effectively monitor plans and programs, and allocate resources (including workforce, finances, and commodities). Further evidence is needed on the impact of improved health information systems on the delivery of health services and population health.

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WORKING PAPER

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